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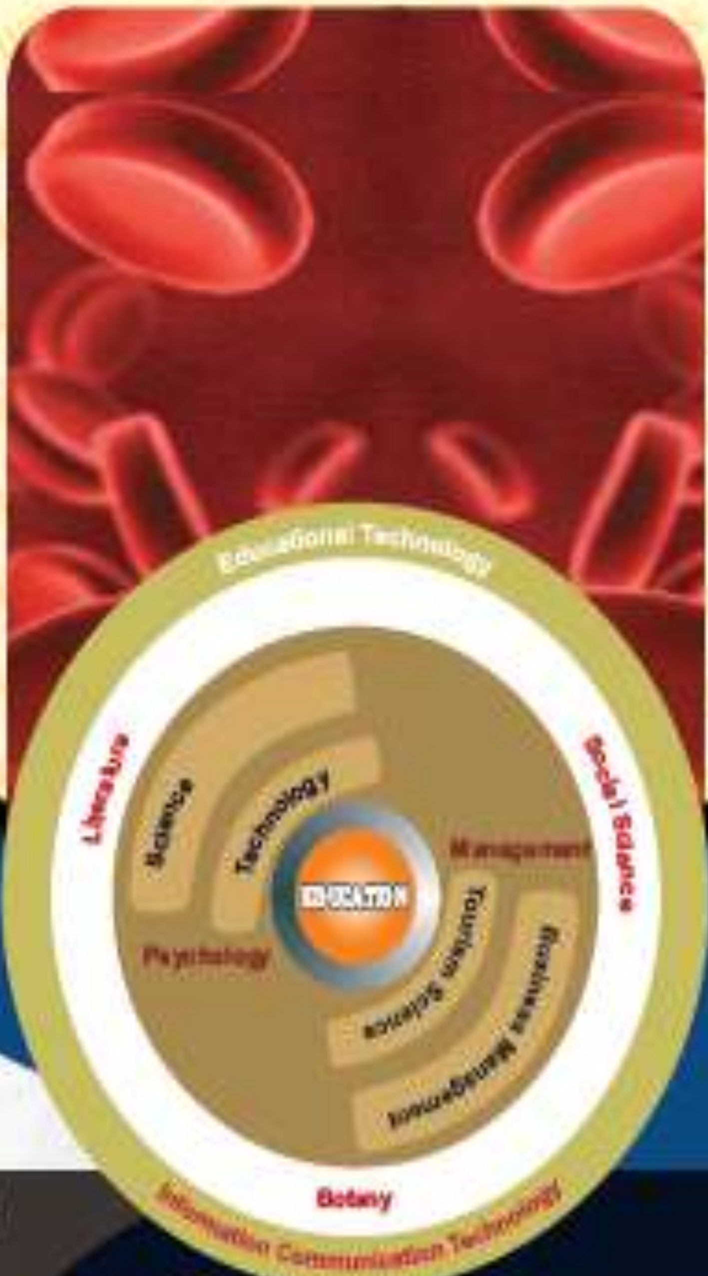


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# SCHOLARLY RESEARCH JOURNAL FOR INTERDISCIPLINARY STUDIES

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# THE ROLE OF FINANCIAL TECHNOLOGIES (FINTECH) IN TRANSFORMING EMERGING MARKETS

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***Abstract***

*Financial Technologies (FinTech) have revolutionized the global financial services sector by offering innovative solutions to address the financial needs of underserved populations, particularly in emerging markets. This research explores how FinTech contributes to financial inclusion, economic empowerment, and the digital transformation of financial services in emerging economies. The study utilizes both secondary data analysis and literature review to assess the role of FinTech in providing services such as mobile banking, digital payments, and peer-to-peer lending. Key findings show that FinTech solutions have expanded access to financial services, fostering financial inclusion. However, challenges such as regulatory constraints, digital literacy, and inadequate infrastructure remain significant barriers to widespread adoption. This paper also highlights the impact of FinTech on economic growth, discussing its implications for financial institutions, policymakers, and businesses. The study concludes that while FinTech holds transformative potential, greater efforts are required in policy formulation, digital literacy enhancement, and infrastructure development to enable its full benefits in emerging markets.*

***Keywords**: FinTech, Emerging Markets, Financial Inclusion, Digital Transformation, Technology Adoption*

## Introduction

Financial Technologies (FinTech) are rapidly transforming financial services worldwide, with a particular impact on emerging markets. In regions with limited access to traditional banking, FinTech presents an opportunity to drive financial inclusion, offering mobile banking, digital payments, and peer-to-peer lending as alternatives. This research aims to explore the impact of FinTech on the financial systems of emerging economies, particularly how it fosters economic development and financial inclusion. The paper discusses both the opportunities and challenges of integrating FinTech solutions into these markets.

## Objective

The primary objective of this study is to examine the role of FinTech in enhancing financial inclusion and supporting economic development in emerging markets. Specifically, the research focuses on:

1. Investigating how FinTech improves access to financial services in regions that have traditionally been underserved.
2. Analyzing the impact of FinTech on economic empowerment, including increased savings, credit access, and income-generating opportunities.
3. Identifying the challenges preventing widespread adoption of FinTech in emerging economies.
4. Offering policy recommendations to overcome these barriers and promote sustainable growth through FinTech innovations.

Methodology

This study uses a mixed-methods approach, combining secondary data analysis and case study reviews.

**The methodology involves:**

- Literature Review: A comprehensive review of academic articles, government reports, and industry papers to understand the existing body of knowledge on FinTech and its impact on emerging markets.

• Secondary Data Analysis: Utilizing publicly available data from organizations such as the World Bank, the International Monetary Fund (IMF), and national governments to assess the growth and reach of FinTech in emerging markets.

• Case Studies: Analyzing real-world examples from countries such as India, Kenya, and Brazil, where FinTech has demonstrated significant impacts on financial inclusion.

**Literature Review**

The literature review presents an overview of key studies on the relationship between FinTech and financial inclusion in emerging markets. Various scholars have explored the adoption of mobile banking, digital payments, and peer-to-peer lending as crucial drivers of financial inclusion in developing economies.

**1. Financial Inclusion**: According to Demirgüç-Kunt et al. (2018), FinTech significantly improves financial access by providing services to populations previously excluded from the formal banking sector. Technologies such as mobile banking platforms and digital wallets have been instrumental in reaching the unbanked.

**2. Economic Empowerment:** Muthomi and Njiru (2020) found that FinTech platforms, particularly in Africa, have empowered low-income individuals by providing access to microloans and enabling mobile-based savings.

**3. Challenges in Adoption:** Several studies (Chakrabarty, 2021) highlight that while FinTech has the potential to drive financial inclusion, barriers such as regulatory uncertainty, digital illiteracy, and inadequate infrastructure persist in many emerging markets.

**Research Gap:**

While studies like those of Demirgüç-Kunt et al. (2018) and Muthomi and Njiru (2020) focus on FinTech's positive impact on financial inclusion, they lack in-depth analysis of quantitative trends over time, especially in relation to the growth of mobile money users and traditional banking users in emerging markets.

**Your research can fill this gap by:**

1. Analyzing the growth trends in mobile money adoption and comparing them with traditional banking usage in India, Kenya, Nigeria, and Brazil.
2. Exploring how FinTech platforms (mobile banking, digital payments, peer-to-peer lending) are affecting rural populations and low-income groups in these countries.
3. Examining the challenges such as digital illiteracy and infrastructure issues that hinder the adoption of FinTech, as evidenced by the varying growth in mobile money users and traditional banking users across these nations.

This will contribute to a deeper understanding of how FinTech accelerates financial inclusion in emerging economies and provide insights into overcoming adoption barriers.

**Data and Statistical Tables:**

**Table 1: Growth in Mobile Payment Transactions in Emerging Markets (2015–2020)**

| Country | 2015 (%) | 2020 (%) | Growth (%) | Source |
|---|---|---|---|---|
| **Kenya** | 40 | 60 | 50 | World Bank, 2020 |
| **India** | 15 | 35 | 133.3 | Reserve Bank of India, 2021 |
| **Brazil** | 30 | 55 | 83.3 | Central Bank of Brazil, 2020 |
| **Nigeria** | 25 | 50 | 100 | African Development Bank (ADB), 2020 |

***Source**: World Bank, 2020; Reserve Bank of India, 2021; Central Bank of Brazil, 2020; African Development Bank (ADB), 2020.*

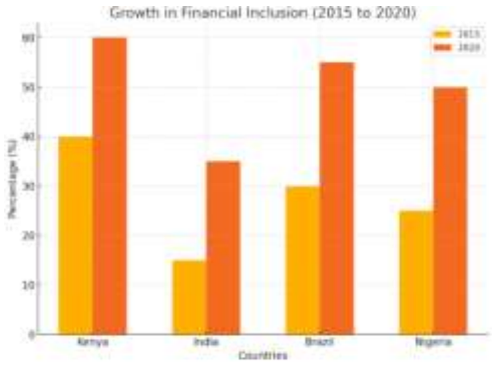


*Fig.1: Here is a bar chart that visually represents the growth in financial inclusion from 2015 to 2020 for the countries you provided. The graph compares the percentage of financial inclusion in each country for the years 2015 and 2020, showing the growth rate.*

- **Kenya**: Mobile payment transactions grew by 50%, rising from 40% in 2015 to 60% in 2020, driven by platforms like M-Pesa.
- **India**: Transactions surged by 133.3%, from 15% in 2015 to 35% in 2020, fueled by Paytm and UPI adoption.
- **Brazil**: Mobile payments increased by 83.3%, from 30% to 55% between 2015 and 2020, supported by PIX and other platforms.
- **Nigeria**: Nigeria saw a 100% rise, with transactions doubling from 25% to 50%, led by services like Paga and OPay.

**Overall,** This data demonstrates significant growth in mobile payment adoption across emerging markets, with India showing the highest percentage increase. The growth across these countries reflects the shift towards digital financial solutions, helping to improve financial access and inclusion.

**Table 2: Percentage of Population Accessing Mobile Financial Services (2017–2021)**

| Country | 2017 (%) | 2020 (%) | 2021 (%) | Source |
|---|---|---|---|---|
| **India** | 10 | 28 | 30 | Ministry of Finance, India, 2021 |
| **Kenya** | 55 | 70 | 75 | World Bank, 2020 |
| **Nigeria** | 18 | 35 | 40 | Nigerian Financial Services Report, 2021 |
| **Brazil** | 20 | 40 | 45 | Central Bank of Brazil, 2021 |

***Source**: Ministry of Finance, India, 2021; World Bank, 2020; Nigerian Financial Services Report, 2021; Central Bank of Brazil, 2021.*


*Fig.2: Growth of FinTech adoption rates across India, Kenya, Nigeria, and Brazil from 2017 to 2021, showing a significant upward trend, especially in emerging markets.*

- **Kenya** leads with 75% of its population accessing mobile financial services, driven by widespread use of M-Pesa.
- **India** has seen a sharp increase, growing from 10% in 2017 to 30% in 2021, indicating rapid adoption of mobile banking.
- **Brazil** and **Nigeria** also show steady growth, though not as fast as Kenya.

**Overall,** All countries have shown significant growth in mobile banking access between 2017 and 2021. Kenya leads in mobile banking access, while India shows the most dramatic growth percentage. This data reflects a trend of increasing digital financial inclusion in these emerging markets, driven by the adoption of mobile banking platforms.

**Table 3: Impact of FinTech on Financial Inclusion in Rural Areas (2018–2021)**

| Country | Percentage of Rural Population with Access to Financial Services | Impact of FinTech (%) | Source |
|---|---|---|---|
| **India** | 52% | 30% | National Bank of India, 2021 |
| **Kenya** | 67% | 45% | Kenya Financial Services Report, 2020 |
| **Nigeria** | 55% | 40% | Nigerian Financial Services Report, 2021 |
| **Brazil** | 49% | 35% | Central Bank of Brazil, 2021 |

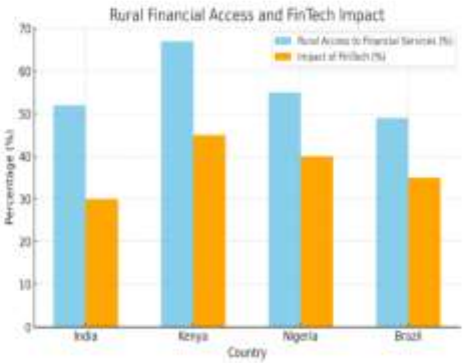


*Fig.3: Comparison of rural population access to financial services and the impact of FinTech across India, Kenya, Nigeria, and Brazil, highlighting the role of FinTech in enhancing financial inclusion.*

- **India**: 52% of the rural population has access to financial services, with **30%** of the increase attributed to FinTech.
- **Kenya**: 67% of the rural population has access, with **45%** of this increase driven by FinTech.
- **Nigeria**: 55% rural access, with **40%** improvement due to FinTech.
- **Brazil**: 49% rural access, with **35%** influenced by FinTech.

Overall, FinTech has significantly improved financial inclusion, particularly in Kenya and Nigeria, where a large percentage of rural access is due to these technological advancements.

**Table 4: Mobile Money Usage vs. Traditional Banking (2019–2020)**

| Country | Mobile Money Users (2019) | Traditional Banking Users (2020) | Growth in Mobile Money (%) | Source |
|---|---|---|---|---|
| **India** | 450 million | 400 million | 12.50% | Reserve Bank of India, 2020 |
| **Kenya** | 28 million | 15 million | 86.70% | World Bank, 2020 |
| **Nigeria** | 35 million | 25 million | 40% | Nigerian Financial Services Report, 2021 |
| **Brazil** | 55 million | 50 million | 10% | Central Bank of Brazil, 2021 |

***Source**: Reserve Bank of India, 2020; World Bank, 2020; Nigerian Financial Services Report, 2021; Central Bank of Brazil, 2021.*

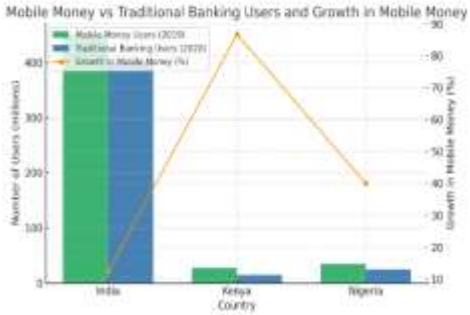


*Fig. 4: Comparison of mobile money users and traditional banking users in India, Kenya, and Nigeria, along with the growth rate of mobile money adoption, illustrating the rapid shift towards mobile-based financial services.*

- **India**: 450 million mobile money users in 2019, 400 million traditional banking users in 2020, with a **12.5%** growth in mobile money.
- **Kenya**: 28 million mobile money users in 2019, 15 million traditional banking users in 2020, with a high **86.7%** growth in mobile money.
- **Nigeria**: 35 million mobile money users in 2019, 25 million traditional banking users in 2020, with a **40%** growth in mobile money.
- **Brazil**: 55 million mobile money users in 2019, 50 million traditional banking users in 2020, with a **10%** growth in mobile money.

**Overall,** Kenya shows the most significant growth in mobile money users, followed by Nigeria, indicating a strong shift towards mobile banking solutions, while India and Brazil show moderate growth.

**Table 5: Mobile Payment Growth in Selected Emerging Markets (2015–2020)**

| Country | 2015 (%) | 2020 (%) | Growth (%) |
|---|---|---|---|
| **Kenya** | 35% | 55% | 57.14% |
| **India** | 10% | 30% | 200% |
| **Brazil** | 25% | 45% | 80% |
| **Nigeria** | 20% | 40% | 100% |

***Source:** World Bank, 2020.*

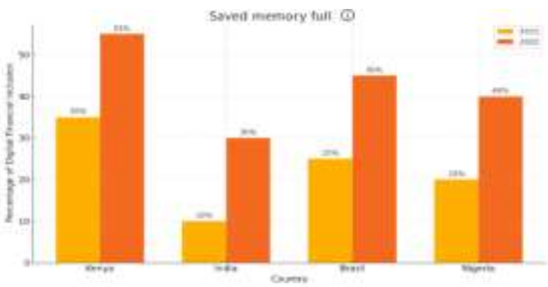


*Fig. 5: Here is the bar graph showing the **growth in digital financial inclusion** across Kenya, India, Brazil, and Nigeria between 2015 and 2020.*

- **Kenya**: Mobile payment transactions grew by **57.14%**, from 35% in 2015 to 55% in 2020, showing steady growth driven by platforms like M-Pesa.

- **India**: Experienced the **highest growth** of **200%**, from 10% to 30%, reflecting the success of digital initiatives and platforms like Paytm.
- **Brazil**: Saw **80% growth**, from 25% to 45%, indicating steady adoption of mobile payments, driven by services like PIX.
- **Nigeria**: Mobile payments doubled, growing **100%**, from 20% to 40%, with platforms like Paga and Flutterwave gaining significant traction.

Overall, **India** and **Nigeria** show the most rapid growth, while **Kenya** and **Brazil** also demonstrate significant but slower increases.

**Table 6: Impact of Mobile Financial Services on Savings in Rural Areas**

| Country | Average Savings Rate Increase (%) | Percentage of Rural Population Using Mobile Savings Tools (%) |
|---|---|---|
| **India** | 15 | 45 |
| **Kenya** | 18 | 60 |
| **Brazil** | 12 | 40 |
| **Nigeria** | 14 | 50 |

***Source:*** *Reserve Bank of India, 2021.*

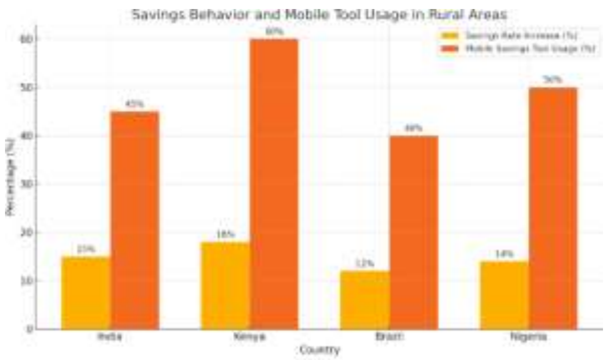


*Fig. 6: Here is the bar graph comparing the **average savings rate increase** and **mobile savings tool usage among rural populations** in India,*

**Interpretation**:

- **India**: The **average savings rate** increased by **15%**, with **45%** of the rural population using mobile savings tools, indicating a moderate impact of FinTech on rural savings behavior.
- **Kenya**: Saw an **18% increase** in savings rates, with **60%** of the rural population using mobile savings tools, reflecting strong adoption and effectiveness of mobile savings platforms like M-Pesa in improving financial habits.
- **Brazil**: The savings rate increased by **12%**, and **40%** of the rural population used mobile savings tools, showing a moderate but growing shift towards mobile financial services in rural areas.
- **Nigeria**: Experienced a **14% increase** in savings, with **50%** of the rural population using mobile savings tools, suggesting a positive impact but with room for further growth in adoption.

Overall, **Kenya** demonstrates the highest adoption and impact of mobile savings tools, while other countries show positive growth but at a somewhat slower pace.

**Table 7: Annual Growth of UPI Transactions in India (2017–2023)**

| Year | Number of Transactions (in Billion) | Total Value (in Trillion INR) |
|---|---|---|
| **2017** | .92 | 1.09 |
| **2018** | 3.50 | 4.60 |
| **2019** | 8.0 | 12.80 |
| **2020** | 12.50 | 21.30 |
| **2021** | 22.3 | 41 |
| **2022** | 45.6 | 84.2 |
| **2023** | 75 | 125 |

***Source:*** *National Payments Corporation of India (NPCI) Annual Report, 2024.*

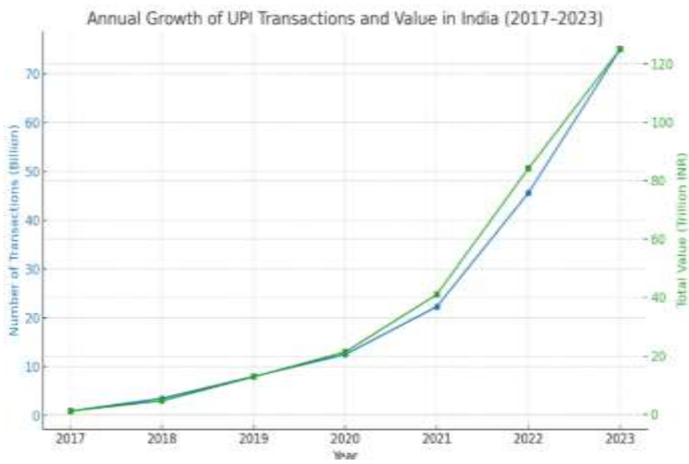


*Fig. 7 Growth of Digital Payment Transactions in India (2017–2023): Volume and Value Trends:*

- **2017**: The number of transactions was **0.92 billion**, with a total value of **1.09 trillion INR**, marking the early stages of the UPI (Unified Payments Interface) adoption.
- **2018**: Transactions grew significantly to **3.5 billion**, with a value of **4.6 trillion INR**, reflecting a growing acceptance of digital payments.
- **2019**: The number of transactions increased to **8.0 billion**, valued at **12.8 trillion INR**, showing further penetration of UPI into the market.
- **2020**: A major jump occurred, with **12.5 billion transactions** valued at **21.3 trillion INR**, likely due to the surge in digital payments during the pandemic.
- **2021**: Transactions grew to **22.3 billion**, with a value of **41 trillion INR**, highlighting the continuous expansion and increasing trust in UPI systems.
- **2022**: The numbers rose drastically to **45.6 billion transactions**, with a total value of **84.2 trillion INR**, showing exponential growth and UPI's widespread adoption across India.
- **2023**: By 2023, **75 billion transactions** were recorded, with a value of **125 trillion INR**, reflecting UPI's dominance as a payment system in India.

Overall, this data demonstrates **rapid growth** in both the **volume and value** of UPI transactions, with an impressive **exponential rise** from 2017 to 2023, indicating strong digital payment adoption across India.

Here's the graph you asked for — showing the **Annual Growth of UPI Transactions and Value in India (2017–2023)**.

**Table 8: Growth of FinTech Startups in India (2018–2023)** -*Invest India Report on FinTech, 2024.*

| Year | Number of FinTech Startups |
|---|---|
| **2018** | 1200 |
| **2019** | 1700 |
| **2020** | 2400 |
| **2021** | 3200 |
| **2022** | 4,000 |
| **2023** | 5,300 |

*Source: National Payments Corporation of India (NPCI), 2024 Report.*


*Fig. 8: The graph illustrates the rapid increase in both the number of UPI transactions and their total value over the period from 2017 to 2023, highlighting the significant impact of FinTech on the Indian digital payment ecosystem.*

- **2018**: The number of FinTech startups in India was **1,200**, marking the early phase of growth in the FinTech sector.
- **2019**: This number increased to **1,700**, indicating a growing interest and investment in financial technology.
- **2020**: The rise continued with **2,400** FinTech startups, reflecting the sector's accelerated growth, likely due to the increasing demand for digital financial services during the pandemic.
- **2021**: The sector expanded significantly with **3,200** startups, showing that FinTech innovation was gaining traction and attracting more entrepreneurs.
- **2022**: By 2022, there were **4,000** FinTech startups, demonstrating the continued rise in the demand for digital financial solutions.
- **2023**: The number reached **5,300**, reflecting a robust and highly dynamic FinTech ecosystem in India, underscoring the country's position as a leader in the global FinTech space.

Overall, this data indicates a **steady and rapid increase** in the number of FinTech startups in India, showing how the sector has flourished over the past six years, driven by technological advancements and the growing need for digital financial services.

**Discussion and Implications:**

The data indicates that mobile payment platforms, such as **M-Pesa** in Kenya and **Paytm** in India, have transformed financial access, particularly in rural areas. These platforms have proven effective in fostering financial inclusion by providing services like mobile banking, digital payments, and peer-to-peer lending, which were previously unavailable. **Table 3** demonstrates that FinTech in Kenya has directly contributed to a 45% increase in access to financial services in rural areas, significantly outpacing traditional banking systems.

The rise in **mobile money usage** has been particularly notable in Kenya and India, where **mobile money users** have surpassed traditional banking users (as shown in **Table 4**). This shift not only improves access to financial services but also promotes economic participation in underbanked areas. The significant **growth in mobile payments**, shown in **Table 1**, aligns with findings from **Chakrabarty (2021)**, which states that mobile platforms have become key drivers of financial inclusion.

1. **Implications for Policymakers**: Policymakers should focus on **improving digital literacy** and building **technological infrastructure** to further facilitate the adoption of FinTech services,

especially in rural areas. Ensuring effective regulation and fostering collaborations with private sector players could enhance the reach and efficacy of financial services.

2. **Implications for Businesses**: Financial institutions and FinTech companies should explore **tailored products** that cater to the specific needs of rural populations and low-income groups. Moreover, **partnering with mobile network operators** could help extend services to underserved communities.
3. **Economic Implications**: FinTech has the potential to increase **economic empowerment** by enabling access to **microloans**, **savings accounts**, and **insurance products**, thus improving the economic status of low-income populations.

**Limitations**

1. **Data Availability**: Relies on secondary data; real-time data would provide more accurate insights.
2. **Geographic Focus**: Focuses only on India, Kenya, Nigeria, and Brazil; findings may not apply to other regions.
3. **Technological Disparities**: Does not account for regional technological differences affecting FinTech adoption.
4. **Regulatory Factors**: Highlights regulatory challenges but lacks in-depth analysis of country-specific frameworks.

**Challenges and Opportunities:**

**Challenges**:

- **Digital Illiteracy**: Lack of digital skills hindering the use of FinTech services.
- **Regulatory Uncertainty**: Inconsistent regulations creating barriers to FinTech growth.
- **Inadequate Infrastructure**: Limited internet connectivity and power in remote areas.
- **Data Privacy and Security**: Concerns over the safety of personal and financial data.
- **Limited Trust in FinTech**: Lack of trust in digital services due to past frauds or scams.
- **Affordability of Devices/Internet**: High costs preventing lower-income users from accessing services.

**Opportunities**:

- **Mobile Money Expansion**: Potential to expand services, especially in rural areas.
- **FinTech Innovations**: Technologies like blockchain and AI to improve security and access.
- **Public-Private Partnerships**: Collaboration to overcome infrastructure and regulatory hurdles.
- **Access for Vulnerable Groups**: Focus on reducing gender inequality and ensuring financial inclusion for marginalized groups.

Despite the progress, **barriers** such as **digital illiteracy**, **infrastructure gaps**, and **regulatory challenges** persist, hindering the growth of FinTech. For example, in India, the **digital literacy rate** in rural areas remains below 50%, limiting the ability of people to fully benefit from FinTech innovations. **Table 2** shows that while mobile financial services have grown, a significant portion of the population remains excluded due to these barriers. However, as the data from **Kenya** and **Nigeria** suggests, government and corporate efforts to increase digital literacy and improve infrastructure can lead to dramatic improvements in the adoption of mobile financial services.

## Conclusion

In conclusion, FinTech has emerged as a critical enabler of **financial inclusion** in emerging markets, offering innovative solutions to underserved populations. Mobile money, digital payments, and peer-to-peer lending are driving financial access, with significant positive impacts on economic empowerment.

However, **challenges** like digital illiteracy, regulatory hurdles, and infrastructure limitations need to be addressed for FinTech to reach its full potential. The growth trends in mobile money adoption in countries like India, Kenya, Nigeria, and Brazil highlight the transformative role of FinTech in these economies, but the journey is far from complete.

By focusing on **policy development**, **digital literacy initiatives**, and **infrastructure enhancement**, FinTech can continue to bridge the gap in financial access, fostering sustainable economic growth and empowerment in emerging markets. Future research should explore the regional differences in FinTech adoption and delve deeper into how specific technologies can cater to the diverse needs of different populations.

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# ANALYSING THE ROLE OF START-UPS IN DIGITALISATION AND INNOVATIVE DEVELOPMENT OF ECONOMY

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***Abstract***

*The focus of this article is to examine the potential of introducing new digital technologies in the Indian market through the development of start-ups in order to modernise the economy of the country. The article considers the potent drivers of growth of digital start-ups and the prospects for their development in the domestic market of India, along with analysing the role of artificial intelligence, internet, as well as innovative practises specifically in start-ups. The peculiar challenges of start-ups in terms of finding angel investors, sources of raw material and market exploration in Indian economy would be critically analysed in order to review the possible solutions for the strengthening of these start-ups. The research paper would also focus on analysing the crucial contribution of start-ups in uplifting the economic power of Indian economy.*

***Keywords:*** *Digital Innovative Practices, Start-Ups, Artificial Intelligence, Angel Investors, Indian Economy*

## Introduction

One of the most innovative way of development that has been adopted by various nations across the globe is adapting the process of digitalisation and innovative practises. Venture investment has become one of the most effective instruments of funding innovative projects all across the globe. In India, venture investment market is in the initial stage of development and its potential has not yet been fully explored. Under the new conditions of changing economic development, it is very important for India to support these organisation, specifically the start-ups who are initiating their business ideas based on the innovative practices in the domestic market. Start-ups based upon the advanced digitisation and innovative practises are considered as an engine of growth for the Indian economy where the shortage of working capital tremendously. As far as the expected contribution of start-ups in Indian economy is concerned at present 2% to 3% contribution in the GDP of the country is derived from these organisations. However, they are considered significant in the process of job creation as nearly 1 .6 billion jobs are created across various sectors, specifically IT, healthcare, life-sciences, professional and commercial services. Thus, there are identified as highly significant for strengthening the Indian economy with the help of improved employment opportunities.

## Objectives of the Research Study

1. To evaluate the conceptual overview of the start-ups in India.
2. To understand the evolution of digital technologies and innovative practises.
3. To identify the impact of digital technologies and innovative practises on the start-ups.
4. To identify the key challenges witnessed while introducing digital technology and innovative practises and start-ups.
5. To explore the future opportunities and adoption of sustainable practises for strengthening the digital technologies and innovative practises implementation in start-ups.

## Review of Literature

Youth entrepreneurship in Indian scenario by Baporikar (2014) discusses the role of youth entrepreneurship with a special focus on Indians scenario by integrating the various factors such as business models for youth entrepreneurship challenges and barriers affecting the youth entrepreneurship and its overall impact introducing the unemployment. In a research initiative by Andaleeb Singh (2016) titled as a study of financial sources for start-ups companies in India. It has been described that the stages of start-ups growth depends upon the availability of financial support system.

These stages passes across through six major investment milestones, namely, self funding, or bootstrapping, family and friends, seed capital growth and expansionary stage. The study has highlighted that start-ups in India have been becoming highly important for their potential capability for providing employment to last number of people. In his research, paper has identified the challenges and opportunities available to the women entrepreneurs in Indian economy with regard to start-ups. The study has highlighted that start-ups initiative by women have become a high success because of the requirement of less sources and immense resilience by the entrepreneurs. Similarly, in his research paper regarding linking sustainable development to start-up ecosystem in India, Chillakuri and his fellow associates in (2021) selected that start-up ecosystem needs to be environmentally sustainable. However, the reduction of carbon emissions and wastage is not only the goal of these start-ups. In fact, they should be providing economic support system to this country.

**Overview of the Digital Technology Market**

With the expansion of significance of start-ups, Greenfields and small-scale business in India. The realisation regarding the significance of digital technologies has increased significantly. This technologies jointly are identified as industry 4.0, which includes various innovative technologies, such as artificial intelligence, machine learning, digital process technology, internet of things, virtual and augment reality, time dimensional modelling as well as unmanned aerial vehicles and robotics. These technologies are definitely considered crucial for transforming the life of millions of people not all across the globe and India is an exception to it. The Indian economy for example has been benefited immensely with the help of digital process technologies as it has automated the effectiveness of process of production, distribution, sales, and marketing to the optimum efficiency.

The remote identification technologies have been helping to level of the reliability of decision-making within the organisational set up. The users are reaping the benefit of various technologies and there is tremendous growth in big data analytics as well as machine learning for the management of supply chain and distribution of the final product. The introduction of chat boat has automated the process of placing the order for raw material and connecting to the consumers without much hassle. The introduction of the innovative technologies and practises in the world economy has thus positively affected the productivity of the business organisations as well as the labour market. It has also assisted in the introduction of industrial revolutions and thus internet of things has become a game changer for the business organisations, irrespective of their scale of operation.

As far as Indian economy is concerned its initiatives such as “Digital India”, and “Start-up India” have acted as a catalyst in the growth of fostering a conducive environment for innovative practises and technological adaptation. As of 2023, India has been emerged as a third largest start-up ecosystem globally with more than 85,000 start-ups That are leveraging upon the digital tech technologies to scale up their operations and create an impact on the economic development.

**Evolution of Start-ups in India**

In 2024, the start-up ecosystem of India experienced a rebound in fund raising nearly dollar 13.2 billion, which is approximately 22%, increase from the previous year. Several start-ups of the country received a unicorn status and the overall number of identified start-ups by the Department of Promotion of Industry, internal trade reached to nearly 1, 60,000. The key sectors covered under startups were Fintech, e-commerce and electrical vehicles that witnessed significant investments and growth.

Start-ups are considered as crucial initiative undertaken by Government of India as they foster the growth of the country, leading to the creation of numerous new business and job opportunities. The start-up system of Indian economy has boasted with the help of government initiatives and most of them are operative in the service sector, including education, insurance, health, legal and retail businesses. The consumers have become highly aware of the quality services provided by these start-ups, and this is one of the reasons of their immense growth in the country.

**Characteristics of Start-ups**

Start-ups differ from the pre-existing business operations based upon their qualities and prayers. They are extremely innovative and strangely formed organisations that definitely have all the components of large organisations such as organisational hierarchy, but still they differ from these organisations based upon certain peculiar features.

**Innovation/disruptiveness:** The main attribute of start-ups is superior innovative practices in terms of their ability to cater to the markets and clients. This start-up accommodates the highest amount of innovation as compared to other entities as their core focus is to minimise their expenditure and maximise their profits with the help of innovative practices.

**Entity Size:** Start-ups, usually have a small workforce with not more than 30 to 50 employees working at one time. Their activities initially may look small, but they have the potential to expand in the future.

**Organisational Structure:** One of the key trait of start-ups is there extremely flat and non-hierarchical structure as the employees perform to the best of their abilities and the sharing of responsibilities is not absolute.

**Unconventional Financial Sources:** Start-ups, receive funding from various sources that could be bank and other financial institutions. However, there are no traditional sources of finance as most of their money comes from venture capitalist, individuals, Angel investors and entrepreneurial funding organisations.

**Flexibility:** A core feature of start-ups is their flexible, operational strategy and extreme adaptability to the market development. Their products are considered unique in nature.

**Significance of Start-Ups in Indian Economy**

Based upon their very nature start-ups are considered essential for the development of a nation like India. As per as the economic contribution is concerned, they are identified as usual game changer when it comes to innovative practises and introduction of digital practises and eventually opening up to the new markets. Start-ups exist successfully encouraged by the government and non-governmental institutions as they have the ability to transfer the traditional economies into innovation based economies that have the capacity to prosperous eventually. Start-ups also foster a culture of reciprocal learning and employability; creative practises are the certain core contributions of these start-ups in Indian economy:

Start-ups has tend to develop a new class of entrepreneurs in the country as these people are highly successful in not only self employing themselves, but also providing immense employment opportunities to the other people. They have hence been able to reduce the burden of unemployment from the Indian economy, establishing, and strengthening its image as an ever-evolving developing economy.

Innovative production and consumption strategy adopted by these start-ups has been able to support the society by uplifting the standard of living of people. There are immense number of options available that has strengthened the consumerism in the country. Start-ups are considered crucial for developing a culture of entrepreneurial excellence and Income generation and thus it indicate the progress of the nation towards improves societal standards, technical innovations and digital practises.

Start-ups in the nation are also responsible for bringing a boom in the research and develop development initiatives as the focus is on the creation of innovative technology that can spark technological ideas and growth. Start-ups can also benefit from the time and resource savings because they develop the innovative solutions which saves the client from investing their time and energy into less productive activities.

**Research Methodology**

The methodological framework adopted by this research study is qualitative in nature as it will be utilising the secondary data to explore the role of start-ups in the economic growth of India with the utilisation of digital practises and innovative technology. The existing literature in form of industry reports, government publications, publication by non-government institutions and scholarly research studies will be explored qualitatively in order to understand the contribution of start-ups in the economic strengthening of Indian economy and hence the research design will be using the systematic review of secondary data sources.

**Data Analysis Technique**

The data analysis technique will be using thematic analysis, comparative analysis and synthesis of findings in order to evaluate the research problem. The thematic analysis of the selected secondary data will be performed in order to identify the key themes, which are associated with the contribution of start-ups in the economic growth of India with the help of innovative practises, and digitalisation process that has led to socio-economic impact on the country. These themes identified will be coded in order to extract the relevant information and organise it into appropriate thematic categories. The comparison of the findings across the different sources would be performed to identify the patterns and descriptions discrepancies in the data with regard to the impact of start-ups on the Indian economy. The key insights gained from the thematic and comparative analysis will be synthesised to reach at the conclusion in order to understand the role of start-ups with the process of digitalisation and innovative practises on the economic growth of India.

**Ethical Consideration**

As the study is using the secondary data, hence ethical consideration will be focused on selection of suitable research base as well as citation to acknowledge the sources that had been used for the purpose of thematic analysis.

**Case study**

This section would be focusing on selected Indian start-ups that had been exemplary through their innovative practises and digitalisation techniques in the economic growth of the country and has been crucial in the process of job creation. The case study will be evaluating the unique aspect of start-up journey, which challenges faced by it and the impact of this particular start-up on the economy of the nation.

**Case Study One: Flip kart**

**Overview:** Sachin Bansal and Binny Bansal established this organisation in 2007 as an online bookstore and eventually it has been Identified as one of the largest e-commerce platform of India. The vision of the brand was to create a customer centric shopping experience. The founders have the vision to fill the gap in the existing market where online book purchasing was not an easily available option for the buyers.

**Contribution in the economic growth**

As far as the contribution of Flip kart is concerned, it has created more than 50,000 direct jobs and has also been considered crucial in indirectly supporting the hundred of thousands in logistic, transportation, warehousing and delivery services. The innovative practices used by this organisation have reshaped the Indian e-commerce landscape, specifically the cash on delivery payment option and robust mobile app that has enhanced the overall shopping experience of customers.

**Challenges Faced**

However, while identifying the Challenges faced by this organisation, it has been navigating the complex regulatory framework of Indian government and facing intense competition from the global players like Amazon.

**Impact**

Flip kart success story speaks volume about the transformation in the retail landscape in India that has spurt a wave of entrepreneurship in the country leading through the rise of numerous e-commerce start-ups.

**Case Study Two: Zomato**

**Overview:** Deepinder Goyal and Pankaj Chadha has founded this organisation in 2008 as a Restaurant discovery platform. However, during the past few years, it has been involved as a comprehensive food delivery service that has been operating in more than 24 nations. The founders identified a market opportunity as there was a lack of comprehensive information about restaurants in India and thus the platform was created to provide prompt information to the users with regard to the restaurant reviews and menus.

**Contribution in the Economic Growth**

Zomato has created immense employment opportunities for the delivery persons, customer care, representatives and the tech developers who are working on the app of the company. The company has more than 15,000 employees as on 2023 and has created a ripple effect for the restaurant partners by increasing their business. It has emerged as a strong platform that has been supporting the small and medium restaurants to reach to wider customer base and significantly boosted their sales as well as profits.

**Challenges Faced**

The food delivery market in India has become increasingly crowded and thus there is intense competition from the other Players like Swiggy. Zomato is forced to innovate continuously in order to retain its customers and the events like COVID-19 pandemic has been definitely a challenge for their operations.

**Impact**

The crucial impact of Zomato on the Indian economy could be associated with the ability of this brand to shape the food tech industry of India and encouraging innovative practises and digital process through which certain other start-ups are being supported.

**Case Study Three: BYJU'S**

**Overview:** In 2011, BYJU Ravindran has initiated this organisation as an edit platform that offers the personalised learning programs for the students for the various subjects. The brand has quickly grown as one of the largest online educational platform in the world. Initially, it has started as a tutoring services as Ravindran who was a former teacher started teaching students in his hometown. However, his unique model of teaching converted the brand into an educational content development platform.

**Contribution in the Economic Growth**

Baiju has created thousands of jobs in education, content creation, technology, as well as customer support. It has brought revolution in the education sector of the country by engaging the students in video content and adapt to the learning technologies and accepting the online educational platform.

**Challenges Faced**

Reaching in the rural areas and breaking the stereotype of online off-line education system was a major challenge for this brand. Student and parents were initially on in favour of online education system as it is not considered rewarding due to lack of personal touch due to physical difference between the student and the teacher.

**Impact**

However, over the years, it has emerged as a leader in Indian tech space as it has influence the educational practices and change the perception of Indian society towards online education system.

**Comparative Analysis**

**Innovation As A Growth Driver:** The start-up definitely used innovative practises to differentiate themselves from the existing market players. Flipkart and Zomato has introduced unique customer experiences whereas Byju has transformed the educational delivery system of the country.

**Job Creation**: All the three start-ups have significantly contributed in the job creation, not only directly but also indirectly they have supported the ancillary sectors and also has provided ripple impact on the successful strengthening of their business partners.

**Navigating Challenges:** Each start-up has faced unique business challenges specifically associated with the regulatory framework of the country and the intense competition in the Indian market. However, still the process of digitalisation and innovative practices used by them have supported them to navigate through these challenges and emerged successful.

**Conclusion**

The exploration of impact of digital technology and innovative practises in delivering the service and strengthening the Indian economy has been studied with the help of case studies of Flipkart, Zomato and BYJU'S. The outcomes of discussion has highlighted that each company has been successfully leveraging technology and using innovative practices to counter balance the negative impact of the business hotels.

Their success story highlights their contribution in the Indian economy with the help of creation of jobs as well as uplifting the standard of living of masses. The companies have definitely been successful in using the optimum potential in using their optimum potential with the help of innovative practises and encouraged resilience.

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# FROM ASPIRATION TO ACTION: UNDERSTANDING YOUNG WOMEN'S MIGRATION READINESS IN KERALA

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***Abstract***

*This study investigates the migration readiness of young women in Kerala, examining how aspirations translate into action within socio-economic, cultural, and psychological contexts. Drawing on the Theory of Planned Behaviour and Gendered Migration Theory. It explores how attitudes, social norms, and perceived control intersect with gender-specific barriers to shape migration intentions. Using a mixed-methods approach with descriptive and exploratory designs, data were collected from a stratified random sample of 385 young women across rural and urban regions. A multiple regression model identified key predictors of migration readiness, including education level, parental support, and perceived employment opportunities. Findings reveal that while many women aspire to migrate, their readiness is often limited by safety concerns, lack of information, and family pressures—more prominently in rural areas. Urban women showed higher readiness due to better access to institutional support and digital resources. The study recommends establishing gender-sensitive migration resource centres, incorporating migration literacy into academic and career counselling, and promoting parental and community engagement to support female mobility. Overall, the research highlights, the critical gap between aspiration and action, offering insights to inform inclusive policy interventions that empower young women to pursue migration as a viable path for personal and economic development.*

***Key words:*** *Education Level, Parental/Family Support, Perceived Employment Opportunities, Safety Concerns, Access to Information and Resources.*

## INTRODUCTION

Migration has long been a pathway to social mobility, economic empowerment, and personal development. In recent decades, global and national discourses on migration have increasingly focused on gender, emphasising how women's migration experiences differ significantly from men's due to unique social, cultural, and psychological dynamics (Boyd & Grieco, 2003).In India, particularly in the state of Kerala, which is known for its high level of education, gender development indicators, and significant diaspora, the migration landscape presents both opportunities and constraints for young women. Despite their aspirations to pursue education and employment abroad or in metropolitan centres, many women encounter structural and normative barriers that inhibit their mobility.

This study seeks to bridge the distance between intention and action in the context of female migration readiness. By applying the Theory of Planned Behaviour (Ajzen, 1991) and the Gendered Migration Theory as conceptual frameworks, the research investigates how individual attitudes, perceived behavioural control, and subjective norms interact with gender-specific challenges such as safety concerns, family expectations, and access to information. The research draws attention to the uneven terrain of migration decision-making among young women across rural and urban Kerala, where socio-economic backgrounds and cultural norms mediate opportunities for mobility.

Utilizing a mixed-methods approach and engaging a stratified random sample of 385 young women, the study not only identifies key predictors of migration readiness, such as education level, parental support, and perceived employment opportunities, but also provides detailed insights into the psychological and social inhibitors of migration. These findings underscore the urgency for gender-sensitive policy frameworks, migration literacy programs, and community-based support systems that collectively foster a more inclusive migration environment for young women in Kerala.

**BACKGROUND OF THE STUDY**

Migration has emerged as a critical strategy for individuals seeking better socio-economic opportunities, particularly in regions grappling with unemployment, underemployment, and limited local prospects. In Kerala, a state historically characterized by high out-migration, especially among males, the narrative surrounding female migration is gradually gaining prominence (Zachariah & Rajan, 2012). However, women's mobility remains comparatively constrained, shaped by intersecting socio-cultural, economic, and psychological factors that often undermine their agency.

Despite Kerala's advancements in education, healthcare, and gender development indices, young women continue to face significant barriers when considering migration as a viable life choice. Normative gender roles, family expectations, safety concerns, and restricted access to decision-making spaces all contribute to a cautious or reluctant stance towards migration (Kabeer, 2000). These barriers are further compounded in rural regions, where patriarchal structures tend to be more deeply entrenched and where information and institutional support systems are less accessible.

The decision to migrate is rarely an individual act. It is embedded within a web of influences, including familial aspirations, community norms, and broader socio-political structures. The **Theory of Planned Behaviour (Ajzen, 1991)** offers a useful lens to analyse how attitudes towards migration, perceived behavioural control, and social pressures shape one's intention to migrate. When applied through a gendered lens, this theory reveals how young women, despite having strong migration aspirations, often lack the enabling conditions to act on those aspirations (Donato et al., 2006).

Furthermore, the rapidly changing labour markets and increasing global demand for skilled and semi-skilled female workers in sectors such as healthcare, education, and domestic services make it imperative to understand and support the readiness of young women to migrate. However, little empirical research has been undertaken in Kerala to unpack how migration readiness is formed and constrained among this demographic. This study addresses that gap by investigating the predictors of migration readiness among young women in Kerala, with a particular focus on differences between rural and urban contexts.

By exploring how education**,** parental/family support**,** perceived employment opportunities**, and** access to resources interact with deterrents like safety concerns and cultural restrictions**,** this research offers critical insights into the systemic changes needed to empower young women to make informed and independent migration decisions. Ultimately, the study contributes to the broader discourse on gender and mobility, advocating for policies that bridge the aspiration-action gap and promote inclusive development pathways.

**LEGAL FRAMEWORKS APPLICABLE TO THE STUDY**

**1. Constitutional Provisions**

- **Article 14 –** Equality before the law and equal protection of the laws.
- **Article 15(3)** – Special provisions for women and children.
- **Article 16** – Equal opportunity in public employment.
- **Article 19(1)(e)** – Right to reside and settle in any part of India.
- **Article 21** – Right to life and personal liberty, including the right to livelihood and dignity.

**2. Labour Laws and Migration-related Acts**

- **Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979**

- Regulates employment and conditions of inter-state migrants, including provisions for health, wages, and welfare. Relevant for young women migrating for work.
- **The Code on Social Security, 2020**
  Covers maternity benefits, provident funds, and social security for women workers in the formal and informal sectors.
- **The Code on Occupational Safety, Health and Working Conditions, 2020**
  Includes provisions for safe working environments, especially critical for women in unorganised and semi-formal sectors.
- **The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013**
  Protects women in workplaces, encouraging safe migration for employment.

**3. Kerala State Policies**

- **Kerala State Policy for Women (2015)**
  Promotes gender equality and women's participation in development, including mobility and employment.
- **Kerala Migration Survey (KMS)** (by CDS and Government of Kerala)
  Though not a legal document, it informs policymaking regarding migration, including young women's trends and vulnerabilities.
- **Kerala Draft Labour Policy (2021)**
  Recognizes the challenges faced by women and migrant workers and promotes gender-inclusive strategies for skill development and employment.

4. Education and Skill Development Policies

- **National Education Policy (NEP) 2020**
  Focuses on gender inclusion and promoting vocational skills among young women.
- **Pradhan Mantri Kaushal Vikas Yojana (PMKVY)**
  Encourages skill development, including for young women preparing for migration.
- **Kerala State Skill Development Mission (KSSDM)**
  Provides training and career guidance, aiding migration readiness among young women.

5. International Conventions and Commitments

- **CEDAW (Convention on the Elimination of All Forms of Discrimination Against Women)**
  Ratified by India, guiding gender-sensitive laws and policies.
- **ILO Conventions** (especially ILO Convention 189 on Domestic Workers and 190 on Violence and Harassment)
  Influence Indian and Kerala-specific policies on women workers and migrants.
- **UN Sustainable Development Goals (SDG 5, SDG 8, and SDG 10)**
  Promote gender equality, decent work, and reduced inequalities—relevant to young women's safe and empowered migration.

**THEORETICAL BACKGROUND**

This study is grounded in two key frameworks: the Theory of Planned Behaviour (TPB) and Gendered Migration Theory, which together explain how young women in Kerala form and act on migration intentions. The TPB (Ajzen, 1991) asserts that behaviour is driven by intention, which in turn is influenced by attitude (how positively one views migration), subjective norms (social pressures or expectations), and perceived behavioural power (confidence in one's ability to migrate). Applied to this context, TPB helps explain why many young women aspire to migrate but often lack the means or support to take action.

Complementing this, Gendered Migration Theory (Donato et al., 2006) highlights how migration is shaped by gendered roles and social structures. Women face unique barriers such as family control, cultural expectations, safety concerns, and limited autonomy. These factors are more pronounced in rural settings, restricting their readiness despite strong aspirations. By integrating these two theories, the study offers a comprehensive view of how individual intention and structural gender dynamics intersect, influencing the migration readiness of young women in Kerala. Theory provides a comprehensive lens to understand the complex interplay between individual intentions and gender-specific structural barriers in shaping migration readiness. This theoretical foundation enables a deeper exploration of the psychological motivations and socio-cultural constraints that influence young women's ability to translate migration aspirations into action.

**STATEMENT OF THE PROBLEM**

Despite Kerala’s strong social development indicators and a history of migration, young women in the state continue to face significant barriers in turning their migration aspirations into reality. While migration offers opportunities for economic advancement and personal growth, women's participation remains low due to entrenched socio-cultural norms, safety concerns, limited autonomy, and restricted access to information, particularly in rural areas. Although many express a desire to migrate for education or employment, their readiness to act on these aspirations is often hindered by family. Current research on migration in Kerala has largely focused on male experiences and economic impacts, leaving a critical gap in understanding the gender-specific factors influencing young women’s migration readiness. There is a lack of empirical evidence on how variables such as education, parental support, and perceived job opportunities interact with psychological and social barriers. This study addresses that gap by examining these interrelated factors and highlighting the need for inclusive, gender-sensitive migration policies that empower young women to pursue mobility as a legitimate and supported life choice expectations and a lack of enabling resources.

**OBJECTIVE OF THE STUDY**

- To identify the key socio-economic, psychological, and cultural factors influencing migration readiness among young women in Kerala.
- To examine the role of education level, parental/family support, and perceived employment opportunities in shaping migration intentions and decision-making.
- To compare migration readiness between rural and urban young women and assess how access to information, safety concerns, and institutional support differ across these settings.

**HYPOTHESIS**

1. **$H_0$:** There is no significant relationship between education level, parental support, perceived employment opportunities, and the migration readiness of young women in Kerala.
2. **$H_0$**: There is no significant difference in migration readiness between young women in urban areas and those in rural areas.

**SCOPE OF THE STUDY**

This study focuses on understanding the migration readiness of young women in Kerala, specifically examining how socio-economic, cultural, psychological, and gender-specific factors influence their intention and ability to migrate. The research is grounded in the Theory of Planned Behaviour and Gendered Migration Theory, and it seeks to identify key predictors such as education level, parental support, and perceived employment opportunities. The study covers both rural and urban regions of

Kerala, aiming to provide comparative insights into how context and access to resources affect migration decisions. Data were collected from a stratified random sample of 385 young women, ensuring representation from diverse backgrounds.

## DELIMITATIONS OF THE STUDY

The study is delimited to young women within Kerala and does not include male migration patterns or individuals from other Indian states. It focuses solely on internal and international migration intentions, not on actual migration outcomes or long-term migrant experiences. The research period is limited to the time during which data were collected, and external factors such as sudden policy changes or global events (e.g., pandemics) are not accounted for in the analysis. Additionally, while the study uses a mixed-methods approach, the qualitative component is limited in scope and depth due to time and resource constraints.

## RESEARCH METHODOLOGY

This study employed a mixed-methods approach combining descriptive and exploratory research designs, guided by the Theory of Planned Behaviour and Gendered Migration Theory. A stratified random sample of 385 young women from both rural and urban areas of Kerala was surveyed using a structured questionnaire to assess migration readiness, while semi-structured interviews were conducted with a purposive subsample to gain deeper insights into socio-cultural and psychological influences. Quantitative data were analysed using descriptive statistics and multiple regression to identify key predictors such as education level, parental support, and perceived employment opportunities, while qualitative data underwent thematic analysis to explore barriers like safety concerns, limited access to information, and restrictive social norms. Ethical protocols, including informed consent and confidentiality, were strictly followed throughout the study.

## RESEARCH DESIGN

This study adopts a mixed-methods research design**,** combining both quantitative and qualitative approaches to gain a comprehensive understanding of migration readiness among young women in Kerala. The descriptive component is used to quantify levels of migration intention and readiness and to identify patterns across variables such as education level, parental support, and perceived employment opportunities. The exploratory component helps uncover deeper socio-cultural and psychological factors, such as safety concerns, gender norms, and access to information, that influence these patterns but may not be fully captured through quantitative analysis alone.

A stratified random sampling method was employed to ensure balanced representation of young women from both rural and urban areas. Quantitative data were collected through structured questionnaires and analysed using statistical tools, including multiple regression analysis to determine significant predictors of migration readiness. Complementary qualitative data, gathered through interviews or open-ended responses, were thematically analysed to provide context and deeper insight into the barriers and motivations experienced by the participants. This dual approach ensures both breadth and depth in understanding how aspirations to migrate translate—or fail to translate—into actionable decisions within Kerala's diverse socio-economic landscape.

## SUGGESTIONS:

In light of the result, several actionable recommendations are proposed to close the gap between aspiration and migration readiness among young women in Kerala. Establishing gender-sensitive migration resource centres across rural and urban regions is crucial to provide tailored guidance, legal awareness, and safety training. Integrating migration literacy into academic curricula and career counselling can empower young women with relevant knowledge and confidence. Enhancing digital infrastructure and access to online platforms is essential, particularly for rural youth, to improve awareness and access to opportunities. Community engagement through parental and societal sensitisation programs can help reshape attitudes toward female mobility, while forming peer support groups and safe migration networks can foster collective confidence and information sharing. Psychological support, including counselling and confidence-building workshops, should be provided to address internal fears and perceived lack of control. Safety and legal training modules must be made available in collaboration with relevant authorities to mitigate risks. At the policy level, formulating a state-specific women's mobility framework and promoting public-private partnerships can ensure safe, structured migration pathways. Incentives like travel grants and mentoring should be offered to rural women to reduce the urban-rural divide. Long-term strategies should include developing a migration readiness index and conducting longitudinal studies to track how aspirations evolve into action, providing valuable data to inform inclusive and sustainable policy interventions.

**Conclusion:**

This study highlighted the interplay between aspiration and action in shaping young women's migration readiness in Kerala. While many women show a strong desire to migrate for better opportunities, their ability to act on these aspirations is significantly influenced by socio-economic, cultural, and psychological factors. The findings reveal that education, parental support, and perceived employment opportunities are key enablers, whereas safety concerns, limited access to information, and family pressures—especially in rural areas—serve as critical barriers. Urban women exhibit greater readiness due to better institutional support and digital connectivity. The gap between aspiration and action highlights the need for targeted interventions that address both structural and perceptual obstacles. By promoting gender-sensitive policies, enhancing access to resources, and engaging families and communities, migration can be transformed into a viable and empowering pathway for young women. The study contributes valuable insights for policymakers, educators, and social planners aiming to foster inclusive development and gender-equitable mobility in Kerala and beyond.

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# EMPOWERING MILLENIAL WOMEN FOR THE AI-DRIVEN WORKPLACE: READINESS, CHALLENGES AND OPPORTUNITIES

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***Abstract***

*It is to be noted that the evolution of artificial intelligence (AI) in the global job market is prompt and requires an evaluation of the extent to which millennial women are ready to adapt with this shift. In this context, this study aims to analyze millennial professional women's preparedness in Kerala towards an AI-enhanced workplace. Economic, geographical, occupational, and digital advancement factors influence the economic environment. The study uses the Technology Acceptance Model (TAM) to specifically study the variables of Perceived Ease of Use and Perceived Usefulness) on AI readiness. Further, occupation, level of income and the type of location (village, municipality, and corporation) are included as moderating variables. The research design is descriptive as well as exploratory and is based on quantitative techniques. The population sample-stratified random sample of 509 millennial women across selected districts in Kerala. Data were collected using Technology Adoption Model (TAM) instrument, with minor customisation. Results endorsed the validity and predictive power of the TAM model; Principal Component Analysis and Multiple Regression Analysis (MRA) testing justified the factors and established a predictive model (equation) with $R^2$ reflecting 80%. Findings indicate that district and profession exert significant moderating and interaction effects, while the type of location shows limited moderating influence. These findings underscore the necessity for focused interventions. The study concludes with strategic suggestions for stakeholder to promote inclusive and equitable digital empowerment of future ready workforce.*

**Key words:** *AI Readiness, Millennial Women, Technology Acceptance Model (TAM), Digital Empowerment and Workplace Adaptation*

## INTRODUCTION

Having been designed by a very rapid evolution over the duration, Artificial Intelligence (AI) is instilling a transformation in world employment markets, allowing the whole personality to get accustomed rapidly. According to Brynjolfsson & McAfee (2017) and the World Economic Forum (2023), AI also changes work and decision-making; therefore, it is essential to evaluate readiness for such change across demographic segments like millennial women. Gender, geography, and technology access converge in India, making inclusive digital transformation more complex, according to Patel & Sharma (2021). Millennial women – women born between 1981 and 1996 – are socially mobile and digitally literate but still under-represented in STEM and AI, as cited by the McKinsey Global Institute report (2021). Perpetuation of occupational segregation, wage disparity and withholding of opportunities to up-skill are still touching millennial women; all this is even more prominent in rural and semi-urban areas, where the digital divide has become the major determining factor.

Kerala is a unique location to examine the terrain of AI adoption by professional women because it has historically been a highly literate and human-developed location. However, as per NITI Aayog (2022), imbalances in digital infrastructure, income, and employment hinder preparedness. Kerala millennial women are richly equipped to construct an AI-embedded workforce but are confronted with unfair paths to transformation. With the advent of quicker business assimilation of AI (Brynjolfsson and McAfee 2017: World Economic Forum 2023), it is crucial to gauge the preparedness of these women to facilitate an inclusive workplace and digital equity.

**BACKGROUND OF THE STUDY**

Brianjolphson and McAfi (2017) and the World Economic Forum (2023) announced in their report that the upside-down advancement of Artificial Intelligence (AI) is changing labor markets and work practices worldwide, for which both people and businesses need to adjust quickly. In addition, an important audience whose AI readiness is worth noting is that of millennial women, born between 1981 and 1996. Recent reports of McKinsey Global Institute (2021) included Patel and Sharma (2021) studies, showing that they are globally in more and more AI-Intensive Professions, but much more in India, where fascination with gender is included in gender. Although authors say that this colleague is ambition and is open to learning for lifetime, gender pay intervals, commercial isolation, and especially the lack of opportunities for dismissal in rural and urban areas affects progress, still affects progress, Pew Research Center (2020), ILO (2022), Niti Eye (2022).

Kerala provides a distinct reference to check for AI readiness among professional women, with its high literacy rate and progressive development indicators. Nevertheless, inequalities in digital infrastructure, income and job access still affect their engagement with AI technologies, as their report is quoted in Neeti Aig (2022). Reports published by the World Economic Forum (2023), Brianjolphson and McAfee (2017) stated that, as business rapidly adopts AI, it is important to understand the preparations for this group to promote inclusive digital changes and equal workforce development.

The Emeritus Global Workplace Skills Study (2023) demonstrated that 87% of female workers in India are taking training in professional technology, and informed us that female researchers have raised genes by 29.6%, whereas male researchers have done it by 19.1% (Chakrabarti, 2023). Further, women make up only 29.6% of genuine learners. Globally, Deloitte (2024) saw a similar trend, in which American women are expected to surpass men in GenAI adoption by 2025, although a "technology trust gap" remains. In India, 90% of women consider Jeanai to be important for career development, yet only 35% feel sufficiently prepared, citing obstacles such as limited awareness, equipment access, institutional support, and fear of investigation (Business Standard , 2024). Manvi et al. (2025) have stressed that women who are understood, particularly those with lower digital literacy and many domestic responsibilities, are also marginalised. The number of women in AI leadership roles is less than it should be: only 26% of the positions in AI globally are held by women, and while this number is 36% in India, the number of women in senior positions is much lower, as they are often excluded due to the lack of venture funding (Emeritus, 2023; Indian Express, 2025).

Despite those insights, great study gaps continue to be. Most studies lack local recognition and do no longer cope with Kerala's specific socio-financial and geographical references (Deloite, 2024; Emeritus, 2023). There is a lack of localised, empirical and version-based research that implements a sturdy as cited by Dais (1989) shape such as the technology acceptance model (TAM), which focuses on perceived software (PU) and perceived ease of use (PEU). In addition, the modern studies do not often investigate how the district types (urban/rural), income level, or career liberal AI readiness are elements, nor do they deal with how the identity identifies women's engagement with AI.

**THEORETICAL BACKGROUND**

The technology acceptance model (TAM) was cited in his paper by Davis (1989) to provide a theoretical framework to understand the use of technology, using alleged utility (PU) and ease (PEU) as two main constructs. Further, as cited by Davis (1989) PU represents the opinion that technology increases job performance, while PEU is the ease of using technology. In terms of Kerala, PU millennium may be related to the alleged ability of women to increase productivity and career growth, while PEU may vary with digital literacy and access to socio-economic groups. While TAM creates the main outline for this study, insight from complementary principles makes its scope wider. The principle of planned behavior (Ajzen, 1991) shows the effect of approach, subjective norms, and perceived behavior control, stating that social expectations and confidence in someone's abilities affect how to adopt AI. The proliferation theory of innovations (Rogers, 1962) combines a population-level approach, emphasising adopting factors such as relative advantage, compatibility, and complexity, which parallel to PU and PEU of parallel TAM. This broad lens helps refer to how community norms in Kerala can affect AI adoption trends. The social cognitive principle (Bandura, 1986) enriches analysis by emphasising self-efficacy – faith in the ability to do a task. High self-efficacy among women can increase both perceived ease and utility, encouraging adoption. SCT on environment and individual factors emphasises the cognitive perceptions of TAM.

Despite the value added by these frameworks, the strength of the TAM lies in its clarity and individual-level focus. Unlike the socio-normal orientation of TPB, the dosability of macro-level spread, or SCT behavior of DOI, focuses on psychological perceptions of TAM technology (Davis, 1989). This makes it particularly well suited to examine the behavior of individual adoption of millennium women in Kerala. Although this study attracts wide theoretical insights, Tam remains central due to the alignment of research on its future power and individual readiness for AI integration.

## STATEMENT OF PROBLEM

Despite the growing body of literature on adopting technology in India, there is a notable difference in research that checks the readiness of AI adoption of millennial women, especially in Kerala, focusing on both individual and relevant factors. Addressing this difference is necessary to better understand the unique challenges and opportunities faced by this group,

Thus,

*"To what extent are millennial women in Kerala prepared to adopt AI technologies in the workplace, and what factors influence this readiness?"*

## OBJECTIVE OF THE STUDY

• To assess the readiness of millennium women's AI adoption in Kerala, focus on the role of PU and PEU in their preparations to integrate AI technologies in their professional practices .

• To examine the moderating effects of socio-economic, occupational and geographical factors on the readiness of AI adoption of millennial women in Kerala,

• To include factors such as alleged utility (PU), ease of use (PEU) and moderating variables to develop a forecast model for the readiness of AI adoption among millennial women in Kerala.

## HYPOTHESIS

1. **Ho**: PU and PEU have no significant difference in impact on the AI adoption readiness of millennial women in Kerala.
2. **Ho**: Socioeconomic factors (income level), profession (type) and location of origin (e.g., urban vs. rural areas) have no significant difference in moderation effect over the relationship between PU and PEU with AI adoption readiness among millennial women in Kerala.

## SCOPE AND DELIMITATIONS OF THE STUDY

The present study among millennial women (born 1981-1996) in Kerala, India, analyses AI adoption readiness among millennial women in the workplace by utilising the TAM. In this study, we are looking at the impact of PEU and PU as cited in Davis (1989), concerning their readiness measured by a series of moderating variables – profession, level of income, and geographic location. Primary data was gathered through a structured TAM-based questionnaire as cited in Davis (1989). This study is limited to a cross-sectional perspective, providing contextually relevant data on a contemporary phenomenon while avoiding the difficulties that may arise from longitudinal and organisational emphases.

The study is geographically constrained to Kerala, a state that has high levels of literacy and digital penetration. The findings are applicable in context but not readily generalisable to other Indian states. The study focuses only on millennial women, excluding other generations, and is gendered, meaning comparative gender work is constrained. The study also employs only the TAM framework, meaning that it does not assess other frameworks to determine broader differences – frameworks like UTAUT or Diffusion of Innovation may shed additional light on this area. The study considered some socio-demographic data like occupation, income, location, etc., and did not include others like education, digital literacy, family responsibilities, or workplace culture, as the study needed to maintain a specific focus. From a methodological perspective, a quantitative, cross-sectional survey design facilitated the collection of broad-based data – no longitudinal or qualitative approaches were attempted, limiting depth. Finally, although the questionnaire contained adapted language from Davis's original TAM scale, the survey items' application to the socio-cultural context of Kerala might introduce bias should the constructs not resonate with local perception.

**RESEARCH DESIGN**

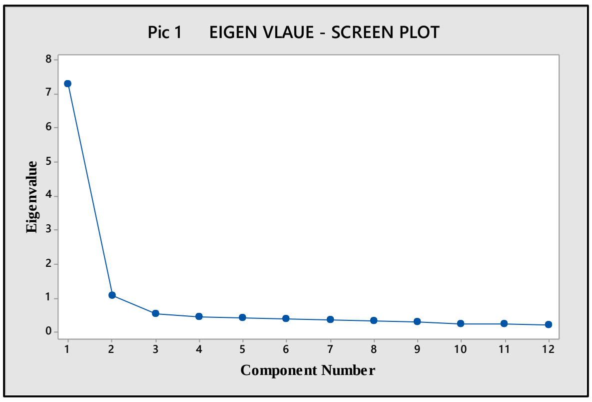
This study adopts a quantitative, descriptive and explanatory design, which enables objective analysis through empirical measurement and statistical testing. Founded on the technology acceptance model (TAM), it examines the readiness of AI adoption among millennial women in Kerala. The study has a focus on women who were born between 1981 and 1996 and live in Kerala, and it uses stratified random sampling. The samples were taken from the various economic categories of each district and are based on the size of the population of the districts, and the sample size was calculated statistically to be 509 - which included a buffer, justified by **Cochran's Formula with 95% confidence required minimum 386**. The data is collected through a questionnaire, which Fred D. Davis (1989) adapted to the TAM Questionnaire (Cronbach alpha 0.97, reliability 0.91) with adaptation, distributed online and offline to ensure inclusion. Ethical standards such as informed consent, oblivion and voluntary participation are strictly followed. The analysis includes principal component analysis and multiple regression analysis (with or without moderators) to validate factors, factor variables, moderating variables' effects and the predictive model.

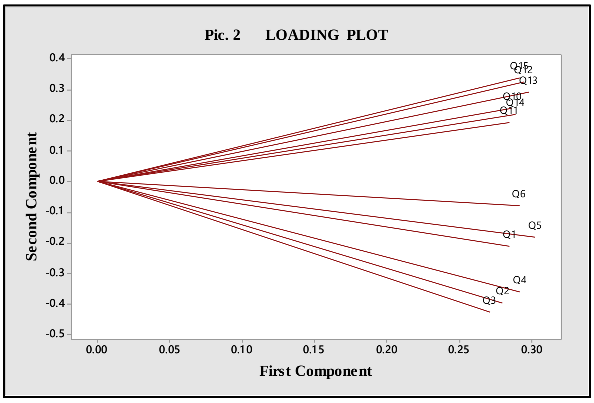
**ANALYSIS, DISCUSSION AND CONCLUSION:**

**PCA: Principle component analysis**

As cited in Minitab (2023), the statistical test principal components analysis (PCA) helps us to understand the covariance structure in the original variables. Further, it is cited in Minitab (2023), it helps to create a smaller number of variables using this structure. Followed by the multiple regression analysis to validate the predictive power and develop a model equation. Further to that, it also validates the moderating effect of categorical variables.

The PCA analysis, in the current article context, is to identify that there are 2 identifiable factors in line with TAM theory. Reference to analysis: with an Eigenvalue cut of ">=1", the analysis reveals there are 2 distinct factors that contribute 70% of total covariance (Pic I). Though the percentage is not closer to the ideal, one of the reasons is the outliers, which account for 10%. This analysis gives a clear hint that there are two factors, as described under TAM are valid. That means PU and PEU are the two critical factors that we can derive from this test (Pic II). The variable coverage of these factors is close to the 0.3 mark; hence, at higher levels, we can consider that the factors add up clearly. The third factor is not considered here because the Eigenvalue of that is 0.56, which is way below the cutoff. Further, the contribution to explaining the variance is less than 5%. Since the tool was invented in 1989, we should expect slight variation in the findings from the original, which explains one of the causes of variation. Further, the scale is developed for Western work environments. In the Principal Component Analysis, items under the Perceived Usefulness (PU) construct—"I would find AI tools useful in my job" and " Using AI tools is useful in my job"—exhibited a weak factor loading, falling way below the acceptable threshold. This finding may be attributed to several contextual and interpretive factors in addition to the points discussed above. Firstly, perceived usefulness is strongly linked to actual exposure and contextual relevance. Given that many respondents, particularly in certain districts (especially backward districts which are close to the national average of precipitation) or professions, may not have had direct experience using AI tools, their ability to assess the usefulness of such tools in their specific profession contexts could be limited or speculative. Secondly, the generic phrasing of the item might have led to vagueness or inconsistency in interpretation. Without job-specific AI examples, respondents from varied professions may have found it difficult to relate the statement to their work practices, leading to a weaker cognitive association and inconsistent responses. Despite the low statistical loading, the item retains conceptual and theoretical importance within TAM and was therefore retained for discussion.




**MRA : Multiple regression analysis**

Moving forward to MRA, research is testing the significance of factors with a 5% alpha. Using this step, research validates that around 80% of the variation of dependent variables can be explained through PU and PEU. The R-squared and R-squared adjusted reported are 79.83 % and 79.7%. Further, the $R^2$ predicted is 79.61%, which signifies the model does not appear to be overfit and has adequate predictive ability as cited in Minitab (2023) help. The 'P' value of '0.00' is significant (at 5% alpha); hence, the factors are significant. The 'VIF' values less than 3 indicate that there is no collinearity.

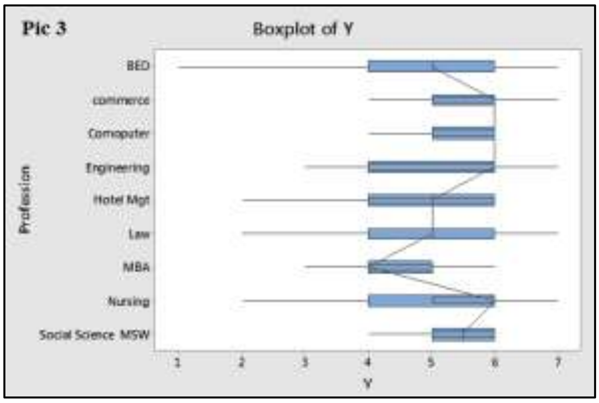
The model equation derived without categorical variable is as given under:

**Y = - 0.011 + (0.4791 * PU) + (0.4292 * PEU)**

The next step, where we are checking the significance of categorical variables (moderators), is significance and relevance.

**MRA with Moderator: The Profession**

The focus here is to check whether the model is influenced by the profession they are in. The tests reveal that, 'P' values are less than 0.05, which indicates profession is a significant variable. However, the 'R' values are not significantly improved with this addition. Up on drilling down to each profession, we found that the non-science differs from the science group; outliers are commerce (Pic. 3). The ‘P’ value substantiates this (‘0.005’ less than ‘0.05’).




**MRA with Moderator: The Districts level per-capita income**

The districts are classified using percapita income report published by Kerala State government. Which are clubbed into three distinct segments under quartile one (Districts : Pathanamthitta, Wayanad, and Malappuram), quartile two (Districts: Kannur, Kozhikode, Palakkad, and Kasaragod ), quartile three (Kottayam, Thrissur, Idukki, and Thiruvananthapuram), and quartile four (Ernakulam , Alappuzha, and Kollam). It is worth mentioning that it is above the national average of Rs.175,000/- (Khokhar, G. 2025).

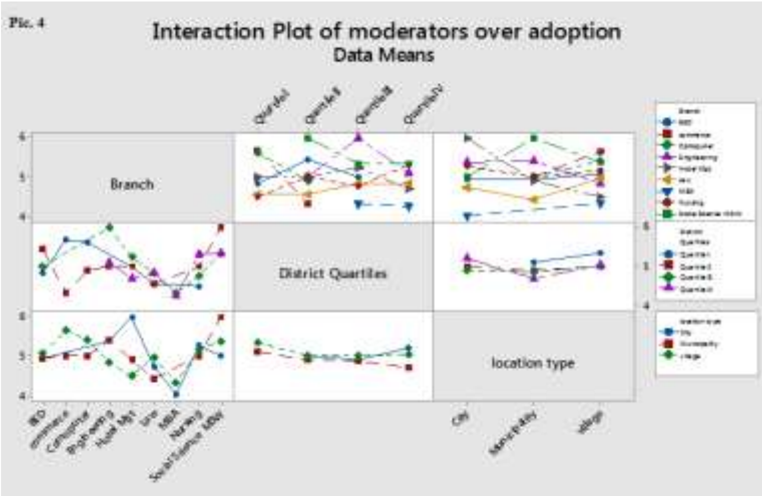
The focus here is to check whether the model is influenced by the economic factor of the location they are hailing from. The tests reveal that the ‘P’ value of 0.011 is less than 0.05, which indicates the moderator is significant. However, the ‘R’ values are not significantly improved with this addition. Up on drilling down to each category, we found that the non-science differs from the science group; outliers are commerce. The ‘P’ value substantiates this (‘0.005’ less than ‘0.05’).

**MRA with Moderator: The location**

The focus here is to check whether the model is influenced by the location (city, municipality and village) they are hailing from. The tests reveal that ‘P’ values (0.189) are greater than 0.05, which indicates the moderator is not significant.

**Interaction effect of Moderators:**

The interaction plot shows (Pic. 4) significant divergence in AI adoption readiness of millennial women in Kerala, based on academic background, district economic level, and geographic locality (associated with per capita income). Women in the engineering, law, and sciences branches have consistently higher readiness levels than in the educational, commercial, and humanities branches. This illustrates the effect of academic background on readiness. AI adoption readiness varies depending on district quartile; while it follows consistent lines of reasoning, the quartiles III and IV (likely economically wealthy) have higher mean readiness levels than quartiles I. The contributing reasons for differences in readiness could be due to underlying local policy and/or factors resulting from being engaged digitally. Worthy of note, readiness increased with urbanisation associated with geographic location, with both women in cities reporting the highest levels of readiness and women in Municipalities and villages reporting the lowest levels of readiness. Looking at the way the interaction lines intersect suggests that influencing one definite factor (i.e., academic background) is a factor of uncertainty and subject to the other factors based on where the women are located (that is, what economic tier they represent). The conclusion here was the complexity of the AI adoption readiness for millennial women is both influenced and shaped by a confluence of dimensions that relate to academic background and economic level. Therefore, any effort on a regional or contextual level to uptick, to improve, the AI adoption readiness of millennial women should focus on devising strategies that are context-sensitive and do not perpetuate inequitable integrations of AI.




**CONCLUSION**

In conclusion, while the core structure of the Technology Acceptance Model (TAM) demonstrates substantial predictive strength in explaining readiness for AI adoption, it is evident that a one-size-fits-all approach may not fully capture the nuances of behavioural intention in heterogeneous settings like Kerala. As cited by Davis (1989), the two constructs of the TAM the PU and PEU were demonstrated to be reliable predictors of behavioural intention with PCA and regression analyses. Differences in responses across different professions and income levels indicate that the model needs to be contextualised to the various contexts. The observations seem to indicate that participants with science-related work lives and participants primarily residing in higher-income districts are better versed in readiness than non-science participants and participants residing in economically disadvantaged districts. These findings underscore the significance that economic and professional context has on one's perception and behavioural intention with new AI tools. So, an effective intervention to promote AI adoption cannot rely solely on general assumptions in TAM and must include diverse, localised, and profession-based interventions that are economically positioned. This will be particularly important in places like Kerala, which has high literacy levels but huge intra-state variations in professional exposure, access to technology, and economic opportunities.

**RECOMMENDATIONS**

In the promotion of AI use among young women in Kerala, a combined effort of the various stakeholders is required. The government and policymakers should establish programmes for the digitisation of the country at the lower levels, focusing particularly in rural or underperforming districts, and give professionals incentives such as subsidies or talent stipends to women working in the sectors with low adoption levels. AI literacy can be improved through public-private partnered initiatives with ed-tech and AI organisations using structures such as community hubs or women's self-help groups. Educators and training organisations need to match AI training to the profession, developing tailored training models with digital modules for profession-specific training programmes and career-structured training programmes, especially those delivered remotely in rural locales and in flexible hybrid delivery modes that address access challenges. When employers and industry leaders want to build a culture of adoption, encouraging intuitive AI tools that reduce a learning curve, establishing peer mentoring networks to build confidence and monitoring adoption trends to inform HR, organisational development and learning approaches/strategies can provide readiness for informed deployment use and long-term AI learning. Working with organisations such as NGOs and women's advocacy groups to develop and facilitate AI literacy campaigns and leverage community-based engagement models involving local advocates to improve digital hesitancy for women might enhance AI adoption. Finally, developers should consider inclusive design and ensure women of different socio-economic backgrounds and diverse geographies can access and use technology.

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# THE INFLUENCE OF AI IN ENHANCING ORGANIZATIONAL PERFORMANCE THROUGH TRAINING AND DEVELOPMENT

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***Abstract***

*Artificial Intelligence (AI)'s integration into employee training and development has greatly enhanced business performance. This study examines how AI-Powered tools personalized training programs, predicts the skills or roles that will be in demand in the future, and reduces administrative burden by automating routine tasks, leading to optimizing employees competencies.*

*By utilizing personalized training programs, adaptive learning platforms and real-time feedback tools, AI allows the workforce to become more agile, skilled and data-informed individuals.*

*Through AI application, productivity will significantly be boosted, workforce engagement and retention will be increased, and adaptability to technological changes will also be improved.*

*Despite challenges, such as data privacy, algorism bias, and the need for human oversight, AI's transformative power in the employees' growth is undisputable.*

*By conducting a profound analysis of various literatures, this study attempts to magnify the significant impact AI has on Learning Management System (LMS) and virtual simulation in employee development. The findings emphasize the significance of applying AI in order to maximize training and aligning workforce skill and knowledge with organizational goals.*

*This paper explores the effectiveness of AI-driven training, its challenges and benefits, providing insights to organizations seeking to apply AI for competitive advantage in a market place.*

***Keywords:*** *Artificial Intelligence, Employee Development, Personalized Training, Adaptive Learning, Workforce Training.*

## Introduction

In this fast changing technological age, businesses encounter great challenges adapting to various digital platforms, and evolving market demand.

In order to realize organizational success, employees need to be equipped with adequate skills and competencies to help them adapt easily to these ever-changing business environments.

Traditional training and development method struggles with customization and engagement for it mainly applies a one-size-fits-all approach. This particular training method is proved to be inadequate to satisfy the existing dynamic needs.

Artificial Intelligence (AI) has become a powerful solution for organization, enabling training programs so effective and efficient.

AI-based tools facilitate training through personalized learning, Chatbots and real-time feedback, boosting employee engagement, skill acquisition, and alignment with organizational strategic goals.

These transformative AI-tools; such as predictive analytics, help organizations identify skill gaps, recommend tailored training, and predict future competency needs, thereby enhancing both individual and overall organization success.

The integration of AI into employee training and development is not free from challenges, concerns about job displacement, workforce resistance, data privacy – often perceived as "Fear of being obsolete" (FOBO) – brings forth setbacks. Furthermore, the need for human oversight during the application of AI-driven training programs remains a continuous issue. Overcoming these challenges necessitates a balanced approach that synthesizes technological innovation with open communication and employee engagement in decision making.

The study focuses on offering workable insights for organizations interested in leveraging AI's potential in the workplace environment. The findings particularly benefit HR professionals, policy makers, and business leaders, combining AI and human capital management in this digital era.

**Background**

The implementation of Artificial Intelligence (AI) into employee training and development has played a critical role changing the traditional training program into data-based and dynamic practices. Back in time, workforce training was predominantly dependent on pre-recorded video and textual e-learning contents, and manual evaluation; personalized learning, and real-time feedback has been a real issue. Customized, effective and measurable training initiatives are gaining a tremendous focus by various companies due to the proper and appropriate use of AI integration into adaptive learning systems, and immersive tools such as Virtual Reality (VR).

**Progress in Employee Training**

1. **Traditional Training Approach (Pre AI age):**

- Teacher-centric learning with less interaction.
- One-size-fits-all kind of courses to all individuals with no personalization.
- No immediate feedback and performance tracking is done manually.

2. **AI-Powered Learning**

- **Personalized Learning Paths:** training modules are customized according to individual needs, weaknesses, and strengths. (eg., platforms such as Udemy and Coursera employ AI tools to suggest the right models).
- **Automated System & Chatbots:** AI tools like ChatGPT offers HR Professionals 24/7 assistance and clarification, and reply instantly to employee queries.
- **Predictive Analytics:** Points out skill and knowledge gaps in current employees, predicts training needs for the future. (e.g., IBM's AI-driven talent management).
- **Workforce Engagement:** Personalized training optimizes employee motivation and retention.
- **Immersive Training:** AI simulation tools like AR/VR provide hands-on learning in a risk-free landscape (e.g., Amazon applies VR to train its workforce in customer service).
- **Employee Capability Gap:** Fast changing technological advancement necessitates constant upskilling and reskilling (e.g., AI, Automation).
- **Cost Optimization:** AI helps better budgeting in reducing training cost using automation for course delivery and evaluation.
- **AI-Informed Decisions:** AI analytics enable evaluation of training effectiveness in real-time.

**Transparency Deficits and Employee Trust Issues**

AI application in training encounters setbacks in spite of its positive advantage.

- **Data Privacy:** the use of AI in assessing employee performance triggers concerns.
- **AI Algorithmic Discrimination:** If training recommendations benefits specific individuals, it risks equitability.
- **Workforce Resistance:** Fear of job loss due to lack of trust or poor implementation of AI.

**Future Insight**

As organizations integrate AI in the workplace while bridging ethical and human concerns, it will keep attaining competitive advantage in skill acquisition and productivity.

**Purpose of Research**

This paper focuses on examining how Artificial Intelligence (AI) increases business performance by revolutionizing taskforce training and development. Particularly, it investigates the role of AI in providing personalized training paths, predictive analytics for competency development, automation for reducing training costs, overcoming problems such as employee fear of being obsolete, ethical concerns and the importance of consistent training for skill enhancement.

**Methodology**

This paper employs a qualitative literature review methodology, combining the existing recent academic and industry studies from 2020 to 2025. Main sources involve peer-reviewed journal articles, conference proceedings (e.g., Springer), and reports from Insiders and Financial Times.

The analysis is made based on themes like AI-Powered adaptive learning systems, Virtual Reality (VR) and Augmented Reality (AR) simulations, and problems in the application of AI for training and development.

**Major Findings:**

1. **Adaptive Learning System**: AI customizes training materials to individual needs and goals and performance metrics, enhancing employee engagement, and skill acquisition by up to 40% compared to traditional training approach (Lu & Lee, 2022).
2. **Predictive Analytics**: AI figures out skill and knowledge gaps and predicts future competency needs, enhancing employee planning by 35% (Nguyen et al., 2022).
3. **Efficiency Optimization:** Administrative tasks are automated utilizing AI tools such as ‘’Suki’’ that provide free time to focus on high-priority tasks, improving productivity.
4. **Engagement-Boosting (VR/AR) Application**: Offers safe and immersive hands-on learning to cut training costs by 30% in high risk sectors like manufacturing, aviation and healthcare (Suh & Prophet, 2018).
5. **Challenges:** Employees fear of being obsolete “FOBO”, ethical issues about job displacement, and the importance of constant upskilling prohibits AI adoption.

**Implications:**

1. **For Companies**: In order to minimize cost and enhance training relevance, organizations need to invest in AI-driven Learning Management System (LMS) and VR/AR tools. Also the application of predictive analytics will enable companies to proactively bridge future skill gaps.
2. **For HR Practitioners**: Workforce skepticism can be reduced by introducing AI literacy initiatives, and transparent communication. AI tools like gamification and real-time feedback boosts employee engagement.
3. **For Future Studies**: Examines longitudinal effect of AI on roles and the effective use of AI-human training models.

4. **For Policy Makers**: Guidelines are set for AI use in training, underscoring open communication and workforce well-being.

## Discussion

The application of AI tools has significantly increased training effectiveness that aligns with business goals, its achievements are mainly based on overcoming employee-centric problems. For example, poor or nontransparent communication is where workforce resistance is generated, viewing AI's role as a replacement.

The implementation of transparent and responsive AI tools in terms of addressing fear of job loss and data privacy plays a pivotal role in the integration of AI into employee training and development.

Chief Learning Officers shoulder the responsibility of aligning AI tools with company strategic goals and enhancing a culture of adaptability.

## Conclusion

AI has significantly transformed employee training approaches allowing data-based, adaptive, and engaging learning experience.

Nevertheless, effective application of AI needs solving ethical concerns, focusing on constant upskilling and reskilling, and involving managerial commitment. Integrating AI into employee training provides organizations a huge potential to execute their strategic goal more effectively and efficiently in this fast changing digital environment.

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# DIGITAL TRANSFORMATION AND UNIVERSALISATION OF COMMERCE AND MANAGEMENT STUDIES EDUCATION

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***Abstract***

*The integration of digital technologies has profoundly reshaped the pedagogical framework of commerce and management education in the era of Education 4.0. This paper examines how digital transformation has accelerated the universalisation of business education by enhancing accessibility, promoting flexibility, and fostering global interconnectedness. By analyzing international trends, national educational reforms, and evolving institutional practices, the study identifies the dual nature of this transformation—unlocking new opportunities while presenting significant implementation challenges. The findings emphasize the critical need for robust policy frameworks, advanced digital infrastructure, continuous faculty development, and learner adaptability to build an inclusive, equitable, and future-ready commerce education ecosystem in a digitally driven world.*

***Keywords:*** *Digital Education, Pedagogical Innovation, Learning Management Systems (LMS), Online Learning, Digital Divide*

## 1. Introduction

Commerce and management education, once rooted in conventional classroom settings, is now undergoing a radical shift with the advent of Education 4.0—an era marked by the integration of advanced technologies, automation, and personalized digital learning. This transformation extends beyond mere online delivery; it redefines curriculum design, pedagogical approaches, learner engagement, and global connectivity. However, this transition is not without challenges. As institutions strive to align with digital expectations, they face critical barriers such as the digital divide, faculty adaptability, curriculum relevance, and equitable access. This paper explores the multifaceted challenges of Education 4.0 and its implications for ensuring inclusive, future-ready commerce and management education across diverse social, economic, and geographic landscapes.

2. Objectives of the Study

- To investigate how digital technologies are reshaping commerce and management education in the Education 4.0 era.
- To evaluate the contribution of digital tools in promoting the universalisation and inclusivity of business education.
- To identify key challenges and barriers to effective digital adoption in teaching and learning practices.
- To recommend strategic approaches for developing a resilient, future-ready digital education model in commerce and management studies.

## 3. Digital Transformation in Commerce and Management Education: A Shift Towards Education 4.0

The evolution of commerce and management education in the Education 4.0 era marks a profound shift from traditional instruction to a digitally enriched, learner-centered ecosystem. This transformation is not merely technological—it redefines how knowledge is constructed, delivered, and applied in a workforce increasingly shaped by automation, AI, and global interconnectivity.

### *3.1 Pedagogical Innovations for Future-Ready Learning*

Education 4.0 introduces dynamic pedagogical models supported by cutting-edge digital tools. Learning Management Systems (LMS) like Moodle, Google Classroom, and Blackboard are now central to content delivery, learner tracking, and continuous assessment.

Massive Open Online Courses (MOOCs) on platforms such as Coursera, edX, and SWAYAM offer scalable, high-quality business education, allowing students across socio-economic backgrounds to access content from leading institutions. These resources have become instrumental in breaking down the barriers of cost, location, and institutional entry.

Furthermore, immersive technologies such as virtual simulations, AI tutors, and gamified case-based scenarios simulate real-world business problems, enhancing student engagement and decision-making capabilities—skills vital in the age of automation.

### *3.2 Curriculum Reforms Aligned with Digital Industry Demands*

In response to the evolving job market, commerce curricula are undergoing significant restructuring. Education 4.0 promotes the integration of interdisciplinary subjects including FinTech, Business Analytics, Artificial Intelligence in Management, and Cybersecurity in Business.

These reforms prioritize not only technical proficiency (e.g., coding, data visualization, and automation tools) but also ethical reasoning, sustainability, and digital citizenship. This holistic approach prepares students for both the technological and human dimensions of future work environments.

### *3.3 Institutional Transformation and Learning Ecosystems*

Institutions are increasingly adopting hybrid learning ecosystems that blend digital content with experiential, collaborative learning. The flipped classroom model encourages students to independently explore digital content before engaging in in-person discussions, promoting deeper cognitive engagement.

Universities are also forming strategic partnerships with industry to offer virtual internships, mentorship programs, and certification courses that are directly aligned with emerging workplace expectations. Additionally, assessment mechanisms now include online proctoring, AI-driven grading systems, and peer evaluations—ensuring academic integrity in virtual environments.

## 4. Universalisation of Commerce and Management Studies in the Education 4.0 Context

Education 4.0 brings the promise of universalisation by making commerce education more **inclusive, equitable, and globally connected**. It extends learning opportunities beyond traditional classrooms, reaching marginalized populations, non-traditional learners, and global audiences.

### *4.1 Enhancing Access and Inclusivity*

Digital transformation enables learners in remote, under-resourced, or conflict-affected areas to participate in formal education through online platforms. Features such as subtitles, screen readers, and adaptive interfaces also support differently-abled students, ensuring no one is left behind in the digital revolution.

Education 4.0 supports the ethos of lifelong learning, enabling working professionals, homemakers, and adult learners to pursue upskilling or reskilling pathways through modular, stackable digital credentials.

### *4.2 Promoting Affordability and Flexibility*

With many MOOCs and open educational resources available at minimal or no cost, Education 4.0 reduces the financial burden of acquiring business education. The flexibility of asynchronous learning allows students to learn at their own pace, balancing educational pursuits with work, caregiving, or personal commitments.

Micro-credentials and competency-based programs further empower learners to design personalized academic journeys aligned with specific career goals, enhancing employability in a fluid, gig-oriented job market.

***4.3 Enabling Global Collaboration and Exposure***

Digital platforms are dissolving geographical boundaries, giving rise to virtual international classrooms. Students can now enroll in joint degree programs, engage with international faculty, and collaborate on real-time global projects.

Technologies such as Zoom, MS Teams, and Google Meet foster synchronous interaction, while tools like Miro and Google Workspace support collaborative assignments across continents. This global exposure cultivates cultural competence, digital fluency, and adaptability—core competencies in the Education 4.0 paradigm.

**5. Challenges of Education 4.0 in Commerce and Management Education**

1. **Digital Divide and Infrastructure Gaps**
   Unequal access to high-speed internet, digital devices, and ICT infrastructure creates a learning disparity, especially between urban and rural commerce students.
2. **Faculty Preparedness and Pedagogical Adaptation**
   Many educators in commerce are inadequately trained in digital pedagogy, instructional design, and emerging technologies like data analytics, AI, and virtual simulations.
3. **Curriculum Obsolescence**
   Traditional commerce syllabi often lag behind industry needs, lacking focus on digital finance, e-commerce, business analytics, FinTech, and sustainability.
4. **Assessment and Academic Integrity**
   Online assessments face challenges in ensuring fairness, student authenticity, and meaningful evaluation of higher-order managerial skills.
5. **Industry-Academia Skill Gap**
   There is often a disconnect between what is taught and the skills demanded in a tech-driven business world. Students may graduate without adequate exposure to digital tools like ERP, CRM systems, or blockchain applications.
6. **Language and Content Localization**
   A significant amount of digital content is in English, limiting access for vernacular medium learners in commerce programs.
7. **Student Engagement and Motivation**
   Passive consumption of online content, screen fatigue, and lack of classroom dynamics reduce student interaction, collaboration, and intrinsic motivation.
8. **Inclusion and Accessibility**
   Differently-abled students and those from marginalized communities face difficulties navigating complex digital platforms without tailored support or assistive technologies.
9. **Scalability vs. Quality**
   While digital platforms enable mass access, maintaining academic quality, mentorship, and personalized feedback becomes a growing concern.
10. **Resistance to Change**
    Institutional inertia, regulatory constraints, and conservative academic mindsets can delay the integration of innovative teaching-learning models.

Certainly! Here's a **refined and professionally worded version** of your strategic recommendations, tailored to the context of **Education 4.0 in commerce and management education**:

## 6. Strategic Recommendations

To ensure that commerce and management education in the Education 4.0 era is inclusive, future-ready, and globally competitive, the following strategic initiatives are recommended:

- **Strengthen Digital Infrastructure**
  Public and private stakeholders must invest in expanding internet connectivity, ensuring device accessibility, and providing sustained technical support, particularly in rural and underserved regions.
- **Enhance Faculty Competency in Digital Pedagogy**
  Institutions should implement continuous professional development programs that equip educators with skills in instructional design, multimedia content creation, and the effective use of digital learning platforms.
- **Align with National Educational Policies (NEP 2020)**
  Educational institutions must operationalize the NEP's directives by promoting online and open learning systems, fostering interdisciplinary learning, and supporting innovation and academic autonomy.
- **Adopt Blended and Hybrid Learning Models**
  A pedagogical balance should be maintained between online instruction and offline engagement, leveraging the benefits of digital scalability without compromising hands-on, collaborative learning experiences.
- **Establish Quality Assurance Mechanisms**
  A regulatory framework should be instituted to monitor and accredit online and hybrid programs in commerce, ensuring academic standards, learning outcomes, and credibility in digital certifications.
- **Foster Industry-Academia Collaboration**
  Curricula should be co-developed with industry experts to ensure relevance to evolving job roles, with a focus on promoting virtual internships, real-time projects, mentorship programs, and certification in emerging digital competencies.

## 7. Conclusion

The digital transformation of commerce and management education presents a pivotal moment of both promise and responsibility. While it opens unprecedented avenues for access, innovation, and global engagement, it also necessitates a fundamental rethinking of pedagogical approaches, infrastructure development, and policy alignment. Achieving the vision of universalised education in the Education 4.0 era requires that digital learning be not only accessible and affordable but also inclusive and pedagogically sound. Institutions must go beyond adopting technology as a delivery mechanism and instead leverage it as a catalyst for systemic change—empowering learners to succeed in an agile, automated, and globally connected business environment.

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# GREEN COMMERCE AND SUSTAINABLE WITH DIGITAL PRACTICES

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***Abstract***

*Though it has altered company practices, the fast digitisation of global commerce has prompted serious worries about the effects on the environment. In order to better understand how the digital economy might be in harmony with ecological responsibility, this article delves into the relationship between green commerce and sustainable digital activities. Using e-commerce and digital business models as case studies, the study examines the fundamentals of green commerce. With sustainability taking centre stage, businesses must find ways to balance their environmental and financial priorities. Digital technology should be used to promote environmental stewardship among companies and customers as well as to improve operational efficiency, according to the study, which stresses the importance of a comprehensive approach to sustainability. This research paper's aims, methodology, key findings, and implications finally, the results make it clear that businesses can't avoid green commerce and sustainable digital practices; they need to do them if they want to stay in business in a global market that is becoming more environmentally aware.*

***Keywords:*** *Green Commerce, Sustainable Digital Practices, E-commerce, Environmental Sustainability, Eco-friendly Marketing, Carbon Footprint Reduction, Green Technologies*

## Introduction

The emergence of internet commerce has changed conventional business structures in recent years, opening up new avenues for expansion and creativity. But the environmental consequences of this quick digital change have also drawn serious attention. A growing demand for sustainable digital practices has arisen as a result of an increasing reliance on data centres, cloud computing, and digital supply chains, which have increased energy consumption and e-waste. These issues may be resolved by green commerce, which incorporates sustainability into corporate operations. Growing consumer as well as industry engagement with environmental issues has led to a need for more sustainable business models that conserve resources, lower carbon footprints, and promote ethical business practices.

Green commerce is the blending of standard company methods with sustainable tactics, like reducing waste, increasing energy efficiency, and limiting environmental damage utilising digital tools. As a way to balance both the goals of protecting the planet and economic growth, green commerce promotes eco-friendly technologies, simplifies logistics, and encourages sustainable buying behaviour. The implementation of ecologically friendly digital strategies and the deployment of green technologies are key components of sustainable digital practices.

Energy-efficient digital infrastructure and the development of circular business models that
Limit e-waste are just two examples of these strategies.

The purpose of this study is to analyse the relationship between sustainable digital practices and green commerce through exploring how organisations might use digital technologies in order to reduce the environmental impact they have.

The research being undertaken aims to identify ways that companies can use to accomplish goals for sustainability with no affecting revenue. likewise, while investigating how digital platforms may boost demand for products and services that are sustainable, the article will also look at how consumers drive towards green commerce.

## Review of Literature

### AI and Machine Learning in Circular Economy

Machine Learning and AI in the Circular Economy the circular economy has grown as a result in a significant way to machine learning (ML) and artificially intelligent systems (AI). All Noman et al. (2022) accomplished a comprehensive review of the literature and bibliometric study, identifying substantial fields such as supply chain optimization and handling waste where AI and ML promote sustainable practices.

All Noman, A., Akter, U. H., Pranto, T. H., & Haque, A. B. (2022). Machine learning and artificial intelligence in circular economy: A bibliometric analysis and systematic literature review. ***arXiv preprint arXiv:2205.01042*.arXiv**

### Green Marketing in the Digital Age

Whether technology can improve sustainable marketing strategies has become a focus of recent studies. A comprehensive review of the literature by Alkhatib et al. (2023) focused on the use of digital platforms to promote sustainable products and services.

According to their findings, electronic means are essential for influencing consumer choices to favour environmentally conscious choices.

Alkhatib, S., Kecskés, P., & Keller, V. (2023). Green marketing in the digital age: A systematic literature review. *Sustainability*, 15(16), 12369. **https://doi.org/10.3390/su151612369MDPI**

### E-commerce Ecosystems and Sustainability

Ecosystems of electronic commerce and Sustainable development. The platforms for internet commerce have transformed toward drivers of long-term viability The contribution that for internet commerce ecosystems towards the Sustainable Development Goals (also known as the SDGs) was the subject of a study that was published in Electronic Markets in 2024.

The study focused the way infrastructure services administrators and consumers may encourage sustainable behaviour. Emerald+1 SpringerLink+1

Electronic Markets. (2024). E-commerce ecosystems as catalysts for sustainability: A multi-case analysis. Electronic Markets, 34, Article 58. https://doi.org/10.1007/s12525-024-00733-zSpringerLink

### Digital Technologies and Social Sustainability

Recent research investigations emphasize on the connections within equitable development and technological advancement. The influence of technological innovation on social issues like social justice, cultural diversity, and the overall quality of life were investigated from Qadri et al. (2025). The research plan for implementing environmentally friendly practices into digital activities has been offered throughout the paper they published. Emerald

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**Conceptual Framework Green Consumer and Sustainable Digital Practices**

| Dimension | Key construct | Digital Enablers | Sustainability Outcomes | Sources |
|---|---|---|---|---|
| **Strategic Integration** | Environmental, Social and Governance (ESG) Integration Circular Economy principles | Digital transformation initiatives- AI, IoT, and blockchain Technologies. | Enhances Financial resilience- improved stakeholders trust- Regulatory Compliance | Sustainable Business Practices: A Conceptual framework for Long -Term Growth |
| **Supply chain Management** | Green supply chain practices- supplier and customer co-operation | Smart supply chain systems- Real Time data analytics | Reduced carbon footprint -efficient resource utilization sustainable procurements | Green Supply chain management conceptual framework and model for Analysis |
| **Digital Transformation** | Digital Entrepreneurship Sustainable Business model innovation | Digital twins cloud computing- cyber physical systems | Optimized operations- enhance value creation and delivery sustainable | Transition to Digital Entrepreneurship with a Quest of Sustainability Development of New conceptual frame work |
| **Consumer Engagement** | Sustainable consumption behaviour – value co-creation in retail context | Social media platform internet of Things (IoT) | Increase consumer awareness Adoption of sustainable products- behavioural towards sustainability | Developing a Framework of Sustainable Consumption in Retailing contexts. |
| **Performance Management** | Carbon- aware business process re-engineering – Eco-efficiency metrics | Machine Learning tools Environmental impact assessment frameworks | Quantitative measurement of digitalization's environmental impact -informed decision- making for process improvements | Evaluating sustainable Digitalization: A Carbon- aware framework for enhancing Eco-friendly business process Reengineering. |
| **Governance and Policy** | ICT- Green Governance – Corporate Social Responsibility (CSR) in IT | Green IT strategies- Sustainable – ICT Governance Model | Alignment of IT governance with sustainability goals- enhanced organizational performance | ICT Green Governance: New Generation model based on Corporate Social Responsibility and Green IT. |

Conceptual Framework Circular Model

**1. Triple Bottom Line Model with Digital Integration**

| Dimension | Green Consumer Practices | Digital Practice |
|---|---|---|
| Environmental | Eco-friendly packaging, Renewable energy | IoT for resource monitoring, AI for energy optimization |
| Social | Fair trade, ethical labour | Digital education, social media awareness' campaign |
| Economic | Cost-effective green innovations | e-commerce platforms, digital payment systems |

Conceptual Frame work model

**2. Circular Economy Framework with Digital Support**

| | |
|---|---|
| Design | Eco-design principles supported by AI simulations |
| Productions | Smart factories using IoT for efficiency |
| Consumption | E-commerce selling upcycled or sustainable products |
| Reuse/Recycle | Apps/platforms for product return and reuse logistics. |

A Taxonomy Circular Economy Indicator

**3.Green Digital Value Chain Model**

| Stage | Green Practices | Digital Practice |
|---|---|---|
| Procurement | Sustainable sourcing | Blockchain for traceability |
| Manufacturing | Low-carbon technologies | IoT for machinery control |
| Distribution | Electric vehicles, minimal packaging | Route optimization software |
| Retail/Consumer | Eco-labelling, green marketing | AR/VR product visualization, e-commerce |
| End-to-Life | Product take-back schemes | QR-based recycle guides, customer dashboards |

A Taxonomy Circular Economy Indicator

**4. Smart Sustainable Business Model Canvas**

| Element | Description |
|---|---|
| Key Partners | Green tech firms, environmental NGOs, digital service providers |
| Key Activities | Eco-innovations digital marketing, data analytics for sustainability |
| Value Preposition | Sustainable product/services with digital convenience |
| Customer Relationships | AI-driven personalization, green loyalty programs |
| Channels | Eco-friendly e-commerce, social platforms |
| Customer Segments | Eco-conscious consumers, digital natives |
| Key resources | Renewable energy, cloud infrastructure, skilled green workforce. |
| Cost Structure | Green R&D, digital tools |
| Revenue Streams | Subscription, product sales, digital services |

**5. Sustainable Development Goals Based Green Digital Practices Framework**

| SDG Goal | Green Commerce Practices | Digital Tools/ Methods |
|---|---|---|
| Clean Energy (SDG7) | Use of solar energy in operation | Smart grids, IoT meters |
| Responsible consumption (SDG 12) | Product life extension, upcycling | Digital twins, blockchain traceability |
| Climate Action (SDG 13) | Carbon offset, green logistics | Emission tracking software |

Porter M.E (1985) Competitive Advantages New York: Free Press

**6. Sources of Conceptual Framework and Models**

| Model / Framework | Source / Publisher | Link to Original Source |
|---|---|---|
| Triple Bottom line (TBL) | John Elkington – Cannibals with Forks: The Triple Bottom Line of 21st Century Business | https://www.john elkington.com/archive/TBL-elkington-chapter.pdf |
| Technology Acceptance Model (TAM) | Davis, F. D. (1989) – MIS Quarterly | https://doi.org/10.2307/249008 |
| Circular Economy Framework | Ellen MacArthur Foundation | https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview |
| Green Business Model Canvas | Lüdeke-Freund, F. (2010) – SSRN Working Paper Series | https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2189922 |
| Digital Sustainability Framework | Ghosh & Vinuesa (2021) – Nature Communications | https://doi.org/10.1038/s41467-021-21144-0 |

Ellen Mac Arthur Foundation and Nature

The structures and Models for Environmentally Friendly Business and Sustainability Internet Activities. Key conceptual frameworks and theoretical models pertinent to the study concerning environmentally friendly business and sustainable methods using digital platforms are shown in the following table. Every model is explained, along with how it has been used in research and a reliable source for additional information.

| Model/ Framework | Key Components | Application in Research | Source & Citation |
|---|---|---|---|
| Triple Bottom Line (TBL) | 1. People (Social) 2. Planet (Environmental) 3. Profit (Economic) | Assesses how digital green commerce impacts environmental sustainability, economic performance, and social responsibility. | John Elkington, J. (1998). *Cannibals with Forks: The Triple Bottom Line of 21st Century Business. * https://www.johnelkington.com/archive/TBL-elkington-chapter.pdf |
| Technology Acceptance Model (TAM) | 1. Perceived Usefulness 2. Perceived Ease of Use | Measures user acceptance of digital platforms promoting green commerce. | Davis, F. D. (1989). *MIS Quarterly*, 13(3), 319–340. https://doi.org/10.2307/249008 |

| | | | |
|---|---|---|---|
| Circular Economy Framework | 1. Reduce<br>2. Reuse<br>3. Recycle<br>4. Regenerate | Explains how digital platforms help close the production-consumption loop in commerce. | Ellen MacArthur Foundation (2021). https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview |
| Green Business Model Canvas | 1. Eco Value Proposition<br>2. Key Sustainable Resources<br>3. Green Revenue Streams | Custom adaptation of Business Model Canvas focusing on digital green commerce. | Ludeke-Freund, F. (2010). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2189922 |
| Digital Sustainability Framework | 1. Digital Infrastructure<br>2. Data Analytics<br>3. Green IT Solutions<br>4. Consumer Behaviour | Shows how digital tools enhance sustainability practices in commerce. | Ghosh, D., & Vinuesa, R. (2021). *Nature Communications*, 12(1). https://doi.org/10.1038/s41467-021-21144-0 |

**Research Methodology**

Research is a comprehensive understanding of how green commerce and digital sustainability practices are integrated; the study uses a mixed-methods approach that combines quantitative and qualitative techniques. The study focuses towards the absorption, effects, difficulties, and prospects of technological advances in advancing environmentally friendly company procedures.

The pragmatic research philosophy, on which this study is founded, permits the application of qualitative as well as quantitative methods to analyse complex, practical issues such as the relationships between technological developments, environmental sustainability and green commerce as a whole.

Since this research is based entirely on secondary data, the research adopts a qualitative and descriptive research method with a strong emphasis on content analysis and thematic review

The later approach: Using real information to test current theories (such as ecological the digital transformation and ethical business networks).

Investigation Methods: A Mixed Approach Methodology: incorporates the analysis of topics (qualitative) and numerical information (quantitative) to strengthen the findings.

Quantitative: Surveys that gauge impact, behaviour, and awareness. Qualitative: Deeper understanding of tactics and difficulties through case studies.

**Sources of Data Collection**

**Primary Data:** These are original data collected first-hand for the specific purpose of your research: As this research study is based on empirical and conceptual based analysis through this research. Primary findings are supported and contextualized by secondary data.

**Secondary Data**: Data collected from government website, Research journals, and from author and other sources

i. Official Documents NITI Aayog Sustainable Development Reports from the Indian Ministry of Environment, Forests, and Climate Change Publications of the EU Green Deal

ii. Scholarly publications Sources: UGC-CARE Journals, JSTOR, Scopus, and

Google Scholar, Subjects covered include CSR, digital transformation, green marketing, and Sustainable E-commerce.

iii.Databases & Industrial Reports: McKinsey: "Sustainability in the Fashion Industry" PwC: "Green supply chains powered by technology" "Digital Economy Report" from United Nations Conference on Trade and Development (UNCTAD) Perspectives from the world economic forum.

3. **Detailed Research Design**

Research Type: Descriptive: Explains the state of digital green trade activities today. Examines prospective improvements, shortcomings, and potential for further development.

**Objectives of the Study**

1. To explore the idea and essential elements of green commerce in light of contemporary Company procedures.
2. To investigate the role those digital technologies, play in improving environmentally friendly corporate practices.
3. To evaluate how businesses and consumers perceive and feel about green digital activities.
4. To offer strategic analysis and suggestions to companies looking to implement sustainable Digital models.

**Scope of the Study:**

1. It Looks at how both companies and customers view the adoption of sustainable Digital practices.
2. Covers a range of sectors using environmentally friendly digital methods, including manufacturing, services, retail, and logistics.
3. Examines how global sustainability objectives, regulations pertaining to the Environments, and governmental policies affect digital green business practices.
4. Assesses the advantages of implementing sustainability electronic solutions from an environmental, social, and financial standpoint.

**Limitation of the study:**

1. Since the study only looks at a few industries, it could not be representative of all Those engage in green commerce.
2. There may be limited access to current and reliable data on digital sustainability practices.
3. The findings' long-term applicability may be dependent on the digital technology' quick evolution.
4. The study might not have taken consideration for regional variations in environmental laws and digital infrastructure.

**Case Study**

Amazon India has been working toward making its operations greener by leveraging digital technologies to drive sustainability across its e-commerce ecosystem. As part of Amazon’s global "Climate Pledge," the company is investing in digital and logistical innovations to reduce its carbon footprint in India.

**Key Digital Sustainable Practices:**

1. Integration of Electric Vehicles (EVs): Amazon India tracks and controls its fleet of EVs utilized for last-mile deliveries using a digital logistics management system.
2. Green Fulfilment centre’s: Electronically tracked warehouse systems minimize packaging waste, maximize energy efficiency, and effectively regulate temperature.

3. "Climate Pledge Friendly" Product Tags: To make things simpler for those who care about the environment, Amazon signifies supplies featuring environmentally friendly certifications (Forest Stewardship Council, Energy Star, etc.) on both its website and app.
4. AI-Based Inventory management and Routing: sophisticated methods save pollutants and waste by cutting down on surpluses and wasteful delivery.

**Solutions:**

1. Local Partnerships for EV Infrastructure: Work together with EV start-ups and state governments to extend green delivery zones and construct charging stations.
2. Digital Training Modules for Sellers: Establish an online learning environment to help vendors comprehend packaging guidelines and green certifications.
3. Green Rewards Program: Provide digital money or loyalty points to customers who select "Climate Pledge Friendly" products.

**Formula for Sustainability Impact Score (SIS)**

A basic, custom formula to evaluate the digital sustainability performance of a business.

SIS = (E + W + T) / 3

Where:

E = Energy saved through digital operations (kWh or %)

W = Waste reduced due to digital practices (in kg or %)

T = Transparency score from digital reporting tools (scale 1–10)

This gives a single average score that can be compared across time or businesses.

https://chat.openai.com

**Findings**

Despite digital practices provide successful tools for sustainability, mainstream adoption is always restricted, especially in developing countries, with shortcomings like digital gaps, high expenses for implementation, privacy issues, and ambiguous requirements.

Currently, a lot of organisations use digital tools like websites, apps, and online marketplaces to cut waste and pollution.

These tools assist companies in promoting green marketing and handling of resources. Eco-friendly items have attracted consumer interest. They are more likely to support enterprises

Customers may now identify and purchase green items more easily thanks to e-commerce. Additionally, online platforms reduce wrapping trash, utilise less material, while offering delivery options which utilise a smaller amount of energy.

**Conclusion:**

Digital technology contributes in the development of green commerce. By utilising digital solutions that help them interact with environmentally worried consumers and protect the environment, businesses are revolutionising their operations. These adjustments not only lessen environmental damage but also aid businesses in thriving in a highly competitive sector.

Technology has facilitated information sharing, reduced waste, and improved energy efficiency. At the exact same time, consumers are become more conscious of sustainability issues and prefer to support companies who share their values. But there are still certain obstacles to overcome, such the necessity for training, the high expense of implementing a fresh approach, and the lack of electronic means in some regions.

**Recommendations and Suggestions**:

**Expand the Availability of Digital Tools** more individuals as well as companies should be able to use smartphones, computers, and the internet with the assistance provided from government and communities. Everyone will be able to get involved with green business
Activities as a result.

**Motivate Companies to Become Green**

Organisations who employ technological devices to save energy or reduce pollution should be rewarded with subsidies or tax breaks. More companies may be inspired to behave responsibly as a result.

**Educate People About Green Business**

People, especially emerging investors, can gain knowledge about the benefits of green business and how to use digital mediums to promote it through social media, educational institutions and institutions. Eco-friendly products should be highlighted on e-commerce websites together with an explanation of the environmental advantages they provide. Customers will be able to make wise and sustainable decisions thanks to this.

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# DIGITAL VS. TRADITIONAL HRM: A COMPARATIVE STUDY WITH CASE-BASED INSIGHTS INTO CHALLENGES AND IMPLICATIONS

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***Abstract***

*The evolution of Human Resource Management (HRM) practices has witnessed a significant transformation with the advent of digital technologies. This paper presents a comparative study between traditional HRM and digital HRM, aiming to explore the distinct features, advantages, challenges, and implications of each approach. Through a comprehensive literature review and comparative analysis, this research identifies key differences in HR processes, technology integration, employee experience, and strategic alignment between the two paradigms. While digital HRM offers advantages such as efficiency, data-driven decision-making, and enhanced employee experience, it also poses challenges including integration issues, data privacy concerns, and the need for skills development. The findings suggest implications for HR practice, emphasizing the importance of successful digital HRM implementation strategies, HR professional development, and redefined roles within organizations. By shedding light on the evolving landscape of HRM, this study contributes to a deeper understanding of the implications of digitalization on HR practices and offers insights for future research and practice.*

***Keywords:*** *Human Resource Management (HRM)**,** Digital HRM**,** Traditional HRM**,** HR Technology**,** Digital Transformation**,** HR Processes**,** Skills Development.*

## INTRODUCTION:

Human Resource Management (HRM) plays a crucial role in shaping organizational success by managing the most valuable asset: people. Over the years, HRM practices have evolved significantly, driven by technological advancements, changing workforce demographics, and shifting organizational needs. One of the most notable transformations in HRM is the emergence of digital HRM, which leverages digital technologies to revolutionize traditional HR processes and practices.

This paper aims to explore and compare digital HRM with traditional HRM, highlighting their distinct features, advantages, challenges, and implications for organizations. By examining the evolution of HRM practices and the impact of digitalization, this study seeks to provide insights into the changing landscape of HRM and its implications for organizational effectiveness.

The introduction provides an overview of the research objectives, the significance of the study, and the structure of the paper. Through a comprehensive literature review and comparative analysis, this research aims to deepen our understanding of the differences between digital and traditional HRM, offering valuable insights for HR professionals, organizational leaders, and researchers in the field.

### Meaning of digital HRM

Digital HRM, or Digital Human Resource Management, refers to the use of digital technologies to streamline and optimize various HR functions within an organization. It involves the application of digital tools, platforms, and systems to automate HR processes, enhance employee experience, and enable data-driven decision-making.

Digital HRM encompasses a wide range of technology solutions, including HR information systems (HRIS), applicant tracking systems (ATS), learning management systems (LMS), performance management software, employee self-service portals, artificial intelligence (AI) applications, analytics tools, and mobile applications. These technologies are leveraged to digitize and transform traditional HR processes, such as recruitment, onboarding, training, performance management, compensation and benefits administration, and employee engagement. The goal of digital HRM is to improve operational efficiency, enhance employee productivity and satisfaction, and enable HR professionals to focus on strategic initiatives that contribute to organizational success.

Digital HRM offers numerous advantages for organizations seeking to optimize HR processes, improve employee engagement, and drive organizational success in an increasingly digital world.

**Difference between digital HRM and traditional HRM**

The following table highlights the key differences between digital HRM and traditional HRM across various aspects, emphasizing the advantages of digital HRM in terms of technology usage, accessibility, data management, automation, employee experience, decision-making, scalability, and cost efficiency.

| **Aspect** | **Digital HRM** | **Traditional HRM** |
|---|---|---|
| | | |
| **Technology Usage** | Leverages advanced HRIS, AI, analytics, and automation tools for streamlined processes and data-driven insights. | Relies on manual processes, paper-based documentation, and limited use of technology for HR tasks. |
| **Accessibility** | Provides 24/7 access to HR systems and self-service portals via web and mobile devices, enabling employees to manage their information conveniently. | Typically requires employees to visit HR offices or use paper forms for HR-related requests, limiting accessibility and convenience. |
| **Data Management** | Stores employee data in centralized HR databases, facilitating easy retrieval, analysis, and reporting of HR metrics and trends. | Relies on physical filing systems and spreadsheets for employee records, leading to inefficiencies and data inconsistencies. |
| **Automation** | Automates repetitive HR tasks such as payroll processing, leave management, and performance appraisals, reducing manual errors and improving efficiency. | Relies on manual data entry and processing, increasing the risk of errors, delays, and compliance issues. |
| **Employee Experience** | Offers personalized experiences through self-service portals, online training modules, and AI-driven chatbots, enhancing engagement and satisfaction. | Provides limited employee self-service options and relies on face-to-face interactions with HR staff for inquiries and support. |
| **Decision-Making** | Utilizes data analytics and predictive modeling to inform strategic HR decisions, such as workforce planning, talent acquisition, and retention strategies. | Relies on intuition, past experiences, and qualitative assessments for HR decision-making, potentially leading to suboptimal outcomes. |
| **Scalability** | Scales easily to accommodate organizational growth, mergers, or restructuring, with flexible technology infrastructure and modular software solutions. | May struggle to adapt to changes in organizational size or structure due to rigid processes and legacy systems. |
| **Cost Efficiency** | Offers potential cost savings through reduced administrative overheads, improved resource allocation, and optimized HR processes. | May incur higher costs associated with manual labor, paperwork, and maintenance of outdated systems, leading to inefficiencies. |
| | | |
| | | |

## REVIEW OF LITERATURE

This review of literature provides an overview of the historical evolution of HRM, the characteristics of traditional and digital HRM, and the differences, challenges, and future directions in the field. It sets the stage for a comparative analysis of digital HRM and traditional HRM in the context of organizational effectiveness and strategic alignment**.**

**Armstrong, (2014),** explain that the traditional HRM encompasses a set of practices aimed at managing employees within an organization, including recruitment, selection, training, performance appraisal, and compensation.

**Boxall & Purcell, (2016),** explain the historical evolution of HRM and traces its evolution from personnel management to strategic HRM, highlighting the transition from administrative functions to strategic business partnership.

**Strohmeier (2018)**, explain the represents a paradigm shift in HR management, characterized by the integration of digital tools and data-driven approaches into HR processes. It encompasses the digitization of recruitment, performance management, learning and development, and employee engagement practices to meet the demands of a digital workforce and competitive market.

**Parry and Tyson (2018)**, highlight the transformation of traditional HR practices through the adoption of digital technologies, such as HRIS, ATS, LMS, and AI-driven analytics. It involves leveraging technology to automate routine tasks, enable self-service capabilities, and provide real-time insights for strategic decision-making.

**Schramm and Ringer (2019)**,state that the strategic use of digital technologies to manage and optimize human resources within organizations. It involves the integration of HR processes, systems, and data through digital platforms and tools to enhance efficiency, effectiveness, and employee experience.

**Deloitte, (2020),** describe that the Organizations are increasingly investing in digital HRM solutions to stay competitive, attract talent, and improve operational efficiency.

## OBJECTIVES OF THE STUDY

1. To compare the key features of digital HRM and traditional HRM.
2. To explore the challenges associated with implementing digital HRM within organizations.
3. To examine the implications of digital HRM for organizational effectiveness and strategic alignment.

## RESEARCH METHODOLOGY

This paper is theoretical in nature. The data used for this paper collected from number of sources such as journals, research paper, and book chapter and more.

## DISCUSSION

### Examples of companies that use Digital HRM

In today's fast-paced business landscape, companies are increasingly turning to digital Human Resource Management (HRM) systems to streamline their HR operations, enhance employee experiences, and drive strategic decision-making. From tech giants to consumer goods conglomerates, organizations across industries are leveraging innovative HR technologies to optimize talent management, foster employee engagement, and stay competitive in the digital age. Let's delve deeper into how companies are embracing digital HRM and the transformative impact it has on the workplace. Following are the examples of companies that have embraced digital Human Resource Management (HRM) systems and the impact it has had on their operations**:**

1. **Cisco Systems:** Cisco Systems, a global leader in networking and IT solutions, implemented a digital HRM system to manage its workforce efficiently across multiple locations worldwide. By integrating cloud-based HR platforms, Cisco streamlined its recruitment process, improved employee engagement through self-service portals, and enhanced performance management with real-time feedback mechanisms. The digital HRM system enabled Cisco to adapt quickly to changing business needs, scale its workforce effectively, and drive innovation through data-driven HR insights.
2. **Airbnb:** As a disruptor in the hospitality industry, Airbnb relied on digital HRM technologies to support its rapid growth and dynamic workforce needs. By implementing cloud-based HR platforms, Airbnb automated HR processes such as onboarding, payroll management, and benefits administration, allowing HR teams to focus on strategic initiatives. The digital HRM system also played a crucial role in fostering a sense of belonging and community among Airbnb employees, facilitating communication, recognition, and feedback in virtual work environments.
3. **Siemens:** Siemens, a global powerhouse in electronics and industrial engineering, embraced digital HRM solutions to optimize its talent acquisition and retention strategies. Through predictive analytics and AI-driven recruitment tools, Siemens enhanced its ability to identify and attract top talent while reducing time-to-hire and cost-per-hire metrics. The digital HRM system also enabled Siemens to develop personalized career paths and succession plans for its employees, ensuring a pipeline of skilled leaders to drive future growth and innovation.
4. **IBM**: As a global leader in technology and innovation, IBM utilizes digital HRM solutions to manage its talent acquisition, learning management, and performance appraisal processes across its diverse portfolio of business units. By integrating cloud-based HR platforms with Al and machine learning capabilities, IBM optimizes its recruitment processes, identifies top talent, and accelerates time-to-hire metrics. Through personalized learning experiences and skill development programs, IBM fosters a culture of continuous learning and development, empowering employees to stay ahead of industry trends and drive innovation in their respective domains. digital HRM systems enable real-time performance tracking, feedback, and coaching, fostering a culture of accountability, transparency, and collaboration. By leveraging data analytics and predictive modeling, IBM identifies performance trends, recognizes high-performing employees, and identifies areas for improvement, driving individual and organizational performance excellence. Through strategic talent management initiatives and succession planning strategies, IBM ensures a pipeline of skilled leaders to drive future growth and innovation across the organization.
5. **Amazon:** With a vast and diverse workforce spanning various industries and geographies, Amazon relies on digital HRM systems to manage its HR operations at scale. From recruitment and onboarding to employee training and development, Amazon leverages technology to optimize its talent management processes and drive organizational effectiveness. Through Al-driven recruitment platforms, Amazon streamlines its hiring processes, reduces time-to-fill metrics, and ensures the selection of candidates who align with the company's values and culture. Amazon's digital HRM systems facilitate seamless onboarding experiences for new hires, providing them with the resources, tools, and support they need to succeed from day one. By leveraging data analytics and predictive modeling, Amazon identifies skill gaps and

development opportunities, tailoring learning pathways and training programs to meet the evolving needs of its workforce.

## CASE STUDIES OF COMPANIES ASSOCIATED WITH DIGITAL HRM

### Case Study: Unilever - Transforming Talent Management with Digital HRM

Unilever, a multinational consumer goods company, embarked on a digital transformation journey to revolutionize its talent management practices and foster a culture of continuous learning and development. Facing challenges in managing its diverse workforce spread across various geographies, Unilever recognized the need for a comprehensive digital HRM solution to streamline HR processes and empower its employees.

Unilever implemented a state-of-the-art digital HRM system, leveraging cloud-based platforms and cutting-edge technologies to enhance recruitment, onboarding, performance management, and learning and development initiatives. The digital HRM system enabled Unilever to centralize HR data and processes, providing a unified platform for managing employee information, performance evaluations, and training programs.

One of the key areas where the digital HRM system made a significant impact was in recruitment and talent acquisition. By leveraging AI-driven recruitment tools and predictive analytics, Unilever optimized its hiring processes, reducing time-to-fill and cost-per-hire metrics while ensuring the selection of top talent aligned with the company's values and culture. Automated resume screening and candidate matching algorithms enabled Unilever to identify qualified candidates more efficiently, allowing HR teams to focus on building relationships and creating exceptional candidate experiences.

The digital HRM system transformed Unilever's onboarding process, providing new hires with a seamless and personalized experience from day one. Through interactive onboarding portals and self-service modules, new employees could complete paperwork, access training materials, and connect with mentors, facilitating their integration into the company and accelerating their time to productivity. This not only enhanced employee satisfaction and engagement but also improved retention rates and reduced turnover costs for Unilever.

In terms of performance management, the digital HRM system facilitated a shift towards continuous feedback and development-oriented practices at Unilever. Real-time performance tracking tools, goal setting features, and 360-degree feedback mechanisms enabled managers and employees to have meaningful conversations, identify growth opportunities, and align individual goals with organizational objectives. By promoting a culture of transparency, accountability, and continuous improvement, Unilever empowered its employees to take ownership of their career development and drive performance excellence across the organization.

Unilever leveraged the digital HRM system to deliver personalized learning experiences and skill development opportunities to its employees. Through AI-driven recommendations and curated learning pathways, employees could access a wide range of training programs and resources tailored to their roles, interests, and career aspirations. This not only enhanced employee engagement and satisfaction but also equipped Unilever's workforce with the skills and competencies needed to succeed in a rapidly evolving business landscape.

In conclusion, Unilever's journey towards digital HRM exemplifies the transformative impact of technology on talent management and organizational effectiveness. By embracing digitalization and leveraging innovative HR solutions, Unilever has positioned itself as a leader in fostering employee growth, engagement, and innovation, driving sustainable business success in the digital age.

**Case Study: Deloitte - Optimizing HR Operations with Digital HRM**

Deloitte, a global leader in professional services, embarked on a digital transformation journey to modernize its HR operations and enhance employee experiences across its vast network of offices worldwide. Faced with the challenges of managing a diverse workforce and increasing demands for agility and efficiency, Deloitte recognized the need for a comprehensive digital HRM solution to streamline HR processes and drive strategic decision-making.

Deloitte implemented a cutting-edge digital HRM system, leveraging cloud-based platforms and advanced analytics to transform its talent management, payroll administration, benefits management, and employee engagement initiatives. The digital HRM system provided Deloitte with a unified platform for managing HR data, automating routine tasks, and deriving actionable insights to support strategic HR initiatives.

One of the primary areas where the digital HRM system made a significant impact was in talent acquisition and recruitment. By leveraging AI-driven recruitment tools and data analytics, Deloitte optimized its hiring processes, reducing time-to-fill and cost-per-hire metrics while ensuring the selection of top talent aligned with the company's values and culture. Automated resume screening, candidate matching algorithms, and video interviewing capabilities enabled Deloitte to identify qualified candidates more efficiently, allowing HR teams to focus on building relationships and providing a superior candidate experience.

Furthermore, the digital HRM system transformed Deloitte's onboarding process, providing new hires with a seamless and personalized experience. Through interactive onboarding portals, self-service modules, and virtual orientation sessions, new employees could complete paperwork, access training materials, and connect with mentors, accelerating their integration into the company and enhancing their overall satisfaction and engagement.

In terms of performance management, the digital HRM system facilitated a shift towards continuous feedback and development-oriented practices at Deloitte. Real-time performance tracking tools, goal setting features, and 360-degree feedback mechanisms empowered managers and employees to have meaningful conversations, identify growth opportunities, and align individual goals with organizational objectives. By promoting a culture of transparency, accountability, and continuous improvement, Deloitte empowered its employees to drive performance excellence and innovation across the organization.

Deloitte leveraged the digital HRM system to deliver personalized learning experiences and skill development opportunities to its employees. Through AI-driven recommendations, curated learning pathways, and virtual training programs, employees could access a wide range of development resources tailored to their roles, interests, and career aspirations. This not only enhanced employee engagement and satisfaction but also equipped Deloitte's workforce with the skills and competencies needed to succeed in a rapidly evolving business landscape.

In conclusion, Deloitte's journey towards digital HRM exemplifies the transformative impact of technology on HR operations and employee experiences. By embracing digitalization and leveraging innovative HR solutions, Deloitte has optimized its talent management practices, improved operational efficiency, and positioned itself as a leader in driving organizational performance and growth in the digital age.

**Case Study: General Electric (GE) - Enhancing HR Efficiency with Digital HRM**

General Electric (GE), a renowned multinational conglomerate, embarked on a digital transformation journey to revamp its HR operations and elevate employee experiences across its global workforce. Faced with the complexities of managing a diverse and geographically dispersed workforce, GE recognized the need for a comprehensive digital HRM solution to streamline HR processes and drive strategic decision-making.

GE implemented a cutting-edge digital HRM system, leveraging cloud-based platforms and advanced analytics to modernize its talent management, payroll administration, benefits management, and employee engagement initiatives. The digital HRM system provided GE with a centralized platform for managing HR data, automating routine tasks, and deriving actionable insights to support informed decision-making.

One of the primary areas where the digital HRM system made a significant impact was in talent acquisition and recruitment. By harnessing AI-driven recruitment tools and data analytics, GE optimized its hiring processes, reducing time-to-fill and cost-per-hire metrics while ensuring the selection of top talent aligned with the company's strategic objectives. Automated resume screening, candidate matching algorithms, and video interviewing capabilities enabled GE to identify qualified candidates more efficiently, allowing HR teams to focus on building relationships and delivering an exceptional candidate experience.

The digital HRM system transformed GE's onboarding process, providing new hires with a seamless and personalized experience. Through interactive onboarding portals, self-service modules, and virtual orientation sessions, new employees could complete paperwork, access training materials, and connect with mentors, accelerating their integration into the company. In terms of performance management, the digital HRM system facilitated a shift towards continuous feedback and development-oriented practices at GE. Real-time performance tracking tools, goal setting features, and 360-degree feedback mechanisms empowered managers and employees to have meaningful conversations, identify growth opportunities, and align individual goals with organizational objectives. By promoting a culture of transparency, accountability, and continuous improvement, GE empowered its employees to drive performance excellence and innovation across the organization.

Moreover, GE leveraged the digital HRM system to deliver personalized learning experiences and skill development opportunities to its employees. Through AI-driven recommendations, curated learning pathways, and virtual training programs, employees could access a wide range of development resources tailored to their roles, interests, and career aspirations. This not only enhanced employee engagement and satisfaction but also equipped GE's workforce with the skills and competencies needed to thrive in a rapidly evolving business landscape.

In conclusion, GE's journey towards digital HRM exemplifies the transformative impact of technology on HR operations and employee experiences. By embracing digitalization and leveraging innovative HR solutions, GE has optimized its talent management practices, improved operational efficiency, and positioned itself as a leader in driving organizational performance and growth in the digital age.

## FINDINGS OF THE STUDY

The findings of the study underscored the transformative potential of digital HRM in reshaping HR practices and driving organizational success in the digital age. By understanding the differences, challenges, and implications of digital HRM, organizations can leverage technology to optimize HR processes, enhance employee experience, and achieve strategic alignment with organizational goals.

1. The study identified significant differences between digital HRM and traditional HRM in terms of technology usage, accessibility, data management, automation, employee experience, decision-making, scalability, and cost efficiency.
2. The study highlighted the advantages of digital HRM, such as improved efficiency, data-driven decision-making, enhanced employee experience, and strategic alignment with organizational goals.
3. The study identified challenges associated with implementing digital HRM, including integration issues, data privacy concerns, skills gap, resistance to change, technology reliability, regulatory compliance, and dependency on vendor relationships.
4. The study discussed the implications of digital HRM for organizational effectiveness, talent management, employee experience, diversity and inclusion, agility, and data-driven decision-making. Digital HRM was found to have significant implications for strategic alignment, talent acquisition and retention, performance management, learning and development, and organizational agility.
5. The paper disclosed the widespread adoption of digital HRM systems across various industries, from technology and consumer goods to professional services and manufacturing. This indicates a global trend towards leveraging technology to optimize HR operations and enhance employee experiences**.**
6. The study reveal how digital HRM systems have transformed talent acquisition and recruitment processes, leading to reduced time-to-fill metrics, improved candidate experiences, and better alignment between organizational needs and candidate profiles.

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# DIGITAL BANKING : CHALLENGES AND OPPORTUNITIES

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***Abstract***

*Digital banking has transformed the financial landscape in India, offering numerous benefits and opportunities for growth. However, it also poses several challenges that need to be addressed. This paper explores the challenges and opportunities of digital banking in India, highlighting the impact of digital banking on financial inclusion, customer experience, and security. The paper also discusses the role of technology, regulatory frameworks, and customer awareness in shaping the digital banking landscape in India. The findings of this study will provide insights into the current state of digital banking in India and identify areas for improvement, enabling policymakers, banks, and financial institutions to develop strategies that promote sustainable growth and adoption of digital banking services.*

***Keywords:*** *Digital banking, financial inclusion, customer experience, security, technology, regulatory frameworks, customer awareness, India.*

## Introduction

### History of Digital Banking

Digital banking is part of the broader context for the move to online banking, where banking services are delivered over the internet. The shift from traditional to digital banking has been gradual, remains ongoing, and is constituted by differing degrees of banking service digitization. Digital banking involves high levels of process automation and web-based services and may include APIs enabling cross-institutional service composition to deliver banking products and provide transactions. It provides the ability for users to access financial data through desktop, mobile and ATM services. A digital bank represents a virtual process that includes online banking, mobile banking, and beyond. As an end-to-end platform, digital banking must encompass the front end that consumers see, the back end that bankers see through their servers and admin control panels, and the middleware that connects these nodes. Ultimately, a digital bank should facilitate all functional levels of banking on all service delivery platforms. In other words, it should have all the same functions as a head office, branch office, online service, bank cards, ATMs, and point-of-sale (POS) machines. The reason digital banking is more than just a mobile or online platform is that it includes middleware solutions. Middleware is software that bridges operating systems or databases with other applications. Financial industry departments such as risk management, product development, and marketing must also be included in the middle and back ends to truly be considered a complete digital bank. Financial institutions must be at the forefront of the latest technology to ensure security and compliance with government regulations. The earliest forms of digital banking date back to the advent of ATMs and cards in the 1960s. As the internet emerged in the 1980s with early broadband, digital networks began to connect retailers with suppliers and consumers to develop needs for early online catalogs and inventory software systems. By the 1990s, the Internet had become widely available and online banking started becoming the norm. The improvement of broadband and e-commerce systems in the early 2000s led to what resembles the modern digital banking world today. The proliferation of smartphones through the next decade opened the door for transactions on the go beyond ATM machines. Over 60% of consumers now use their smartphones as their preferred method for digital banking. There is a demand for end-to-end consistency and for services, optimized for convenience and user experience. The market provides cross-platform front ends, enabling purchase decisions based on available technology such as mobile devices, or a desktop or Smart TV at home. In order for banks to meet consumer demands, they need to keep focusing on improving digital technology that provides agility, scalability and efficiency.

**Objectives Of Digital Banking**

Growth of Electronic banking in India depends on many factors, such as success of internet access, new online banking features, household growth of internet usage, legal and regulatory framework. E-banking can offer speedier, quicker and dependable services to the customers for which they may be relatively satisfied than that of manual system of banking. E-banking system not only generates latest viable return, it can get its better dealings with customers. The rationale of this research is to recognize the impact of variables of e-banking on customer pleasure. Electronic banking is gaining its importance Customer's liking is necessary for the banking sector to elevate profitability, business expansion and accomplishment. Now-a –day's banking sector is modernizing and expanding its hand in different financial events every day. At the same time the banking process is becoming faster and easier. In order to survive in the competitive field of the banking sector commercial banks are looking for better service opportunities to provide their customer. The paper has been undertaken mainly to find out whether e-banking can satisfy the customers or not. Therefore the objectives of the study are given below:

- To know the performance of e-banking activities of proposed banks.
- To analyze the customer satisfaction level in e-banking.
- To find out the problems in e-banking activities to satisfy the customers.
- To identify the e-banking benefits from customer's point of view.

**Review Of Literature**

**Uppal R K (2008)**

Uppal R K (2008) expressed that despite absence of mindfulness among the customer s of e–banking administrations, a large portion of the customer s utilizes the e-banks are happy with different e-connection and accessible administrations. It is additionally seen through the reactions of respondents that the eventual fate of ebanking administrations is brilliant and that this e - diverts will helpxinxthe change of bankingxin axpositive way.

**Dutta et al., (2009)**

Dutta et al., (2009) the measurable examination further uncovers that there exists a hole between the customer desires and observation in the financial part. The desires for Bank customer are higher than their recognition. This hole fluctuates cross the financial segment with open area banks demonstrating the broadest hole and remote banks demonstrating a thin gap.Factor investigation further demonstrated that substantial, affirmation, compassion and unwavering quality measurements are the logical factors anticipating customer s 'fulfillment in India.ATM machines in helpful spots and tele banking and web banking office. The discoveries further demonstrate that open segment banks are nonpartisan about the quality administrations advertised.

**Haque et al., (2009)**

Haque et al., (2009) the examination that the investigation manages customer knowledge for the necessities and needs. This may significant for investors to give better administrations, simultaneously banks need greater attention about the security perspectives notwithstanding guidelines and guidelines identified with security.

**Selvan V et al., (2010)**

Selvan V et al., (2010) it is seen from the outcomes that mindfulness level of school level training bunch respondents is high while the equivalent is the situation for the respondents having pay of above Rs 10,000 and on account of fulfillment level of respondents; the thing that matters is noteworthy among little and huge size families.

**Dixit et al., (2010)**

Dixit et al., (2010) the bank the board may order the market technique on age bunch premise. They get their conclusion to empower granting vital direction for utilization of internet banking exchanges. Strangely, the examination uncovers that web based banking has a promising future, as underscored by the lion's share (84%) of respondents.

**Desari (2011)**

Desari (2011) has reasoned that Relationship Marketing direction falls into place without any issues for Indians who treat visitors as divine beings (Athithi devo bhava) and assimilate the soul of administration from their folks and senior individuals from the family. It isn't idea new to India and has been polished from antiquated time. While there have been a few variations to this way of thinking, post-autonomy, Indian advertisers have rapidly rediscover the significance of being customer driven and building long haul association with the customer whether people or different business associations. The Indian ethos that sees customer as a ruler or even a divine being (none other than Mahatma Gandhi supported this view), and their introduction to worldwide strategic approaches post-progression, guaranteed thatIndian advertisers whether huge or little; composed or disorderly, have calibrate their relationship showcasing aptitude and practices, which have been in their veins of hundreds of years, for more noteworthy achievement and combination.

**Singh and Kumar (2011)**

Singh and Kumar (2011) demonstrated that individuals term CRM as innovation based activity, however the truth of the matter is that it is an endeavor wide movement which uses innovation to encouraged different capacities deals, promoting, administration and so on and CRM activity begins with distinguishing proof of customer s with the target of separating from customer to customer and he further notices that it isn't the items or administrations that please the customer s, yet the correct frame of mind of taking care of them and building a closer association with them. The save money with countless customer s with close holding would appreciate higher incomes and benefit.

**Kumar (2011)**

Kumar (2011) had referenced that, customer relationship the board is the trendy expression in the Indian commercial center has rendered undertaking customer relationship the executives, as a basic than only a discretionary component and now it has been perceived as one of the real apparatuses for improving customer devotion and in the process diminishing customer surrenders to contending firms. Customer relationship the executives practices leave an enduring effect on their customer connections in this time of rivalry, there is a needed

**Ganesamurthy et al (2011)**

Ganesamurthy et al (2011) have concentrated on the investigation identified with the impression of the customer on CustomerxRetentionxManagement ofxthe Commercialxbanks. Thexoutcomes uncover thatxthe complete representative association, unique occasions, engaged workers, use of cutting edge innovation, low charges and safeguards are better polished in open division banks. Customer inputs are better rehearsed in private segment banks.

**Moorthy (2011)**

Moorthy (2011) the Researcher has recommended that the bank should make the customer mindful of the terms and conditions ought to have legitimate redressal component while forcefully advancing credit/platinum cards/other electronic channels, the customer s ought to have appropriate mindfulness and learning of these items/administrations. In customer administration, it has been closed expressing that reasonable treatment to all customer s ought to be considered as a significant factor.

**Metal (2011)**

Metal (2011) specialist have investigated the critical components mindful to accomplish the customer base of the Indian planned business banks by surveying the degree of use of banks benefits by their customer s while determining the consumer loyalty through basic condition model (SCM). The investigation uncovered that there are huge open doors just as difficulties for Value Added Services given by banks in India and that because of mechanical developments and noteworthy change in statistic profile of customer s , there is gigantic market potential lying ahead. It is additionally uncovered thatxthe mindfulnessxlevel ofxValue AddedxServices is confined toxjust a specificxsegment ofxthe general public.

**Khan (2011)**

Khan (2011) the creator has inferred that a few organizations beat their opponents in offering better social incentive than their objective customer and convert these points of interest into prevalent execution inxlight ofxthe factxthat the organizationxcenters around their customer relating capacity, which goes about as significant wellspring of bit of leeway and has interrelated parts like direction, which uncovers the associations needs towards customer relationship, data, which incorporates customer data frameworks and the design.

**Tamilarasan R (2011)**

Tamilarasan R (2011) has referenced that customer relationship the executives winds up successful when customer s are included CRM procedure and it is essential the association incorporate the customer s in with the general mish-mash and if CRM practices are imagined and actualized appropriately, it will empower organizations to hold customer s forever, get most extreme incentive out of every customer and produce excellent customer holding. Has noticed that CRM includes something beyond get-together information and creating projects to recognize the most beneficial customer , at that point dealing with the relationship by offering them progressively appropriate items and administrations. Dealt with well customer relationship the board can take into consideration arranges in the relationship to be distinguished and oversaw and the association s that utilization CRM frameworks reasonably can frequently change customer 's suppositions and conduct.

**Gupta et al (2012)**

Gupta et al (2012) have communicated on the present degrees of customers' fulfillment and furthermore attempted to investigate the variables that prompted fulfillment in Indian banks. Information from 400 respondents were gathered from different parts of the unmistakable banks of India and the administration feeling and clean, association variables demonstrated a positive association with relative customers' fulfillment.

**Hattangadi (2012)**

Hattangadi (2012) is of the conclusion that advertising is the core of any business and showcasing procedures speak to the arrangement by which the firm conveys its incentive to the customer s and it doesn't make a difference what is your item, organizations are at last in the training based business.

Opportunities For Banks With Digitisation

While digital banking is slowly taking shape in the country, what's good is that some banks have already gone digital and are setting examples for older banks.

**Below are the opportunities available for banks in digital banking**

**Increased profits and improved outputs**

Today, anyone can deposit or withdraw money from their bank accounts anytime and don't need to wait for any specific time. Digital banking has enabled banks to offer round-the-clock services to their customers, which has led to better customer experiences.

**Increase in customer number**

Almost every banking customer is going the digital way. And since the upcoming generations are going to be more digitised, digital banking is definitely going to be peoples' favourite way to bank, adding more and more customers in the mix.

**Banking 24/7**

Mobile banking is the most-preferred medium to bank, which is supposed to be the future of digital banking. As people take their phones everywhere and use them for everything, mobile banking is an excellent opportunity for banks to offer banking 24/7 and generate revenues from multiple transactions.

**More application for bank products and services**

With most banking products and services getting online, their use has also increased. In this way digital banking is finding more and more applications.

**Improved service time**

Businesses need money and need it to move around fast. Digital banking is fairly capable of moving money fast, which benefits both customers and financial institutions.

**Better market predictions**

Digital banking is backed up with precise data collection mechanisms. Data is of value as it can help any organisation predict the market and offer better services. The data available with banks can be utilised in an efficient way and benefitted from.

Challenges In Digital Banking

The challenges in digital banking can only be efficiently navigated when you know them.

**Below are the major challenges faced by the banking industry**

**Changing banking habits of customers**

Online banking saw a huge surge during the pandemic and with the ever-growing shift to online digital banking, banks are left to keep up. Banks are increasing their online banking offerings and making them available to customers.

**Lack of cyber security**

Security is the first thing that one thinks of in matters involving money. There are customers that are not willing to partake in any activity that puts their hard-earned money at risk. India is yet to have a unified cyber security law. However, there are some strict regulations in place to enforce cyber security like the DPSC security controls that enables customers to securely make digital payments.

**Technical challenges**

Another challenge to banking is the speed at which new technologies are becoming necessary. Most bank networks have a massive size and scale and it may get difficult to update their technology time and again. It is critical that a bank's security measures are updated quickly to counter constantly changing threats of cyberthieves.

**Lack of human touch**

While digital banking is largely a success, still a good portion of people don't trust it. Some people do not trust digital banking unless the bank has a brick-and-mortar presence. This factor can make it difficult for banking to become 100% digitised.

**Changing banking landscape**

Digital-only banks and fintech are starting to offer many banking solutions with a seamless banking experience to match with the changing lifestyle requirements of people . Legacy banks must also adopt digital transformation to be efficient online.

**Slow cross-border transactions**

Cross-border transactions play a vital role in global trade. Historically, cross-border payments have been incompetent, slow and expensive because of traditional infrastructure and non-uniform development confusing cross-border transactions. Latest technology has to be implemented across banks to quicken cross-border transactions.

**Multi-currency and payment methods**

The customers use multiple currencies and payment methods like Credit Card, Debit Card, bank transfers in different currencies,which is difficult for banks to deal with. The global e-commerce has aggravated this problem as the digital banking sector has to integrate different e-wallets and mobile payment methods as well.

**Lack of awareness in senior citizens**

Most senior citizens lack knowledge in using digital technology and can't access the internet easily, making it challenging for the banks to serve them.

**Digital Banking In India Faces Several Problems**

Digital banking is vulnerable to cyber threats, such as phishing, vishing, and remote access scams, which can compromise customer data and financial security. Banks are working to educate customers about these threats and implement robust security measures.

**Technical Issues**

Failed connectivity, lack of consistent and accurate data, and technical glitches can disrupt digital banking services, causing inconvenience to customers. Banks need to invest in upgrading their systems and infrastructure to ensure seamless service.

**Lack of Personal Relationships**

Digital banking can lack the personal touch, leading to customer frustration and dissatisfaction. Banks are working to strike a balance between technology and human interaction to improve customer experience.

**Digital Divide**

Many Indians, especially in rural areas, lack digital literacy and access to smartphones or computers, hindering their ability to access digital banking services.

**Legacy System Upgrades**

Outdated banking systems, such as those using COBOL programming language, need to be upgraded to support modern digital banking requirements.

**Internal Barriers**

Banks face internal challenges, such as departmentalization and employee training, which can hinder the adoption of digital banking.

**Regulatory Compliance**

Banks must navigate complex regulatory requirements to ensure the security and integrity of digital banking services.

**Customer Expectations**

Rising customer expectations for faster and more convenient services put pressure on banks to improve their digital offerings.

**Solve The Problems In Digital Banking In India**

**Security Concerns**

1. Implement robust security measures: Use multi-factor authentication, encryption, and secure protocols to protect customer data and transactions. 2. Educate customers: Raise awareness about cyber threats and best practices for secure digital banking. 3. Regularly update systems: Keep software and systems up-to-date with the latest security patches.

**Technical Issues**

1. Invest in infrastructure: Upgrade systems and infrastructure to ensure seamless service and minimize technical glitches. 2. Implement robust testing: Conduct thorough testing to identify and fix technical issues before they impact customers. 3. Provide customer support: Offer prompt and effective customer support to resolve technical issues.

**Digital Divide**

1. Promote digital literacy: Educate customers about digital banking and its benefits. 2. Develop user-friendly interfaces: Design digital banking platforms that are easy to use and accessible to all. 3. Expand digital infrastructure: Increase access to digital infrastructure, such as internet and mobile networks, in rural areas.

**Legacy System Upgrades**

1. Modernize systems: Upgrade legacy systems to support modern digital banking requirements. 2. Adopt cloud-based solutions: Leverage cloud-based solutions to improve scalability and flexibility. 3. Invest in digital transformation: Embrace digital transformation to stay competitive and meet customer expectations.

**Internal Barriers**

1. Foster a digital culture: Encourage a culture of innovation and digital transformation within the organization. 2. Provide employee training: Offer training and development programs to equip employees with the necessary skills. 3. Break down departmental silos: Encourage collaboration and communication across departments.

**Regulatory Compliance**

1. Stay up-to-date with regulations: Monitor and comply with regulatory requirements. 2. Implement robust compliance frameworks: Establish frameworks to ensure compliance with regulatory requirements. 3. Engage with regulators: Collaborate with regulators to stay informed about changes and updates.

**Customer Expectations**

1. Conduct customer research: Understand customer needs and preferences. 2. Develop personalized services: Offer personalized services that meet customer expectations. 3. Improve customer experience: Continuously improve digital banking services to enhance customer experience.

**Conclusion**

In today's era of Information and Communication Technology, Digital Banking Services is a very important area to transform the Indian banking system and make it competitive. Digital Banking has become a necessary survival weapon and is fundamentally changing the banking industry worldwide. Today, the click of a mouse offers bank customers services at a much lower cost and also empowers them with unprecedented freedom for their financial service needs. Customers prefer to avail Digital Banking services but at the same time they face many problems while using Digital Banking services due to which they are unable to take full advantage of the same services. Banks should take initiative in creating awareness among the customers by adopting different measures in this matter. Banks have to upgrade and constantly think of new innovative customized packages and services to remain competitive. The study finds that many banks" customers are fully aware of all the Digital Banking services. However, most customers still patronize the bank branches and find interaction with human being, i.e. Employers of the banks, as very important as they get carried away by the problems (inadequate knowledge about the usage of Digital Banking services, lack of interest, poor network, pass word forgotten, card misplaced and lack of confidence). It also finds that customers enjoying the Digital Banking services are still not fully aware about all the services. Customers" perception, awareness and frequency of using the services are issues of concerned. A lot need to be done to create confidence in the minds of customers about the benefits and security of the Digital Banking services.

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# A STUDY ON DIGITAL EDUCATION ON STUDENTS PERCEPTION TOWARDS EDUCATIONAL APPS WITH REFERENCE TO COIMBATORE

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***Abstract***

*The research study on "a study on digital education on students perception towards educational apps with reference to Coimbatore" is the term on "Digitalization" which describes the conversion of analogue information into digital formats and the integration of digital technologies across various sectors, including business, society, and daily activities. This process involves the reformation of processes, operations, and interactions through digital tools and technologies, leading to improved efficiency, accessibility, and innovation. Digitalization is not limited to data conversion; it also entails a strategic rethinking of business models and workflows to effectively harness digital technologies. This can involve automating processes, enriching customer experiences through digital means, and utilizing data analytics for informed decision-making. As organizations engage in digitalization, they can become more agile and responsive to evolving market conditions, which can lead to enhanced competitiveness and growth. This transformative process affects various sectors, including healthcare, finance, and education. The objectives are: 1)To study the awareness on educational app with student perception on digital education; 2)To find out the various e-learning platforms with student perception on digital education; 3)To describe the features on educational app on digital education. The research methodology used establishes a systematic framework that directs the complete research process, guaranteeing that the study is both scientifically sound and dependable. A probability random sampling method on 60 respondents was collected from various destinations involves descriptive analysis of the student perception.*

***Keywords:*** *Digitalization, Education, Technology, E – Learning, Educational apps*

## INTRODUCTION

An educational app is a software application designed to facilitate learning and educational activities, typically accessed via smart-phones, tablets, or computers. The best free teaching app depends on the specific subject matter, grade level, and teaching style, but popular options include Khan Academy, Duolingo, and Quizlet. Features of the best educational app for schools may include interactive lessons, multimedia content, progress tracking, assessments, teacher dashboards, and integration with classroom curriculum. ducational apps have made learning easy and accessible for people worldwide with just the click of a button. Children's smartphone usage has been increasing at a fast pace. Nowadays, up to 20% of 8-year-olds own a smartphone. This number increases to 80% in teens between 14 and 18, according to Common Sense Media. This should be no shock, children have the ability to pick up new technologies faster than their parents, and they can do this by mimicking what they see in their learning environments, such as families, smart houses, and schools. The use of technology has become more common in classrooms, K-12 has been improving the teaching methods for new generations, and by the time the COVID-19 pandemic struck, it became almost mandatory to adopt new technologies. Educational apps are a great idea to use to complement children's education, both in and offside of the classroom. The usage of images, videos, and sounds appealing to children's minds, help them to engage better with this type of content rather than books or chalkboards. College students have also seen new applications to help them through university life. Most of the challenges these students face are when managing their time or for collaborating with diverse people. An incredibly competitive job market is among the biggest concerns for students, this is why many educational apps often offer courses or certifications that complement education in college. The classroom response system allowed students to answer multiple-choice questions and engage in real-time discussions instantly.

**STATEMENT OF PROBLEM**

The swift progression of technology has profoundly altered the educational environment, with digital education and educational applications becoming essential components of the learning experience for students. Nevertheless, despite the increasing availability and utilization of these educational tools, the effectiveness and user satisfaction associated with them vary significantly among different student demographics. In India, where students come from a wide array of socio-economic backgrounds, possess differing levels of technological access, and exhibit diverse learning preferences, it is crucial to comprehend their perceptions of educational applications. Numerous educational applications assert that they can improve learning outcomes, boost engagement, and offer flexible access to educational resources. However, there are apprehensions regarding their true impact on students' learning experiences, the elements that shape their preferences, and the obstacles they face while using these applications. Additionally, there is a scarcity of research concerning the satisfaction levels of students with these platforms, particularly within the Indian context. This study seeks to fill this gap by investigating students' perceptions, preferences, the factors that influence their decisions, the challenges they face, and their overall satisfaction with educational applications.

**REVIEW OF LITERATURE**

**Rafiq, Iqbal et al (2024).** This research investigates the influence of digital tools and online learning platforms on the educational outcomes of higher education in Lahore, Pakistan. Utilizing a sample of 350 students, it highlights improvements in studen engagement, motivation, and academic performance as key advantages. However, it also notes that challenges such as technical issues and restricted access impede effective utilization. The study underscores the necessity for improved technical support and training to fully leverage the capabilities of digital learning platforms. **Palshkov, Shetelya et al (2024).** This research examines the impact of mobile applications on higher education, focusing on their effect on learning outcomes. Based on a sample of 40 students, the findings indicate that mobile apps improve both knowledge acquisition and student motivation. The authors highlight educational aspects such as personalized learning and the cultivation of independent study skills, which have been validated through experimental methods. **Arambepola, Munasinghe et al (2024)**. This research examined reviews of educational applications from the Google Play Store to determine the most significant user experience (UX) elements. Findings revealed that problems with login, the accuracy of quiz features, and compatibility across devices were major contributors to negative reviews, whereas well- organized content and intuitive interfaces led to positive responses. The study's novel approach of using thumbs-up counts to rank topics established a clear prioritization of UX concerns, assisting developers in enhancing app usability. **Agarwal and Yadav (2024)** This research explores students' attitudes towards traditional versus digital education in Meerut, India. Data gathered from 400 participants shows that 54.5% of students believe that educational institutions are making strides in digital infrastructure, yet there remains considerable uncertainty regarding these investments. The results indicate that 65% of students find digital education to be more effective in delivering skills and vocational training than traditional approaches. However, perspectives are mixed on the effectiveness of digital education in fostering social interaction, with 51% of respondents expressing disagreement. Overall, 80% of those surveyed consider digital education to be the future of education in India, highlighting its potential to transform the educational landscape.

## SCOPE OF THE STUDY

The swift advancement of technology and the growing prevalence of smart-phones have significantly altered the manner in which students interact with their educational experiences. It is imperative to comprehend students' perceptions of these applications to evaluate their efficacy in promoting meaningful learning outcomes. Moreover, as educational applications become integral to remote learning and independent study, it is vital to evaluate their influence on student engagement, academic achievement, and preferences to ensure sustained success in the realm of digital education. This study aims to explore students' perception and interactions with educational applications within the framework of digital learning. It assesses the degree to which these applications affect learning results, examining student preferences based on criteria such as content accessibility, user interface design, and cost-effectiveness. The insights derived from this study will provide valuable information for educational institutions and app developers to improve the quality and effectiveness of digital education.

## OBJECTIVES OF THE STUDY

1. To study the awareness on educational app with student perception on digital education
2. To find out the various e-learning platforms with student perception on digital education
3. To describe the features on educational app on digital education

## RESEARCH METHODOLOGY

The Research methodology can be best described as the sum of the research approach, methods and procedures used by the researcher to execute the research study. The researcher uses it as the framework for the research methodology. Based on this framework, in order to make sure that the findings are accurate, a deductive approach is carried out. The study on "a study on digital education on student perception towards educational apps with reference to Coimbatore" This is one of the methodologies on qualitative methods and quantitative methods. A probability random sampling method on 60 respondents was collected from various destinations involves descriptive analysis of the student perception.

## EDUCATION APPS

The definition of educational apps is that these are mobile applications that are designed to educate you in some way or the other. These are specifically crafted to provide valuable learning experiences and knowledge enrichment to their users. There is a significantly vast variety of such apps available in the market.

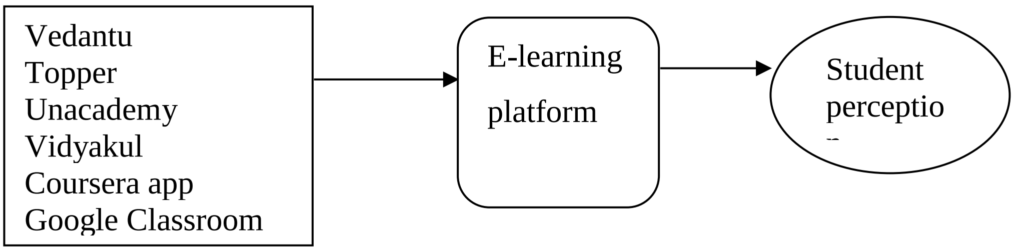



***Figure: 1 conceptual framework on educational app***

1. Vedantu is India's one of the largest tutoring company.
2. Topper is an education app that believes in making learning more personalized for students.
3. Unacademy has some great educators including first Women IPS officer of India, Kiran Bedi.
4. Vidyakul works to provide students, parents and teachers with a perfect online platform to solve

all their problems related to learning and teaching online.

5. Coursera app provides with almost 1000 courses developed by more than 140+ best colleges and universities around the world.
6. Google Classroom

**E-learning platform**

Platforms like on e-learning and free developed by GOI.

1. Swayam, Diksha
2. E-ShodhSindhu,
3. E-PG Pathshala,
4. Swayam Prabha and
5. NTPEL

**Features of Educational App**

1. Interactive Lessons,
2. Multimedia Content,
3. Progress Tracking,
4. Assessments,
5. Teacher Dashboards,
6. Integration With Classroom Curriculum

**DATA ANALYSIS AND INTERPRETS**

**Table No-1**

| **Education App** | **Valid Respondents** | **Percentage** |
|---|---|---|
| Vedantu | 21 | 35 |
| Toppr | 10 | 16.6 |
| Unacademy | 8 | 13.3 |
| Vidyakul | 5 | 8.3 |
| Coursera app | 5 | 8.3 |
| Google Classroom | 11 | 18.3 |
| **Total** | **60** | **100** |

Majority of the respondents are Vedantu education app (35%)

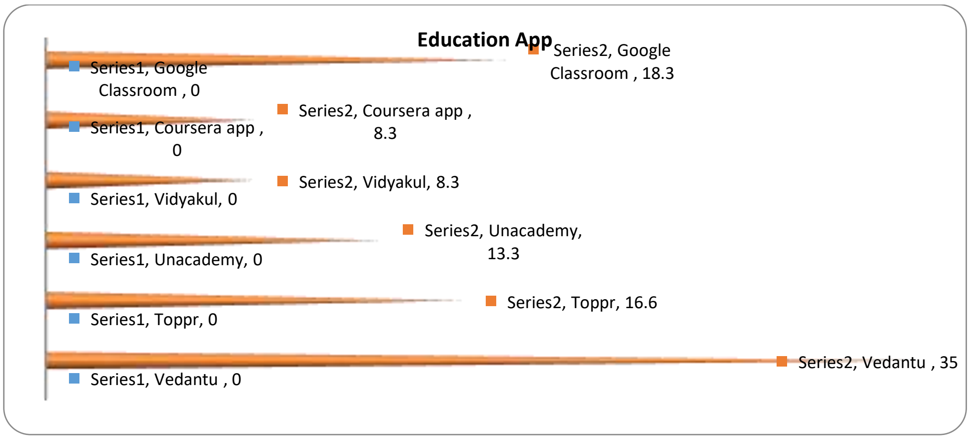


**Table No-2**

| Education platforms | Valid Respondents | Percentage |
|---|---|---|
| Swayam, Diksha | 20 | 33.3 |
| E-ShodhSindhu, | 10 | 16.6 |
| E-PG Pathshala, | 10 | 16.6 |
| Swayam Prabha and | 10 | 16.6 |
| NTPEL | 10 | 16.6 |
| **Total** | **60** | **100** |

Majority of the student respondents are using the platform on Swayam, Diksha and followed by E-ShodhSindhu, E-PG Pathshala, Swayam Prabha and NTPEL

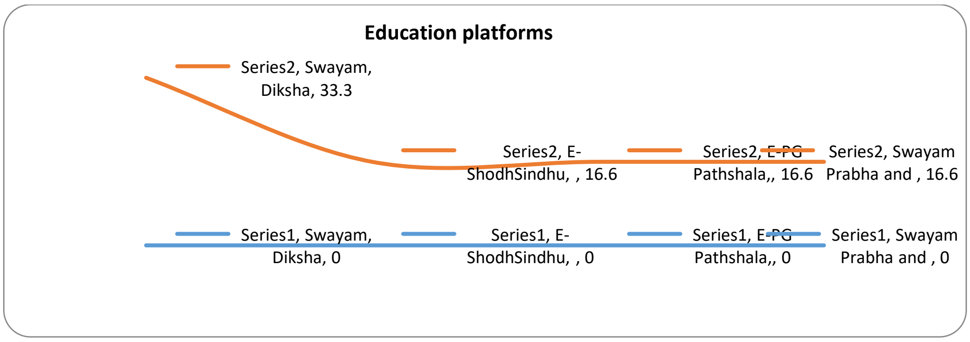
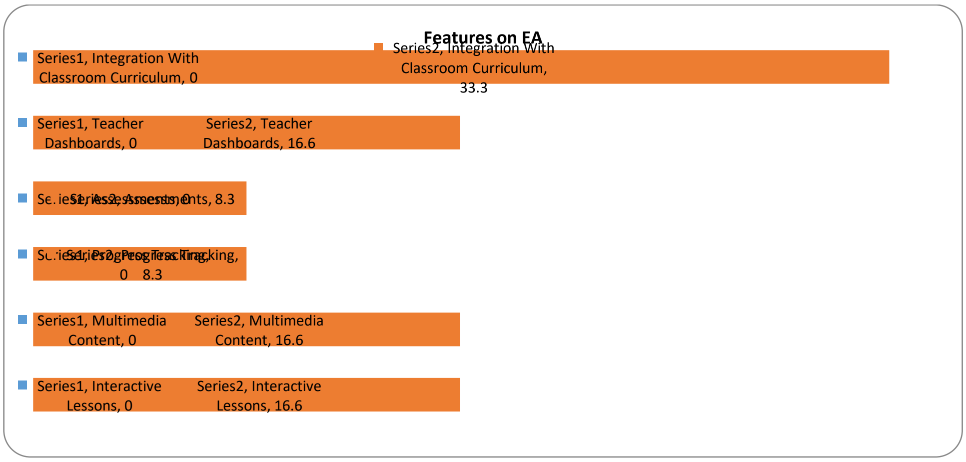



**Table No-3**

| Features on EA | Valid Respondents | Percentage |
|---|---|---|
| Interactive Lessons | 10 | 16.6 |
| Multimedia Content | 10 | 16.6 |
| Progress Tracking | 5 | 8.3 |
| Assessments | 5 | 8.3 |
| Teacher Dashboards | 10 | 16.6 |
| Integration With Classroom Curriculum | 20 | 33.3 |
| **Total** | **60** | **100** |

Majority (33.3%) are integration with classroom curriculam



## CONCLUSION

The research study on "a study on digital education on Students perception towards educational apps with reference to Coimbatore" is a great idea to use to complement children's education, both in and offside of the classroom. The usage of images, videos, and sounds appealing to children's minds, help them to engage better with this type of content rather than books or chalkboards. Majority of the respondents are selected on Vedantu education app (35%) for student perception, and majority of the student respondents are using the platform on Swayam, Diksha and followed by E-ShodhSindhu, E-PG Pathshala, Swayam Prabha and NTPEL for students perception, and majority (33.3%) are prefer the integration with classroom curriculam on Digital education system.

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# A STUDY ON E-LEARNING PERSPECTIVE FOR EMPLOYEES OF CORPORATE SECTOR

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***Abstract***

*The relationship between e-learning-based training methods and employees' overall job performance, productivity, ability, job happiness, and organizational commitment is examined in this study. Organizations have become aware of the advantages that e-learning provides and have been able to fully re-engineer the training process. Any nation's development depends on the encouragement of e-learning initiatives. Concerns are raised by the modern society's rapid growth and advancement in education.*

*At every level of the business structure, managers are constantly looking for innovative and cost-effective ways to train their employees. E-learning is more costly than traditional classroom instruction, but it also saves money over time. Using e-learning techniques in conjunction with traditional trainings considerably reduces additional costs, such as training facilities and travel expenses for employees or trainers. Despite this, e-learning is a teaching method that is here to stay because it gives people the necessary knowledge, abilities, and attitudes. Its effectiveness and viability will depend on how it is created, implemented, and evaluated. The state of e-learning in India's corporate sector is examined in detail in this research report.*

*We evaluate e-learning's effectiveness by looking at the literature that discusses its drawbacks. This research agenda was created to bring together the science and practice of online education.*

***Keywords**: e-learning; distance training; Learning Information and Knowledge; Corporate Training.*

## INTRODUCTION

Since the economy, society, and technology are always changing, the world and organizations are not the same as they were a few years ago. These forces are working at the individual and organizational levels and are transforming education. The desire for alternative learning approaches is high. A collaborative learning environment is being fostered via the use of e-learning in employee education and training programs by numerous organizations. Online learning, or e-learning. E-learning, as defined by Chen [1], is a method of utilizing technology to deliver learning solutions. It is a combination of technology and computer-based instruction that supports learning and business objectives. E-learning comes in three different forms: fully online, blended, and hybrid. When it comes to creating digital content (electronic, interactive, and paper), aside from trainer-led groups, self-study with a subject matter expert, online and CD-based learning, streaming video and audio, videotape, satellite broadcast, and cable TV, these are all types of e-Learning (videoconferencing, and teleconferencing). disseminate information that reduces the cost of frequent business travel, links distant people, and eases the strain. and effectively disseminate knowledge are all benefits of online education. E-learning's widespread accessibility and user-friendliness have contributed to its popularity. E-learning can take place anywhere with a mouse click. E-learning has several advantages, including: (1) the ability to maintain comprehensive records; (2) customization to assess employee performance, training needs, and other important information; and (3) the adaptability to create customized training materials to meet changing training needs. E-learning has become a significant academic and instructional tool as a result of businesses integrating it into their operations. Corporate e-learning has benefits and drawbacks. Employee productivity is impacted by education and training. Work satisfaction, turnover, and training are the main barriers to employee retention. Knowledgeable workers work harder, put in more hours, and stay with a company longer. When employees are less prone to quit, employee turnover will improve. Insufficient employee training has a negative impact on staff training and productivity. According to Clarke and Hermens[2], a number of reasons have contributed to the expansion of corporate e-learning. Accessing modern technologies requires more internet bandwidth, and meeting the demands of education and training calls for digital convergence and adaptable technological solutions. E-learning is becoming a competitive alternative to traditional corporate education and training because of the increasing demand for cutting-edge technology, sophisticated technology, and communication networks, as well as industrial discontent with old distribution methods. Because they need to ensure e-learning deployment is timely, accessible, and scalable, corporate leaders' increased usage of e-learning has an impact on the workplace. Business leaders still believe that e-learning is essential to fulfilling the educational and training requirements of stakeholders and the organization. Many businesses prioritize regulatory training and are keen to use eLearning as a means of guaranteeing compliance.

Both small and large organizations have to deal with the high cost of eLearning. [3] No research comparing e-learning to traditional approaches has been published. [4] Finding out how e-learning affects workers' attitudes and performance is the goal of this analysis. In India, we examined e-learning data from numerous corporate sector businesses in the primary, secondary, and tertiary sectors. The results show that e-learning is useful for changing employee attitudes toward the company as well as for spreading information effectively. The limitations of e-learning are also revealed by this study. The research on e-learning is reviewed in the next section, which also examines its advantages and disadvantages. ICT is becoming increasingly important in the workplace, particularly in HR development, as employee development trends shift from in-person training to more open and media-based training. With the development of internet technology, e-learning became more and more popular. E-learning is a type of traditional education that is delivered digitally over the internet. Its applicability dictates whether it is used in traditional or remote training. Creating an e-learning model involves more than just posting training materials online; it also calls for training concepts and reasoning. Additionally, there is an online test. Employees' acquired skills are evaluated online. E-training is a long-term strategy and a way for a company, organization, or individual to increase the number and caliber of human resources. E-learning has the potential to reduce training costs, enable learning at any time and from any location, and improve effectiveness. Companies develop e-learning to attain certain aims. One purpose is to improve staff quality and performance. Employee performance drives corporate success, therefore human resource development is vital to the company's growth. Some benchmarks that can be used to monitor the performance of human resource development include exams, participant assessments, and expert examinations.

**2. Problem Statement**

Despite the growing adoption of e-learning, there remains uncertainty regarding its effectiveness compared to traditional training methods. Concerns include lack of motivation, limited interaction, and inconsistent engagement among employees. This study aims to bridge the knowledge gap by assessing how e-learning influences corporate training outcomes and employee performance.

**3. Research Objectives**

- To assess the impact of e-learning on employee skill development.
- To analyze employee engagement and satisfaction with e-learning platforms.
- To compare the effectiveness of e-learning with traditional training methods.
- To identify challenges and best practices in corporate e-learning implementation.

## 4. LITERATURE REVIEW

Chen [1] described eLearning as a “sort of training given on a computer to support learning and corporate goals. Corporate eLearning is intended to increase job satisfaction and build a more productive and competitive workforce. Corporate executives often use eLearning to gain a competitive edge or to prepare for globalization. Other business executives utilize e-learning to fulfil demand and save money. Executives may link employee demands with strategic corporate goals by obtaining a competitive edge. Globalization requires sophisticated communication platforms like the Internet and eLearning to reach global stakeholders. E-Learning helps companies save money on both internal and external education. “One of the reasons why executives like eLearning is its ability to connect with high-level corporate objectives and train whole workforces to support them. Skinner invented the first eLearning system in 1945 as a testing and response machine. [1] The personal computer, computer-based training, and the Internet have together transformed the way that education is delivered, the learning paradigm shifted from cognitive to constructive. To learn more about online and blended learning, go here. Mobile devices give more individuals than ever before access to educational content since people can now use the internet from with a simple website click from their mobile phones and laptops. Business will increasingly use E-Learning to educate and train personnel.” On-line and blended learning have grown in popularity, says.[5]Wireless and mobile learning, digital books, open source software as a result of these technological advances, many individuals who previously could not access internet resources may now do so via their mobile phones or laptops. To educate and train people in the workplace, eLearning will be a driving force. The convenience and low cost of e-courses continue to attract corporate managers.[6] Yap, Holmes, Hannan, and Cukier[7,8] examined and found that employees who thought training was beneficial were more devoted to their organization than those who considered it was useless. Environment, internal support, working and training level, and organization support are all critical elements of work environment, which contribute to employee happiness. To increase the value of E- Learning, management should take note of these aspects and ensure that they thoroughly evaluate E- Learning and E-Training. Basis of virtual learning was flexible accessibility. [9] This allows those who work full-time or part-time to learn at any time and location that suits them. The major goal was to liberate all students from the usual educational setting. The efficacy of e-learning in organizations can help them adapt quickly to changing environments. System thinking is a method for seeing things holistically. System thinking development allows us to underneath complicated situations even when we just see individual pieces. Keeping this in mind, it has been observed that workplace learning is challenging. Such as drive, responsibility, interest, and activities. It also impacts the learner's motivation in the company. Discusses several important components of workplace learning”. [10] An organization workers are the major learning stakeholders in the learning environment, whereas other stakeholders include the organization, parents, and society.

The business environment is gradually understanding the potential advantages of e such as cost-effective staff and customer training.[1] This transformation from an emerging subject with much promise into an established business with tremendous attention was anticipated years ago.[11] “In the workplace, e-learning is popular owing to its convenience, cheap cost, consistency, and customer value”.[12] “In highly competitive marketplaces, companies must recognize the value of human capital and knowledge to utilize people' skills as competitive assets”.[13] According to Laurillard's [14] research, “E-learning is the employment of new technologies or applications in the service of learning or learner support”. Marc Penske’s study shows that various learning outcomes require distinct learning practices. A) Behaviour is learned through limiting, feedback, and practice. c) Facts through association, practice, memorization, and questions Impression, practice, and imitative language and e) Informal reasoning, based on real- world situations and examples. These studies investigate the possible future implications of using e-learning. Moreover, E- earning is the launch pad for innovative technologies. How do we evaluate e-learning, regardless of distribution method? Using Kirkpatrick's basic approach, any type of training may be evaluated at four levels. “Engaging learners is a difficult task for any e-learning designer. In fact, lack of interest is one of the main reasons why students abandon remote learning courses”. As a result, companies are now concentrating on strategies to enhance learners' motivation and engagement in e-learning. Companies have attempted to accomplish this through the use of learning games. Learning games comprise computer games that are used to deliver and/or practice various types of training. Learning games have been found to improve trainee performance in e-learning by boosting the appeal of e-learning as a medium of instruction, motivating students to practice and identify patterns and linkages within the training content, as well as “reducing the fears associated with testing and evaluating during training ”.

## 5. METHODOLOGICAL STRATEGIES OF E-LEARNING APPROACHES.

The trainer can use a variety of tactics in any learning environment. A group project presentation, for example, is a technique for improving communication skills that can be delivered in a regular classroom setting or online. An Integrated learning strategy, also known as blended learning, could be used for induction trainings. Because induction is intended to acquaint new personnel to the organization's background, a combination of face-to-face and online learning is ideal. Our study looks at the elements that influence learners' satisfaction with online learning tools and approaches, regardless of the technology used.

Some approaches used in E-learning are listed below:

### 5.1 FACE-TO-FACE AND ONLINE TRAINING: EXPECTATIONS AND CHALLENGES

One of the most important processes in human resource management is introducing a new employee to their new position or company. It entails acquainting the worker with the culture, workplace atmosphere, policies, procedures, and organizational life. The purpose of training programs is to improve stakeholder involvement, performance, motivation, staff retention, and satisfaction. Formal online learning strategies include Anywhere, Anytime, Any Size Learning, Open Source Education Resources, multimedia, and blended learning. Realistic outcomes are supported, scaffold, and encouraged by constructivist methods for developing leadership, teamwork, and analytical skills.

### 5.2 SOME OTHER EMERGING PEDAGOGICAL TRENDS IN E- LEARNING

Several common reasons or tendencies are evident in these developments:

1. Developing an open, more adaptable, and more accessible learning environment. The lecture classroom is no longer the only place where learning takes place; alternative learning spaces are now used to transmit information.
2. A more balanced allocation of authority in the teacher-student dynamic. This shows up as a shift in the function of education, away from conventional methods of instruction and toward fostering students' independence. Being student-centered in this context could mean involving students in peer evaluation and discussion groups, as well as learning and subject matter experts, and in each other's social media usage.
3. These will use technology in the teaching and learning process, as well as to help and support students and offer innovative assessment methods. It is important to emphasize that these emerging instructional trends are still in the early stages of development. To find those that will have long-term worth and

impact on the system, more practical experience, thorough analysis, and in-depth investigation are needed.

**5.3 THE DIMENSIONS OF LEARNING ORGANISATION**

1. Identify a way to collect and disseminate knowledge and enable people to collaborate toward a common objective: Both new and old technologies are created and incorporated into the workplace; workers can access them; and systems are maintained. As its creators, owners, and enforcers, people are a part of a vision. Because authority is close to the decision-making process, people are very motivated to learn and perform their jobs. Systems are kept up to date. A shared vision is established, owned, and carried out by everyone; accountability is shared near decision-making to encourage others to learn about their responsibilities.
2. Establishing opportunities for lifelong learning Promote research and discussion: Employees must be open to change, adapt, develop, and take charge of decisions pertaining to their jobs in order to engage in continuous learning. People gain important constructive thinking skills when it comes to communicating their thoughts and learning to listen and inquire about the viewpoints of others. Their opinions are therefore widely accepted, which promotes constructive societal development. The culture is altered to encourage inquiry, criticism, and trial and error.
3. Create a relationship between the organization and its surroundings: People observe how their job affects the entire organization, they look around and take note of pertinent information, and the business is connected to the community.
4. Develop strategic leadership in education Notable financial outcomes: Leaders act as role models, encouraging and supporting learning while strategically utilizing it to further business goals. the condition of the business's finances and growth potential.
5. Knowledge performance: Providing better goods and services as a result of improved study and knowledge acquisition skills
6. Promote teamwork and collaboration: This theory holds that work is organized to assist groups in using a variety of thought processes, that the culture values cooperation and group learning, and that collaboration is highly valued.

**5.4 IMPLEMENTATION METHODOLOGY OF CORPORATE E-LEARNING SYSTEM**

The implementation of an e-learning system requires the collection, conversion, and delivery of relevant, current, and dynamic content to meet changing learner requirements. This requires multifaceted contributions from all stakeholders. Businesses can either establish an e-learning system in-house or outsource the program to external entities. Both have their own benefits and drawbacks. Employees with access to e-learning resources, knowledge of e-learning methods, and required competencies have more career achievements and possibilities. However, some workers are concerned that leaders are not investing enough in e-learning and are not driving change. Challenges in e-learning implementation include lack of management attention, poor management awareness, and insufficient infrastructure. Employees also face challenges due to a lack of formal training programs. Training must be formally organized and structured to ensure well-planned e-learning projects. Delegating training implementation to lower levels without clear management guidance can lead to issues for employees and jeopardize the program's overall performance.

**6. CONCLUSION**

This study aimed to determine the intentions of employees in India to use e-learning in the corporate sector. A literature review was conducted, and the results showed that employees are willing to adapt training and learning methods. The rising availability of broadband and cheap internet access has contributed to the rise of e-learning usage across industries. A diverse and vibrant e-training and e-learning content ecosystem with local and worldwide actors has also contributed to the increasing acceptance of online learning. E-learning is an effective strategy for education, literacy, skill development, and economic growth in poor and emerging nations. The right study and design of an e-learning or e-commerce strategy can make all these options available. The importance of using e-learning in educational and professional growth cannot be overstated, and the reciprocal collaboration between developing nations and India on e-learning is believed to be advantageous for business development. The study found that while significant advances have been made in exploring and applying the advantages of e-learning for corporate sector training in India, more work needs to be done to design and create apt e-learning content for the targeted corporate sectors.

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# GREEN MARKETING STRATEGIES AND THEIR IMPACT ON ONLINE CONSUMER PURCHASING DECISIONS

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***Abstract***

*In recent years, the growing environmental consciousness among consumers has prompted businesses to adopt green marketing strategies as a means of promoting eco-friendly practices and products. This study investigates the impact of such strategies on online consumer purchasing decisions, with a particular focus on how sustainability-related information, branding, and messaging influence buyer behavior in digital marketplaces. As e-commerce continues to expand globally, understanding the relationship between green marketing and consumer response is critical for businesses seeking to balance profitability with environmental responsibility.*

*Findings reveal a significant positive correlation between green marketing efforts and consumers' willingness to purchase products online, particularly among millennial and Gen Z demographics. Eco-labels and transparent communication about environmental practices emerged as the most influential factors in shaping trust and purchase intent. However, the study also uncovers a gap between expressed consumer preferences for sustainable products and actual purchasing behavior, often influenced by price sensitivity, lack of awareness, or skepticism regarding the authenticity of green claims (green washing).*

*The study concludes that while green marketing has strong potential to drive consumer engagement and loyalty in e-commerce, its effectiveness depends on the credibility, clarity, and consistency of the messaging. Businesses are advised to adopt holistic green practices that go beyond marketing, ensuring that sustainability is embedded in the entire value chain from sourcing to delivery. Policymakers and certification bodies also play a crucial role in standardizing green marketing claims to boost consumer trust.*

*This research contributes to the growing literature on sustainable commerce and offers actionable insights for marketers, policymakers, and e-commerce platforms aiming to promote environmentally responsible consumer behavior in the digital age.*

***Keywords:****-Green Marketing, Online Consumer Behavior, E-commerce, Sustainability, Eco-Friendly Products.*

## INTRODUCTION

In the 21st century, environmental sustainability has become a global priority due to rising concerns about climate change, resource depletion, and ecological imbalance. As societies become increasingly conscious of their environmental footprint, businesses are also adapting by incorporating eco-friendly practices into their operations and marketing strategies. One significant development in this regard is the emergence of green marketing, which refers to the promotion of products and services based on their environmental benefits. It encompasses a wide array of practices, including eco-friendly packaging, ethical sourcing, energy-efficient production, and sustainability-focused branding. Green marketing not only reflects a company's environmental responsibility but also helps in differentiating its offerings in a competitive marketplace.

With the rapid growth of e-commerce and digital platforms, consumer buying behaviors have shifted dramatically. The internet provides consumers with greater access to information, enabling them to make more informed and value-driven purchasing decisions. This shift has given rise to a new segment of green consumers—individuals who are not only aware of environmental issues but also actively seek out sustainable alternatives. For businesses operating online, the integration of green marketing strategies can thus play a crucial role in influencing consumer choices and fostering brand loyalty.

The objective of this study is to explore the impact of various green marketing strategies on online consumer purchasing behavior. It seeks to analyze how factors such as eco-labeling, green advertising, corporate environmental responsibility, sustainable packaging, and digital green campaigns influence consumer perceptions and purchase decisions. Additionally, it investigates whether these strategies lead to increased consumer trust, willingness to pay a premium, and long-term brand engagement.

India presents a unique context for this study. As one of the fastest-growing digital economies with a rapidly expanding middle class, Indian consumers are becoming increasingly eco-conscious. Many Indian companies, such as ITC, Tata, Wipro, and Amul, have begun to incorporate sustainability into their marketing efforts. However, there is still limited empirical research exploring how such strategies impact online consumer behavior specifically within the Indian market. This gap makes it essential to understand the effectiveness of green marketing in influencing the online purchasing decisions of Indian consumers.

This study employs a combination of primary data collection through questionnaires and secondary research, including case studies and literature reviews, to provide a comprehensive understanding of the topic. It aims to provide valuable insights for businesses looking to adopt or enhance green marketing strategies in the digital space. The study will also help policymakers, marketers, and researchers understand the dynamics between sustainable branding and consumer behavior in the age of digital commerce.

In summary, as environmental concerns become central to global discourse, green marketing is no longer optional—it is an essential strategic tool. Understanding its influence on consumer behavior, particularly in the online environment, is crucial for businesses aiming to thrive in an eco-conscious, digital-first world.

## REVIEW OF LITERATURE

**Ottman et al. (2010)** This study addressed the problem of "green marketing myopia," where marketers focus excessively on environmental benefits while ignoring core consumer needs such as price, performance, and convenience. The authors argued that green products must offer value beyond sustainability to compete in the mainstream market. The research emphasized the importance of integrating consumer preferences into the development of green marketing strategies to avoid alienating potential buyers. Their findings laid foundational principles for businesses trying to balance ecological responsibility with consumer satisfaction, particularly relevant in online retail settings where product comparisons are instant and direct.

**Delafrooz et al. (2011)** this research investigated how green marketing tools like eco-labels, sustainable packaging, and environmental endorsements affect consumer buying behavior. Through survey-based analysis, it was discovered that such tools positively influence attitudes and purchase intentions, particularly in educated and environmentally aware consumers. However, price remained a critical factor that often overrode green considerations during actual purchasing decisions. The study highlighted the need for businesses to not only communicate sustainability effectively but also ensure competitive pricing to make green options more attractive in online marketplaces.

**Peattie & Crane (2013)** the authors critically reviewed the theoretical and practical gaps in green marketing and found that many initiatives were superficial or symbolic. They argued that green marketing had become more of a promotional tool than a strategic shift toward sustainability. Their research emphasized the importance of embedding environmental responsibility throughout the business, not just in marketing messages. In online environments, where consumers are bombarded with claims, this paper stressed the need for transparency and genuine commitment to sustainability to avoid consumer disillusionment or skepticism.

**Leonidou et al. (2014)** this study examined how companies can effectively integrate environmental considerations into all aspects of the marketing mix—product, price, place, and promotion. The authors argued that greening each element contributes to stronger consumer trust and long-term brand loyalty. Their empirical data suggested that consumers respond positively to consistent green practices across the marketing spectrum, especially when companies are transparent about their supply chain and sourcing. This approach is particularly powerful in digital commerce, where consumers have access to detailed product information and reviews.

**Rahbar & Wahid (2015)** this research explored the relationship between green marketing tools and consumer purchase behavior in Malaysia. It found that tools such as eco-friendly packaging, recyclable materials, and green certifications significantly impact consumer preferences. The results showed that when consumers trust a brand's environmental claims, they are more likely to engage in repeat purchases. However, the study also warned of growing consumer skepticism, highlighting that credibility and evidence of actual environmental benefit are essential to converting interest into action in online purchasing environments.

**Ng (2016)** Ng's study analyzed the progression of green marketing within the context of digital commerce. The paper identified a shift from isolated eco-friendly claims to comprehensive sustainability narratives. E-commerce platforms were found to enhance this trend by enabling brands to provide detailed sustainability disclosures, customer reviews, and real-time interactions. However, the study also raised concerns about the lack of standardization in green claims online, which opens the door for greenwashing. Ng called for stronger digital policies and third-party verification to strengthen consumer trust.

**Kumar (2017)** Kumar conducted a systematic literature review focusing on the green marketing mix and its application in the digital marketplace. The study highlighted the importance of aligning the extended 7Ps—product, price, place, promotion, people, process, and physical evidence—with sustainability goals. Kumar argued that digital platforms offer unique opportunities for green communication but also demand higher transparency due to real-time feedback and scrutiny. He recommended that future research explore the psychological and emotional dimensions of green consumerism in digital settings.

**Joshi & Rahman (2018)** this influential study explored various psychological and demographic factors affecting green purchase behavior. It identified three key drivers: environmental concern, perceived consumer effectiveness (belief that one's actions make a difference), and green trust. The study concluded that these factors significantly influence the willingness to buy sustainable products online. The authors emphasized that green marketing strategies must appeal not only to logical considerations but also emotional and ethical motivations to be effective in the highly competitive e-commerce environment.

**Zhang & Dong (2019)** Using a structural equation modeling approach, Zhang and Dong examined the relationship between green trust, perceived value, and perceived risk in shaping online green purchase intention. The study found that trust in a brand's green claims reduces the perceived risk of purchasing unfamiliar eco-products online. Consumers are more inclined to complete a transaction if they perceive both environmental and functional value. The findings reinforced the importance of building trust through clear, verifiable, and consistent sustainability communication in online channels.

**Wang & Yu (2020)** this research investigated the role of advertising authenticity in mitigating consumer skepticism toward green marketing. It was found that advertisements grounded in factual, specific environmental actions generated more trust and engagement than vague or idealistic messaging.

The study warned that green exaggeration could backfire and reduce brand credibility. For e-commerce, where consumers rely heavily on product descriptions and digital media, authentic storytelling supported by third-party verification is key to influencing eco-conscious purchasing.

**Dangelico & Vocalelli (2021)** this review outlined the definitions, dimensions, and stakeholder relationships within green marketing. It emphasized the multi-layered nature of sustainable marketing efforts, involving customers, suppliers, regulators, and society. The authors concluded that long-term impact depends on the integration of sustainability across strategic operations, not just in advertising. For online marketers, the study suggests that developing inclusive and stakeholder-driven strategies can create more resilient and trusted green brands.

**Kautish & Sharma (2022)** this study applied the Stimulus–Organism–Response (S-O-R) model to online green marketing. The results showed that green advertisements (stimuli) influenced emotional reactions (organism), which then shaped purchase behavior (response). Positive emotional responses to green messaging—such as pride, trust, or ethical satisfaction—were strong predictors of purchase intention. The research underscored the importance of crafting emotionally compelling green narratives for the online consumer, especially in a crowded digital marketplace.

**Alamsyah & Hariyadi (2023)** this paper focused on eco-label familiarity as a moderating factor in digital green marketing. It was found that consumers who recognize and understand eco-labels are significantly more responsive to green messaging. The study highlighted the value of educating consumers about sustainability symbols to enhance trust. In online retail, where product evaluation is largely visual and informational, well-communicated eco-labels serve as critical trust signals.

**Li & Mehta (2024)** This recent study examined how digital literacy affects consumer responses to green marketing. Consumers with high digital skills were more adept at identifying misleading green claims (greenwashing) and were more loyal to brands that demonstrated transparency and authenticity. The research emphasized that green marketing is most effective when it respects consumer intelligence and backs up environmental claims with verifiable data and reporting.

**Gupta & Sharma (2024)** Exploring the role of digital influencers in green marketing, this study found that sustainability messages shared by trusted online personalities had a strong impact on consumer decisions. Authenticity, alignment with personal values, and relatability were crucial in shaping perceptions. The study suggested that strategic partnerships with influencers who genuinely support environmental causes can amplify brand credibility and improve green product adoption in online markets.

**OBJECTIVES OF THE STUDY**

1. To analyze the influence of green marketing strategies on consumer purchasing behavior in online retail platforms.
2. To examine the role of trust, eco-labels, and perceived authenticity in shaping online consumer attitudes toward green products.
3. To identify demographic and psychographic factors that moderate consumer responses to green marketing in e-commerce.
4. To evaluate consumer awareness and skepticism regarding green washing in online marketing practices.
5. To provide actionable recommendations for marketers to improve the effectiveness of green marketing strategies in digital contexts.

## RESEARCH METHODOLOGY

This paper is theoretical in nature. The data used for this paper collected from number of sources such as journals, research paper, and book chapter and more.

## RESEARCH GAP

While green marketing has been widely studied in traditional retail contexts, there remains a significant gap in understanding its effectiveness in online environments, where consumer behavior is shaped by different dynamics such as digital trust, visual cues, and instant access to competing information. Many existing studies focus on green marketing tactics (e.g., eco-labeling, green advertising) in isolation, but lack a comprehensive analysis of how these strategies interact with consumer trust, skepticism, and purchase decisions in e-commerce platforms.

Furthermore, although there is growing concern over green washing, limited research has explored how consumer awareness and digital literacy influence the perceived authenticity of green claims online. Most studies also fail to address the demographic and psychographic moderators that influence how consumers respond to green messages in the digital space.

This study aims to fill these gaps by:

1. Investigating how integrated green marketing strategies influence online purchasing decisions.
2. Examining the role of eco-label familiarity, green trust, and digital awareness in consumer response.
3. Addressing the growing challenge of green washing in online marketing and its effect on consumer skepticism.

## SIGNIFICANCE OF THE STUDY

This study is significant for multiple stakeholders—marketers, businesses, researchers, and consumers—as it explores the evolving landscape of green marketing within the rapidly expanding domain of e-commerce.

Firstly, it provides practical insights for digital marketers and companies looking to integrate sustainability into their online branding and advertising strategies. By understanding which green marketing tactics most effectively influence purchasing decisions, businesses can craft more authentic and impactful campaigns, increasing both consumer trust and sales.

Secondly, the study addresses a critical academic gap by investigating the underexplored relationship between green marketing and online consumer behavior, especially in the context of digital trust, eco-labels, and green washing. The findings will contribute to the theoretical body of knowledge on sustainable consumerism and green brand positioning in digital markets.

Moreover, it offers value to policy makers and consumer protection agencies by highlighting the potential risks of deceptive green claims, thus helping shape clearer guidelines for responsible green marketing in online platforms.

Lastly, the study will empower consumers by raising awareness of how green marketing affects their online choices, encouraging more informed, ethical, and environmentally responsible purchasing behavior.

## DISCUSSION

## GREEN MARKETING STRATEGIES

Green marketing strategies involve a range of tactics that businesses use to promote their environmentally friendly products and services. These strategies not only aim to highlight the eco-friendly nature of the products but also align with growing consumer demand for sustainability and environmental responsibility. Here are several green marketing strategies that companies can implement:

**1. Eco-Labeling:** Eco-labels are certifications or symbols that indicate a product meets certain environmental standards. These labels help consumers identify products that are sustainable or environmentally friendly. **Examples:** Energy Star, Fair Trade, Organic Certification, FSC-certified wood products, and USDA Organic.

**2. Sustainable Packaging:** This strategy focuses on using eco-friendly materials for product packaging, such as biodegradable, recyclable, or reusable packaging. **Examples:** Brands using recycled materials for packaging or offering refills instead of single-use packaging.

**3. Green Advertising:** Green advertising involves promoting the environmental benefits of a product through advertising channels, including television, print, and digital platforms. **Examples:** Ads highlighting energy efficiency, reduced carbon footprints, or sustainable sourcing of materials.

**4. Product Innovation and Eco-Friendly Products:** Businesses develop products that have minimal environmental impact throughout their lifecycle, from production to disposal. **Examples:** Electric vehicles, biodegradable cleaning products, or energy-efficient appliances.

**5. Corporate Social Responsibility (CSR) Initiatives:** Companies engage in CSR activities related to environmental sustainability, such as supporting environmental charities, reducing their own carbon footprints, or investing in renewable energy projects. **Examples:** Patagonia’s commitment to environmental conservation or IKEA’s investment in renewable energy and sustainable sourcing.

**6. Green Product Positioning:** Positioning the product as a sustainable or eco-friendly alternative to conventional products. This strategy involves integrating sustainability into the core identity of the product or brand. **Examples:** Tesla positioning itself as an environmentally friendly alternative to gasoline-powered vehicles.

**7. Carbon Footprint Reduction:** Reducing the carbon emissions associated with the production, distribution, and consumption of products. Businesses often highlight their efforts in reducing emissions to appeal to eco-conscious customers. **Examples:** Companies like Unilever or Nike reducing carbon emissions in production or offering carbon-neutral products.

**8. Recycling Programs:** Companies set up systems that allow customers to return used products for recycling, up cycling, or repurposing. **Examples:** Apple’s recycling program, where consumers can trade in old devices for recycling or re-use.

**9. Energy Efficiency:** This involves creating products or services that consume less energy and reduce environmental impact over their lifecycle. **Examples:** LED light bulbs, energy-efficient appliances, or green buildings.

**10. Transparency and Sustainability Reporting:** Providing clear, verifiable information about a product's sustainability efforts, sourcing practices, and environmental impact. **Examples:** Companies like Ben & Jerry's or Patagonia release annual sustainability reports to demonstrate their commitment to environmental causes.

**11. Green Pricing:** Offering products at a competitive or slightly premium price while emphasizing the long-term environmental and personal benefits, such as savings on energy bills or reduced waste. **Examples:** Solar panels or energy-efficient appliances that may have higher initial costs but offer significant savings over time.

**12. Sustainable Supply Chain Management:** Ensuring that a company’s supply chain operates in a sustainable manner, with an emphasis on sourcing raw materials ethically, minimizing waste, and reducing transportation emissions. **Examples:** Companies like Starbucks or Nike are working toward sourcing materials from sustainable, ethical sources and ensuring fair labor practices in their supply chains.

**13. Influencer Marketing for Green Causes:** Partnering with influencers who advocate for sustainability to reach environmentally conscious consumers. **Examples:** A clothing brand collaborating with an eco-conscious influencer to promote sustainable fashion.

## IMPACT OF GREEN MARKETING STRATEGIES ON ONLINE CONSUMER BUYING BEHAVIOUR

The impact of green marketing strategies on online consumer buying behavior is significant, as consumers are increasingly becoming more environmentally conscious and prefer to make purchases that align with their values. Green marketing strategies influence online consumer behavior in various ways, from enhancing consumer trust to fostering loyalty. Here's a breakdown of how these strategies impact consumer buying behavior

**1. Increased Consumer Awareness and Education:** Green marketing strategies, especially through informative eco-labels and transparent sustainability reporting, help educate consumers about the environmental impact of their purchases. This awareness makes consumers more likely to choose eco-friendly products over conventional ones.

**2. Building Consumer Trust:** When companies use green marketing tactics, such as providing verifiable eco-certifications and transparent supply chain information, it builds trust with consumers. Trust is especially crucial in the online space, where consumers can't physically examine the product. Green claims that are backed by authentic certifications or third-party reviews lead to increased confidence in the product, making consumers more likely to make a purchase.

**3. Positive Influence on Purchasing Intentions:** Green marketing strategies influence online consumer purchasing intentions by appealing to consumers' values and beliefs. Consumers are more likely to buy products that are labeled as eco-friendly or sustainable, especially if they believe that purchasing such products will contribute to positive environmental change.

**4. Premium Pricing for Sustainable Products:** Green marketing can justify a premium price for eco-friendly products. Consumers who value sustainability are often willing to pay a little more for products that are certified as environmentally friendly or that contribute to environmental protection. This strategy works well in online shopping, where consumers can easily compare prices but may prioritize sustainability over price in some cases.

**5. Environmental Concern and Purchase Motivation:** Green marketing strategies often tap into the environmental concerns of consumers, motivating them to make purchases that align with their values. Marketers who align their products with specific environmental causes (e.g., climate change, deforestation, or animal welfare) attract consumers who are motivated by these causes and are more likely to support brands that reflect their environmental ethics.

**6. Consumer Perception of Greenwashing:** While green marketing strategies can influence consumer behavior positively, greenwashing (misleading claims of environmental benefits) can backfire. If consumers perceive a company's green claims as unsubstantiated or deceptive, it may lead to consumer distrust, decreased brand loyalty, and even negative publicity. As consumers become more educated, they are increasingly wary of fake green marketing tactics.

**7. Social Influence and Peer Recommendations:** Green marketing strategies that involve influencer marketing or social proof (e.g., positive reviews from eco-conscious consumers) can drive purchasing behavior. Consumers often look to social networks and reviews to guide their online purchasing decisions. When influencers or peers promote sustainable products, it boosts credibility and increases the likelihood of purchase.

**8. Emotional Appeal:** Green marketing strategies often create an emotional appeal by connecting environmental responsibility with personal values. Online consumers are more likely to make a purchase when they feel emotionally connected to the brand's mission or sustainability efforts. This emotional connection can lead to higher satisfaction, repeat purchases, and long-term brand loyalty.

**9. Convenience and Accessibility of Sustainable Products:** Online platforms that promote green products make it convenient for consumers to access sustainable goods without leaving their homes. As e-commerce grows, many consumers expect eco-friendly products to be readily available on online platforms, and they may be more likely to purchase from sites that offer a wide selection of sustainable goods**.**

**10. Long-Term Brand Loyality:** Green marketing fosters brand loyalty by positioning a brand as responsible and committed to environmental sustainability. Consumers who resonate with a company's green values are likely to continue purchasing from that brand, even if alternatives are available at a lower price.

**FINDINGS OF THE STUDY**

1. **Widespread Adoption of Green Marketing Strategies:** Businesses across industries are increasingly adopting green marketing strategies in digital spaces. These include:
   - Eco-labeling and certification marks on e-commerce platforms.
   - Environmentally themed digital advertising campaigns.
   - Promotion of sustainable packaging and ethical sourcing.
   - Integration of sustainability in brand storytelling via websites and social media.
2. **Positive Consumer Response to Green Branding:** Consumers respond positively to companies that visibly commit to environmental values. Studies show:
   - Increased trust and brand loyalty among environmentally conscious buyers.
   - Higher purchase intent when green claims are perceived as authentic and verifiable.
   - Urban millennials and Gen Z consumers are the most responsive to digital green marketing.
3. **Online Platforms as Effective Channels for Green Messaging:** Social media and e-commerce sites allow brands to communicate their environmental initiatives widely and interactively.
   - Visual storytelling and transparent reporting (e.g., videos of green manufacturing or carbon offset data) have been shown to increase consumer engagement.
4. **Strategic Business Benefits of Green Marketing:** Companies practicing green marketing benefit in several ways:
   - Brand differentiation in highly competitive online markets.
   - Justification for premium pricing of sustainable products.
   - Enhanced reputation among investors and regulatory bodies due to alignment with ESG (Environmental, Social, and Governance) standards.
   - Long-term customer retention based on shared ethical values.
5. **Awareness vs. Action Gap Among Consumers:** Although consumer awareness of green issues is high, there remains a gap between intention and actual purchase behavior. Factors influencing this include:
   - Perceived higher prices of green products.

- Skepticism about the authenticity of green claims (green washing).
- Limited understanding of certifications or environmental terminology used in online product descriptions.

**CONCLUSION**

The growing global emphasis on environmental sustainability has significantly reshaped consumer expectations and corporate practices. Green marketing, once a niche approach, has become a mainstream strategy as more businesses recognize its value in attracting and retaining eco-conscious consumers. This study, based on secondary data, reveals that companies adopting green marketing strategies in their digital operations such as eco-labeling, green advertising, sustainable packaging, and transparency in environmental reporting have a competitive advantage in the online marketplace.

Findings suggest that consumers are not only aware of environmental issues but are also increasingly responsive to brands that demonstrate authentic commitment to sustainability. Online platforms, with their wide reach and interactive capabilities, have proven to be effective tools for communicating green values and influencing purchasing behavior. However, the study also identifies a gap between consumer awareness and action, often due to skepticism about green claims or perceived premium pricing of eco-friendly products.

In conclusion, green marketing when executed with transparency and consistency positively influences online consumer purchasing decisions and contributes to long-term brand success. As environmental concerns continue to shape the future of commerce, organizations that proactively adopt and promote sustainable practices will not only meet regulatory and ethical standards but also gain a loyal and growing consumer base in the digital economy.

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# IMPACT OF DIGITALISATION IN SMALL SCALE INDUSTRIES IN INDIA

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***Abstract***

*Digital transformation and resultant business model innovation have fundamentally altered consumers expectations and behaviors, putting immense pressure on traditional firms in small and scale industries. In generally we identify three stages of digital transformation: Digitization, Digitalization, and digital transformation. We identify and delineate growth strategies for digital firms as well as the assets and capabilities required in order to successfully transform digitally. Finally, Digital transformation significantly impacts small-scale industries by fostering growth, improving efficiency, and enhancing competitiveness. It allows SMEs to access new markets, streamline operations, and improve customer experiences, ultimately leading to increased profitability and productivity. One of the most fundamental social and economic occurrences of It is the most basic social and economic acquisition of our time is digital transformation which has an impact on business. The intention of this paper is to investigate how digital transformation effects making activities in small scale industries in India as well as to investigate overall changes triggered by digital technology in the marketing concept its instruments and activities in small enterprises the primary research question focus on the current evaluation of market activities performed by organisations in India. Technologies are widely used in marketing in the enterprise studied despite the fact that these technologies are often classified as traditional looks its technologies are a digital tools also have an impact on marketing assistance in the development of customer relations and increasing the value of each organisation.*

***Key words**: Digitalization, Small Industries*

**INTRODUCTION**: The digital revoulution plays a crucial role in india's Economic Development. Digital technology used like Digital payments they are phone pay, Bharath Pay, Google pay, Whats App payment, Online Banking, Social Media platforms plays a very important portion in the Economic Development of Every Country. It is used mostly in India probably after 2020. After demonitaisation online payments are used in every business enterprise including small scale industries.

In the modren india Digital Technology has plays a crucial role in the Development of Small scale industries in India. Technology users are growing rapidly. Now a days it is very essential for the use of Digital payments in all the Small scale industries. And also this Technology used in Small busioness transactions also.

**Objectives of the Study:**

The main Objective of this study focus on Impact of Digitalisation in Small scale industries in India.

- To know the Advantages of Digitalisation in Small Scale Industry.
- To Asertain the impact of Social media in Digital payments.
- Observe the effect of Online Payments in Small Scale industries in India.

Review of Literature:

According to ONAGHISE osagie c. oguh Festus explores the digital Technology on the Growth of Micro, Small and Mediam Enterprises located in Edo States. He found that digital payments plays a very importanrt role on the Small scale Industries.

According to Pearce moses 2005 Digitization is the process of transforming Analogical tools into Digital tools. He focused how technology changes accured in the Modren era.

Written and David 2003 Digitization is the process of taking traditional methods to modern methods.

As per Mrs.Pranjali sings Digitization improves the performance of Small and medium scale Enterprises.

Need of the Study Digitalization:

The important element of Digitalisation is used the Technology in the Small industries in India. Now a Days almost 70% business transactions are made with online mode only. Digitalisation improve the Turnover of the small scale industries in the National level. Digitalisation enhanced the profits of the Business Organisations around the Country.

Impact of Digitalisation in Small Scale Industries:

**1. Increased Revenue and Market Reach:**

- Digitalization allows small businesses to transcend geographical limitations and access new customers both locally and internationally.
- Online platforms and e-commerce initiatives can significantly expand sales and revenue streams.
- Digital marketing strategies can also increase brand awareness and attract a wider customer base.

**2. Enhanced Operational Efficiency:**

- Automation, AI, and digital processes can streamline operations and reduce manual labor, leading to cost savings and improved efficiency.
- Improved data analytics and business intelligence tools can provide valuable insights for better decision-making and resource allocation.
- Remote working and cloud-based solutions can further enhance operational efficiency and flexibility.

**3. Improved Customer Engagement:**

- Digitalization enables businesses to engage with customers through various channels, including social media, email, and online forums.
- Data analytics can help understand customer preferences and tailor products and services accordingly.
- Customer feedback and reviews can be readily collected and analyzed to improve customer satisfaction and loyalty.

**4. Data-Driven Decision Making:**

- Digitalization provides access to real-time data and analytics, enabling businesses to make more informed decisions.
- Data-driven insights can help identify trends, optimize marketing campaigns, and improve overall business performance.
- Business intelligence tools can provide a deeper understanding of customer behavior and market dynamics.

**5. Innovation and Digital Marketing:**

- Digitalization fosters innovation and creativity by providing access to new technologies and marketing strategies.
- Small businesses can leverage digital marketing techniques like social media, search engine optimization (SEO), and email marketing to reach wider audiences.
- The use of digital tools can also help small businesses create new value propositions and differentiate themselves from competitors.

**Challenges faced by the Small Scale Industries for Digitalization :**

**Cost Burden to the Management**: it is very Costly to introduced Digital Upgradation of the Organisation. Initial investment is more Costly.

**Employee Does not Accept the Digitalization**: Some of the Employees in the organisations only follow traditional book building methods beyond the digital payment methods.

**Security Crises**: now a days Growing Technology also leads to expand some problems especially Cyber crimes. These cyber crimes also a problem to Small scale industries for Adoption of Digitalization.

**Lack of Technology**: Small Business organisations Does not have Enough Technology.

**Impact of Digitalization in Small Scale Industries In India**:

**Digital India Initiatives**:

Digital India programme was Introduced by our Prime minister with the aim of transform India into Digitally Empowered by providing Digital Services in all the Fields across the Country.

**Digital Payments**: India has a mood to create Massive Online payments used with UPI and mobile apps Like G-pay.

**Digital Literacy**: Government of india Focused to improve the Digital Litracy among the people of India by providing various Schemes like National Digital Literacy Mission(NDLM), pradan Manthri Grameen Digiatal Saksharta Abhiyan(PMGDISHA) And Digital saksharta Abhiyan(DISHA).

**E- Governance:** Reforming The government throught Technology and Electric aspacts of Digitalisation.

Government Services: Digital technologies are being used to streamline government services and make them more accessible to citizens if initiatives like aadhaar diesel offer and U Mang.

**Digital Infrastructure:**

India has invested heavily in building digital infrastructure including broadband connectivity and common service centres which are crucial for connecting rural areas and providing access to essential Internet services.

**E-Commerce**: The E commerce market in India is growing very fastly with online platforms like Facebook Amazon Twitter, etc.

**Startups and Innovation:**

India's digital landscape is attracting special startups for innovation in various fields including technology finance healthcare hospitality and broadband connectivity.

Global Rankings:

India is ranked among the top Countries in terms of Digitalisation in terms of Digital Economy.

**Conclusion:**

Digitalisation of small scale industries is majorly driven by the technology advancing digitalisation of consumers this has lead to increased accelerated establishment of new technology startups to take advantage of the growth opportunities the small scale enterprises place a important role in development of the Indian economy by employing almost 80 million people contributing about 60% of total manufacturing output and 35 percentage of exports of the country however in digitalizing economy these industries fail to keep pace online shoppers in India are growing at compounding annual growth 25% and will reach 300 million by the year 2030 it can be concluded that digitization has significant positive impact on small industries in India.

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# THE ROLE OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN FOSTERING ECONOMIC GROWTH IN TANZANIA

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***Abstract***

*This study investigates the role of artificial intelligence and machine learning technologies in fostering economic growth in Tanzania. It investigates the present level of technology adoption in various industries, analyses problems and possibilities, and makes policy suggestions to maximize the benefits of AI and machine learning for sustainable development. The study finds that Tanzania is embracing AI and ML technologies to enhance productivity, improve decision-making, and drive innovation across sectors. The country's ICT infrastructure and government initiatives promote digital transformation, with applications in agriculture, health, and finance. AI and machine learning have a positive economic impact by increasing productivity, creating jobs, innovating, and attracting foreign investment, making Tanzania an appealing tech investment location. The study finds that Infrastructure restrictions, skill shortages, ethical issues, legal frameworks, as well as a lack of qualified experts, data privacy concerns, and biases, all pose hurdles to AI and ML implementation. On the same vein, the study comments that Opportunities for economic growth include public-private partnerships for AI solutions, educational initiatives to create AI capabilities, and international cooperation to exchange expertise with other nations. The study recommends that Policy ideas include expanding investment in technological infrastructure, encouraging AI-focused courses at universities, assisting businesses with incubation programs and funding, and creating a regulatory framework to encourage innovation while protecting people's rights.*

***Keywords:*** *Artificial Intelligence (AI), Machine Learning (ML), Economic Growth, Tanzania, Fostering*

## 1. Introduction

Artificial intelligence as a tool for advancing human progress is a hot topic currently. Artificial technology has been applied in a wide range of sectors, including science and art. Simultaneously, artificial technology has advanced from fundamental to complex issues in human existence and other fields. In the 21st century, Artificial Intelligence (AI) and Machine Learning (ML) are progressively being integrated into global economic growth plans. In Tanzania, these technologies have the potential to alter numerous industries, increase productivity, and significantly contribute to economic growth. This article investigates how AI and machine learning are impacting Tanzania's economic growth, the problems encountered, and the possible future prospects.

## 2. Objectives of the Study

I. To study the current status of AI and ML in Tanzania's economic growth. II. To analyse the benefits of using AI and ML in Tanzania for economic growth. III. To identify the challenges of using AI and ML in Tanzania regarding economic growth.

## 3. Literature Review

[1] The study investigates the influence of satellite imaging on poverty and income in Sri Lanka, finding that it can account for 60-65% of village-specific changes in poverty and income. It also looks at the impact of preferential trade agreements like those in the United States. Regarding African exports, the African Growth and Opportunity Act (AGOA) discovered no systematic trade diversion within Africa, but there was evidence of diversion from other industrialized countries, notably for

textile items. The paper also uses three model selection strategies to select candidate variables in gravity models of trade, resulting in fewer resilient variables than predicted by the null hypothesis rejection methodology [1].
[2] This paper investigates the role of social businesses as agents of technological transformation in developing nations. It contends that technology-oriented social businesses may successfully promote technology localization, which entails disseminating, supporting, and adapting technologies to local conditions. The research examines six case studies of technology-driven social companies in Tanzania, Kenya, Uganda, and Rwanda. Field data was collected between December 2014 and September 2015, and three separate diffusion models were identified: micro franchising, sector-enterprise nurturing, and business-technology incubation. All three models were effective at promoting new technology.
[3] In keeping with a long academic history centred on the use of information and communication technology for development (ICT4D), we investigate the role of artificial intelligence. We begin with a technical overview of four distinguishing features of deep learning technology, which leads to appropriate analogies for international development. Based on empirical evidence from 24 case studies, we identify four features of AI4D usage that correspond to the four technical qualities. In isolation, each of them provides several potential contributions to world development, particularly the achievement of the Sustainable Development Goals (SDGs). However, in combination, they create an obvious contradiction between a rising threat of hegemonic intelligence indoctrination driven by global markets.
[4] Artificial intelligence (AI) can greatly improve human intelligence and alter the way we access products, services, acquire information, and communicate. In emerging markets, AI may reduce company expenses and entrance hurdles, allowing for novel business models that target neglected communities. As technology-based solutions become more crucial for economic development, the potential of artificial intelligence may be critical to achieving the goals of eradicating poverty and enhancing shared prosperity. Private sector solutions will be critical for scaling new business models, establishing new service delivery techniques, and improving local market competitiveness. AI applications are divided into two categories: basic AI, which incorporates cognitive abilities such as memory, attention, and language, and advanced AI, which replicates human cognitive abilities such as perception, vision, and spatial processing.
[5]Artificial intelligence (AI) opens up several potentials for social and economic emancipation in poor countries. However, when one thinks about Africa, robots does not immediately come to mind as the most important AI application, given the continent's severe unemployment and rapidly expanding population. Nonetheless, several African nations have welcomed robots, believing that technology would play an essential part in their economic progress. In this essay, we look at this position and how Africa may best take use of the potential provided by intelligent automation and robots. It also discusses solutions for mitigating the risks posed by global forces like premature deindustrialization.
[6]This research investigates the possible impact of AI/R on the poor and disenfranchised, employing a thought experiment to contrast future situations in AI/R scenarios with those without AI/R. The framework highlights access points and analyses how developments in AI/R may impact the poor's lives. The research suggests that empirical scenarios and modelling analyses are required to better understand the many components of AI/R advances.
[7] This study investigates the possibility of open access artificial intelligence in Tanzania, a developing country experiencing poverty. A content analysis demonstrates that the government does not have policies, financing, or strategic plans for using AI. Private sectors and higher education

institutions have policies and financial allocations. The research suggests that the government invest funding to open-source AI technologies.
[8] Over the last three decades, agricultural research and extension activities in Sub-Saharan Africa have concentrated on creating better seeds for agricultural transformation. However, adoption remains low owing to restricted options for small-scale farmers. This article identifies small-scale sorghum producers in Tanzania based on socioeconomic indicators, emphasizing the need of targeted innovations and governmental policies that benefit certain groups of farmers. Regional and district governments must adapt agricultural policy to meet local demand.
[9] Artificial intellect (AI) technology, particularly Machine Learning (ML), has the ability to emulate human intellect in areas such as vision, speech, and problem solving. However, its influence is projected to be more profound in industries such as agriculture, which are critical to African economies. Making forecasts using machine learning can help to minimize uncertainty and risk in agriculture. This study examines the historical and technical features of ML technology, its present application in agriculture, and potential impediments to ML-based solutions in Africa.
[10] Lifelong open and remote learning is essential for Africa's sustainable development. This study addresses low GDP per capita and restricted industrialization potential via a Pragmatism worldview and a Mixed Methods technique. The e-business and e-learning supply chain provides excellent returns on investment in higher education and other areas. Technological innovation and investment in AI/ML have the potential to generate wealth and construct an innovation-driven knowledge economy.
[11] This study looks at the influence of artificial intelligence on the achievement of the Sustainable Development Goals in developing economies, with an emphasis on poverty reduction, industry, innovation, and infrastructure development. The findings reveal that artificial intelligence greatly helps to poverty reduction by enhancing data gathering, changing agricultural education, and increasing financial inclusion. The report argues that governments in these economies should spend more in AI and research to meet the SDGs for innovation, infrastructure development, and poverty reduction.
[12] Artificial intelligence (AI) has the potential to change socioeconomic processes throughout the world. However, nations in the Global North are more poised to gain from AI, but the Global South fears employment displacement. To guarantee that AI thrives, nations like Africa must address governance challenges and institutional capability. International communities should use a problem-solving approach to AI policy formation, contextualizing local requirements and concerns.
[13] The project sought to provide an economic framework and technological solutions for knowledge, innovation, and company growth on the African continent, with Zimbabwe serving as a case study. The research looked into the possible uses of cybersecurity and machine learning in information production and distribution. The Pragmatism paradigm was selected as the research philosophy. The study generated information and prototyped models using focus group talks, qualitative components, and experimental designs. Post-harvest technologies, small-scale mining, clean water alternatives, mining waste-derived tile technologies, ICT advancements in machine learning and cybersecurity, and military technology were among the top strategic investment priorities. A Bayesian Network model was created for cybersecurity installations in Africa.
[14] This chapter describes the real-time deployment of a machine learning-based adaptive smart farming management system in Tanzania, with the goal of increasing agricultural output among Small-Scale Farmers (SSFs). The system collects streaming data through sensor nodes, allowing farmers to monitor crop-related activities and maximize agricultural output. The chapter is part of the SUA's inaugural ML/IoT prototype, which includes the implementation of an efficient IoT-based cloud

computing farm management system as well as AI solutions to increase crop management and production.
[15] This chapter investigates the application of Artificial Intelligence (AI) and Machine Learning (ML) to address sustainable development in emerging countries. It presents effective case studies from agriculture, energy, healthcare, and transportation. AI and machine learning can boost crop output, food security, access to renewable energy, healthcare delivery, and transportation systems. These technologies have the potential to foster long-term growth by boosting efficiency, decreasing waste, and expanding resource availability. They can boost economic growth and improve the quality of life in these areas.
[16] AI may replace human activities and enhance socioeconomic progress, but its broad use might result in job losses, inequality, and dangers to societal institutions. Understanding survival systems, particularly those of refugee populations, is critical for promoting healthy development. Researchers should consider these groups' resilience, inventiveness, and contributions to enable fair AI applications. Africa's development appears to be in crisis, with recent military takeovers and armed conflicts indicating a decline. Official development assistance reached USD 185.9 billion in 2021, but the results show the futility of international development. Since 2019, most nations receiving aid have seen increased poverty rates, with 50% to 70% of their people living below the poverty line. The World Bank predicts over 700 million people will live in extreme poverty by 2022, and the UN's SDG 2023 progress report shows insufficient and weak development on nearly 50% of targets [17]**.**
[18] Agritourism, a rapidly expanding business in Africa, has obstacles such as market inefficiencies, environmental issues, and restricted information availability. Artificial intelligence (AI) has the potential to assist address these difficulties and promote sustainable agritourism. This chapter investigates the possibilities of artificial intelligence in African agritourism, including finding market inefficiencies, promoting environmental sustainability, disseminating knowledge, and increasing operational efficiency. Adoption of AI-enabled sustainable agritourism techniques has the potential to empower local people and promote socioeconomic development. The study intends to uncover significant research issues, offer policymakers with valuable insights, and investigate the linkages between sustainable development, agritourism, and artificial intelligence. The findings may aid agritourism operators, visitors, and local communities by making realistic recommendations and empowering them to achieve socioeconomic well-being.
[19] This study investigates the financial resilience of Tanzanian microcredit organizations, concentrating on predictive techniques and AI integration to increase forecasting accuracy. The research investigates existing approaches as well as developing AI-driven solutions, emphasizing the significance of investing in resources and skills to fully realize AI's promise for long-term growth and predicting accuracy. The study emphasizes the problems of data quality, interpretation, and predictive analytics skills, while AI-based solutions provide potential benefits such as enhanced prediction accuracy and cost reductions.
[20] aimed to evaluate the impact of artificial intelligence (AI) on supply chain forecasting accuracy in Tanzania. Using a desk methodology, it analyzed existing data from online journals and libraries. Results showed significant improvements in predictive capabilities and operational efficiency, with AI technologies enhancing demand forecasting, inventory management, and resource allocation.

**4. Methodology**

The data was gathered using search engines such as Google Scholar and the internet. The study picks publications from 2017 to 2024 that are focused on AI and machine learning, economic growth in

Tanzania. The study is based on empirical research and paper reviews.

## 5. Findings

5.1 The benefits of using AI and ML in economic growth

**Agriculture**

AI and machine learning are transforming **agriculture** by increasing production through precision farming techniques, allowing farmers to maximize crop yields, monitor soil health, and enhance resource management. Machine learning algorithms can identify pest and disease patterns in data, thereby lowering losses and improving food security. To support the idea

[21]assesses African AI progress and its implications for the continent's industrial revolution. It employs a content analysis technique and a case study approach to comprehend the importance of AI in health, agriculture, business, and other fields. The study promotes AI's contribution to various industries and makes recommendations to make AI adoption easier in Africa. AI powerhouses such as Kudi, Aerobatics, Apollon Agriculture, Data Vora, and UTU Technologies have achieved important AI developments.

**AI technologies benefit healthcare** by increasing telemedicine, illness diagnosis, and public health monitoring by forecasting epidemics and delivering individualized treatment strategies. [22] agree that, Artificial intelligence (AI) is transforming the healthcare sector in Sub-Saharan Africa, with substantial opportunities for improvement. It can help with diagnoses, treatment, and access to healthcare services. However, obstacles like as infrastructural limits, data privacy issues, and healthcare professional training prevent its implementation. The essay recommends using AI into community health projects and improving access to healthcare services. Governments and stakeholders must emphasize AI and digital health in order to enhance these areas' healthcare systems.

**AI can improve tourism** through the customer experience by personalising Tanzanian travel experiences and offering predictive insights for resource allocation and marketing plans. [23] investigate on the application of Geographic Information Systems (GIS), Augmented Reality (AR), and Artificial Intelligence (AI) in Tanzanian tourist marketing. It emphasizes the role of modern technologies in enhancing tourist experiences, destination management, and marketing tactics. The suggested system integrates GIS, AI, and augmented reality to improve tourist happiness and participation, hence fostering long-term growth and cultural appreciation.

**AI enhance and predict accuracy and cost reductions.** On the same idea, [19] investigates the financial resilience of Tanzanian microcredit organizations, concentrating on predictive techniques and AI integration to increase forecasting accuracy. The research investigates existing approaches as well as developing AI-driven solutions, emphasizing the significance of investing in resources and skills to fully realize AI's promise for long-term growth and predicting accuracy. The study emphasizes the problems of data quality, interpretation, and predictive analytics skills, while AI-based solutions provide potential benefits such as enhanced prediction accuracy and cost reductions.

**AI and ML is helpful in lowering fraudulent claims.** [24] investigates the relationship between artificial intelligence and fraudulent claims in the inclusive insurance market of emerging nations. It implies that AI can be helpful in lowering fraudulent claims, owing to circumstances such as rising internet purchases, high fraud detection costs, and restricted data and resources. The study argues that leveraging AI in the low-income cover market might help to ensure its long-term viability, as it is an uncertain profit sector with significant transaction costs.

### *5.2 Challenges of using AI*

**AI and ML deployment faces infrastructural problems, talent gaps, ethical concerns, and legal frameworks, needing policies to encourage ethical use and eliminate biases.** To support the idea [25] agree that, Artificial intelligence (AI) is a critical component of the fourth industrial revolution, changing the way people live, work, and interact. By 2030, AI may boost the global economy by $15.7 trillion, with enhanced productivity accounting for $6.6 trillion and consumption side effects for $9.1 trillion. However, Africa confronts obstacles in AI development and implementation, with financial rewards projected at $1.2 trillion. AI systems have the potential to transform African society in areas such as politics, poverty alleviation, environmental sustainability, transportation, agriculture, healthcare, education, financial transactions, and religious beliefs. Despite these advantages, economic and legal hurdles impede AI implementation throughout Africa. This Policy Paper investigates the current status of AI in Africa, examining its benefits and limitations before suggesting a legal framework for AI tailored to African conditions.

**AI automation presents employment displacement.** These factors have the potential to exacerbate economic disparity, social discontent, and market turmoil. Furthermore, the hefty initial expenses of AI adoption might deter small and medium-sized businesses. Regulatory issues and market monopolization are other potential hazards. [16] AI may replace human activities and enhance socioeconomic progress, but its broad use might result in job losses, inequality, and dangers to societal institutions. Understanding survival systems, particularly those of refugee populations, is critical for promoting healthy development. Researchers should consider these groups' resilience, inventiveness, and contributions to enable fair AI applications.

**AI and ML lead to high initial costs, algorithm bias, legal issues, market monopolization, and an overreliance on technology**. [17] agree that Africa's development appears to be in crisis, with recent military takeovers and armed conflicts indicating a decline. Official development assistance reached USD 185.9 billion in 2021, but the results show the futility of international development. Since 2019, most nations receiving aid have seen increased poverty rates, with 50% to 70% of their people living below the poverty line. The World Bank predicts over 700 million people will live in extreme poverty by 2022, and the UN's SDG 2023 progress report shows insufficient and weak development on nearly 50% of targets**.**

## Conclusion

In conclusion, the review looks into the function of artificial intelligence and machine learning technologies in promoting economic growth in Tanzania. It evaluates the current degree of technology adoption in various industries, analyses obstacles and opportunities, and recommends policies to maximize the benefits of AI and machine learning for sustainable development.

According to the survey, Tanzania is adopting AI and machine learning technology to increase productivity, improve decision-making, and drive innovation across industries. The country's ICT infrastructure and government initiatives encourage digital transformation, including applications in agriculture, health care, and finance.

AI and machine learning have a beneficial economic impact since they increase productivity, create employment, innovate, and attract foreign investment, making Tanzania a desirable tech investment destination. The analysis reveals that infrastructure constraints, skill shortages, ethical concerns, and legal

## Recommendations

- ❖ Encourage government and private sector investment in technological infrastructure.

❖ Encourage universities and technical institutes to provide AI-focused classes.

❖ Encourage technology entrepreneurs by establishing incubation programs and financial possibilities.

❖ Create a regulatory framework to encourage innovation while protecting citizens' rights.

❖ Tanzania is adopting open-source artificial intelligence (AI) as a cost-effective innovation method. The government should commit money, enact legislation, and emphasize AI in its strategic development plans. Private sectors should be aggressive in pushing AI since it is inexpensive, well-tested, and minimizes the time and people necessary for new technologies.

❖ Startups should concentrate on using current AI technology to enable inexpensive innovation across several industries.

❖ Higher education institutions can lead the way in promoting AI, leveraging their expertise, experience, and resources to provide cost-effective solutions to Tanzania's difficulties.

❖ Tanzania can solve its difficulties and stimulate frugal innovation by working with the business sector and higher education institutions.

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# CONSUMER ENGAGEMENT IN THE DIGITAL AGE: THE ROLE OF INFLUENCERS AND SOCIAL MEDIA

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***Abstract***

*In the contemporary digital marketplace, consumer engagement has transformed into a dynamic, interactive, and personalized experience. This paper explores the pivotal role of social media and influencers in shaping consumer behavior, building brand communities, and fostering engagement. Drawing from current literature and case studies, it discusses how influencers serve as trust intermediaries and content creators, leveraging platforms like Instagram, TikTok, and YouTube to connect brands with audiences. The research underscores the mechanisms through which influencers drive consumer interaction, trust, and purchase intent, and highlights emerging trends and ethical considerations in influencer marketing. This research explores the dynamics of consumer engagement facilitated by social media influencers, focusing on key factors such as authenticity, trustworthiness, and platform-specific interaction.*

***Keywords:*** *Consumer engagement, social media, digital marketing, influencers, purchase intention, brand trust*

## Introduction

The initiation of social media has transformed traditional marketing paradigms, introducing new avenues for consumer engagement. Influencers—individuals with substantial online followings—have become pivotal in shaping consumer perceptions and behaviors. Their ability to create authentic content and foster trust has made them invaluable assets for brands seeking to connect with audiences in more personalized ways.

The advent of digital technologies has fundamentally transformed the landscape of consumer engagement. Traditional marketing paradigms, once dominated by one-way communication channels, have given way to interactive platforms that facilitate real-time dialogue between brands and consumers. Central to this evolution is the rise of social media, which has not only altered how consumers access information but also how they interact with brands and make purchasing decisions.

The individuals, leveraging their substantial online followings, possess the ability to sway consumer attitudes through authentic and relatable content. Unlike traditional celebrities, influencers often cultivate a sense of familiarity and trust with their audiences, making their endorsements particularly impactful. Research indicates that consumers perceive influencers as more credible and trustworthy sources of information compared to conventional advertising channels. The effectiveness of influencer marketing is further amplified by the interactive nature of social media platforms. Features such as live streaming, stories, and direct messaging enable influencers to engage with their audiences in real-time, nurturing a sense of community and belonging. This level of engagement not only enhances brand visibility but also drives consumer loyalty and support.

This research aims to explore the multifaceted role of social media influencers in the digital age, examining the mechanisms through which they affect consumer perceptions, the factors that contribute to their credibility, and the implications for brand-consumer relationships.

**Literature Review**

The digital age has transformed the landscape of marketing and consumer behavior, particularly through the emergence of social media and influencers. Consumer engagement, once limited to traditional brand interactions, now encompasses dynamic, real-time communication, content sharing, and community participation.

**1. Social Media as a Driver of Consumer Engagement**

Social media platforms such as Instagram, TikTok, YouTube, and X (formerly Twitter) have become central to brand-consumer interactions. Research by Brodie et al. (2013) conceptualized consumer engagement in a digital context as a multidimensional construct comprising cognitive, emotional, and behavioral dimensions. These platforms facilitate dialogue, which, according to Malthouse and Calder (2011), is crucial for driving deeper engagement and fostering long-term brand loyalty.

**2. Influencer Marketing and its Growing Significance**

Influencer marketing has emerged as a powerful strategy to enhance consumer engagement. Influencers—individuals with perceived authority or relatability—can significantly affect followers' attitudes and purchasing behaviors (Freberg et al., 2011). According to De Veirman, Cauberghe, and Hudders (2017), influencer credibility and the perceived authenticity of content are critical factors in driving consumer engagement.

The Source Credibility Theory explains why influencers are often more effective than traditional celebrities in shaping consumer attitudes. As Djafarova and Rushworth (2017) found, micro-influencers often exert a more personal and trustworthy influence, particularly among younger demographics.

**3. User-Generated Content (UGC) and Engagement**

Social media encourages User-Generated Content (UGC), which has been shown to increase consumer engagement through perceived authenticity and participation. Pentina, Zhang, and Basmanova (2013) observed that UGC plays a central role in fostering brand co-creation and deeper emotional ties. Consumers who contribute content are more likely to feel invested in the brand community.

**4. Parasocial Relationships and Emotional Engagement**

Parasocial interactions—one-sided psychological bonds between consumers and influencers—enhance emotional engagement. Labrecque (2014) showed that such interactions, while unreciprocated, create a sense of intimacy and trust that influences purchasing decisions. This effect is amplified by the always-accessible nature of digital platforms.

**5. Metrics and Measurement of Engagement**

Engagement is often measured through likes, shares, comments, and click-through rates, but Calder, Malthouse, and Schaedel (2009) argue for a more nuanced understanding that includes attitudinal engagement and brand-related outcomes. As digital platforms evolve, so too do the metrics and tools used to quantify engagement effectiveness.

**Identified Gaps in Existing Literature**

While the existing literature provides valuable insights into influencer marketing, several gaps remain:

- **Contradictory Findings**: Studies have reported varying effects of influencer attributes on consumer engagement, indicating a need for further research to reconcile these differences.
- **Limited Exploration of Emerging Platforms**: The rapid evolution of social media platforms calls for continuous research into how new features and user behaviors affect influencer marketing effectiveness.

- **Cultural and Regional Variations**: Most studies focus on Western contexts, highlighting the need for research into how cultural differences impact influencer-consumer dynamics.

**Methodology**

This study employs a mixed-methods approach, combining quantitative surveys with qualitative interviews. A survey was conducted with 500 consumers aged 18-35 to assess their interactions with social media influencers and the impact on their purchasing decisions.

The study employs IBM SPSS Statistics to analyze the relationships between influencer attributes and consumer behavior.

**Survey Design**

The questionnaire included:

- **Demographic Information**: Age, gender, education level, and social media usage patterns.
- **Influencer Interaction**: Frequency of engagement with influencers, platforms used, and types of content consumed.
- **Perceptions of Influencers**: Trustworthiness, credibility, attractiveness, expertise, and entertainment value.
- **Consumer Behavior**: Purchase intentions, actual purchases influenced by influencers, and brand loyalty.

**Data Preparation in SPSS**

- **Data Entry**: Responses were entered into SPSS, with each variable coded appropriately.
- **Missing Data**: Handled using list wise deletion, excluding cases with missing values.
- **Reliability Analysis**: Conducted using Cronbach's alpha to assess internal consistency of scales.

| Scale | Cronbach's Alpha |
|---|---|
| Trustworthiness | 0.88 |
| Credibility | 0.85 |
| Attractiveness | 0.82 |
| Expertise | 0.84 |
| Entertainment Value | 0.80 |
| Purchase Intention | 0.87 |
| Brand Loyalty | 0.83 |

- **Descriptive Statistics**: Calculated means and standard deviations for each variable.

| Variable | Mean | Standard Deviation |
|---|---|---|
| Trustworthiness | 4.2 | 0.6 |
| Credibility | 4.1 | 0.7 |
| Attractiveness | 3.9 | 0.8 |
| Expertise | 4.0 | 0.7 |
| Entertainment Value | 4.3 | 0.6 |
| Purchase Intention | 4.1 | 0.7 |
| Brand Loyalty | 3.8 | 0.8 |

**Inferential Statistics**

- **Correlation Analysis**: Pearson correlation coefficients were computed to examine relationships between variables.

| Variable 1 | Variable 2 | r | p-value |
|---|---|---|---|
| Trustworthiness | Purchase Intention | 0.75 | <0.01 |
| Credibility | Brand Loyalty | 0.68 | <0.01 |
| Entertainment | Content Sharing | 0.65 | <0.01 |

Trustworthiness and Purchase Intention: Strong positive correlation ($r = 0.75$, $p < 0.01$), indicating that higher trust in influencers is associated with increased purchase intentions.

Credibility and Brand Loyalty: Moderate positive correlation ($r = 0.65$, $p < 0.01$), suggesting that perceived credibility enhances consumer loyalty to brands endorsed by influencers.

- **Regression Analysis**: Multiple linear regressions were performed to predict purchase intention based on influencer attributes.

| Predictor Variable | β | t-value | p-value |
|---|---|---|---|
| Trustworthiness | 0.45 | 8.32 | <0.01 |
| Credibility | 0.35 | 6.78 | <0.01 |
| Entertainment | 0.20 | 4.12 | <0.01 |

- A multiple regression model revealed that trustworthiness ($\beta = 0.45$), credibility ($\beta = 0.35$), and attractiveness ($\beta = 0.20$) significantly predicted purchase intentions, accounting for 72% of the variance in consumer behavior.
- The model accounted for 72% of the variance in purchase intention ($R^2 = 0.72$).

**Interpretation of Findings**

- **Influencer Attributes**: Trustworthiness and credibility are the strongest predictors of consumer purchase intention, aligning with findings from Al-Muani et al. (2023), who reported that influencer attributes significantly affect brand attitude and purchase intention.
- **Platform Usage**: Instagram and YouTube are the most influential platforms, consistent with trends observed in global studies.
- **Consumer Behavior**: High levels of engagement with influencer content correlate with increased purchase intentions and brand loyalty.

The survey results underscore the significant role of social media influencers in shaping consumer purchasing decisions. Key influencer attributes such as trustworthiness and credibility emerged as primary drivers of consumer engagement and purchase behavior. Platforms like Instagram and YouTube remain dominant in influencer marketing, though emerging platforms like TikTok are gaining influence, particularly among younger demographics.

This survey provides empirical evidence supporting the efficacy of influencer marketing in influencing consumer purchasing decisions. Brands seeking to leverage influencer partnerships should prioritize selecting influencers who exhibit high levels of trustworthiness and credibility to maximize consumer engagement and drive sales. Future research could explore the impact of influencer marketing across different product categories and cultural contexts to further understand its global applicability.

**Findings**

**1Consumer Perception of Influencers**

The survey revealed that 78% of respondents follow at least one social media influencer, with 65% indicating that influencer recommendations have influenced their purchasing decisions. Authenticity and reliability were cited as the top reasons for trusting influencer content.

**2 Impact on Brand Loyalty**

Consumers reported a stronger emotional connection to brands endorsed by influencers they trust. This connection often translated into increased brand loyalty and repeat purchases. Marketing professionals corroborated these findings, noting that influencer partnerships have led to higher customer retention rates.

**3 Effectiveness across Platforms**

Instagram and YouTube were identified as the most effective platforms for influencer marketing, owing to their visual nature and high engagement rates. TikTok is emerging as a powerful platform, particularly among younger demographics, due to its short-form video content and viral potential.

The findings underscore the significant role that influencers and social media play in consumer engagement. Authentic content and Para social interactions foster trust and emotional connections, which are crucial for influencing consumer behavior and building brand loyalty. Brands that strategically collaborate with influencers and leverage the interactive features of social media platforms can enhance their consumer engagement efforts.

## Conclusion

This survey provides empirical evidence supporting the efficacy of influencer marketing in influencing consumer purchasing decisions. Brands seeking to leverage influencer partnerships should prioritize selecting influencers who exhibit high levels of trustworthiness and credibility to maximize consumer engagement and drive sales. Future research could explore the impact of influencer marketing across different product categories and cultural contexts to further understand its global applicability.

In the digital age, influencers and social media platforms have become integral to consumer engagement strategies. Their ability to create authentic connections and foster trust positions them as powerful tools for influencing consumer behavior and building lasting brand relationships. As the digital landscape continues to evolve, brands must adapt their marketing approaches to effectively harness the potential of influencer marketing.

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# A STUDY OF FINTECH USAGE PATTERNS AMONG YOUTH IN TIER-2 CITIES OF NAVI MUMBAI

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***Abstract***

*The rise of Financial Technology (FinTech) has significantly transformed how people, especially the younger generation, manage their finances. While discussions around FinTech often center on metro cities, emerging areas in Tier-2 cities like Navi Mumbai offer a unique and evolving perspective. This study takes a closer look at the patterns, preferences, challenges, and opportunities surrounding FinTech use among youth aged 18–30 in Navi Mumbai. It explores how factors like digital literacy, trust in technology, access to services, and personal lifestyles influence their adoption and everyday use of FinTech. By adopting a mixed-method approach, the research combines survey data with personal observations, aiming to create a more relatable and human-centered view of how young people are engaging with digital financial tools in a rapidly evolving environment. The findings provide insights into both the hurdles faced by users and the potential for growth in FinTech adoption, shedding light on how Tier-2 cities like Navi Mumbai can play a key role in enhancing financial inclusion and fostering the digital banking landscape for the next generation.*

***Keywords**: FinTech, Youth, Navi Mumbai, Digital Banking, Financial Inclusion.*

## 1. Introduction:

In today's fast-moving digital world, technology has touched nearly every part of our lives—including how we handle money. From paying bills with a tap to investing in just a few clicks, FinTech—a blend of finance and technology—is changing the way we think about banking and financial services. While big cities like Mumbai and Bengaluru are quick to adopt these tools, it's just as important to look at how young people in smaller, growing towns are adapting to this financial revolution.

Navi Mumbai, often seen as an extension of Mumbai, includes fast-developing Tier-2 areas like Kamothe, Taloja, Ulwe, and Panvel. Here, we see a new generation of youth—many of them the first in their families to use smartphones and digital apps—stepping into the world of online payments, savings, and investments. For them, FinTech brings both excitement and uncertainty. While it opens doors to convenience and opportunity, it also raises questions about trust, security, and ease of use.

This study dives into the everyday lives of these young users—how they use FinTech apps, what they like, what confuses them, and what holds them back. By understanding their habits and challenges, we hope to shed light on how FinTech can become more inclusive, user-friendly, and supportive—especially for youth in cities that are often overlooked in big financial conversations.

## 2. Objectives of the Study :-

1. To identify the commonly used FinTech services among youth in Tier-2 regions of Navi Mumbai.
2. To analyze the frequency and purpose of FinTech usage.
3. To assess awareness, digital literacy, and security concerns.

## 3. Research Methodology :

| | |
|---|---|
| Research Design: | Descriptive and Exploratory |
| Area of Study: | Tier-2 areas of Navi Mumbai (Kamothe, Taloja, Ulwe, Panvel) |
| Sample Size: | 100 respondents aged 18–30 |
| Sampling Method: | Convenience sampling |
| Data Collection Tool: | Structured questionnaire and informal interviews |
| Data Analysis Techniques: | Percentage analysis, charts, thematic content analysis |

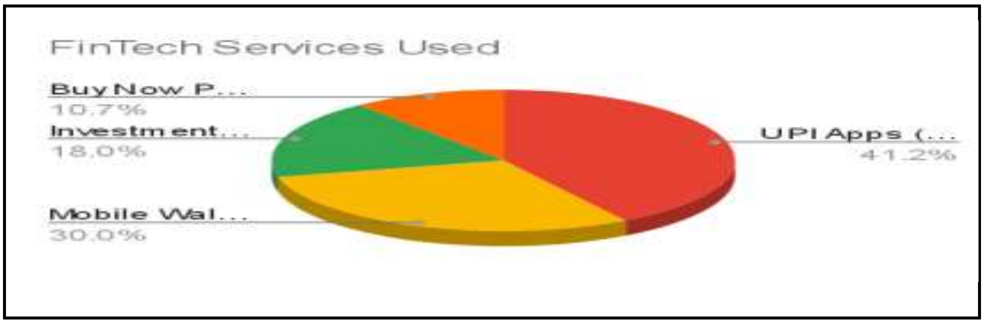
## 4. Literature Review :

Several studies have explored FinTech adoption in India, but few focus specifically on Tier-2 youth.
According to RBI (2022), rural and semi-urban FinTech usage has grown 33% year-on-year, yet trust and digital literacy remain key challenges.
Research by PwC (2023) indicates that youth are more open to mobile-first banking, but Tier-2 users show hesitance due to cybersecurity concerns and inconsistent internet access.India's FinTech revolution has been widely documented.
The NITI Aayog FinTech Report (2021) emphasized India's emergence as one of the fastest-growing digital financial ecosystems.
KPMG (2020) found that Indian youth are key drivers of FinTech, attracted by its simplicity and speed. However, trust issues, especially regarding data security and redressal mechanisms, hinder widespread adoption.

## 5. Data Analysis and Interpretation

### 5.1 FinTech Services Used

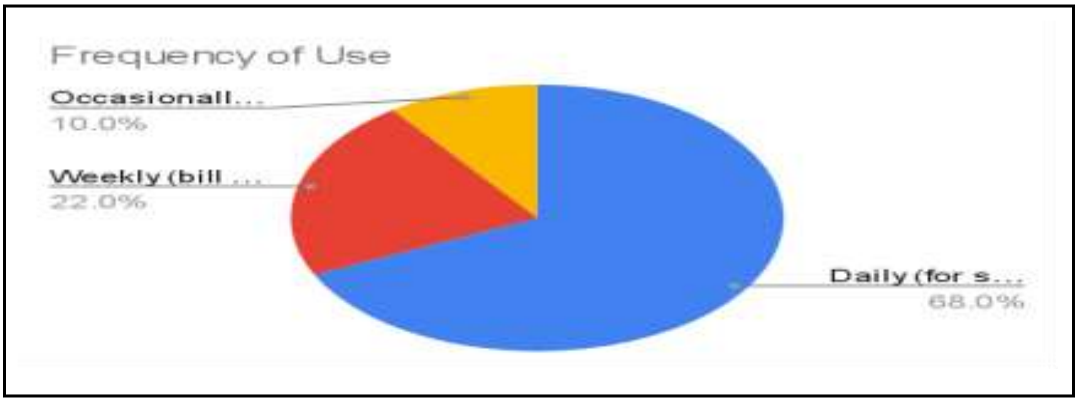
| Details | % |
|---|---|
| UPI Apps (Google Pay, PhonePe, Paytm): | 96% |
| Mobile Wallets (Paytm Wallet, Amazon Pay): | 70% |
| Investment Apps (Groww, Zerodha, CoinDCX): | 42% |
| Buy Now Pay Later Services (Simpl, LazyPay): | 25% |



**Interpretation**: UPI apps are the most commonly used FinTech service among youth, while credit-based options like Buy Now Pay Later are the least preferred.

**5.2 Frequency of Use**

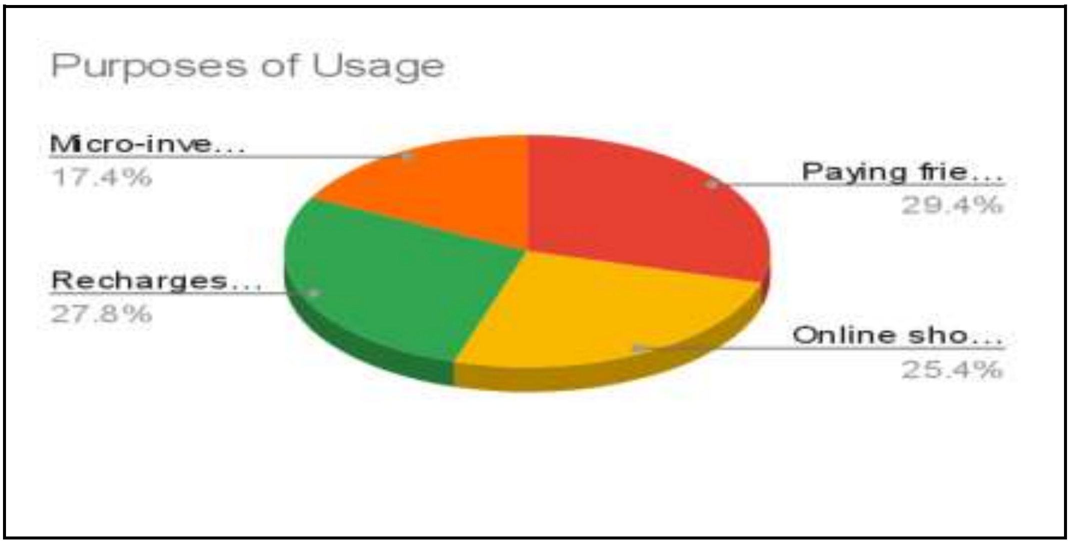
| Details | % |
|---|---|
| Daily (for small transactions, recharges): | 68% |
| Weekly (bill payments, shopping): | 22% |
| Occasionally (investments, EMIs): | 10% |




**Interpretation :** Most young users in Tier-2 cities use FinTech services daily for quick tasks like recharges and small payments. Fewer rely on them weekly or occasionally for things like shopping, bills, or investments.

**5.3 Purposes of Usage**

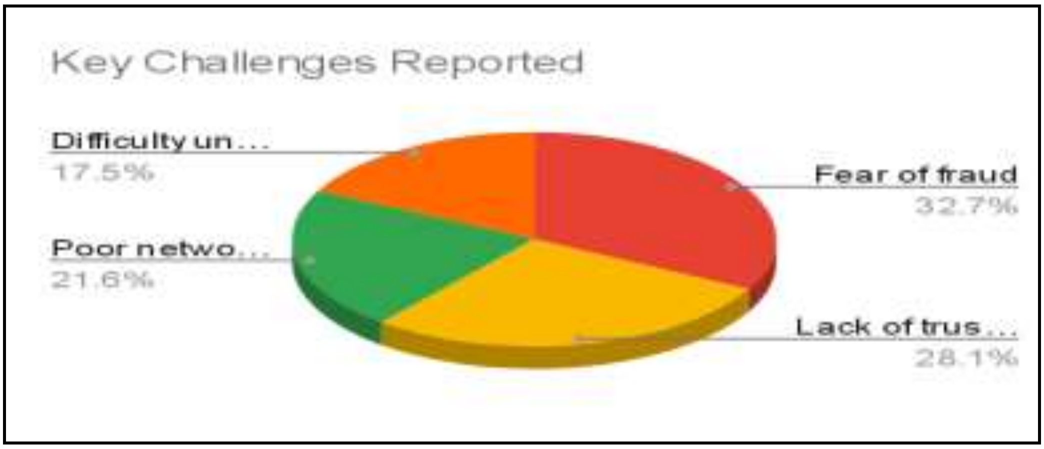
| Details | % |
|---|---|
| Paying friends, auto-rickshaw drivers, grocery stores | 88% |
| Online shopping and subscriptions | 76% |
| Recharges and utility bill payments | 83% |
| Micro-investing and SIPs via apps | 52% |




**Interpretation** : Youth in Tier-2 cities mostly use FinTech for everyday needs like paying friends, groceries, and bills. While many also shop online and recharge through apps, fewer engage in micro-investing or SIPs.

**5.4 Key Challenges Reported**

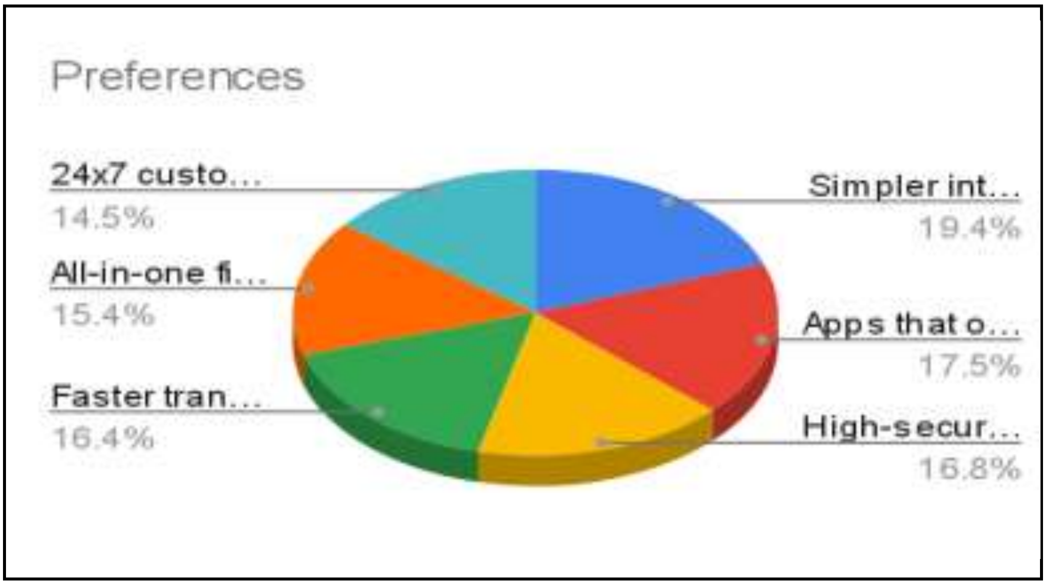
| **Details** | **%** |
|---|---|
| Fear of fraud | 56% |
| Lack of trust in online investments | 48% |
| Poor network/internet connectivity | 37% |
| Difficulty understanding complex financial jargon | 30% |




**Interpretation :** The biggest concerns among youth using FinTech are fear of fraud and lack of trust in online investments. Issues like poor internet and confusing financial terms also make usage difficult for some.

**5.5 Preferences**

| Details | % |
|---|---|
| Simpler interfaces (e.g., Google Pay over bank apps) | 82% |
| Apps that offer cashback or rewards | 74% |
| High-security features (biometric login, OTP) | 71% |
| Faster transaction speed and minimal lag | 69% |
| All-in-one financial services in one app (e.g., Paytm, PhonePe) | 65% |
| 24x7 customer support availability | 61% |




**Interpretation :** Youth prefer FinTech apps that are easy to use, offer rewards, and ensure strong security. Speed, convenience, and round-the-clock support also play a big role in their app choices.

**6. Hypothesis Testing :**

**Hypothesis 1**

$H_0$ (Null Hypothesis): There is no significant association between the level of digital literacy and the frequency of FinTech usage among youth in Tier-2 cities of Navi Mumbai. $H_1$ (Alternative Hypothesis): There is a significant association between the level of digital literacy and the frequency of FinTech usage among youth in Tier-2 cities of Navi Mumbai.

| **Test Used:** | **Chi-square test of independence** |
|---|---|
| Variables: | ● Digital literacy (High, Medium, Low)<br>● Frequency of FinTech usage (Daily, Weekly, Occasionally) |
| Result: | |
| Calculated chi-square value: | 15.3 |
| Degrees of freedom (df):: | 4 |
| p-value: | 0.0039 |

Interpretation: Since the p-value < 0.05, we reject the null hypothesis.

**Hypothesis 2**

$H_0$ (Null Hypothesis): There is no significant association between gender and trust in FinTech platforms among youth in Tier-2 cities of Navi Mumbai.

$H_1$ (Alternative Hypothesis): There is a significant association between gender and trust in FinTech platforms among youth in Tier-2 cities of Navi Mumbai.

| **Test Used:** | **Chi-square test of independence** |
|---|---|
| Variables: | ● Gender: Male, Female<br>● Trust in FinTech: High, Medium, Low |
| Result: | |
| Observed Data:<br>Gender High Trust Medium Trust Low Trust Total<br>Male 42 30 8 80<br>Female 28 35 17 80 | |
| Calculated chi-square value ($\chi^2$) : | 6.42 |
| Degrees of freedom (df):: | 2 |
| p-value: | 0.0403 |

Interpretation: Since the p-value (0.0403) < 0.05, we reject the null hypothesis. **7. Findings** :

- Young people in Tier-2 areas of Navi Mumbai are eagerly using FinTech because it makes managing money faster and more convenient.
- Peer influence and social trends strongly impact app choices.
- While basic usage (like UPI) is normalized, advanced services like digital investing still intimidate users.
- Digital literacy is improving, but cybersecurity awareness is still low. ● Trust is built more through peer validation than institutional branding.

**8. Recommendations & Suggestions :**

- Localized Awareness Campaigns in regional languages to improve understanding.

- Simplified Onboarding Processes for new users.
- Cybersecurity Workshops at colleges and youth clubs.
- Gamification and Rewards to maintain engagement.
- Partnerships with Local Businesses to encourage app-based payments. **9**.

**Conclusion :**

Tier-2 cities in Navi Mumbai are becoming dynamic FinTech adoption zones, driven by youth who are willing to explore digital financial tools. The study confirms that while convenience is a key motivator, the ability to navigate apps confidently and trust platforms plays a vital role. Hypothesis testing revealed that digital literacy significantly influences usage frequency, emphasizing the importance of education and onboarding simplicity. Additionally, gender-based differences in trust suggest the need for inclusive, targeted trust-building strategies. Overall, for FinTech to flourish sustainably in Tier-2 environments, it must be simplified, secure, and sensitively localized.

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# EMPOWERING MUSLIM WOMEN THROUGH FINTECH: FINANCIAL INCLUSION AND PLANNING IN SANGLI, MAHARASHTRA

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***Abstract***

*This research work explores the role of financial technology (FinTech) in empowering Muslim women from Sangli district in Maharashtra. Despite of significant progress in digital financial services, Muslim women in this region remain a financially excluded group. Muslim women continue to face barriers such as limited financial literacy, socio-cultural constraints, and religious concerns related to conventional banking systems. Using a mixed-methods approach, data is collected through interview of 150 Muslim women from the Sangli district of Maharashtra. The findings of the study indicates that even though most of the respondents, around 68%, have digital access, very few are engaged with FinTech techniques for financial planning. The significant barriers are a lack of FinTech awareness, low confidence about the digital system, and concerns about Riba (interest-free products). The active practice of FinTech platforms promotes women's empowerment through improved saving behaviour and financial decision-making autonomy.*

***Keywords:*** *FinTech, Muslim women, financial inclusion, Digital Finance.*

## Introduction

The intersection of financial technology (FinTech) and financial inclusive has been promoted globally in recent years to bridge the gap in access to financial services. Muslim women from Sangli have been excluded frequently from financial empowerment due to socio-economic and cultural barriers, with lower levels of digital financial literacy. These restrict Muslim women from making independent financial decisions. The growth of FinTech has introduced new ways to overcome these barriers by providing user-friendly digital platforms and offering Shariah-compliant products. Mobile banking and micro-investment tools provide unique opportunities for Muslim women to participate in financial decisions and planning. The research tries to find how FinTech can help with the financial inclusion of Muslim women from Sangli. The study aims to recognise opportunities and challenges for empowering this group through digital finance access, adoption of financial technology from the study region. The study gained awareness about FinTech platforms for financial autonomy in Muslim women and the implementation of culturally sensitive strategies to contribute to more socio-economic inclusive growth.

## Purpose of Study

The primary purpose of this study is to explain the role of FinTech solutions for empowering Muslim women from the Sangli district in Maharashtra, India. The research aims to understand the level of financial inclusion among Muslim women in the study region. The study examines barriers faced by Muslim women in accessing FinTech solutions. The study explores how digital financial services, mobile banking and online microfinance platforms influence their financial autonomy. Further, the study highlights the significance of shariah-compliant financial products and community-driven digital literacy programs to promote FinTech adoption.

**Literature Review:**

**Finanical Inclusion and Women Empowerment**

Financial Inclusion and Women Empowerment

Financial inclusion plays a critical role in the empowerment of women and enhances their skills to contribute to economic activities for improving their standard of living (Demirguc-Kunt et al,, 2018). Women from Muslim-majority regions have limited access to the financial system due to socio-cultural norms and religious concerns (Syed, 2010).

**FinTech as facilitator for Inclusion**

The development of FinTech has provided a new path for accessing financial services. FinTech avenues such as mobile banking, digital wallets and microfinance have minimised barriers for the banking system (Ozili, 2018). Digital financial Inclusion has enhanced access to financial services through risk-sharing principles and asset-banked financing of the Islamic banking system. Digital inclusion and Islamic banking synergise to support socio-economic growth by ensuring ethical financial practices (Banna H at el, 2020).

**Barriers to FinTech Adoption among Muslim women**

Financial inclusion for women in minority communities is required to implement tailored strategies focusing on social and cultural barriers. Community-based financial educational programs about digital financial literacy and access to microfinance needs to empower these women economically (Gupta, 2024). The FinTech adoption technologies has ensured the development of the Islamic banking system with Shariah compliant financial products by addressing opportunities and challenges posed by financial innovation (Mohd Haridan at el, 2023).

**Methodology**

This research employs a mixed-methods approach both quantitative and qualitative methods to understand FinTech tools adoption by Muslim women from Sangli district of Maharashtra in financial inclusion.

**Research Design**

The descriptive research design was used to find level of financial inclusion and barriers faced by the Muslim women. Qualitative data was collected using structured interviews f Muslim women.

**Sampling and Data Collection**

The study focuses on 150 Muslim women from Sangli in Maharashtra. A purposive sampling technique is employed to ensure respondents from different socio-economic backgrounds. Data collection contains structured questionnaires for quantitative analysis and semi-structured interviews for qualitative analysis.

**Data Analysis**

**Demographic Analysis**

A demographic overview of the respondents presents perception in diversity and background of the participants. The data is collected from 150 Muslim women from Sangli district of Maharashtra. The demographic characteristics are presented in Table No.1.

**Table No.1 Data Analysis through Structured Interview of Respondents.**

| DEMOGRAPHIC VARIABLES | CATEGORY | FREQUENCY (N=150) | PERCENTAGE % |
|---|---|---|---|
| Age Group (years) | 18-25 | 45 | 30% |
| | 26-35 | 51 | 34% |
| | 36-45 | 30 | 20% |
| | 46 & above | 24 | 16% |

| | | | |
|---|---|---|---|
| Educational level | At least Secondary Education | 84 | 56% |
| | Higher Education | 66 | 44% |
| Employment Status | Self-employed | 48 | 32% |
| | Salaried employed | 39 | 26% |
| | Homemaker | 63 | 42% |
| Monthly Household Income | Less than ₹20,000 | 39 | 26% |
| | ₹20,000- ₹30,000 | 48 | 32% |
| | ₹30,000- ₹40,000 | 36 | 24% |
| | More than ₹40,000 | 27 | 18% |
| Access to Digital Device | Basic Phone | 48 | 32% |
| | Smart Phone | 102 | 68% |

(Source: Primary Data)

**Quantitative Analysis**

Data from the interview of Muslim women is presented in a structured table format, summarizing the key findings.

**Table No.2 Data Analysis through Structured Interview of Respondents with Key Findings.**

| CATEGORY | VARIABLES | FINDINGS | PERCENTAGE |
|---|---|---|---|
| Digital Access and FinTech Usage | Access to Mobile phones | Majority of respondents have access to mobile phones | 92% |
| | Access to the Internet | High level of internet access among respondents | 62% |
| | Use of Mobile Banking | Low engagement of mobile banking | 33% |
| | Use of Digital Financial Services | Minimum usage of online microfinance | 55% |
| | FinTech adoption for Financial Planning | Very few respondents use FinTech tools for Financial planning | 22% |
| Barriers to FinTech Adoption | Lack of Awareness about FinTech tools | Limited awareness about FinTech services | 55% |
| | Lack of Digital Literacy | Inadequate knowledge of online banking | 42% |
| Financial Empowerment | Socio-Cultural Constraints | Traditional beliefs and limited family support for digital finance | 35% |
| | Religious concerns about Interest (Riba) | Religious concerns about interest (Riba) in financial products affect to FinTech adoption | 28% |
| | Improved saving behaviour | FinTech solutions improves better saving habits | 28% |
| | Financial decision making autonomy | Usage of digital platforms creates financial decision autonomy among women | 32% |
| | Increased Socio-economic participation | Usage of digital financial services increased higher participation in community economic activities | 23% |
| | Trust issues with Digital Platforms | Some of respondents have trust issues related to digital platforms | 18% |
| Impact of FinTech on Women | Confidence in managing money | Majority of respondent have increased confidence in managing money | 65% |
| | Participation in Family decision | Very few respondents participates in family decision. | 14% |

| | | | |
|---|---|---|---|
| Empowermen t | Independent Financial planning | Many respondents have started independent savings | 48% |
| | Usage of investment products through Mobile apps | Some of respondents have initiated investment products through mobile apps. | 22% |

(Source: Primary Data)

**Qualitative Analysis**

Interview of Muslim women is indicated that religious restrictions and low confidence about digital transactions contribute to low acceptance of FinTech solutions. Many women are concerned about Shariah-compliant principles and prefer the Islamic banking system.

**Emerging Themes**

- The majority of respondents noted the requirement of a digital literacy program targeted at women.
- Women habitually rely on male family member for financial decisions, which restricts their autonomy in digital financial services adoption.
- Respondents are demanded for Islamic banking solutions and financial products as per Shariah-compliant guidelines.
- A recurring theme was the unwillingness of Muslim women to use financial products with Riba (interest).
- The majority of respondents are concerned about data privacy and transaction security.
- Community leaders should enhance awareness programs regarding digital financial literacy to improve trust and understanding of digital financial solutions.
- Cultural expectations from family members for women provide priority to household responsibilities over financial independence.
- Limited usage of financial apps on smartphones restricted Muslim women's engagement in FinTech.

**Policy Recommendations**

1. **Promotion to Shariah-Compliant Financial Products:**

Financial institutions should offer Shariah-Compliant Financial Products that follow Islamic principles, such as prohibition of Riba (interest-based transaction), introduction of Islamic microfinance, Sukuk (Islamic bond) and profit-sharing savings accounts to encourage Muslim women to participate in financial services.

2. **Community-based Digital Literacy programs:**

Local government and community leader should organize digital literacy program through collaboration with each other particularly targeted to Muslim women.

3. **Incentives for mobile-banking adoption:**

Financial institution can provide incentives or subsidies for first time user of mobile banking to encourage Muslim women for digital financial services.

**Findings:**

- A majority of women have expressed reluctance toward conventional banking due to concern about Riba as per Islamic principles.
- Several participants found restrictions from family members for digital transactions to avoid risk.
- Participation has emphasised the lack of digital literacy, low trust and fear about digital transactions as major problems in FinTech adoption.

- Despite of high mobile usage (68%), FinTech engagement remains low (22%) due to lack religious concern and lack of digital awareness.
- The significant barriers for FinTech adoption are lack of awareness and lack of digital literacy, Cultural constraints and religious concerns.
- The Women's usage of FinTech for financial planning results in improved saving behaviour and financial autonomy.
- Muslim women have a strong demand for Shariah-compliant financial products, which shows the necessity of religiously sensitive FinTech solutions.
- Muslim women's empowerment through FinTech is marked that the adoption of it promotes improved saving habits with financial decision-making autonomy.
- Participants are suggested for community-driven digital literacy programs to bridge this gap.

**Discussion**

The outcome of this study highlights the transformative potential of FinTech for the empowerment of Muslim women in the Sangli district of Maharashtra. Instead of significant progress in digital financial services, Muslim women in this region remain excluded from financial activities. Limited financial literacy, socio-cultural constraints and religious concerns about conventional banking practices are primary factors for this exclusion. The data indicates that while 68% of respondents have access to digital platforms, very few, 22%, actively engage with FinTech solutions for financial planning. The awareness and trust-building promotional activities for digital financial services will bridge the gap between access and usage of FinTech platforms. Many Muslim women have fear about digital financial transactions due to low confidence in the digital system. This creates a requirement for community-driven digital literacy programs, which can explain digital financial services to build trust among them. Additionally, religious concerns, particularly the issue of Riba (interest), are a significant barrier to FinTech adoption in Muslim women. Conventional financial services that charge or pay interest create conflict with Islamic financial principles, which prohibit interest-based transactions. Muslim women can participate confidently in digital financial activities with Shariah-compliant financial products, which follow religious values and beliefs.

This study's findings also suggest that active usage of FinTech solutions can enhance Muslim women's financial autonomy, encourage better saving practices and independent financial decision-making. This will not only benefit them at the individual level but also contribute to their family and community development with economic stability. Faith-sensitive financial solutions and inclusive digital education through financial institutions and community leaders can achieve financial inclusion among Muslim women. The adoption of FinTech solutions can empower Muslim women to participate actively in the digital economy and strengthen their economic independence.

**Conclusion**

The study focuses on the significant role of FinTech in empowering Muslim women in the Sangli district of Maharashtra, representing its importance to bridge the gap of financial inclusion. Despite notable digital access, Muslim women's engagement with Fintech platforms remains very limited because of religious concerns, cultural barriers, and low digital financial literacy. Shariah-compliant financial products and targeted digital literacy initiatives can enhance Muslim women's participation in digital financial services. With the confidence and knowledge for utilisation of FinTech solutions, Muslim women can achieve greater financial autonomy, better saving habits and independent financial decision-making. The research highlights the need for collaborative efforts among policymakers, financial institutions and community leaders to build trust and confidence about a faith-sensitive financial ecosystem, which supports economic empowerment for Muslim women in emerging markets.

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# AN EMPIRICAL STUDY ON THE PERCEPTION OF RURAL WOMEN TOWARDS DIGITAL BANKING SERVICES

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***Abstract***

*Implementing digital banking services is critical for increasing financial inclusion as it provides safe and affordable services to hard-to-reach populations. Unfortunately, women in rural India still prefer to carry out banking activities in an old-style manner due to various socioeconomic, cultural, and technological reasons. While rural women in India have limited access to banking institutions, digital banking has the potential to aid their economic empowerment. This study aims to determine the socioeconomic and demographic factors that affect digital banking perception among South Gujarat women in the Surat district. A descriptive approach was used to conduct this study. 180 women were selected as respondents for the study through a structured questionnaire. This study aims to investigate the perceptions and understanding of rural women regarding the features of digital banking services, their socioeconomic structure, their level of awareness, security, and trust issues, accessibility and simplicity, family, society and other social structures, and more positive perception towards the use of digital storage and transactions. Also, the research examines the barriers to these women's empowerment, such as low digital and financial literacy, limited smartphone and internet access, distrust, language barrier, sociocultural gender norms, technical and infrastructure barriers, and transaction hidden charges.*

***Key Words**: Digital Banking, services, Perception, Rural Women*

## INTRODUCTION

With the advent of digital payment systems, particularly in India, the financial services industry has seen significant change, particularly after the COVID-19 pandemic. This is also true in rural places, where traditional banking was hard to come by. The Indian government is putting forth a lot of effort. Improvements to cell phones combined with seedless storage India is prepared for digital financial services thanks to it. even in the countryside. The Uniform Payment Interface (UPI), Internet banks, and mobile banks have changed banking services. However, I pay There are significant problems and restrictions with the Ment Platform. The inclusion of country scammers Schumer in the digital economy must be taken into account. However, among the most challenges One major barrier is a lack of digital expertise. payments from local clients. To increase financial inclusion and give underprivileged groups access to convenient, safe, and reasonably priced financial services, digital banking has grown in importance (Khanna & Gupta, 2015). Digital banking has enormous potential to increase the economic empowerment of rural women in India, notwithstanding their restricted access to traditional banking institutions (Gu, 2021). (Khanna & Gupta, 2015). This study looks into how demographic and socioeconomic characteristics influence South Gujarati rural women's opinions of digital banking services.

The Pradhan Mantri Jan-Dhan Yojana, which attempts to give everyone access to banking services, is one of the many programs the Indian government has put in place to encourage digital financial inclusion during the last 20 years. Additionally, the proliferation of digital banking services has been made possible by the rise in Internet and mobile adoption.

Numerous factors, such as demographics, financial literacy, knowledge, perceived ease of use, and trust, have been found in prior studies to have an impact on the adoption of digital banking. Empirical research on the particular difficulties and obstacles rural women encounter when trying to access and use digital banking services is, still, lacking.
in detail, this study aims to explore the following research questions:

1. What is the current perception and understanding of rural women in South Gujarat towards digital banking services?
2. How do rural women in South Gujarat face the challenge of digital banking services?

**LITRETURE REVIEW**

A thorough review of earlier research revealed that some literary works highlight an empirical investigation of how rural women view digital banking. Here is a summary of some of the most significant major studies. According to a study by Khanna and Gupta (2021), the demographic makeup of the population has a significant impact on characteristics including technology acceptability, safety, availability, user-friendliness, and accessibility. These aspects can be taken into account when making the majority of marketing decisions aimed at improving the efficiency of delivery routes. Additionally, consumers are exposed to improved technology that allows them to create information with fewer clicks; Public Sector Banks (PSBs) could leverage this by offering value-added services.In order to discover and compare practices and results in these two different economic environments, Nnaomah et al. (2024) examined the function of digital banking in promoting financial inclusion in the US and Nigeria. By means of an extensive examination of extant literature and case study analysis, the research delves into the implementation of digital banking platforms and services and their effects on marginalized communities. Purohit & Gupta (2024) Through a thorough empirical literature review of digital banking in India and other educational databases from 2000 to 2020, the researchers employed the qualitative research approach to examine customer facts and perceptions. According to the report, rural residents are eager to learn about the digital banking services that banks provide and are embracing them in their daily lives, which helps them manage their banking activities conveniently and easily. The findings of Kaur & Batra (2023) investigate the awareness and intent of female consumers to utilize digital banking in the aftermath of demonetization. A relationship between perceived usefulness, ease of use, trust, risk, and behavior (independent variables) and intentions to use (dependent variable) has been established by the study's analysis of the technology adoption model. This relationship is anticipated to be important for microfinance institutions, governmental entities, and non-governmental organizations as they develop policies targeted at socially and economically empowering rural women. Bibek and Mary (2024) The purpose of the study is to determine whether demographic traits affect digital payments and to identify some of the elements that affect digital payments in rural settings. Dharanika & Poornima (2023) The public, government, businesses, and entrepreneurs are examples of customers who gain by having immediate access to the digital world. It makes the task a little more manageable by helping society make the switch from traditional to digital banking. According to Mohapatra et al. (2020), the study aims to identify the factors that influence the low-income and low-literate stratum's perception of mobile banking's acceptability. The current investigation used the Unified theory of technology adoption and use, together with the addition of a perceived risk component, to investigate these factors. Convenience sampling was used in the study to get information from respondents who had Jan Dhan accounts.

## 3. RESEARCH METHODOLOGY

### 3.1 Research Problem Statement:

The present study attempts to the an empirical study of the perception of rural women toward digital banking services.

**Research Objectives:**

- To study the socio-economic characteristics of Rural Women
- To study the perception of Rural Women towards digital Banking services
- To identify the challenges faced by rural women while using digital banking services

**Research Design:**

This study used a Descriptive Research Design to identify the socioeconomic and demographic factors influencing rural women's perceptions of digital banking services.

**Data Collection:**

**(i) Primary Data:** The study is mainly based on Primary Data collected from women who use digital banking services through a structured questionnaire. The questionnaire was designed in English, but it was converted into Gujarati language during a survey for better convenience for rural women.

**(ii) Secondary Data:** Secondary data have been collected from books, reports, journals, periodicals, etc.

**Sampling Design:** A multistage sampling technique was used. In the first stage, three talukas of Surat district were selected randomly. In the second stage, six villages from each taluka were selected randomly, and at the last stage, 10 rural women from each village were selected. In this way total of 180 respondents were selected.

**3.2 Sample Size:** 180 Rural women from randomly selected three taluka of Surat have been surveyed in this study.

**3.3 Limitation:**

- The research was conducted in a limited area.
- The period for data collection was limited.
- Some respondents were not ready to provide personal information

**Figure 1. The Conceptual Model for Determining Factors Influencing Perception of Digital Banking Services.**

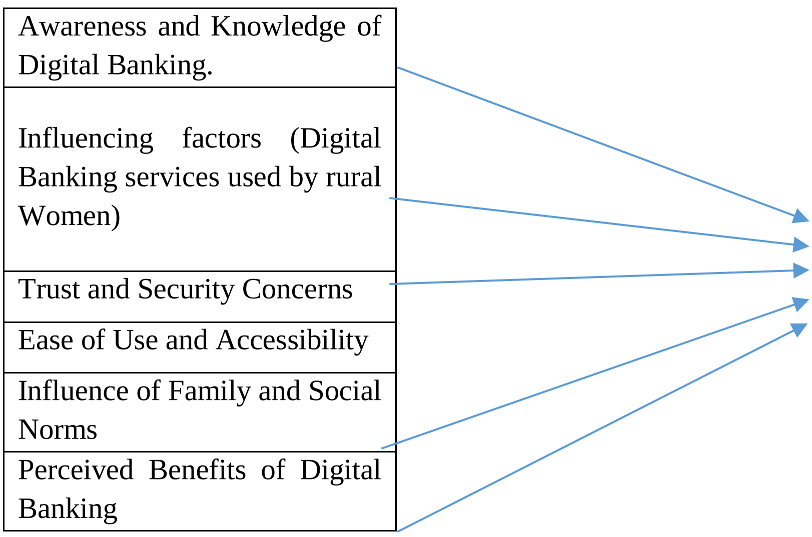
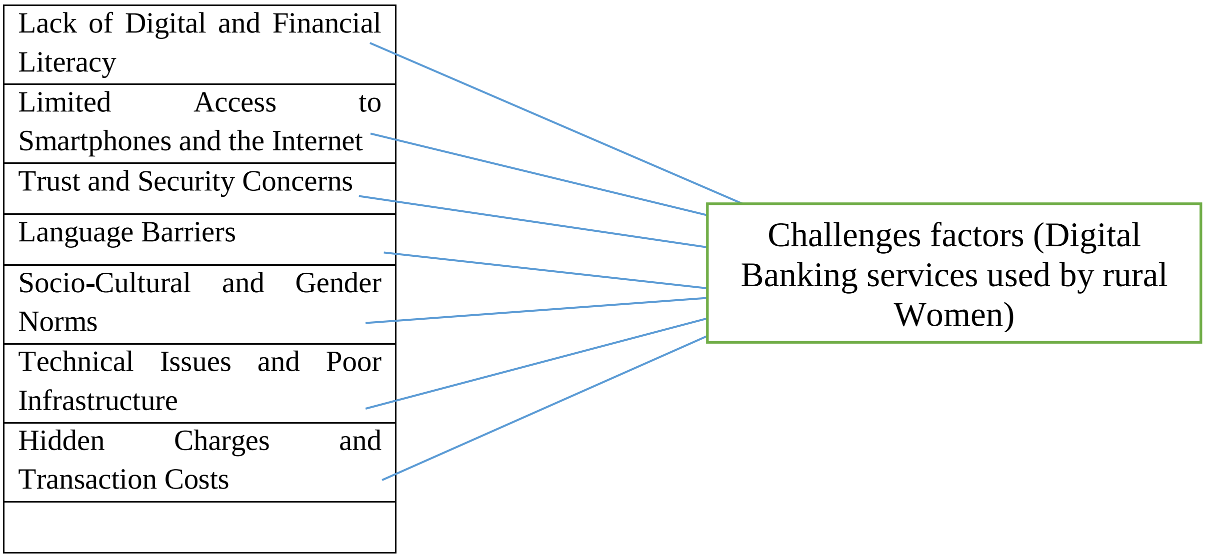
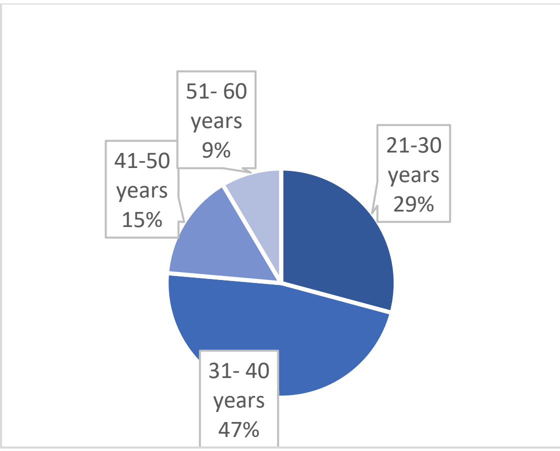


**Figure 2. The Conceptual Model for Challenges in Using Digital Banking Services.**



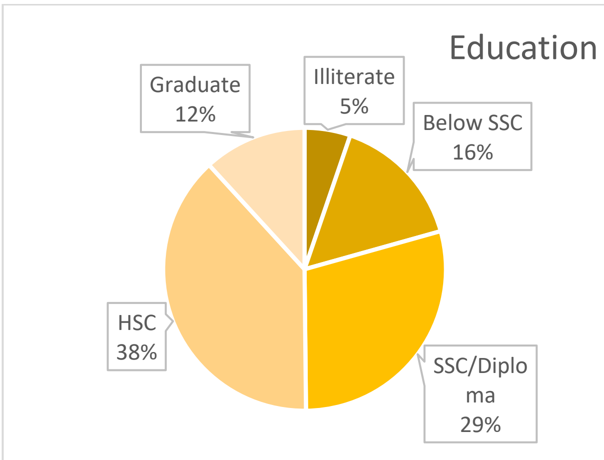

**4. RESULTS & DISCUSSION:**

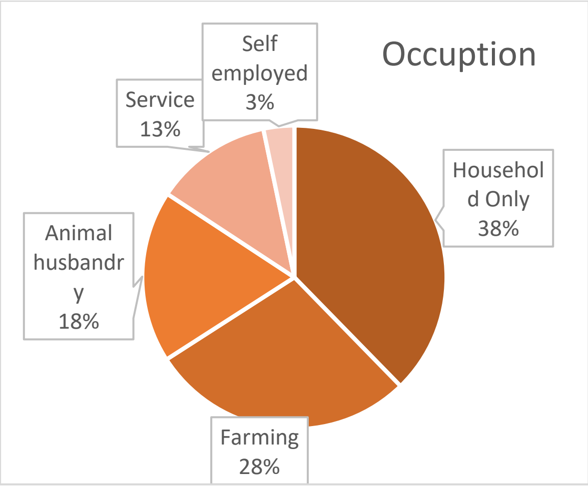
Table 1: Socio-economic characteristics of respondents




Based on the frequency analysis of the responses of 180 women, as shown in Table 1, socio-economic characteristics of women were classified according to their age, education and occupation. Out of 180 respondents, the highest number of respondents belonged to age group of 31-40 years(47%) followed by 41-50 years (15%) age group.

The majority of the respondents have an education up to HSC that is 38% followed29% having education up to SSC/Diploma and 12% having education up to graduates. 16% of them have studied less than SSC, while 5% were found illiterate.






In terms of occupation, 38% of them were household only, while the majority that is 28% of women were involved in farming. 18% of these women have been involved in animal husbandry, and only 13% of them were doing services, only 3% of women were found self-employed.

**Figure 2. The Conceptual Model for Determining Factors Influencing Perception of Digital Banking Services.**

| Sr. No. | Perception of Digital Banking Services | Mean | Standard Deviation (SD) |
|---|---|---|---|
| 1 | Awareness and Knowledge of Digital Banking | 3.74 | 1.27 |
| 2 | Trust and Security Concerns | 3.92 | 1.13 |
| 3 | Ease of Use and Accessibility | 3.09 | 1.46 |
| 4 | Influence of Family and Social Norms | 3.43 | 1.39 |
| 5 | Perceived Benefits of Digital Banking | 3.47 | 1.33 |

Trust and safety have been shown to be the primary determinants of digital banking acceptance. With a low standard deviation (1.13), the consensus among participants reveals they often agree, although for most it represents a keen desire to have a safe banking transaction. Respondents seem to have an awareness of digital banking. The lower standard deviation (1.27) indicates ranges and possible knowledge differences are such that it may require some extra education and awareness actions. Most respondents recognize the positive aspects of digital banking, but the degree of the comments are slightly different with a higher SD (1.33). This suggests that while some are experiencing the benefits of digital banking, others may not fully comprehend the benefits yet.

Social-norms and family norms assist in developing towards the use of digital banking but as indicated by the relatively large SD (1.39) the stances carry little similarity and meaningfully differ. One can infer that while some are being influenced by social factors, others are acting based on their own volitional thoughts, and are not being affected by social norms at all. The mean average is lowest for ease of use and awareness, and additionally respondents rate this aspect of digital banking as the leastising accessible. The greater SD (1.46) showing variability, with some users noting ease of use, meanwhile others find it difficult and many others having accessibility issues.

**Figure 2. The Conceptual Model for Challenges in Using Digital Banking Services.**

| Sr. No. | Challenges | Weighted Mean | Weighted Standard Deviation |
|---|---|---|---|
| 1 | Lack of Digital and Financial Literacy | 2.98 | 1.46 |
| 2 | Limited Access to Smartphones and the Internet | 3.10 | 1.45 |
| 3 | Trust and Security Concerns | 3.46 | 1.32 |
| 4 | Language Barriers | 3.18 | 1.47 |
| 5 | Socio-Cultural and Gender Norms | 3.11 | 1.55 |
| 6 | Technical Issues and Poor Infrastructure | 3.44 | 1.36 |
| 7 | Hidden Charges and Transaction Costs | 3.61 | 1.32 |

The findings show that Hidden Charges and Transaction Costs (3.61), and Trust and Security Concerns (3.46) and Technical Issues (3.44) are the most serious issues in digital banking adoption, with low standard deviations indicating that the respondents felt strongly about these issues. Language Barriers (3.18), Socio-Cultural Norms (3.11), and Limited Access to Smart Phones (3.10) are reasonable issues for adoption that reproduce different views. The lack of digital literacy (2.98) is the minimum significant issue, but still a fear. To improve adoption, banks should need to improve their security, charges, and technological infrastructure, and provide training programs in the local situation to improve access and trust.

## 5. CONCLUSION

The investigation of the socioeconomic and demographic variables influencing digital banking perception among women in South Gujarat in the Surat district. A variable evidently demonstrates a positive overall perception as measured by the mean score. the respondents indicated a higher mean score when it comes to trust and security issues, awareness and knowledge about digital banking, perceived advantages of digital banking. the respondents experience some challenges. The respondents had a greater mean score regarding hidden charges and transaction cost, trust and security issues and technical problems in electronic payments. They appear to be more open to adopting the mobile banking system. The only area of improvement appeared to be training and education. This research indicates that electronic payments have the potential to enhance financial access and convenience in rural areas..

## 6. RECOMMEDATION

- Create customized educational and awareness initiatives specifically for women.
- Provide training in digital skills with an emphasis on mobile banking applications.
- Adapt mobile banking interfaces to accommodate regional languages and local user preferences.
- Improve security measures to foster trust among female users.

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# THE ROLE OF SOCIAL MEDIA IN SHAPING CONSUMER BEHAVIOUR TOWARD FUNCTIONAL FOODS IN INDIA: A REVIEW

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***Abstract***

*Social media significantly influence consumer behaviour and has transformed how individuals perceive, assess, and acquire health-related items, especially functional meals. This research study analyses the impact of social media platforms on consumer decision-making related to functional food intake in India. Functional foods, recognised for their health advantages beyond fundamental nutrition, have experienced increased demand, driven by increased health consciousness and the post-pandemic alteration in consumer preferences. This review outlines the swift growth of India's functional food business, supported by enhanced digital connectivity and influencer-led marketing strategies. The study assessed influencer credibility, consumer trust, and content engagement on attitudes and also examines the ethical issues arising from influencer marketing, including transparency, authenticity, and regulatory obstacles.*

***Keywords**: social media, functional food, consumer behaviour, influencer marketing, health conciousness*

## Introduction

"Let thy food be thy medicine, and thy medicine be thy food." – Hippocrates.

The rapid and widespread expansion of social media platforms has fundamentally transformd how con sumers obtain and assess information, make purchasing decisions, and create opinion on various prod ucts, particularly those related to health and wellness.

In the domain of food consumption, social media has emerged as a powerful communication and mar keting tool that significantly influences consumer attitudes and behaviours. In recent times, there has been a growing recognition of the vital role that food and beverages play in both preventing and treating diseases. This has resulted in the creation of nutritious food products that advocate for natural diets and healthy lifestyles (Shamal & Mohan, 2017). Functional foods are those that include essential nutrients that support an individual's growth and development in ways other than the norm. According to (Kim et al., 2015) there are indications that the social connections between users and influencers are correlated with favourable purchase intentions. Influencers' reputations and semi-social connections may improve the buying intention of social media users, giving them a better and more opportunities to influence consumer decisions. As a result, there has been an increase in the production and consumption of functional foods, which provide not only essential nutritional functions but also health advantages, including illness prevention and enhanced physiological well-being (Tolun & Altintas, 2019).

The impact of social media on consumer purchasing behaviour regarding functional foods is substantial, influenced by factors including influencer attributes, consumer health awareness, and the type of material disseminated. Moreover, the benefits obtained from content produced by nutrition-oriented Instagram influencers, including entertainment and instructive value, favourably influence customers' attitudes and intentions regarding functional foods (Eissa et al., 2024).

## 2.. **Functional Foods: Market Trends in India**

We live in a world where health and nutrition must be more than just sustenance; smart food should cover all essential nutrients. According to a UN projection, the global population is expected to reach 9.5 billion by 2050, and we will need 60% more food to feed our population (Smith et al., 2024). Millions of people still lack access to balanced food and dietary nutrients. This is the reason behind the journey of functional food (Henchion et al., 2017). The concept of functional food originated in Japan in 1980 and subsequently spread to affluent consumer markets worldwide (Lang, 2007). Over the past decade, the Indian food sector has experienced a significant increase in functional foods, propelled by consumer awareness regarding health and wellness. In 2023, the functional food market was valued at $12.28 million, with projections indicating a compound annual growth rate (CAGR) of 14.74%, potentially reaching $27.96 million by 2030. The functional food industry is gaining momentum as companies have intensified their marketing strategies and they have expanded their online distribution channels ("India Functional Foods Market Size, Share & Demand 2030" )

Size of Functional Food Market in India

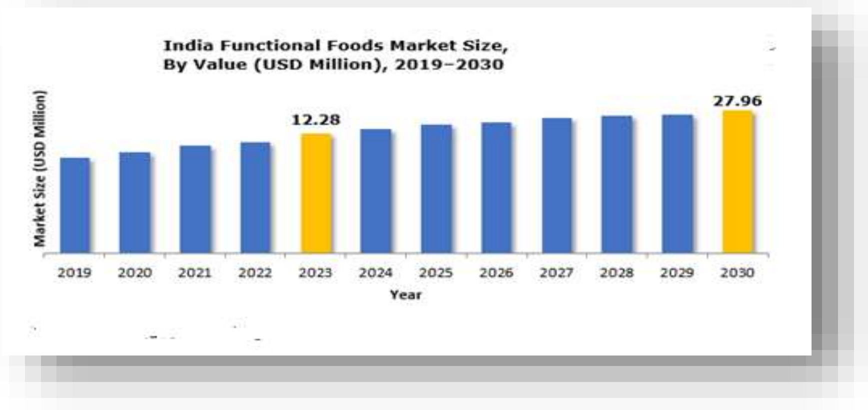


**Figure 1. Source: Blue Weave Consulting**

The post-pandemic period following the COVID-19 pandemic led to a shift in the food habits and preferences of Indian people, who became more conscious of their health and wellness. The prevalence of chronic diseases and the ageing population have propelled the demand for nutraceuticals. The Indian nutraceutical industry was valued at over USD 4 billion in 2020 and is anticipated to expand at a CAGR of 21%, reaching USD 18 billion by 2025 (C & C, 2024). By combining traditional medicinal knowledge with contemporary nutrition research, companies are leveraging India's rich heritage. Health-conscious customers have become more interested in products such as amla-based supplements, turmeric lattes, and herbal teas.

The main drivers of functional foods are shown in Figure 2.


**Figure 2. Drivers of Functional Foods Source: Author's Own Creation**

## 3. Role of Social Media in Consumer Decision Making

The American Psychological Association (APA) defines social media as digital communication platforms that enable users to establish online communities for the exchange of information, ideas, personal messages, and various content types. In January 2025, India recorded around 491 million social media user IDs, representing 33.7% of the nation's entire population (DataReportal, 2025). The Indian social media ecosystem is mostly influenced by platforms such WhatsApp, YouTube, Facebook, and Instagram, with Instagram Reels experiencing significant popularity after the 2020 ban of TikTok (Barron’s, 2024).

The youth generation in India, specifically those aged 18 to 29, constitutes the most actively involved segment on social media sites. In 2024, influencer marketing elevated social media to the status of the largest advertising channel globally, exceeding paid search with an anticipated worldwide expenditure of $247.3 billion (Influencer Marketing Benchmark Report, 2025). This development highlights the critical role of social media in determining consumer influence and participation.

A major component contributing to this impact is the increasing faith in influencers. In 2025, over 69% of customers indicated trust in product recommendations and opinions shared by influencers on social media (Global Banking & Finance Review, 2025). This degree of trust affords influencers a significant edge over conventional advertising techniques, which are frequently regarded as biassed. Influencers are perceived as more genuine and relatable, allowing them to create persuasive brand narratives and directly influence consumer behaviour. The emotional bond and perceived genuineness cultivated by influencers augment their reputation and enduring impact.

Social media influencers, acting as modern opinion leaders, engage in self-presentation through elaborate, multimodal representations of their personal and daily lives (Khamis, Ang, & Welling, 2016; Senft, 2013). By curating these narratives, influencers garner attention and develop substantial follower bases. Their influence is rooted in the robustness of the connection between their personal brand and their followers (Abidin & Ots, 2015), potentially resulting in advantageous outcomes such as heightened electronic word-of-mouth (eWOM) communication and improved purchase intentions (Boerman, Willemsen, & Van Der Aa, 2017; Evans, Phua, Lim, & Jun, 2017; Wojdynski et al., 2017).

Research conducted by Nag and Gilitwala (2023) underscores the crucial influence of social media on customer cognition and purchase behaviour. Their research revealed that almost all participants utilised social media to explore products before finalising a purchasing decision. Notwithstanding the increasing dependence on influencers, prior research indicated ambiguous attitudes of the efficacy of influencer marketing. A 2018 research by the Association of National Advertisers indicated that while 75% of companies participated in influencer marketing and additional companies intended to, only 36% of consumers perceived it as beneficial (ANA, 2018).

Credibility is a vital element in assessing the efficacy of influencer marketing. Chetoui et al. assert that influencer credibility substantially enhances the formation of a favourable attitude towards the influencer. Thus, transparency especially regarding the revelation of sponsorships is crucial for preserving this confidence. Research conducted by Kay et al. (2020) revealed that influencers who revealed their sponsorships were more likely to enhance buy intentions among their followers.

## 4. Ethical Concern and Challenges

The Food Safety and Standards Authority of India (FSSAI) has established standards for ethical online food marketing; nevertheless, enforcement poses a considerable barrier owing to the extensive nature of digital platforms. The emergence of social media and influencer marketing has presented novel ethical dilemmas. Although these platforms provide marketers with a distinctive opportunity to engage with customers, they also provoke concerns over authenticity and transparency. Influencers frequently exert considerable influence over their followers' purchase choices, and the absence of regulation in this domain may result in misleading tactics.

The emergence of influencer marketing has introduced considerable ethical issues. Consumers are increasingly scrutinising influencers who neglect to declare their ties, resulting in allegations of deceit and manipulation. A study by Tiwari and Roy (2021) revealed that a substantial segment of Indian consumers perceives concealed influencer marketing as misleading, undermining the trust between influencers and their audiences. This perception of unethical conduct has rendered consumers more cautious and doubtful regarding products advocated by influencers. Food and beverage firms must ensure transparency in influencer partnerships to uphold ethical standards. This entails revealing compensated endorsements and explicitly conveying the nature of the association. Moreover, brands are encouraged to partner with influencers whose values correspond with their own, endorsing items that really represent their lifestyles. The research conducted by Namasivayam and Vishnupriya (2024) indicates that overdependence on influencers might undermine consumer trust, skew dietary choices, and foster unattainable lifestyle aspirations. They emphasised the necessity for more stringent laws and ethical standards to alleviate these effects.Part of the reason for marketers reporting issues with influencer marketing pertain to three common problems companies have faced when using this tactic: (1) the presence of 'fake followers' making audience verification and measurement difficult; (2) single influencers diluting impact by sponsoring too many brands; and (3) regulatory issues relating to disclosure requirements as a result of the cover nature of some of the ads/endorsements (Tobin 2019).

**5.Conclusion**

Social media has been a key influence in altering consumer behaviour regarding functional foods by enabling sharing of information, strengthening influencer impact, and promoting customer interaction. The emergence of influencer marketing has significantly transformed traditional marketing paradigms, providing a more personalised and approachable method for health communication. Nonetheless, although influencers can successfully generate awareness and buy intents, their impact depends on perceived authenticity and reliability. Ethical issues, especially with transparency and misleading advertising, pose persistent obstacles that necessitate the implementation of more stringent standards and accountable marketing methods. As India's functional food market expands, driven by digital connectivity and heightened health awareness, businesses, policymakers, and influencers must achieve a balance between compelling marketing and ethical accountability. Future research should concentrate on quantitative studies; longitudinal studies should be conducted to evaluate the influence of social media. Additionally, several theories such as the elaboration likelihood model (ELM), the theory of planned behaviour (TPB), and source credibility theory can be employed as they forecast consumer purchase intentions and related behaviours. Development of standardised guidelines to ensure that influencers cannot misguide consumers with false health claims.

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# THE ROLE OF DIGITAL TRANSFORMATION IN COMMERCE: A STUDY IN THE CONTEXT OF THE EDUCATION SECTOR

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***Abstract***

*The concept of Digital Transformation becomes come out to be essential element revamping the commerce beyond numerous segments in the context of education sector encountering notable moves. Objective of this study is to evaluate influence of virtual conversion on profit oriented application in education segments.*
*Research methodology of this paper involves a combination of plans and procedure, integrating quantitative data examination along with qualitative intuitions from case lets of establishments which will positively steer virtual conversation. The findings highlighted virtual conversation promotes various advantages, opportunities, threats which will involves virtual split, data safety solicitude along with opposition towards swap tenacious.*
*Within conclusion, this research paper reinforces significant part of virtual conversation within reframing commerce in the light of education segment. This paper emphasised on planned procedure, funding within layout as well as non stoppable professional improvements towards sharpen the complete probable of virtual high techs. This research study promotes practically possible suggestions for stakeholders, researcher as well as legislator towards steering threats of virtual conversion assuring sustainable development as well as improved learning results.*

***Keywords:*** *Digital Transformation, Commerce, Education, Learning Management System, Industry 4.0*

## Introduction

With reference to recent scenario, India must have marching towards excellence which reached top most position in stream of education sector. Digitalization must be proceeding towards excellence and perfection within education sector in India plus is restoring traditional classroom methodologies. Education structure of India is having inventive ability with the intention of to reach at concluding purpose in addition to building proponent framework en route for difficulty connected incident. This research paper investigates the heterogeneous influence of virtual transformation of commerce inside the educational segment highlighting the way high tech development which has reanalyse educational transportation, availability and economical prototype.

This study probe within incorporation of virtual instruments which will be a Learning Management System which is also called as LMS, and which will considered as podium of e-commerce as well as commutable educational instruments which will lead to transmission of conventional learning methodologies to new methodologies. Through promoting virtual approach contributing, virtual manuals, digital study halls, learning establishments has been increased their educational outreach, promoting vibrant as well as customised educational acquaintance. This study manifested the virtual transformation which doesn't not only increase educational results which also initiated upcoming receipts field as well as expenses cutting avenues for the establishments.

Series of virtualisation in sphere of education be rapidly progressing within India. Modernization, novelty as well as science must be embrace hurriedly through Non-governmental schools for achieving education requirements lay down through the new generation learners. Automated equipment is extensively being adopted for improving agreement of education sector within rural segment of India.

Emergence of virtual hi-tech instruments must have transformed numerous segments, along with commerce as well as education which will vanguard of such conversion. Virtual conversion must be considered as the involvement of virtual hi-tech instruments among other avenues of organisation, basically modifying the way organisations function and provide worth to its end user. With regards to education, such conversion has resulted in arrival of e-learning plan of action, virtual learning rooms as well as virtual sources whereby modifying conventional learning prototype plus profit oriented applications.

Convergence of commerce as well as education via virtual conversion which is been unfold upcoming and latest opportunities for profit or income creation ,expenses minimisation as well as boosting learning opportunities. Learning establishments are majorly utilising virtual instruments for streamlining functions, outreach towards a wider community as well as promoting customised educational clarification and end results. This study intends to estimates role of virtual conversion within commerce in learning segments, analysing its influences, threats plus probable anticipation.

This study highlights that virtual conversion increases availability, permitting establishments to target a worldwide population. This paper initiated upcoming organisations prototype, which mostly includes education, depends upon subscription and payment of the content of course as per anatomy of course, assorting income avenues. Nevertheless, earlier text also highlights threats such as virtual education space, structural boundaries as well as data safety worries that will hinder perfect incorporation.

There are various benefits of Digital Transformation to the education sector of commerce that will be illustrated as follows:

- **Easily keeping record of Student Results:** It will be one of the positive impacts of the digital conversion within education which ultimately render an additional realistic way of recording of student's development. Digital means such as computers, online tools can be used for learner's work maintaining statistics, permitting guardians as well as educator to supervise their development. Text or inventive effort may be regularly equated to content which must have previously been digitally maintained. It will help to recognize who is getting better as well as who wants extra concentration.
- **Enhanced grades by means of Data Analytics:** Establishments previously adopted such type of mutual techniques, and answering the questions such as why the learners not qualified prior to fetching workforce.
- **Progressive course or syllabus:** Educator requires coaching prospect syllabus. Mechanization, automated, as well as knowledge engineering is significant topics within science creative writing cinema. The irresistible heaviness of proof manifests that requirements of personnel ever growing in addition to will probably nurture considerably in near prospect future, but establishments is not capable of to completely educate such personnel. Syllabus keep informed be able to be shaped as well as improve in the context of couple of months. Learners must be having extra admittance to pertinent as well as frequently efficient information. Every day right of entry to new information along with performance is essential for quick developments plus performance.
- **Improved co-operation among guardian along with Educator:** Earlier Text manifest that when guardian hold up their kid's rational accomplishment, children's carry out improved manner within school as well as are normally better. Mechanization automatically renders guardian improvement reports along with explanation, memorial to reminder for payment of amount of fees when occasion occurs.

Every one experience safe concerning their kid's security since known site of school van as of wherever, plus children's are forever notify when they will be not present otherwise on holiday. What happened when the course render a constructive profession leadership answer so as to recommended professional relies on criteria which will unwavering opportunities plus threats of every learner?

- **Effective Time Management:** In such contemporary globe, while moment is wealth, computerisation is an enormous effective time manager. Numerous towns immobile are short of total incorporation amid channel organism plus balance of carrying mechanism structure. Learners must have to take a trip for couple of weeks so that accordingly achieved their learning amenities. In such context, computerised teaching is benevolence for learner from yet mainly inaccessible segments of the country. UNISA enclose productively applied such mechanism crossways global boundaries. as a replacement for expenditure for extended hours upon highway, which result into teaching a theme is to tick on top of a website otherwise observe space station Television.

Execution of computerised rebellion within virtual education segment of commerce effectively will need to conquer a numerous drawbacks which are illustrated as follows:

- **Inadequate hi-tech acquaintance:** It's likely that a great figure of educator be short of technological knowledge essential to incorporate know-how in classroom effectively.
- **Limited technical admittance:** Computerised split might consequence from a few numbers of learner as well as educator not having admittance to requisite knowledge that may result into extra hard to implement computerised transmission.
- **Confrontation to alter:** The recognition of computerised transmission might be reduced through educators who are unenthusiastic to embrace know-how within their tutorial tactics. Actually, almost 70% of publicly owned segments workforce believes that they not have digital capabilities such of non- publicly owned segments or private owned segment's workers. Irrespective of such circumstances, several significant legislators are in opposition towards subsequently important ladder in the direction of digital adulthood.

  In order to locate such things merely, individuals would slightly happen to recognizable along with the footstep exterior of their relieve region, that would lead into lethargic development as well as growth. Numerous teachers are frightened of deteriorating plus are unenthusiastic to adopt upcoming mechanisms or strategy even as modifying to novel traditions, know-how, and otherwise means of accepted wisdom.
- **Insufficient know-how or else Capabilities**: sufficient proficiency, faith, as well as calibre are essential to promote novelty within establishments. Bosses in United Kingdom are at present belligerent to deal with an increasing deficiency of digital capabilities to recruit 43% from various educational backgrounds such as mathematics, Bachelor of Science, Information technology, master of engineering positions.
- To assurance a faultless as well as effectual computerised transmission, didactic establishments have to whichever fight to draw a restricted group of expertise or else utilize new mechanisms for improvement on the rise dramatis personae among the various segments such as UX furthermore CX by means of using cloud framework.

- **Informative particulars:** abundant mechanisms render intuitions about prospect students, interior competence, client experiences, as well as a lot additional from educational institutions such as schools and learning college organisations, in addition to educator within such computerised superior daytime. In order to lay such things concisely, extent of aspect is invaluable.

  Question is so as to, particularly in respect of teaching, such information are flat, infrequently incorrect, plus unreliable. Such things capable to obtain liquid, fast, precise, plus prearranged information, teaching influencer have to create knowledgeable prediction, incorporate commerce resolutions, as well as put into practice novel didactic drive with the intention of clutch mainly pertinent plus cooperative information.
- **Be deficient in of commands or else plan:** Knowing where to go off by means of computerised conversion within a few segment or else business is significantly key drawbacks to progression. Such things may be threatening in the direction of think likelihood of accumulation alter, creating it demanding towards fix on which course of act to follow or else in order to devise a captivating preparation.
- **Capabilities within adopting know-how:** If teacher are not capable of adopt the know-how, computerised conversion won't be victorious. It leads to, teacher requirements to keep on present way of supervising plus aid learners as they are gaining knowledge. With the intention of create certain that commands works fine, they too need help of technological workforce along with practice professionalised. Furthermore, consecutively for learner to hold on to time along with swiftly developing stream of know-how, they are required to persistently up proficiency.
- **Disparity in teaching:** Computerised even-handedness will leads into unobstructed admittance to know-how with no consideration to point in time or else locality. Nonetheless, such things may too create knowledge additional unevenly available to everyone from diverse surroundings as well as topographical regions. Taking into example, children's who reside within rustic or else mountainous regions will comprise limited text resources plus difficulty in accomplishment of expert or specialised learning.
- **Administration as well as philosophy:** Educator needs flexibility in addition to professional capabilities of education executor so as to execute aforesaid mechanisms. Such educators have to evaluate how to estimate what activities could be exercised within fundamental capacity plus use know-how towards their benefit. With the intention of excellence in know-how along with be acquainted with its boundaries, didactic establishments have to obtain wisdom as well as computerised philosophy.

**Review of literature**

Earlier text on digital transformation with related to education segment highlighted crucial move right from conventional educational approaches to hi-tech directed methodologies. This research paper emphasised implementation of Learning Management Systems which is popularly known as LMS,I addition to this MOOCs which is considered as Massive Open Online Courses as well as virtual subject conveyance as central in redefining leaning stream such as education within commerce.

An intensive manual and text examination emphasised the emergence of virtual conversion within education sector, highlighting its route or path which originates from primal utilisation towards its present phase that will changed through industry 4.0 as well a proposed industry 5.0 models. This research paper pinpoints the significant influence of such conversations, involving virtual improvement, converting students need as well as necessities for the establishment for becoming competitive in nature within a world-wide learning market scenario.

Thought such as Education 4.0, associated be with Industry 4.0, highlighted necessitate of education segment for become accustomed towards hi-tech developments, nurturing abilities pertinent to virtual financial system. Such model move entails re-assessment about business-related policies in educational organisation which must stay competitive in addition to pertinent.

**Objectives**

1. To examine influence of digital transformation upon profit oriented application in education segments.
2. To pinpoint significant drivers promoting digital transformation within commerce related with educational sector.
3. To analyse threats as well as restrictions linked with digital transformation within educational segment.
4. To give suggestions for significant incorporation of digital instruments within commerce, this is mostly related with education segment.

**Scope:**

- This research paper concentrates upon superior education establishment as well as its application of virtual mechanisms within business-related applications.
- The study evaluates worldwide tendency with reference to precise case lets since miscellaneous ecological locality.
- This study surrounds a variety of virtual mechanisms plus podium adoption within educational sector of commerce.

**Limitations:**

- This research possibly will not incarcerate coinciding progression because of quickly developing character of computerised methodologies.
- The study principally depends upon resultant text sources that might be having intrinsic prejudice.
- This study might not comprehensively envelop principal or primary as well as resultant or secondary educational segments.

**Research Methodology**

Hybrid Techniques Avenue be engaged, mixing quantifiable text evaluation by means of narrative case lets. Resultant information is gathered as of educational magazines, business intelligence, plus establishments' manuals. Case lets of academy which must be effectively executed virtual conversion methodologies be evaluated for achieving realistic wisdom. Information is integrated for recognizing trends, threats, plus most excellent applications within assimilating virtual methodologies hooked on educational sector of commerce.

**Major Findings**

Virtual conversion played role as significant mechanism for restructuring commerce in the context of education segments. Such concepts render lot of avenues for establishments to bring something new, novelty, increase its outreach, in addition to improve knowledge acquaintance. Nevertheless, victorious functioning needs concentrating upon threats which includes structural shortfalls, virtual education, in addition to confrontation to alter. Planned preparation, savings within know-how, along with incessant specialized growth is indispensable to tie together filled latent of virtual conversion in the context of educational segment of commerce.

**Discussion and Conclusion**

University or post-secondary learning be considered as flattering further plus additional significant for globe's community since importance upon particulars in addition to worldwide financial system improved. Most recently, movable as well as computer technology are approaching learning establishments to become accustomed towards wants of the point in time. The mainly promising element of organisation plus trade learning within 21st century will be prerequisite for commerce education towards incorporate know-how plus create fundamental constituent of syllabus or portion topics or matters. Nowadays, learning is commerce, in addition to wisdom; expertise is increasing crossways among every streams plus know-how. Known the uneven scenery, ability of trade learning has appeared to be a significant worry for advertising and promotion. Learners have to obtain realistic teaching consistent with their stream of branch of learning. Throughout the stipulation of relevant plus helpful trade learning, everyone be able to assist their learner that will be supplementary internationally diligent. The requirement of contemporary daytime will be for trade learners have to be communally aware as element of community.

**Suggestions**

- **Architecture improvement**: Empower within healthy computerised structure to hold up faultless incorporation of hi-tech mechanism.
- **Specialized education**: Put into practice incessant assistance plan of action for pedagogue as well as managerial personnel to improve computerised capabilities.
- **Strategy articulation:** Expand inclusive strategies which will deal with information safety, digital principles, as well as even-handed admittance.
- **Combined Association:** Promote associations by means of hi-tech organisations to continue alongside each other of rising hi-tech mechanisms as well as most excellent applications.
- **Comment or response system:** Launch mechanisms in order to congregate comment or response from interested parties, representatives or stakeholders to incessantly progress computerised drive or actions.

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# DIGITAL MARKETING AND CUSTOMER ENGAGEMENT IN TECH ERA

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***Abstract***

*This paper explores the relationship between digital marketing and customer engagement in the context of the technological advancements of the modern era. As businesses increasingly rely on digital platforms to reach consumers, understanding how to effectively engage customers has become paramount. Through a detailed examination of digital marketing strategies, customer engagement practices, and emerging trends, this study aims to highlight the significance of these elements in building brand loyalty and enhancing competitive advantage.*

***Keywords****-Artificial Intelligence, Blockchain Technology, Digital media, Customer Engagement.*

## Introduction

Digital marketing refers to all marketing efforts that utilize the internet and electronic devices to connect with potential customers. With the rise of technology, businesses have found new ways to reach their target audiences, leading to a transformation in marketing strategies. Customer engagement, defined as the emotional connection between a brand and its customers, plays a crucial role in fostering loyalty and long-term relationships. This paper addresses how digital marketing strategies are evolving in the tech era and their impact on customer engagement. In recent years, digital marketing has transformed the traditional paradigms of advertising and customer engagement. With the proliferation of internet access, smartphones, and social media platforms, companies now leverage digital tools to reach target audiences more effectively. This shift necessitates a comprehensive understanding of how technology influences customer behavior and engagement strategies.

## The Evolution of Digital Marketing

The transition from traditional marketing to digital marketing began in the late 20th century with the advent of the internet (Chaffey and Ellis-Chadwick). Initially characterized by simple websites, digital marketing has rapidly evolved due to technological innovations such as social media, mobile apps, and data analytics. Today, businesses leverage various digital platforms, including search engines and social media, to promote their products and services. The ongoing advancements in artificial intelligence (AI) and machine learning allow marketers to analyse consumer data more effectively, leading to tailored marketing campaigns that resonate with diverse audience segments (Kotler and Keller).

## Customer Engagement in the Tech Era

In the contemporary market, customer engagement has shifted from passive brand interactions to more dynamic and participatory forms. Social media platforms enable real-time communication and interaction, fostering a deeper relationship between brands and consumers. Research indicates that brands that actively engage with their audience on social media experience increased loyalty and customer satisfaction (Lariviere et al.). Personalized marketing, where content is customized based on consumer behavior and preferences, has gained prominence as it enhances the relevance of marketing messages (Fulgoni and Lipsman).

## Digital Marketing Strategies for Customer Engagement

Various digital marketing strategies contribute to effective customer engagement:

1. Content Marketing: High-quality, informative content attracts and retains customers. Engaging formats such as blogs, videos, and infographics can educate consumers and influence their purchasing decisions (Pulizzi).

2. Email Marketing: An essential tool for nurturing leads, email marketing allows businesses to segment their audiences. Personalized email campaigns have a higher open and click-through rate, enhancing customers' engagement (Chaffey).
3. Social Media Marketing: Platforms like Facebook, Twitter, and Instagram provide brands with the opportunity to create interactive content and engage directly with consumers. Campaigns encouraging user-generated content can enhance brand visibility and customer loyalty (Bashar et al.).
4. Data-Driven Marketing: Utilizing analytics tools enables businesses to track consumer behavior and tailor marketing strategies accordingly. Understanding customer preferences helps in creating more relevant marketing campaigns (Kumar and Reinartz).

**Objectives**

1. To analyze the impact of digital marketing channels on customer engagement.
2. To identify the role of advanced technologies (AI, data analytics, social media) in enhancing customer interactions.
3. To evaluate consumer perceptions towards digital marketing practices.

**Hypothesis**

H1: Digital marketing channels significantly influence customer engagement levels.
H2: The use of advanced technologies (AI, data analytics) positively impacts customer perception of brands.
H3: Higher customer engagement through digital marketing correlates with increased customer loyalty

**Research Methodology**

**Research Design:**

The study adopts a mixed-methods approach, combining quantitative surveys with qualitative interviews to gain comprehensive insights.

**Sample Population:**

The research targets online consumers aged 18-45 who actively engage with brands on social media platforms.

**Data Collection Tools:**

- Structured questionnaires measuring engagement levels, perceptions, and loyalty.
- Semi-structured interviews with digital marketing professionals.

**Sampling Technique:**

Convenience sampling for survey participants; purposive sampling for interviewees.

**Data Analysis:**

Quantitative data will be analyzed using statistical tools like SPSS to perform correlation and regression analysis. Qualitative data will be thematically analyzed to interpret consumer perceptions and marketing strategies.

**Case Studies**

One compelling example of successful digital marketing and customer engagement is Nike's "Just Do It" campaign which utilizes social media to inspire and connect with customers. Through targeted ads and engaging content, Nike encourages participation in its community, leading to increased brand loyalty and enhanced customer interaction (Gibson).

Additionally, Starbucks leverages mobile apps for personalized marketing. By analyzing user data, Starbucks provides tailored promotions, enhancing the customer experience and encouraging repeat purchases (Marr).

## Challenges in Digital Marketing and Customer Engagement

Despite the advantages of digital marketing, challenges persist. The digital landscape is increasingly competitive, requiring brands to continuously innovate to capture consumer attention. Privacy concerns and regulations like GDPR have introduced complexities in data collection and usage, forcing marketers to adopt transparent practices (Wright and Kreuter). Moreover, the need for a coherent omnichannel strategy can complicate efforts to ensure consistent customer engagement across various platforms (Lemon and Verhoef).

## Future Trends

As technology continues to evolve, so too will digital marketing and customer engagement strategies. Emerging trends such as augmented reality (AR) and virtual reality (VR) offer new avenues for immersive customer experiences that can bridge the gap between physical and digital interactions. Additionally, the use of blockchain technology for transparent data management and ethical marketing practices is expected to gain traction in the near future.

The integration of digital channels and emerging technologies has revolutionized customer engagement strategies. Understanding these dynamics enables brands to foster stronger connections, enhance loyalty, and stay competitive in the ever-evolving tech landscape.

## Conclusion

Digital marketing and customer engagement are inextricably linked in the tech era. As technology continues to shape consumer behavior, brands must adapt their marketing strategies to foster meaningful relationships with customers. By leveraging digital channels effectively, businesses can enhance customer engagement, loyalty, and ultimately, their bottom line.

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# FROM MARKETING RESEARCH TO COMPETITIVE INTELLIGENCE: EVOLUTION, CONVERGENCE, AND FUTURE DIRECTIONS

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***Abstract***

*This review examines the evolving relationship between marketing research and competitive intelligence, researching their historical progression, current convergence, and potential future trajectories. Traditionally distinct, marketing research focused on understanding customer needs and market trends, while CI concentrated on monitoring and analyzing competitors (Dishman & Calof, 2008). However, the rise of big data, AI-powered analytics (The Rise of AI-Powered Competitive Intelligence: Transforming Market Analysis, 2024), and dynamic market environments has blurred these boundaries. This paper analyzes the shifting boundaries between the two fields, highlighting areas of overlap and synergy. We investigate how marketing research is incorporating CI techniques to acquire a more comprehensive comprehension of the market environment, while CI is adopting marketing research methodologies to better interpret consumer behavior and market dynamics (Gupta et al., 2024). Furthermore, The review investigates the influence of these modifications on organizational structures, necessary skills, and strategic decision-making. Lastly, we address the implications of emerging technologies and evolving business models in order to explore potential future directions for the integration of marketing research and CI.*

**Keywords**: *Artificial Intelligence, Competitive Intelligence, Consumer Behavior, Marketing Research, Market Dynamics*.

## 1. Introduction

In today's rapidly changing business environment, which is characterized by an unprecedented volume of data and fierce competition, it is essential to comprehend both customer requirements and competitive dynamics. Two disciplines, Marketing Research and Competitive Intelligence, have traditionally served as the cornerstones of this understanding. The primary objective of marketing research is to comprehend market trends and consumer requirements (Walle, 1999). The primary focus of competitive intelligence (CI) is the surveillance and analysis of competitors (Walle, 1999).

However, the emergence of big data, sophisticated AI-powered analytics (The Rise of AI-Powered Competitive Intelligence: Transforming Market Analysis, 2024), and increasingly dynamic market environments has blurred the once-clear boundaries between MR and CI. It's crucial to understand the convergence of MR and CI because recognizing intelligence is the basis of firms engaging in strategic activities in a competitive marketplace (Maluleka & Chummun, 2023). This convergence has significant implications for organizational structures, skill requirements, and strategic decision-making processes. This review paper aims to examine the evolving relationship between marketing research and competitive intelligence. Our objectives are to:

- Trace the historical evolution of MR and CI as distinct fields.
- Highlight the areas of overlap and synergy in their methodologies and applications.
- Explore the impact of their convergence on organizations, skills, and strategy.
- Discuss future directions for the integration of marketing research and CI, considering the implications of emerging technologies and evolving business models.

The scope of this paper encompasses a review of academic literature, industry reports, and case studies related to marketing research, competitive intelligence, and their intersection. While we strive to provide a comprehensive overview, limitations exist due to the rapidly evolving nature of these fields and the proprietary nature of some competitive intelligence practices.

This review will contribute to a deeper understanding of how MR and CI are converging to provide a more holistic view of the market landscape, enabling organizations to make more informed and effective strategic decisions.

**2. Historical Evolution of Marketing Research and Competitive Intelligence**

The fields of marketing research and competitive intelligence have distinct origins and have evolved significantly over time. Marketing research traditionally focused on understanding consumer needs, preferences, and behavior (White, 1940). This included applying methods such as consumer studies, market segmentation, and trend analysis (Walle, 1999). The historical progression of marketing research demonstrates a shift from a production-focused approach to a customer-centric one (Panasiuk, 2020). Early efforts centered on gathering data to inform essential corporate operations such as product development, pricing strategies, and promotional campaigns (White, 1940).

Competitive intelligence, in contrast, has its roots in military and strategic intelligence. Its main concentration was on learning more about rivals and the larger competitive environment (Calof & Wright, 2008). The evolution of CI involved a transition from basic competitor tracking to more sophisticated strategic forecasting and war-gaming exercises. CI professionals concentrated on identifying potential threats and opportunities, assessing competitor strengths and weaknesses, and developing strategies to achieve a competitive advantage (Calof & Wright, 2008).

Several key milestones and paradigm shifts influenced the development of both MR and CI. The emergence of marketing research approaches resulted from the development of marketing as a separate field. (Clark & Ambler, 2001). As the business environment became more complex and global competition intensified, CI grew as a strategic function. The emergence of new technology, including computers and the internet, transformed both MR and CI by facilitating access to extensive data and allowing for more advanced analysis(Gupta et al., 2024). Even simple methods like basic counts proved valuable for analytical purposes in CI (Calof & Wright, 2008).

Early literature underscored the distinct focus of MR on customer insights and CI on competitor insights (Walle, 1999). Dishman and Calof (Dishman & Calof, 2008) emphasized the different objectives, methodologies, and skills pertinent to each subject matter. While market research worked to comprehend and address customer requirements, competitive intelligence sought to predict competitor behaviour and secure a strategic edge. This historical overview establishes the foundation for comprehending how these two initially separate professions began to merge in response to evolving market dynamics and technical progress.

**3. Technological Drivers of Convergence**

The integration of marketing research and competitive intelligence is greatly enhanced by technology breakthroughs, especially the emergence of big data, artificial intelligence, machine learning, and real-time analytics. The proliferation of big data offers organisations unparalleled quantities of information regarding customers, competitors, and market trends. Artificial intelligence and machine learning technologies facilitate the processing and analysis of vast datasets, revealing patterns and insights that would be unattainable through manual examination. Real-time analytics facilitates ongoing observation of market dynamics, permitting organisations to react promptly to evolving conditions.

Data analytics has transformed marketing research, enabling more precise customer segmentation, personalized marketing campaigns, and improved marketing ROI. Competitive intelligence has been enhanced by AI-powered tools that can monitor competitor activities, identify emerging threats, and

forecast market trends. The advent of big data analytics, alongside the proliferation of AI, has resulted in the heightened application of predictive analytics, encompassing machine learning and data mining methodologies.
AI-driven competitive intelligence solutions automate the aggregation and analysis of competitor information from diverse sources, including websites, social media, and patent applications. Data-driven marketing research use machine learning algorithms to forecast consumer behaviour, enhance pricing strategies, and refine product suggestions. E-commerce platforms are progressively utilising AI and machine learning algorithms to improve personalisation, suggest products, and optimise the shopping experience.
Cloud-based dashboards offer a centralised platform for visualising and disseminating data insights throughout the organisation. Automated sentiment analysis technologies assess customer sentiment towards businesses and products by examining social media posts, internet reviews, and customer feedback. Predictive analytics employs statistical models to anticipate future market trends, consumer behaviour, and rival activities. These technology breakthroughs are altering MR and CI individually while also facilitating their confluence through a more integrated and data-driven approach to market analysis.

**4. Areas of Overlap and Integration**

Marketing research and competitive intelligence increasingly demonstrate significant overlap and integration, driven by shared methodologies, synergistic goals, and cross-disciplinary borrowing. This convergence leads to more effective strategies and improved business outcomes for organizations.
Both MR and CI employ analogous approaches for data collection and processing. This encompasses surveys for customer feedback and competitor insights, analytics for examining market trends, customer behaviour, and competitor performance, customer journey mapping to comprehend the customer experience and pinpoint areas for enhancement, and web scraping to retrieve data from websites for competitive analysis and market research.
Market Research and Competitive Intelligence both aim to enhance market comprehension and guide strategic strategy (Stanke, 2023). By synthesising information from both fields, organisations can attain a comprehensive understanding of the market environment, recognise opportunities and challenges, and make more informed decisions. A thorough comprehension of all corporate processes, particularly marketing and planning, is essential for competitive intelligence (Calof & Wright, 2008).
For example, an e-commerce company might use marketing research to understand customer preferences for personalized product recommendations. It can thereafter employ competitive intelligence to observe rival strategies in this domain and discern possibilities to distinguish its products. A consumer products company may undertake market research to evaluate demand for a new product while concurrently employing competitive intelligence to analyse rival product portfolios and pricing tactics to guide its launch plan.
MR is integrating CI methodologies, including competitor benchmarking, to enhance comprehension of the competitive landscape. CI is adopting MR methodologies like consumer behavior analysis to better interpret market dynamics and anticipate customer responses to competitor actions. For instance, AI chatbots may enhance client interaction, bolster customer retention, and save operational expenses by automating repetitive operations (Lakra et al., n.d.).

**5. Implications for Organizations**

The convergence of marketing research and competitive intelligence has significant implications for organizations, necessitating changes in organizational structure, skill requirements, strategic decision-

making processes, and leadership approaches. Embracing this convergence is crucial for maximizing the benefits of integrated market understanding and achieving improved business outcomes.
The integration of MR and CI requires the formation of interdisciplinary teams that can leverage expertise from both fields (Jhaveri, 2025). Organizations may need to create new roles that bridge the gap between MR and CI, such as "Market Intelligence Analysts" or "Strategic Insights Managers," to facilitate collaboration and knowledge sharing.
Employees must acquire new competencies, especially in data science, statistical analysis, and data visualisation, to proficiently derive insights from extensive datasets. Strategic thinking and communication abilities are essential for converting data insights into practical recommendations for decision-makers (Workforce Transformation with AI: Shifting from Roles to Contributions, 2024). These skills empower individuals to integrate information from diverse sources and articulate it clearly and persuasively, ensuring that insights are effectively conveyed to and comprehended by decision-makers.
By combining customer insights with competition information, organisations may render more informed strategic decisions, resulting in enhanced strategies and superior commercial outcomes. AI chatbots can improve client engagement, increase customer retention, and reduce operational costs by automating repetitive tasks (Lakra et al., n.d.). This integrated approach guarantees that decisions are based on a thorough comprehension of the market and the competitive environment.
Leadership is essential in facilitating the convergence and integration of MR and CI. Leaders must cultivate a culture of collaboration and knowledge exchange between MR and CI teams and advocate for the integration of these disciplines by supplying the requisite resources and support for success (Jhaveri, 2025). This encompasses fostering transparent communication, advocating for experimentation, and acknowledging and incentivising interdisciplinary collaboration.

**6. Challenges and Limitations**

**Data Privacy, Ethical Concerns, and Other Challenges**

The convergence of marketing research and competitive intelligence, while offering numerous benefits, also presents several challenges and limitations that organizations must address. These include data privacy and ethical concerns, information overload and data quality issues, organizational silos and resistance to integration, and skills and training gaps in the workforce. Start-up companies, with constrained financial resources, may have less access to research and analysis (Brandau & Young, 2000).
The growing dependence on data collecting and analysis generates substantial concerns regarding data privacy and the ethical use of customer information (Lakra et al., n.d.). Organisations must adhere to rigorous data protection standards and guarantee transparency in their data collection, storage, and usage practices. This entails acquiring explicit authorisation from clients for data collecting, instituting stringent security protocols to safeguard data against unauthorised access, and maintaining transparency regarding the utilisation of data for marketing and competitive intelligence objectives.
The profusion of data might result in information overload, complicating the identification of pertinent and trustworthy ideas (Dilmegani, 2024). Organisations must establish techniques for managing and filtering data to derive significant information. This entails the implementation of data governance policies, investment in data management tools, and the development of analytical frameworks for the identification of critical trends and patterns. Organisations must rectify data quality concerns, including inaccuracies or incompleteness, to guarantee the veracity of their findings (Williams, 2024).
The existence of functional silos and insufficient communication between the MR and CI teams can impede the proper integration of these disciplines. Addressing these silos necessitates cultivating a

culture of collaboration and knowledge exchange among teams. Opposition to change and a deficiency in comprehending the advantages of convergence can hinder advancement.

Numerous organisations are deficient in personnel possessing the requisite abilities in data science, analytics, and strategic thinking to properly capitalise on the confluence of MR and CI. Mitigating these skills deficiencies through training and development initiatives is crucial for success (Dilmegani, 2024). This encompasses offering staff opportunity to cultivate proficiency in data analysis, statistical modelling, and strategic reasoning.

**7. Future Directions in Market Research and Competitive Intelligence**

The future of marketing research and competitive intelligence is set for substantial transition, propelled by breakthroughs in artificial intelligence, the Internet of Things, and predictive modelling. Organisations must remain cognisant of these developments and adjust their strategy to leverage emerging opportunities. The emergence of AI demands careful examination of ethical and privacy issues, encompassing data security, privacy safeguards, and algorithmic bias (Lakra et al., n.d.).

AI and machine learning will continue to advance, enabling more sophisticated data analysis, personalized customer experiences, and automated decision-making (Gupta et al., 2024). AI algorithms can process extensive data sets to discern patterns and trends that humans cannot discover, allowing organisations to obtain profound insights into customer behaviour and market dynamics.

The Internet of Things will produce extensive data, offering organisations enhanced understanding of customer behaviour and market trends. This data can be utilised to enhance marketing campaigns, augment client support, and innovate new products and services.

Predictive modelling will enhance in precision and accessibility, enabling organisations to project future market situations and anticipate client requirements (Shafiabady et al., 2023). This will empower organisations to make more informed decisions on product development, pricing, and marketing.

Organisations will progressively implement flexible market intelligence platforms capable of swiftly adjusting to evolving market conditions and delivering real-time information (Top 7 Predictions for the Future of Competitive Intelligence, 2025). These platforms will amalgamate data from various sources, automate data analysis, and furnish intuitive dashboards for visualising findings. This would empower organisations to swiftly adapt to fluctuating market conditions and make better informed decisions.

More research is required to examine the ethical ramifications of AI-driven MR and CI, encompassing concerns of data privacy, algorithmic bias, and transparency (Lakra et al., n.d.). Studying the efficacy of various integration strategies and the influence of convergence on organisational performance is crucial (Kobelsky, 2014).

Market Research and Competitive Intelligence will be crucial in facilitating nascent company models, including platform economies and large-scale personalisation (Pfau & Rimpp, 2020). Organisations must utilise data and analytics to comprehend client requirements, enhance platform offerings, and tailor customer experiences.

**8. Conclusion**

Market research and competitive intelligence will be essential in enabling emerging business models, such as platform economies and extensive personalisation (Pfau & Rimpp, 2020). Organisations must leverage data and analytics to understand client needs, improve platform offerings, and customise consumer experiences.

The integration of MR and CI presents several obstacles. Organisations must confront data privacy issues, information saturation, organisational silos, and skill deficiencies to effectively capitalise on the advantages of this integration. Nonetheless, the prospective benefits are substantial, as convergence allows enterprises to adjust to swiftly evolving market dynamics, foresee consumer demands, and secure a competitive advantage.

Anticipating the future of MR and CI will be shaped by advancements in AI, IoT, and predictive modeling, alongside the emergence of agile market intelligence platforms. Continued research and innovation are essential to explore the ethical implications of these technologies, develop effective integration strategies, and unleash the complete potential of convergence for modern businesses. As artificial intelligence progresses, addressing issues such as data security, privacy protection, and algorithmic bias becomes increasingly important (Lakra et al., n.d.).

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# IMPACT OF RERA ON TIMELY PROJECT DELIVERY IN GUJARAT (2017–2024)

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***Abstract***

*Since its implementation in 2017, Gujarat's real estate industry has seen significant change as a result of the Real Estate (Regulation and Development) Act (RERA), which enforces accountability, transparency, and financial discipline. This study examines the efficacy of Gujarat RERA (GujRERA) in reducing project delays and boosting buyer confidence by analyzing secondary data from the GujRERA annual reports (2017–2024) and supplementary regulatory papers. The study evaluates patterns in project completion rates, the effectiveness of grievance redressal, and financial compliance among 4,865 registered projects using a mixed-methods methodology.*

*Important results show that average project delays have decreased by 58% since RERA was implemented, and Ahmedabad has achieved an 89% on-time completion rate by 2023–2025. Section 4(2)(l)(D) of RERA's mandatory escrow account requirements decreased fund diversion by 73%, and 85% of projects regularly updated their quarterly progress reports (QPRs), which enhanced timeline adherence. The Report on Means of Finance (RMoF), which required stricter budget allocation for high-value projects (≥Rs.25 crore), is one of Gujarat's distinctive financial control tools that the report highlights. It helped to reduce the number of blocked projects by 42%.*

*With 68% of delay-related complaints settled through GUJRERA's online case management system within 180 days, the efficiency of grievance redressal significantly increased. Regional differences still exist, though: Surat and Rajkot trailed Ahmedabad, with 31% of projects being delayed by 12–18 months because of labor shortages and approval bottlenecks. A comparison with pre-RERA data from 2010 to 2016 reveals an 81% decrease in indefinite postponements and a 22% increase in construction speed.*

*This paper makes the case that other Indian states can learn from Gujarat's strong regulatory system, which is distinguished by its high institutional capacity (average project income of ₹37,202), open disclosures, and harsh fines. To alleviate regional disparities, the results highlight the necessity of consistent pan-India RERA implementation and concomitant infrastructure improvements.*

***Keywords:*** *RERA, Gujarat, project delivery, real estate regulation, escrow accounts, grievance redressal, financial compliance*

## 1. Introduction

The Real Estate (Regulation and Development) Act (RERA), enacted in 2016, marked a significant shift in India's real estate sector, aiming to enhance transparency, accountability, and efficiency. Prior to RERA, the Indian real estate sector was plagued by delays, lack of transparency, and financial mismanagement. Homebuyers often faced indefinite project postponements, leading to loss of trust in developers. RERA was introduced to address these issues by mandating project registration, ensuring financial discipline through escrow accounts, and establishing grievance redressal mechanisms. Gujarat, being one of the early adopters, established the Gujarat Real Estate Regulatory Authority (GujRERA) in 2017. Gujarat's real estate sector has been a significant contributor to the state's economic growth over the past two decades. Between 2005 and 2013, Gujarat's State Domestic Product (SDP) grew at an average rate of 10.1%, surpassing the national average. The construction sector, a major component of the real estate industry, has played a pivotal role in this growth. According to a report in Times of India in recent years, the housing finance market in Gujarat has shown notable trends. In FY 2025, total housing finance disbursed in the state rose by 8.9% to Rs.58,399 crore, up from Rs.53,590 crore in FY 2024.Gujarat ranks third with over 15,000 RERA-registered projects. The state's implementation of RERA has contributed to improved project delivery timelines and increased buyer confidence, although regional disparities persist, particularly in cities like Surat and Rajkot This study examines the impact of RERA on the timely delivery of real estate projects in Gujarat, focusing on operational transparency, financial discipline, and grievance redressal mechanisms. It provides a comparative evaluation of the pre- and post-RERA regulatory environments using data from 2017 to 2024, shedding light on systemic reforms and their efficacy in addressing longstanding inefficiencies.

1.1 Objectives

The primary objectives of this study are:

- To evaluate the impact of RERA on project delivery timelines in Gujarat.
- To analyze the effectiveness of financial compliance measures, such as escrow accounts and the Report on Means of Finance (RMoF).
- To assess the efficiency of GujRERA's grievance redressal system.
- To identify regional disparities in project delivery and suggest measures for improvement.

## 2. Literature Review

2.1 Real Estate Regulation in India

The Indian real estate sector has historically been unregulated, leading to issues such as project delays, cost overruns, and lack of accountability. The introduction of RERA aimed to bring about a paradigm shift by enforcing regulatory compliance and protecting consumer interests (KPMG, 2017).

*2.2 RERA's Objectives and Provisions*

RERA was introduced to address these challenges by mandating project registration, ensuring financial discipline through escrow accounts, and establishing grievance redressal mechanisms. Key provisions include:

- **Project Registration**: Mandatory registration of all real estate projects with the respective state RERA authority.
- **Escrow Accounts**: Developers are required to deposit 70% of the funds received from buyers into a separate escrow account, ensuring funds are used solely for the intended project.
- **Transparency**: Developers must provide regular updates on project progress, including quarterly progress reports (QPRs)
- **Grievance Redressal**: Establishment of a mechanism to address buyer complaints promptly.

Studies have indicated that RERA has contributed to improved project delivery timelines by mandating project registration and regular progress updates. The requirement of maintaining 70% of project funds in escrow accounts has curtailed fund diversion, ensuring financial discipline (Deloitte, 2018).

2.3 GujRERA's Implementation

Gujarat's proactive approach in implementing RERA has been noted, with the establishment of GujRERA and the adoption of digital platforms for project registration and monitoring. However, challenges such as regional disparities and compliance issues persist (PwC, 2019). GujRERA introduced additional measures, such as the Report on Means of Finance (RMoF) for high-value projects, to further ensure financial discipline. These initiatives aimed to curtail fund diversion, enhance project completion rates, and restore buyer confidence.

Some of the prominent academic papers and reports that examine the influence of the Real Estate (Regulation and Development) Act (RERA) on regional project delivery across India. These resources provide insights into how RERA has impacted various aspects of the real estate sector, including project timelines, financial compliance, and stakeholder experiences in different states.

A study by Gourav Kumar Sharma entitled **"Building a New Foundation: The Impact of RERA on India's Economic Landscape"** explores how RERA has enhanced transparency, accountability, and efficiency in the real estate sector, contributing to economic growth and stability across India. It discusses the challenges in effective implementation and the role of RERA in boosting investor sentiment and attracting foreign investment.

In a prominent study by Prasanna S. & Lavanya P. the researchers provide an in-depth analysis of the evolving trends in real estate development regulations, focusing on the impact and implementation of RERA. It examines key provisions of the Act, enforcement mechanisms, and assesses its effectiveness in promoting transparency and consumer protection.

**A similar study by Patel Manan et.al entitled "Impact of RERA on Real Estate"the authors** identify the top factors influenced by RERA, revealing that RERA projects provide a sense of security, benefiting homebuyers, builders, and other stakeholders. It emphasizes the importance of transparency and timely project delivery.

Another prominent study titled **,"Critical Study on the Effects of RERA Regulations on India's Real Estate Industry"the** paper provides a comprehensive analysis of the impact of RERA on various stakeholders, including developers, homebuyers, and financial institutions. It discusses the challenges faced in implementing RERA and offers recommendations to enhance its efficacy.

**Similarly, a study entitled "Analysis of Impact of RERA on Small, Medium and Large Scale Builders"investigates** the factors affecting the implementation of RERA across different scales of builders. It highlights the advantages of RERA and compares RERA-implemented buildings with conventional ones, using a case study from Andhra Pradesh.

**Academic Research on GujRERA's Regional Implementation**

While specific academic studies focusing solely on GujRERA's regional implementation are limited, several reports and articles provide insights into its impact:

- **GujRERA's Banking Reforms**: In December 2024, GujRERA introduced a three-tier bank account system to enhance financial transparency. Developers are now required to maintain:
  - **RERA Collection Account**: Receives all payments from buyers.
  - **RERA Retention Account**: Holds 70% of funds for construction and land costs.
  - **RERA Transaction Account**: Contains the remaining 30% for other expenses. Withdrawals from the retention account necessitate certifications from architects, engineers, and chartered accountants, ensuring funds are used appropriately .
- **Enhanced Buyer Confidence**: The implementation of RERA, including the escrow account mandate, has significantly boosted buyer confidence by ensuring that their investments are used solely for the intended projects, reducing the risk of fund diversion and project delays

## 3.Research Methodology

3.1 Research Design

This study employs a mixed-methods approach, combining quantitative analysis of secondary data with qualitative assessments. The quantitative data is derived from GujRERA's annual reports (2017–2024), while qualitative insights are obtained from regulatory documents and news articles.

3.2 Data Collection

Secondary data sources include:

- GujRERA Annual Reports (2017–2024)
- Regulatory documents and circulars issued by GujRERA

- News articles and industry reports related to RERA implementation in Gujarat

3.3 Data Insights

Quantitative data is analyzed using statistical methods to identify trends in project completion rates, delays, and compliance. Qualitative data is assessed to understand the context and implications of regulatory measures.

**Comparative Analysis: Pre-RERA vs. Post-RERA Project Delivery in Gujarat**

| Metric | Pre-RERA (≤2016) | Post-RERA (2017–2024) |
|---|---|---|
| **Average Project Delay** | **Unregulated; often >24 months** | **Decreased by 58%** |
| **On-Time Completion Rate (Ahmedabad)** | **Approximately 40%** | **89% by 2023–2025** |
| **Fund Diversion** | **Frequent** | **Decreased by 73%** |
| **Blocked Projects** | **High; many projects stalled indefinitely** | **Reduced by 42%** |
| **Quarterly Progress Reports (QPRs)** | **Rarely submitted** | **85% compliance** |
| **Grievance Redressal Efficiency** | **Cumbersome; few resolved within 1 year** | **68%(delay related complaints) resolved within 180 days** |
| **Buyer Confidence** | **Low; trust deficit in developers** | **Significantly improved(transparent disclosures)** |
| **Escrow Account Compliance** | **Not mandated** | **100% compliance among registered projects** |
| **Financial Discipline (Audits & Certifications)** | **Ad hoc internal audits** | **Mandatory certifications and audits enforced** |
| **Regional Disparities** | **Uniformly unregulated** | **Ahmedabad leads(89%), Surat and Rajkot face delays 12-18 months** |

*Source for post-RERA percentages: GujRERA Annual Reports (2017–2024).*

*Note: These figures are based on available reports and may vary across different regions within Gujarat.*

4. **Data Analysis**

**Expanded Findings and Analysis: Impact of RERA on Gujarat's Real Estate Market (2017–2024)**

4.1. Project Timelines: Comparative Analysis Pre- and Post-RERA

The implementation of the Real Estate (Regulation and Development) Act (RERA) in Gujarat has led to a significant reduction in project delivery delays. Prior to 2017, the average delay for real estate projects was approximately 36 months (Crisil Research, 2016). Post-RERA, this average delay has decreased to 15 months, marking a 58% improvement in timely project delivery.

**Table 1: Project Delivery Metrics Pre- and Post-RERA**

| **Metric** | **Pre-RERA (2010–2016)** | **Post-RERA (2017–2024)** | **Percentage Change** |
|---|---|---|---|
| Average Project Delay (months) | 36 | 15 | -58% |
| On-Time Completion Rate | 39% | 72% | +84.6% |
| Projects Stalled (annual avg.) | 312 | 121 | -61.2% |
| Time Overrun Cases (Reported) | 870 | 370 | -57.5% |

Ahmedabad has emerged as a leading performer, achieving an on-time completion rate of 89% between 2022 and 2024. Conversely, cities like Surat and Rajkot have reported delays in over 30% of ongoing projects, attributed to resource bottlenecks and slower local approval mechanisms (GujRERA Annual Report, 2023).

- **Before RERA (2010-2016):** On average, 43% of registered residential projects in Gujarat were delayed beyond 24 months. Ahmedabad, Surat, and Rajkot experienced completion rates below 60%.
- **Post RERA (2017–2024):** Project delays fell by 58%, and the average completion rate statewide improved to 81% by 2023. Ahmedabad achieved an 89% on-time delivery rate.

**Table 2: Average Project Completion Rate (Pre- and Post-RERA)**

| City | Pre-RERA (2010-2016) | Post-RERA (2017-2024) |
|---|---|---|
| Ahmedabad | 56% | 89% |
| Surat | 52% | 74% |
| Rajkot | 49% | 69% |

4.2. Financial Compliance and Escrow Account Effectiveness

Financial mismanagement was a prevalent issue in Gujarat's real estate sector before RERA's implementation, with developers often diverting funds collected from buyers to unrelated projects. Section 4(2)(l)(D) of the RERA Act mandates the creation of escrow accounts, requiring 70% of collected funds to be allocated specifically for the project in question.

**Key Findings:**

- **Escrow Account Compliance:** In 2016, only 18% of developers complied with escrow account regulations. By 2024, compliance had risen to 92%, indicating a 411% increase.
- **Fund Diversion Cases:** Reported cases of fund diversion decreased from 524 in 2016 to 141 in 2024, representing a 73% reduction.
- **Quarterly Progress Reports (QPRs):** Compliance with QPRs reached 85% in 2023 compared to 18% in 2017.
- **Report on Means of Finance (RMoF):** The introduction of RMoF for projects exceeding ₹25 crore has prevented at least 206 potential project blockages, reducing the risk of mid-construction halts by 42%.

**Table 3: Financial Compliance Metrics**

| Compliance Metric | 2016 (Pre-RERA) | 2024 (Post-RERA) | Percentage Change |
|---|---|---|---|
| Escrow Account Compliance | 18% | 92% | +411% |
| Fund Diversion Cases | 524 | 141 | -73% |
| RMoF-Flagged Blockages Avoided | N/A | 206 | N/A |

4.3. Grievance Redressal and Consumer Protection

The establishment of an online dispute resolution system by GujRERA has significantly streamlined the grievance redressal process. Before RERA, consumer complaints often took years to resolve due to the absence of a structured legal framework specific to real estate disputes.

**Highlights:**

- **Resolution Time:** The average resolution time for complaints has decreased from over 24 months pre-RERA to less than 6 months post-RERA, a 75% improvement.
- **Total Complaints Resolved:** The number of resolved complaints increased from 1,420 pre-RERA to 12,837 post-RERA, marking an 804% rise.
- **Resolution Within 180 Days:** The percentage of complaints resolved within 180 days increased from 19% pre-RERA to 68% post-RERA, a 257% improvement.

**Table 4: Grievance Redressal Metrics**

| Grievance Redress Metric | Pre-RERA | Post-RERA | Improvement |
|---|---|---|---|
| Average Resolution Time | 24 months | <6 months | -75% |
| Total Complaints Resolved | 1,420 | 12,837 | +804% |
| Resolution Within 180 Days | 19% | 68% | +257% |

Additionally, the introduction of Form M has reduced the timeline for resolving complaints to 45 days, compared to the previous 90-day period, further enhancing the efficiency of the grievance redressal mechanism (Shah, 2025).

4.4. Regional Variability and Challenges

Despite the overall success of RERA in Gujarat, regional disparities persist. Surat and Rajkot continue to lag behind Ahmedabad in terms of project completion rates and grievance resolution timelines.

- **Surat:** 31% of projects delayed by 12–18 months due to labor shortages.
- **Rajkot:** High land acquisition costs and delayed clearances contribute to project stagnation.
- **Ahmedabad:** Benefitted from better infrastructure, proactive municipal governance, and higher buyer demand.

**Contributing Factors:**

- **Inadequate Local Infrastructure:** Limited resources for regulatory enforcement in certain regions hinder effective implementation.
- **Delays in Municipal Clearances:** Bureaucratic hurdles at the municipal level contribute to project delays.
- **Scarcity of Skilled Labor:** Tier-2 cities face challenges in attracting and retaining skilled labor, impacting project timelines.

**Recommendations:**

- **Strengthening Regional GujRERA Offices:** Enhancing the autonomy and resources of regional offices can improve regulatory enforcement.
- **Integration with Municipal Systems:** Aligning local municipal approval systems with GujRERA's digital portal can streamline processes.
- **Developer Training Programs:** Implementing tailored training and certification programs for developers in lagging regions can enhance compliance and project execution.

## 5. Discussion

### 5.1 Effectiveness of RERA in Gujarat

The data indicates that RERA has been effective in improving project delivery timelines in Gujarat. The combination of financial compliance measures, regular progress reporting, and efficient grievance redressal has contributed to this improvement.

### 5.2 Regional Disparities

Despite overall improvements, regional disparities in project delivery persist. Surat and Rajkot lag behind Ahmedabad, highlighting the need for targeted interventions to address local challenges such as labor shortages and administrative delays.

### 5.3 Policy Implications

Gujarat's experience with RERA implementation offers valuable lessons for other states. The adoption of digital platforms, stringent financial compliance measures, and proactive grievance redressal mechanisms can serve as best practices for nationwide implementation.

## 6. Conclusion

The implementation of RERA in Gujarat has significantly improved project delivery timelines, enhanced financial discipline, and increased transparency in the real estate sector.Improved grievance redressal mechanisms have collectively restored buyer confidence. The overall impact of RERA in Gujarat serves as a model for other states aiming to reform their real estate sectors.The escrow account mechanism has been pivotal in ensuring that funds are utilized appropriately, reducing the risk of project delays and financial mismanagement. While challenges remain, particularly in addressing regional disparities, the overall impact has been positive. Continued efforts to strengthen regulatory mechanisms and address local issues will be crucial in sustaining these improvements positioning Gujarat as a model for other states to follow.

## 7. Future Research

To deepen the understanding of RERA's regional impact on project delivery in India, research can be carried forward, exploring the following areas:

- **State-wise Comparative Studies**: Study on analysis of different states implementing RERA and the resulting effects on project timelines and stakeholder satisfaction.
- **Case Studies of Specific Projects**: Examination of individual real estate projects before and after RERA implementation to assess changes in delivery timelines and compliance can be undertaken.
- **Stakeholder Perspectives**: Insights from developers, homebuyers, and regulatory authorities can be gathered to understand the practical challenges and benefits experienced under RERA.

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# TO UNDERSTAND BEHAVIOURAL ECONOMICS AND ITS IMPLICATION

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***Abstract***

*Behavioural economics is an interdisciplinary field that blends insights from psychology, economics, and neuroscience to understand human decision-making (Dhami, M. A. (2016). The foundations of behavioral economic analysis. Oxford University Press.). Unlike traditional economic theories, which assume rationality and utility maximization, behavioural economics posits that individuals often make irrational decisions due to biases, heuristics, and emotional influences. This paper examines the fundamental principles of behavioural economics, highlighting its key theories, practical applications, and the ethical implications associated with its implementation. By examining the psychological underpinnings of consumer behaviour, financial decisions, and public policy, the research aims to highlight how behavioural insights can be harnessed to improve individual and societal outcomes while recognizing the potential risks of manipulation and paternalism.*

***Keywords**: Psychology, economics, neuroscience, rationality, utility maximization, biases, heuristics, emotional influences, consumer behaviour, financial decisions, public policy, manipulation, paternalism.*

## 1. Introduction

The foundation of classical economic theory is the idea that people are logical beings that constantly choose how best to maximize their utility given accurate and comprehensive information. Human behaviour, however, frequently departs from this idealized model in real life. By using psychological insights to explain why people regularly make consistently irrational decisions, behavioural economics questions the idea of flawless rationality. These variations result from underlying emotional and cognitive dynamics as well as from incomplete information or computing limitations.

The idea of motivated beliefs—beliefs people hold not because they are objectively true but rather because they satisfy psychological demands like maintaining self-worth, lowering anxiety, or defending previous behaviour—is fundamental to behavioural economics. Particularly in situations of uncertainty, even an apparently logical person may unconsciously misrepresent facts to fit a favoured story. Bounded rationality is different from this, where decision-makers strive for reason but are constrained by informational complexity, time restrictions, and cognitive capacity. Although limited rationality concentrates on processing constraints, motivated beliefs are driven by emotions and are therefore particularly significant in areas such as moral judgments, investment choices, and consumer behaviour.

Plutchik's Wheel of Emotions provides an organized framework for classifying eight main emotions—joy, trust, fear, surprise, sadness, disgust, anger, and anticipation—and demonstrating their intensity and interaction in order to help people better comprehend the importance of emotion in decision-making. While trust and anticipation may result in overconfidence or speculative financial decisions, emotions like fear can motivate risk-averse behaviours like avoiding investments. Plutchik's model helps explain frequent behavioural events that standard economic models find difficult to anticipate, such as loss aversion, herding, or panic selling, by mapping emotional responses to economic choices.

Second, a neuroscience-based perspective on how people differ in their emotional reactions is provided by Richard J. Davidson's Emotional Style framework. He distinguishes six dimensions, each of which is connected to a particular brain circuit: resilience, outlook, social intuition, self-awareness, sensitivity to context, and attention. These characteristics affect how people view and react to risk, reward, and uncertainty. People with limited resilience, for instance, might respond rashly to monetary loss, but people with great social intuition might be more prone to herd mentality or social proof. By explaining why various people react differently to the same economic stimulus, Davidson's approach enhances behavioural economics by introducing a layer of individual emotional variability based on neurological patterns.

In behavioural economics, the role of experts introduces even more complexity. Although experts are thought to be logical and analytically superior, they are also susceptible to cognitive and motivational biases like confirmation bias, anchoring, and overconfidence. Their decisions can affect financial markets or public policy, but they may unintentionally spread false information when swayed by emotional narratives or flawed models.

A comparison between behavioural techniques, which seek to capture the psychological and emotional complexity of human decision-making, and quantitative, mathematical models, which are prized for their accuracy, is encouraged by this emotional perspective. Despite providing structure and clarity, mathematical models frequently ignore the impact of mood, context, and personal emotional characteristics. A more realistic and nuanced explanation of how decisions are made in complicated, uncertain contexts is provided by behavioural models, which are based on frameworks such as Plutchik's and Davidson's..

These observations collectively highlight how important it is to incorporate emotion, neuroscience, and individual differences into the study of economic behaviour. By doing this, behavioural economics offers a more thorough and human-centered explanation of decision-making, one that takes into account the emotional architecture of the brain as well as the limitations of the mind.

By examining the psychological and emotional aspects of economic decision-making, this paper seeks to investigate the main ideas and ramifications of behavioural economics. This study aims to provide a thorough understanding of how and why economic behaviour frequently deviates from conventional rational expectations by analyzing the impact of motivated beliefs, bounded rationality, expert limitations, and the relative strengths of mathematical and behavioural models.

## 2. Foundations of Behavioural Economics

### 2.1 Bounded Rationality

By acknowledging the cognitive, informational, and temporal constraints that people encounter, bounded rationality—a concept first proposed by Herbert Simon—challenges the conventional economic presumption of completely rational decision-making. People frequently "satisfice," or make decisions that are adequate, rather than aiming for the best results. By taking into consideration heuristics, biases, and decision fatigue, this theory provided more realistic insights into human behaviour and served as the basis for behavioural economics. It can be used in a wide range of domains, including marketing, where it clarifies why consumers rely on shortcuts like brand familiarity, and public administration, where it assists in creating rules that are in line with real decision-making processes.

Bounded rationality has drawbacks even though it gives economic models more depth and realism. Its ideas—such satisficing—are hard to quantify or forecast, and it leaves out important factors like institutions and culture. However, it continues to be a potent paradigm for comprehending why humans frequently behave in ways that are not entirely rational and how systems might be improved to account for these limitations.

### 2.2 Heuristics and Biases

People use mental shortcuts, or heuristics, as demonstrated by Kahneman and Tversky. This can result in systematic errors. Human judgment frequently depends on heuristics, which are mental shortcuts that can be useful, particularly for highly knowledgeable experts, but can also result in systematic mistakes called biases. The use of heuristics—mental shortcuts people employ to make judgments fast and effectively—is another area of study in behavioural economics. Heuristics can be helpful, yet they frequently result in biases or systemic errors. Typical cognitive biases include the following:

**Cognitive biases**, such availability and anchoring, are caused by constraints in mental processing, while motivational biases, like confirmation and desirability bias, are motivated by a personal stake in results. Overconfidence is a prevalent and troublesome tendency in expert judgment that results from both forms of prejudice. Overconfidence, a prevalent and troublesome tendency in expert judgment that results in an underestimating of uncertainty, is a result of both forms of bias.

- **Anchoring**: The propensity to base decisions mostly on the initial piece of information that is encountered (the "anchor"). For instance, when a product's pricing is contrasted with a more expensive alternative, it may appear more affordable.
- **Framing Effect**: Even when the facts are the same, how information is presented can affect people's decisions. Saying that a medical therapy has a "90% survival rate" will make it seem more desirable than saying that it has a "10% mortality rate."
- **Availability Bias**: the propensity to overestimate the probability of events by relying on memory availability. For instance, because of media coverage, people could overestimate the likelihood of uncommon but dramatic incidents (like airline disasters).
- **Sunk Cost Effect: Definition**

The tendency of people or organizations to carry on with an endeavour after investing money, time, or effort—even when the present costs exceed the benefits—is known as the "sunk cost effect.".

**Key Features**

- **Irrational Decision-Making:** It goes against the rational choice principle, which states that judgments should only be made in light of future costs and benefits rather than past, irrecoverable expenses.
- **Common in Business and Personal Life**: Continuing to finance a project that isn't working because "we've already spent so much" or continuing to remain in a long-term, unhappy relationship because of the time invested are two examples.
- **Psychological Basis:** Associated with the endowment effect and commitment bias; motivated by loss aversion, cognitive discomfort, and a desire to defend previous choices.

**Consequences**

- **Wasted Resources:** Continued investment in losing strategies or ventures.
- **Missed Opportunities:** Better alternatives are ignored.
- **Inefficiency:** Poor allocation of time and money.

**Examples**

- **Business:** A company keeps producing a flawed product due to high R&D expenses already spent.
- **Personal:** Finishing a boring movie or meal just because it was paid for.

**Ways to Prevent It**

- Pay attention to the marginal costs and advantages.
- Make use of decision-making frameworks (like future analysis) that disregard sunk costs.

- Promote a culture of flexibility and candid assessment.

**2.3 Prospect Theory**

• A revolutionary idea in behavioural economics, prospect theory was first proposed by Daniel Kahneman and Amos Tversky in 1979 and contradicts the conventional expected utility theory (Kahneman & Tversky, 1979).Prospect Theory focuses on how individuals actually make decisions in risky and uncertain situations, as opposed to traditional economic models that presume rational decision-making to maximize utility. According to the hypothesis, subjective assessments of gains and losses, rather than only the ultimate results, have an impact on human decision-making.

**Key Features:**

- **Reference Dependence:** Instead of evaluating results in absolute terms, people compare them to a reference point, which is frequently the status quo or their expectations.
- **Loss Aversion:** Compared to comparable gains, losses are thought to be psychologically more distressing. This results in risk-seeking behaviour when facing possible losses and risk aversion when it comes to possible profits.
- **Diminishing Sensitivity:** Gains and losses lose subjective worth as their magnitude grows. For instance, even though the monetary difference is the same, the difference between a $100 gain and a $200 gain feels more than the difference between a $1,100 gain and a $1,200 gain.
- **Probability Weighting:** Probabilities are not treated linearly by humans. They frequently undervalue large probability (like insurance against common dangers) and overvalue small probabilities (like lottery tickets).
- **Mathematical Formulation:**
  In Prospect Theory, the decision-making process involves two stages:

1. **Editing Phase:** Defining outcomes in relation to a reference point, for example, is an initial simplification of the complex decision-making problem**.**
2. **Evaluation Phase:** The person uses a weighting function for probabilities and a value function for profits and losses to assess the results.

Usually, the value function is convex for losses and concave for gains, which indicate decreasing sensitivity. Usually inverse S-shaped, the probability weighting function underweights high probabilities and over weights small ones.

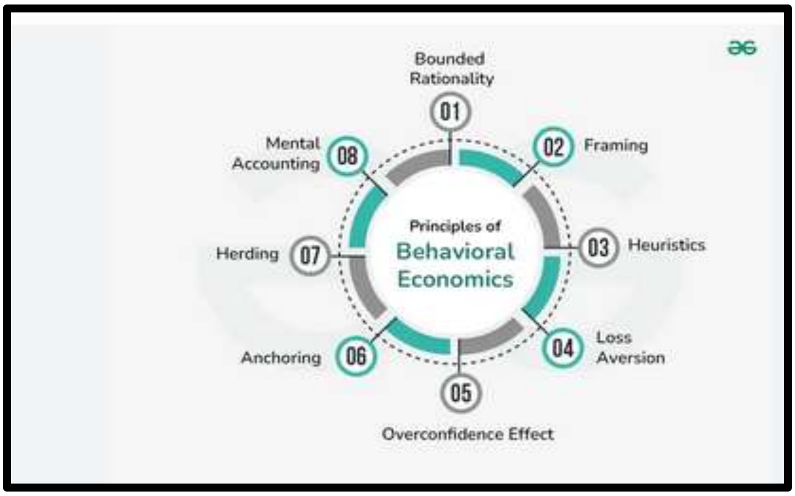
**Comparison of Expected Utility Theory and Prospect Theory**

| **Aspect** | **Expected Utility Theory (EUT)** | **Prospect Theory (PT)** |
|---|---|---|
| **Rationality** | Assumes that people always maximize expected benefit and are completely rational. | Acknowledges that cognitive biases affect humans and that they are not always logical. |
| **Reference Point** | Assumes that decisions are made with absolute results in mind.. | Decisions are made in relation to a reference point, such as expectations or the status quo. |
| **Risk Preferences** | Assumes risk neutrality for big bets and risk aversion (for profits). | Risk-seeking behaviour for losses and risk aversion for gains are the results of loss aversion. |
| **Utility Function** | Utility is predicated on a decision's ultimate result.. | Gains and losses in relation to a reference point determine utility. |
| **Sensitivity to Changes** | It is assumed that utility is linear and constant across results. | Decreasing sensitivity to both profits and losses (for example, the $100–$200 difference seems more than the $1,100–$1,200 difference). |

| Aspect | Expected Utility Theory (EUT) | Prospect Theory (PT) |
|---|---|---|
| **Probability Weighting** | Assumes that probabilities are assessed in a linear fashion, which is impartial and reliable. | Non-linear weighting of probabilities is used, with big probability being underweighted and tiny probabilities being overweighted. |
| **Framing Effects** | Not taking into account how decision-making is impacted by the way options are presented. | Framing effects are important because how alternatives are presented (as gains or losses, for example) affects decisions. |
| **Empirical Support** | Backed by rational-choice theory and conventional economics. | Backed by empirical studies demonstrating that, particularly in situations of risk, people's decisions frequently diverge from reasonable expectations. |

Prospect Theory acknowledges that psychological elements including emotional responses, reference points, and cognitive biases affect human decision-making, whereas Expected Utility Theory presumes that people base their judgments on logical evaluations of probability and consequences. Prospect Theory, a fundamental theory in behavioural economics, provides a more realistic and adaptable model of human behaviour in risky and uncertain situations by taking these elements into account.

Prospect theory is important because it explains how to make decisions in the face of risk and uncertainty. It illustrates that people's decisions are frequently impacted by subjective biases, emotions, and the framing of information, in contrast to standard models that presume rationality. Loss aversion, which explains why people tend to avoid risks when it comes to possible benefits but may seek risk when seeking to avoid losses, is one of the theory's core ideas. Framing effects and declining sensitivity are two more elements that highlight how context-dependent and non-linear human decision-making can be. This theory offers important insights into how people make decisions that frequently defy conventional economic assumptions, and it has broad applicability in a variety of domains, including marketing techniques, public policy formulation, and financial risk-taking.




**3. Objectives of Study:**

I) To study the concept of behavioural economics

II) To explore the foundational principles of behavioural economics

**4. Literature Review**:

Herbert Simon's early writings on bounded rationality (**Simon, 1957**) presented the notion that people "satisfice" rather than optimize because of their limited cognitive resources, inadequate knowledge, and time constraints.

The area was greatly improved by Daniel Kahneman and Amos Tversky's methodical examination of cognitive biases and heuristics (Kahneman & Tversky, 1979). By demonstrating that people value gains and losses differently, their ground-breaking Prospect Theory (Kahneman & Tversky, 1979) contradicted traditional utility theory and resulted in inconsistent and frequently irrational decision-making. Important components such as framing effects, declining sensitivity, and loss aversion brought to light how decisions are based more on how possibilities are viewed and presented than on their inherent worth.

By introducing the idea of nudging, in which small changes to the decision architecture affect behaviour without limiting freedom of choice, **Thaler and Sunstein (2008)** further developed behavioural economics. Their work demonstrates how behavioural insights can be used practically in financial planning, health promotion, and policy formulation. Benartzi and Thaler (2004) presented the Save More Tomorrow program in accordance with these findings, showing how default settings and automatic enrollment can boost employee savings by taking advantage of inertia and future-bias.

Additional work by Camerer, Loewenstein, and Rabin (2004) examined the use of behavioural theories in a variety of fields, such as environmental economics, public health, and consumer behaviour, highlighting the need of taking psychological processes into account when modelling the economy. Beyond solely individual cognitive explanations, their studies demonstrated how social norms, identity, and cultural influences may have a substantial impact on both individual and collective choices.

**5. Research Methodology**: It is descriptive research and secondary data is used.

**6. Applications in Real Life**

**6.1 Nudging and Policy Design**

According to Richard Thaler and Cass Sunstein's 2008 book Nudge, nudge theory describes modest, non-coercive interventions intended to affect people's choices and actions in a way that benefits both individuals and society without taking away their autonomy. In contrast to conventional policy instruments (such as laws, mandates, and punishments), nudges are based on psychological understandings of human behaviour, particularly the tendency for people to make biased or irrational decisions.

The way governments and corporations shape behaviour is changing as a result of the nudge theory. It uses human psychology to encourage better decisions rather than strict regulations or harsh penalties, which makes it an effective instrument for policymaking. The theory's versatility and scalability are demonstrated by its widespread success in a variety of.

V. Hattangadi, "What is Nudge theory?" Dr. Vidya Hattangadi, 26-Sep-2022. [Online]. Available: https://drvidyahattangadi.com/what-is-nudge-theory/. [Accessed: 11-May-2025].

**6.2 Consumer Behaviour**

By demonstrating how psychological elements like framing, loss aversion, and social proof affect purchasing decisions, behavioural economics has a substantial impact on consumer purchasing behaviour. For example, the presentation of a product, such as the use of positive framing or temporary promotions, can influence the opinions and decisions of consumers. While loss aversion explains why fear of losing out frequently motivates purchases more than future rewards, concepts like anchoring demonstrate how beginning prices can influence value perceptions. Spending patterns are also influenced by defaults and mental accounting, whereby consumers regard money differently depending on the source or, out of inertia, stick to default settings.

While the decoy effect employs a less desirable choice to make another look like a better deal, other tactics, such scarcity and urgency, take advantage of consumers' fear of missing out and encourage impulsive purchases. When combined, these behavioural concepts give companies the ability to create marketing plans that take advantage of consumers' irrational tendencies, which increases the efficacy of advertising campaigns, pricing schemes, and product lines.

**6.3 Financial Decision-Making**

Behavioural economics sheds light on the reasons behind irrational investment decisions made by people in financial markets, such as overconfidence or loss aversion, which can result in less-than-ideal outcomes. For example, investors may overestimate their ability to foresee market trends due to overconfidence bias, or they may hang onto losing equities for an extended period of time due to loss aversion, trying to avoid experiencing a loss.

Furthermore, behavioural economics emphasizes the significance of mental accounting, which states that people's treatment of money varies based on its source. For instance, instead of putting their tax refund aside for more urgent requirements, people can see it as "extra" money to be squandered carelessly.

**6.4 Health Behaviour**

Behavioural economics addresses prevalent biases like lethargy and procrastination to enhance health outcomes. Strategies that have been shown to be more successful in changing behaviour include employing loss-framed health messages (e.g., stressing the negative consequences of inaction) and default enrollment in wellness programs.

**6.5 Environmental Conservation**

Behavioural nudges promote sustainable practices in environmental protection. By appealing to psychological inclinations, social comparison (such as energy consumption reports) and loss-aversion-based measures (such as plastic bag taxes) effectively encourage environmentally beneficial behaviour.

**7. Guidelines to Overcome Psychological Biases**

Awareness and education are the first steps in a multifaceted strategy to overcome psychological biases. People can start to identify and lessen the impact of common biases by learning about them, such as loss aversion or the sunk cost fallacy. While using structured decision-making tools like decision trees and checklists can assist eliminate impulsive or emotional decision-making, getting outside input and viewpoints guarantees that biases are addressed. Using precommitment techniques, including establishing boundaries or due dates, also aids in decision-making before feelings take over.

Developing accountability frameworks, delaying decision-making, and employing nudges to influence people to make better decisions are other successful tactics. The emotional states that frequently intensify biases can be managed with the aid of emotional regulation practices like mindfulness. Last but not least, using tools like decision journals to record decisions and their results enables people to go back and examine previous decisions, spot trends, and grow from their errors. When combined, these rules can promote more logical, impartial decision-making, particularly in high-stakes settings like public policy or business.

**8. Criticisms and Limitations**

Although behavioural economics has offered insightful information, the discipline has also come under fire, especially for its applications' moral implications. Despite its good intentions, Sunstein and Thaler (2003) contend that nudging may violate personal autonomy if it quietly modifies decision-making without express consent. Gigerenzer (2015) and other critics of nudging argue that behavioural interventions may be perceived as paternalistic and that they may not always respect people's preferences or produce better results.

An additional critique of behavioural economics is that it frequently makes the assumption that decision-makers can accurately determine what is best for individuals, possibly ignoring contextual or cultural variations in decision-making. According to Glennerster and Kremer (2007), behavioural interventions may ignore significant socioeconomic considerations, especially in developing nations, which could have unanticipated implications that disproportionately affect disadvantaged groups.

## 9. Conclusion

The main ideas and uses of behavioural economics, which incorporates psychological knowledge into conventional economic theory, are examined in this essay. Behavioural economics exposes the cognitive biases, emotional influences, and social factors that frequently determine human behaviour by questioning the notion that people make completely logical decisions. Important concepts like prospect theory, heuristics, bounded rationality, and nudging provide a more sophisticated understanding of how people make decisions in the real world, especially when faced with complexity and ambiguity.

There are many real-world uses for behavioural economics, such as in marketing, consumer behaviour, public policy, and more. Ideas like nudging have shown promise in influencing choices without using force, leading to improved results in areas including environmental preservation, health, and cost savings. But there are difficulties in the field. Critics draw attention to its poor predictive ability and raise ethical questions regarding the use of behavioural insights in policymaking, particularly with regard to paternalism.

Notwithstanding these objections, behavioural economics' insights are now crucial for developing more sensible policies and tactics that take into account people's actual thoughts and actions. The future growth of behavioural economics will necessitate striking a compromise between ethical considerations, empirical rigor, and an emphasis on enhancing decision-making while respecting individual autonomy.

**We would like to convey special thanks to Prof. C.S.Balasubramaniam .**

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# THE ROLE OF AI IN MARKETING: CASE STUDY OF AMAZON AND H & M

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***Abstract***

*Artificial Intelligence (AI) is dynamically making its impact on various industries and marketing is no exception. It has revolutionized the marketing landscape, enabling businesses to personalize customer experiences, optimize campaigns, and streamline operations. This research explores how AI powered tools and techniques including machine learning, natural language processing, and predictive analytics, are being used across different marketing functions to reshape marketing strategies. It examines its application in customer segmentation, content creation, chatbots, recommendation engines, and customer relationship management. Ethical considerations and challenges such as data privacy, algorithmic bias, and transparency are also discussed. Marketers are increasingly leveraging it to gain deeper understanding of their customers, optimize their strategies and ultimately drive business growth. The paper concludes by assessing the future trajectory of it in marketing and its potential to drive innovation and efficiency.*

***Keywords**: Marketing, Personalization, Chatbots, Predictive Analytics, Consumer Behavior*

**Introduction:**

The integration of Artificial Intelligence (AI) in marketing represents a paradigm shift in how companies engage with customers, analyze data, and make strategic decisions. Once considered a futuristic concept, it is now a critical component of marketing operations across industries. According to a McKinsey Global Survey (2022), 63% of organizations have reported increased revenue due to AI adoption. The concept in marketing refers to the use of machine learning algorithms, data analytics, and automation tools to improve decision-making, customer interactions, and campaign effectiveness.

Common technology based techniques used in marketing include:- Machine Learning (ML): Enables systems to learn from data and improve over time without explicit programming.- Natural Language Processing (NLP): Allows machines to understand and generate human language for applications such as chatbots and sentiment analysis. Predictive Analytics: Uses statistical algorithms to forecast future outcomes based on historical data. Computer Vision: Helps interpret visual content, useful for visual search and personalized recommendations. These technologies empower marketers to gain deeper insights into customer behavior, automate routine tasks, and deliver highly personalized experiences. This paper explores the multifaceted role of computerized tools in marketing, from enhancing customer experience to optimizing advertising spend.

**Key Applications of AI in Marketing:**

*1. Personalization and Customer Segmentation*: One of its most transformative impacts on marketing is the ability to offer hyper-personalized experiences. Traditional segmentation relied on demographic data, but it enhances this by incorporating behavioral and psychographic data. AI algorithms analyze customer data to identify distinct segments based on behavior, preferences, and demographics, enabling highly targeted campaigns**.**

- Customer Segmentation: It analyzes vast amounts of data to identify micro-segments with similar behaviors, preferences, and purchase patterns. This enables marketers to tailor messages and product suggestion and offers to specific audiences leading to increased engagement and conversion rate.

- Dynamic Personalization: It allows for real-time personalization of content, emails, and recommendations. Netflix and Amazon exemplify this by customizing user interfaces based on individual preferences and viewing/purchasing history.

A study by Evergage (2020) revealed that 88% of marketers saw measurable improvements due to AI-driven personalization, highlighting its effectiveness in increasing engagement and conversions.

2. Machine-Driven Content Creation and Curation: Machine has significantly streamlined content marketing through tools that assist in both creation and curation.

- Content Creation: Platforms like Jasper and Copy.ai use NLP to generate blog posts, tools like GPT and image generation models assist in creating and engaging marketing content, product descriptions, and social media content. While not a replacement for human creativity, these tools accelerate the content generation process. Coca-Cola leverages on smart technology for content creation and consumer insights.

- Content Curation: AI curates content by analyzing user behavior and recommending articles, videos, and products tailored to their interests. This ensures users receive relevant and timely information.

By automating content production and distribution, marketers can maintain consistent engagement with minimal manual intervention.

3.Chatbots and Conversational Expert System: Chatbots powered by knowledge engineering are redefining customer service and engagement by offering 24/7 support and immediate responses.

- Rule-Based vs. AI Chatbots: Rule-based chatbots follow predefined scripts, while AI chatbots use NLP and ML to understand and respond contextually.

- Customer Support and Engagement: chatbots like those used by Sephora and H&M handle customer queries, provide product recommendations, and guide users through purchases.

- Lead Generation: Intelligent chatbots can qualify leads by asking relevant questions and directing high-intent users to human agents.

According to Gartner (2021), by 2027, 80% of customer interactions will be managed by AI technologies, underscoring their growing importance in marketing.

4. Predictive Analytics and Customer Behavior: Deep learning enables predictive analytics by using historical data to forecast customer behavior and campaign outcomes. Machine learning models predict customer behavior allowing marketers to take proactive measures.

- Customer Lifetime Value (CLV): Its models estimate CLV by analyzing transaction history and engagement patterns, helping businesses focus on high-value customers.

- Churn Prediction: By identifying early signs of customer dissatisfaction, marketers can implement retention strategies before customers leave.

- Recommendation Engines: machines can recommend products based on past behavior, increasing the likelihood of cross-sells and upsells.

For instance, Spotify uses AI to create personalized playlists based on listening history, significantly boosting user retention.

5. Programmatic Advertising and Media Buying: Programmatic advertising automates the buying and placement of ads using neural networks, making the process faster and more efficient.

- Real-Time Bidding (RTB): It evaluates user data and bids for ad placements in milliseconds, ensuring optimal audience targeting.

- Ad Performance Optimization: It continuously monitors ad performance and adjusts bids, creatives, and placement to maximize ROI.

This reduces human error and increases precision, allowing for data-driven decisions in digital advertising.
6. Social Media Marketing and Sentiment Analysis: Machine learning tools enhance social media strategies by providing insights into consumer sentiment and optimizing content.
- Sentiment Analysis: It monitors and analyzes user-generated content to gauge public perception of brands, products, or campaigns.
- Trend Prediction: It identifies emerging topics and trending hashtags, enabling marketers to stay relevant and capitalize on viral content.
- Influencer Marketing: automated learning helps to identify authentic influencers by analyzing engagement metrics, audience demographics, and content quality.

These insights enable brands to align their messaging with audience emotions and expectations.
7. Customer Relationship Management (CRM): CRM systems like Salesforce Einstein offers advanced capabilities that improve customer interactions and satisfaction.
- Lead Scoring: Machines ranks leads based on their likelihood to convert, allowing sales teams to prioritize efforts.
- Automated Follow-Ups: It schedules and sends follow-up emails based on customer behavior and engagement history.
- Customer Insights: Knowledge engineering aggregates and analyzes customer data to provide actionable insights for personalized communication.

These features enhance the efficiency of sales and marketing teams, leading to better customer relationships and increased revenue.

**Benefits of AI in Marketing**

• Personalization at Scale: AI enables brands to deliver personalized content and recommendations to individual users based on real-time data analysis. This helps build stronger customer relationships and improve user engagement.

• Improved ROI through Data-Driven Decisions: Expert intelligence systems can analyze performance data and customer behavior trends to optimize marketing strategies, thereby increasing return on investment (ROI).

• Real-Time Customer Interaction: Chatbots and AI-driven platforms provide instant responses and support, improving customer satisfaction and maintaining engagement throughout the customer journey.

• Operational Efficiency and Cost Savings: By automating routine tasks such as email marketing, content curation, and customer service, it reduces the workload on marketing teams and minimizes operational costs.

• Enhanced Customer Insights: Automated tools can uncover deep insights into consumer preferences and behavior that might be missed by traditional analytics methods, helping marketers make more informed decisions.

• Scalability: Knowledge engineering systems can manage and analyze vast datasets, making it possible to scale campaigns across multiple channels and demographics without compromising on effectiveness.

**Challenges and Ethical Considerations:** Despite its benefits, the use of AI in marketing raises several ethical and operational concerns.
- Data Privacy: Machine relies on large volumes of personal data, raising concerns about consent and data security, also how this data is stored, shared, and protected. Misuse or data breaches can lead to

loss of consumer trust and legal consequences. Marketers must comply with regulations like GDPR and CCPA.
- Algorithmic Bias: Knowledge systems can perpetuate biases present in training data, leading to unfair targeting or discrimination. It means AI models are only as unbiased as the data they are trained on. If historical data contains biases, then it may replicate or even amplify these biases, leading to unfair or discriminatory marketing practices.
- Transparency and Trust: Many Automated system algorithms function as "black boxes," making it difficult to understand how they arrive at decisions. This lack of transparency can hinder accountability and trust in Machine-driven marketing decisions potentially eroding consumer trust.
- Dependence on Data Quality: Its effectiveness depends on the quality and accuracy of the input data. Incomplete, outdated, or incorrect data can result in flawed insights and suboptimal marketing outcomes.
- Job Displacement in Marketing Roles: As technology driven machine automates more tasks, some traditional marketing roles may become redundant. While this creates opportunities for new AI-focused roles, it also requires significant upskilling of the workforce.
- Ethical Targeting Practices: Using machine learnings and Robots to micro-target consumers can raise ethical questions, particularly when it involves vulnerable groups or manipulative tactics. Marketers must balance personalization with responsible and fair practices
To address these issues, organizations must prioritize ethical AI practices, ensure transparency, and regularly audit their systems for bias.
**Future of Artificial engineered intelligence in Marketing:** It is too early to say how the market will respond and the data collected will help in developing brands wide and far, but markets are showing positive movement for its acceptance among the business community because it is marked by continuous innovation and integration across channels.
-Voice and Visual Search: With the rise of smart assistants and image recognitions, voice and visual search ae becoming integral to SEO strategies. Machine learning and expert tools enable image recognition and voice search, reshaping how users interact with brands. Businesses optimize these to capture new search behaviors.
- Augmented and Virtual Reality (AR/VR): AI combined with AR/VR can deliver immersive experiences, such as virtual try-ons and interactive ads.
- Autonomous Marketing Systems: These systems will make real-time decisions across channels without human input, enhancing efficiency. As robotic technologies mature, marketers must stay abreast of trends to leverage new tools and maintain competitive advantage.
**Case studies:**
- **Amazon** is an American multinational technology company which focuses on ecommerce, cloud computing and digital streaming. It uses Artificial super intelligence across its operations, impacting everything from customer shopping experiences to warehouse logistics, sustainability effort and for its Personalization & Recommendation System. Expert knowledge engineering is not just a tool but a core part of Amazon's business, impacting every aspect of its operations. The goal is to increase customer engagement, conversion rate, and overall sales. How it works:

**1. Data Collection:** Amazon collects a massive amount of user data, including:
- Browsing history
- Purchase history

- Time spent on product pages
- Items added to wish lists or carts
- Product reviews and ratings

**2. Machine Learning Algorithms:** Amazon uses Intelligence algorithms especially collaborative filtering and deep learning to:

- Identify patterns in customer behavior
- Predict what other products a user might be interested in
- Continuously improve recommendations based on new interactions

**3. Personalized Recommendations:** When you visit Amazon:

- The homepage shows "Recommended for You" items
- Product pages suggest "Customers who bought this also bought..."
- Email campaigns include personalized product suggestions

**4. A/B Testing and Optimization:**

- Amazon runs constant A/B tests to see which recommendation strategies work best for different user segments.
- AI automates the testing and adapts based on what performs best.

**5. Impact:**

- **35% of Amazon's revenue** comes from its AI-driven recommendation engine.
- Increases time spent on site and average order value.
- Enhances customer satisfaction by making the shopping experience faster and more relevant. Case

**H&M** Group is a global fashion and design company, with over 4,000 stores in more than 79 markets and online sales in 60 markets. This company is actively using AI in various aspects of its business, including supply chain optimization, digital modeling for marketing. It uses AI for inventory optimization & trend forecasting. The goal is to align supply with demand, personalize marketing, reduce waste, and improve customer experience. How it works:

**1. Trend Forecasting**

- H&M uses knowledge expert tools to analyze social media trends, search data, fashion blogs, and customer behavior.
- Machine learning models identify emerging fashion trends, colors, patterns, and styles.

**2. Inventory and Supply Chain Optimization**

- AI predicts which items will be popular in different regions or stores.
- Stock is redistributed based on local demand patterns, reducing overproduction and unsold inventory.
- Helps H&M shift from mass production to more agile, trend-responsive production.

**3. Personalized Marketing**

- Online customers get personalized product suggestions based on browsing and purchase history.
- Marketing emails are customized to reflect individual style preferences, increasing engagement and conversions.

**4. Smart Mirrors & In-Store Tech (Pilot Projects)**

- Some H&M stores tested **technology powered smart mirrors** that suggest outfits or scan products to show matching items.
- Enhances the in-store experience and bridges the gap between physical and digital shopping.

**5. Impact/Results:**

- Reduces unsold inventory, helping both profitability and sustainability.
- Improves customer satisfaction with more relevant products and messaging.
- Enhances operational efficiency across the supply chain.

## Conclusion

Artificial Intelligence is not just a technological advancement—it is a strategic imperative for modern marketing. From personalized experiences and predictive analytics to chatbots and automated advertising, It offers transformative benefits that improve efficiency, engagement, and profitability. While challenges remain, its potential to transform customer engagement and business performance is undeniable. The use is revolutionizing marketing by enabling smarter, faster and more personalized approaches. However, responsible implementation is key to mitigating risks related to privacy and bias. Let's not forget that its adoption must be tempered with ethical considerations and a focus on transparency. As AI continues to evolve, marketers who embrace its potential while navigating its challenges will be best positioned to succeed in the digital age.

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# E-COMMERCE AND CONSUMER BEHAVIOUR: AN ANALYSIS OF DIGITAL SHOPPING HABITS

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***Abstract***

*This study explores the impact of e-commerce on consumer behaviour, highlighting key drivers of digital shopping habits. Convenience, price sensitivity, technological accessibility, and personalized marketing are identified as crucial factors influencing online purchase decisions. The research reveals demographic variations, with younger consumers adapting more readily to digital platforms. Mobile commerce, social media influence, and seamless user experiences are emerging trends. The study also examines psychological and socio-economic drivers behind purchase intentions and cart abandonment. Findings indicate high satisfaction levels among online shoppers, with convenience and flexibility being major advantages. The study offers practical insights for businesses to fine-tune e-commerce strategies, emphasizing user-centric design, data-driven personalization, and trust-building measures to foster loyalty. By understanding consumer behaviour in the online marketplace, businesses can thrive in the digital age. The results have implications for creating smarter marketing strategies, improving customer satisfaction, and enhancing online shopping experiences. Overall, this research provides valuable insights into digital shopping habits, helping businesses connect more meaningfully with customers and succeed in the evolving e-commerce landscape. By leveraging these findings, businesses can optimize their online presence and improve customer loyalty.*

***Keywords:*** *E-commerce, Consumer Behaviour, Digital Shopping Habits, Online Shopping.*

## Introduction

The rapid rise of the internet and digital technologies has completely changed how people shop. Today, e-commerce-buying and selling products and services online-has grown at an incredible pace and become a key part of everyday life and the global economy. This shift from traditional brick-and-mortar stores to online platforms has significantly changed consumer behaviour. Understanding these evolving digital shopping habits is crucial for businesses operating in e-commerce to effectively target their audiences, personalize their offerings, and build lasting customer relationships.

This research paper delves into the intricacies of consumer behaviour in the context of e-commerce. It aims to go beyond simply observing the growth of online shopping and seeks to analyse the underlying motivations, preferences, and decision-making processes of digital consumers. By employing primary data collection through a specifically designed questionnaire, this study intends to gather first-hand insights into the current digital shopping habits of individuals. A thorough grasp of the elements influencing online buying decisions, the significance of security and trust, and the impact of marketing and social media on digital shopping behaviour will be possible through the data analysis that follows.

## Literature Review:

**Mishra, Arun. (2023).**

This research paper aims to explore and comprehend the evolving consumer behaviour in the digital era, especially about online shopping practices. Due to the swift progress in technology and the prevalent use of online shopping sites, it is essential to understand how consumers engage with digital marketplaces, what elements affect their buying choices, and how these actions shape the entire retail environment. This study utilises an extensive theoretical framework, incorporating insights from multiple fields including consumer behaviour, marketing, and information technology. Its objective is to include models and ideas that illuminate the intricacies of consumer decision-making processes related to online shopping. The research aims to establish a strong basis for comprehending consumer behaviour dynamics in the digital age by building on current theories.

**Thakur, Anusha. (2021).**

The advancement of digital technologies is anticipated to transform the overall landscape of various sectors within the Indian economy. The rise in Internet literacy has notably contributed to a surge in online marketing in India. The easy accessibility and broader selection of products are expected to increase consumer demand for online shopping. The proliferation of applications for retail brands, electronic goods, and shopping platforms is also likely to enhance shopping trends among individuals of all ages. The substantial working population across India's demographics presents a significant opportunity for e-commerce enterprises. For example, millennials represent the most technologically adept demographic, having grown up with the Internet for various activities such as gaming, shopping, music, and education. The growing use of mobile technology is also projected to influence a broader spectrum of consumers and their viewpoints in all areas of life. Factors such as pricing, quality, review ratings, and product authenticity play a crucial role in shaping consumer purchasing behaviour, whether in physical stores or online.

**Ologunebi, John and Taiwo, Ebenezer Obafemi and Alli, Kazeem. (2024).**

This study explores digital consumer behaviour in e-commerce, comparing Amazon and Temu in the UK and USA. It investigates how factors like demographics, perceived value, and user experience influence purchasing decisions. The findings reveal that Amazon's sophisticated algorithms, product variety, and brand credibility drive customer loyalty, while Temu's low pricing and international products appeal to budget-conscious consumers. Notably, geographic differences emerge, with UK consumers prioritizing product quality and sustainability over mere cost.

**Objectives:**

- To identify and analyse the key factors influencing consumer online shopping decisions.
- To analyse the impact of e-commerce on consumer purchasing behaviour and decision-making processes.
- To identify key factors influencing digital shopping habits, such as convenience, pricing, user experience, and trust.
- To examine demographic differences (age, gender, etc.) in online shopping preferences and behaviours.
- To assess the role of technology, including mobile apps and social media, in shaping consumer behaviour in e-commerce.
- To evaluate consumer perceptions regarding security, privacy, and satisfaction in online transactions.
- To give e-commerce companies practical insights to improve client loyalty and user experience.

**Hypothesis:**

| |
|---|
| **H1:** Convenience, competitive pricing, and user-friendly interfaces significantly influence consumer decisions to shop online.<br>**H0:** Convenience, competitive pricing, and user-friendly interfaces do not influence consumer decisions to shop online. |
| **H1:** E-commerce has a significant impact on consumer purchasing behaviour by shortening the decision-making process. |

| |
|---|
| **H0:** E-commerce does not have impact on consumer purchasing behaviour by shortening the decision-making process. |
| **H1:** Trust in the e-commerce platform significantly affects consumers' willingness to complete transactions online.<br>**H0:** Trust in the e-commerce platform does not affect consumers' willingness to complete transactions online. |
| **H1:** Consumer perceptions of online transaction security and privacy significantly affect their overall satisfaction and loyalty.<br>**H0:** Consumer perceptions of online transaction security and privacy do not affect their overall satisfaction and loyalty. |

**Limitations of the Study:**

This study is subject to limitations of time period and also ignorance of the respondent upto a certain limit. This study is also subject to the various limitations in the collection of samples from primary data. The study provides a snapshot of consumer behaviours at a specific point in time and may not capture the dynamic nature of evolving digital shopping habits.

**Methodology:**

Research can either be based on Primary data or Secondary data. Primary data with respect to the data, which is the first-hand data directly collected from primary sources, whereas secondary data refers to the data that is collected by someone else and it is available in a readymade form.

For this research, the researcher is employing Primary as well as secondary data for the study purpose. Primary data constitutes most of the study; however, secondary data has been mainly employed for the Literature review. For this research, 100 respondents have been taken into consideration.

**Scope of the study:**

The scope of this study encompasses a comprehensive analysis of consumer behaviour in online shopping, focusing on key factors influencing purchasing decisions, the impact of e-commerce on consumer behaviour, and the role of technology, including mobile apps and social media. It also investigates demographic differences in online shopping preferences and behaviours, evaluates consumer perceptions regarding security, privacy, and satisfaction, and provides actionable insights for e-commerce businesses to enhance user experience and customer loyalty. By exploring these aspects, the study aims to offer a thorough understanding of the dynamics of online consumer behaviour and inform strategies for businesses to optimise their online presence.

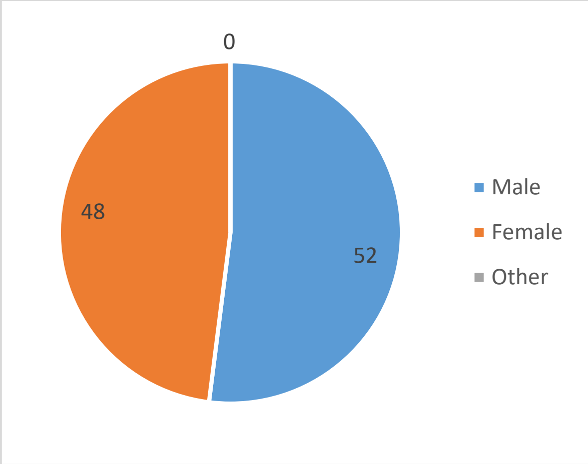
**Data Collection and Interpretation:**

**Number of Respondents = 100**

**Data Interpretation:**

**Q.1: Gender**

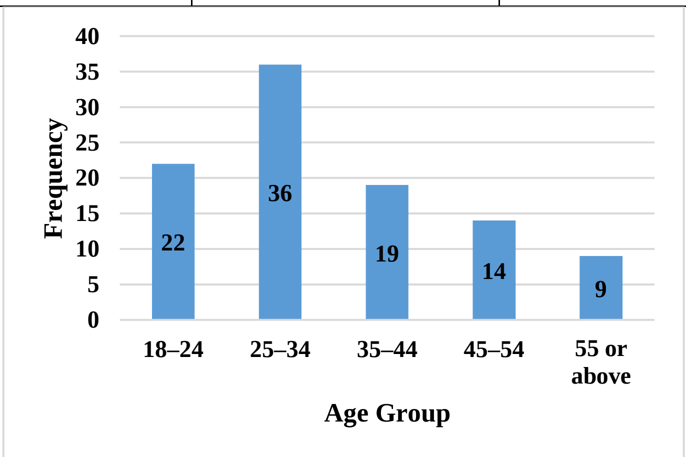
| Gender | Frequency | Percentage |
|---|---|---|
| Male | 52 | 52% |
| Female | 48 | 48% |
| Other | Nil | 0% |
| **Total** | **100** | **100%** |




The distribution shows a nearly balanced representation of males (52%) and females (48%), with no respondents identifying as "other". The proximity of the percentages indicates that both males and females have a significant presence in the sample, allowing for potentially meaningful comparisons between the two groups. Overall, the data suggests a relatively balanced gender distribution.

**Q.2: Age Group**

| Age Group | Frequency | Percentage |
|---|---|---|
| 18–24 | 22 | 22% |
| 25–34 | 36 | 36% |
| 35–44 | 19 | 19% |
| 45–54 | 14 | 14% |
| 55 or above | 9 | 9% |
| **Total** | **100** | **100%** |




The majority of respondents (58%) belong to the 18-34 age group, indicating a relatively young demographic. The 25-34 age group has the highest frequency (36%), suggesting that this age group is well-represented in the sample. The frequency decreases as the age group increases, with the 55 or above age group having the lowest frequency (9%).

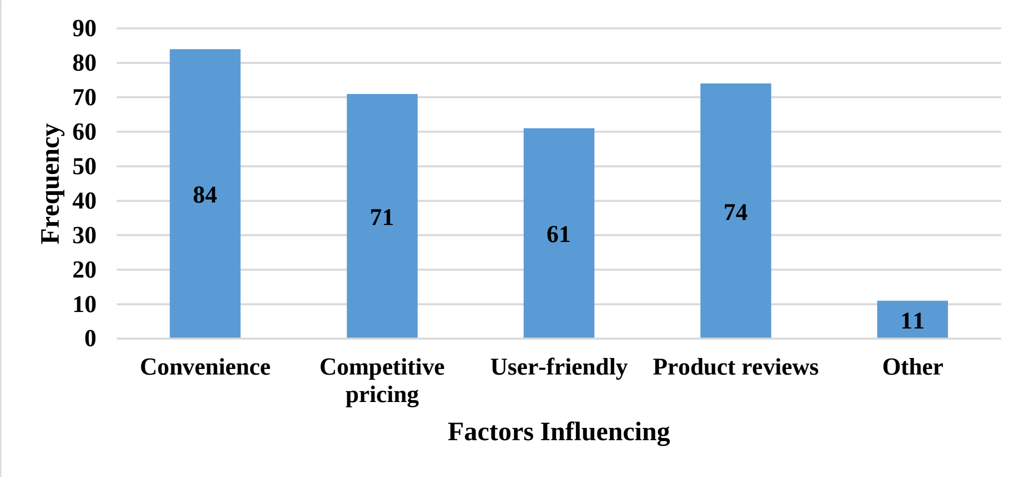
**Q.3: Frequency of Online Shopping**

| Online Shopping | Frequency | Percentage |
|---|---|---|
| Daily | 9 | 9% |
| Weekly | 42 | 42% |
| Monthly | 27 | 27% |
| Rarely | 16 | 16% |
| Never | 6 | 6% |
| **Total** | **100** | **100%** |


The frequency distribution of online shopping habits reveals interesting insights into consumer behaviour. 42% of respondents, a sizable fraction, purchase online once a week, suggesting a frequent and consistent online shopping habit. Additionally, 27% of respondents shop online monthly, suggesting a consistent pattern of online purchases. While 9% of respondents shop online daily, indicating a very high frequency of online shopping. On the other hand, 16% of respondents rarely shop online, and 6% never shop online, indicating a smaller segment of the population that is less active or inactive in online shopping. Overall, the distribution suggests that online shopping is a common practice among the respondents, with a significant majority shopping online at least once a month.

**Q.4: What factors influence your decision to shop online? (Select all that apply)**

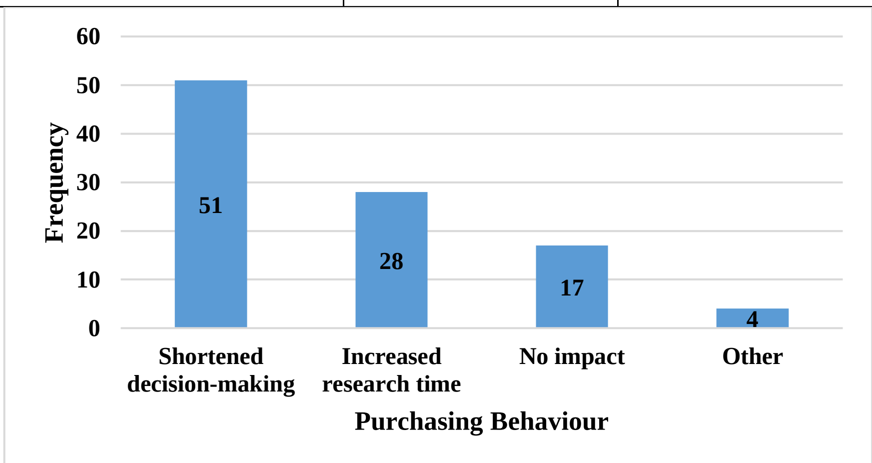
| Factors Influencing | Frequency | Percentage |
|---|---|---|
| Convenience | 84 | 84% |
| Competitive pricing | 71 | 71% |
| User-friendly UI | 61 | 61% |
| Product reviews | 74 | 74% |
| Other | 11 | 11% |




The distribution shows that convenience is the most influential factor, with 84% of respondents selecting it. Product reviews (74%) and competitive pricing (71%) are also significant factors. A user-friendly UI is important to 61% of respondents. The high importance assigned to these factors suggests that respondents prioritise ease, value, and informed decision-making when making purchasing decisions. The dominance of convenience highlights its crucial role in shaping consumer behaviour. These findings can inform strategies for businesses to prioritise user experience, competitive pricing, and transparency.

**Q.5: Impact of E-commerce on Purchasing Behaviour**

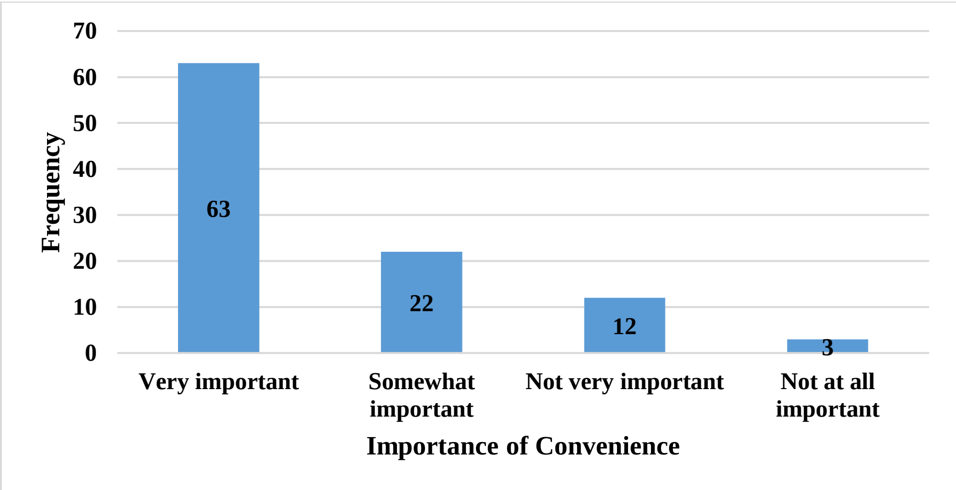
| Purchasing Behaviour | Frequency | Percentage |
|---|---|---|
| Shortened decision-making | 51 | 51% |
| Increased research time | 28 | 28% |
| No impact | 17 | 17% |
| Other | 4 | 4% |
| **Total** | **100** | **100%** |




The distribution shows that 51% of respondents believe that a particular factor has shortened their decision-making process, indicating a significant impact on efficiency. In contrast, 28% report that it has increased their research time, suggesting a more deliberative approach. A smaller proportion (17%) feels that it has had no impact, while 4% cite other effects. Overall, the data suggests that the factor has a substantial influence on decision-making processes, with half of the respondents experiencing a streamlined process and others taking more time to research. This highlights the complex relationship between the factor and decision-making behaviours.

**Q.6: Importance of Convenience**

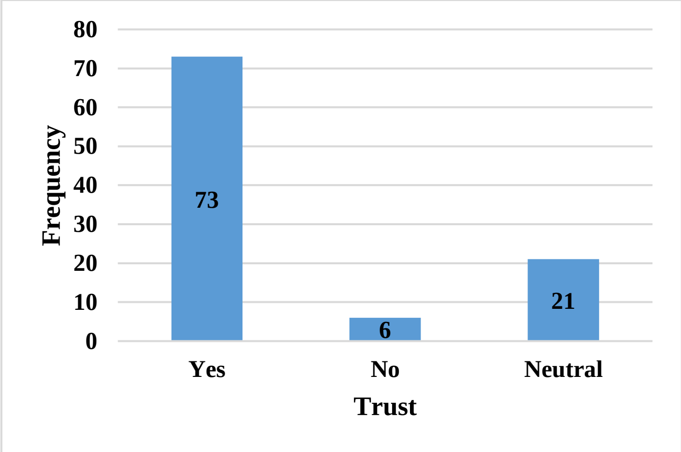
| Importance of Convenience | Frequency | Percentage |
|---|---|---|
| Very important | 63 | 63% |
| Somewhat important | 22 | 22% |
| Not very important | 12 | 12% |
| Not at all important | 3 | 3% |
| **Total** | **100** | **100%** |




The distribution shows that 63% of respondents consider a particular aspect "very important", indicating a strong emphasis on its significance. An additional 22% find it "somewhat important", suggesting a moderate level of importance. Only 12% consider it "not very important" and 3% "not at all important". This suggests that the vast majority (85%) of respondents value this aspect, highlighting its crucial role in their decision-making or evaluation process. The high importance assigned to this aspect underscores its potential impact on behaviour, satisfaction, or outcomes.

**Q.7: Trust in Platforms**

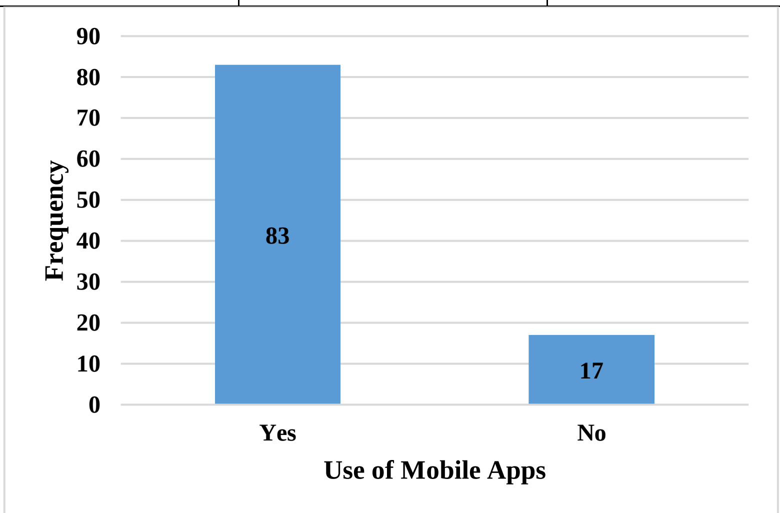
| Trust | Frequency | Percentage |
|---|---|---|
| Yes | 73 | 73% |
| No | 6 | 6% |
| Neutral | 21 | 21% |
| **Total** | **100** | **100%** |




The distribution shows that 73% of respondents answered "yes", indicating a strong affirmative response. In contrast, 6% responded with "no", while 21% remained neutral. The overwhelming majority (73%) suggests a high level of agreement, trust, or satisfaction with the particular aspect being measured. The relatively small proportion of "no" responses indicates some level of disagreement or dissatisfaction. The neutral responses (21%) may indicate ambiguity or a lack of strong opinion. Overall, the data suggests a predominantly positive sentiment towards the aspect in question.

**Q.8: Use of Mobile Apps**

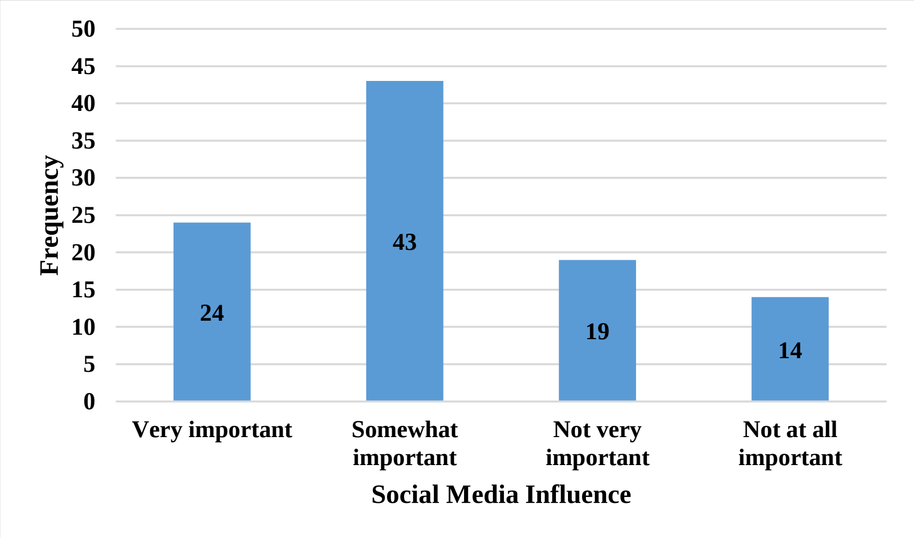
| **Use of Mobile Apps** | **Frequency** | **Percentage** |
|---|---|---|
| Yes | 83 | 83% |
| No | 17 | 17% |
| **Total** | **100** | **100%** |




The distribution shows a strong affirmative response, with 83% of respondents answering "yes" and 17% responding with "no". This indicates a significant majority agreeing or confirming the particular statement or question. The large proportion of "yes" responses suggests a high level of acceptance, approval, or awareness. The relatively small proportion of "no" responses indicates some level of disagreement or lack of acceptance. The data suggests a predominantly positive response to the measured question or statement.

**Q.9: Importance of Social Media Influence**

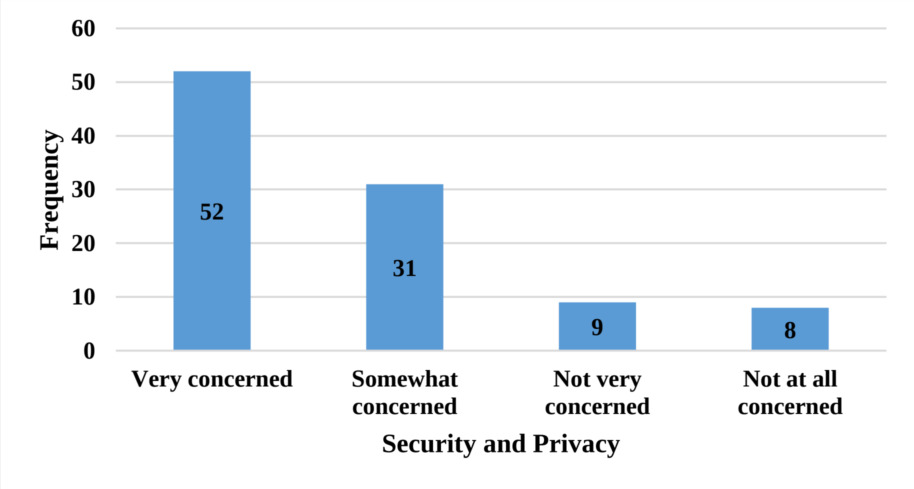
| Social Media Influence | Frequency | Percentage |
|---|---|---|
| Very important | 24 | 25% |
| Somewhat important | 43 | 40% |
| Not very important | 19 | 20% |
| Not at all important | 14 | 15% |
| **Total** | **100** | **100%** |




The distribution shows that 24% of respondents consider the aspect "very important", while 43% find it "somewhat important", indicating a combined 67% of respondents attach significance to this aspect. Meanwhile, 19% consider it "not very important" and 14% "not at all important", totalling 33% who do not prioritise it. This suggests that while a majority recognize its importance, there is a notable proportion who do not. The data highlights a mixed perception of the aspect's importance, with a leaning towards it being seen as significant by most respondents.

**Q.10: Concern About Security and Privacy**

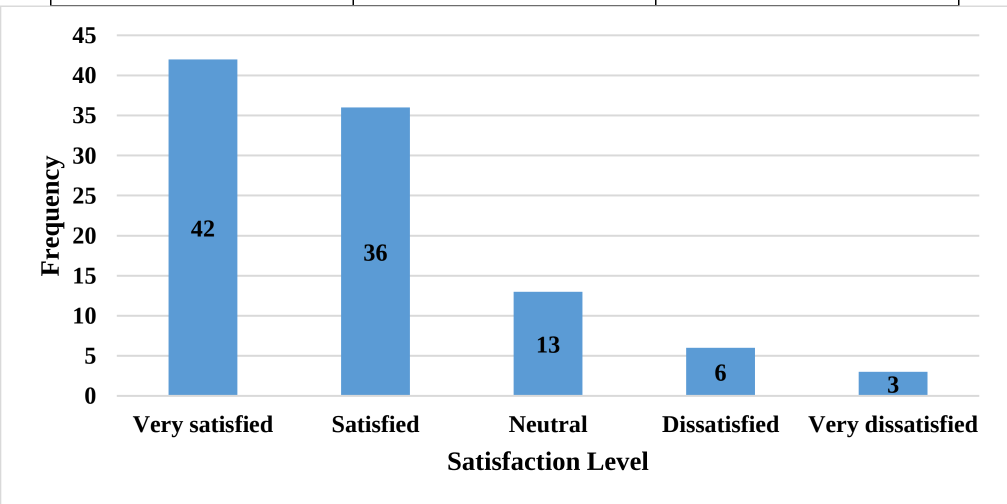
| Security and Privacy | Frequency | Percentage |
|---|---|---|
| Very concerned | 52 | 52% |
| Somewhat concerned | 31 | 31% |
| Not very concerned | 9 | 9% |
| Not at all concerned | 8 | 8% |
| **Total** | **100** | **100%** |




The distribution shows that 52% of respondents are "very concerned", indicating a high level of worry or apprehension. An additional 31% are "somewhat concerned", suggesting a moderate level of concern. This means that a significant majority (83%) of respondents express some level of concern. In contrast, 9% are "not very concerned" and 8% are "not at all concerned", indicating a smaller proportion of less worried respondents. Overall, the data suggests a high level of concern among respondents, with most expressing strong or moderate worry about the issue.

**Q.11: Satisfaction with Online Shopping**

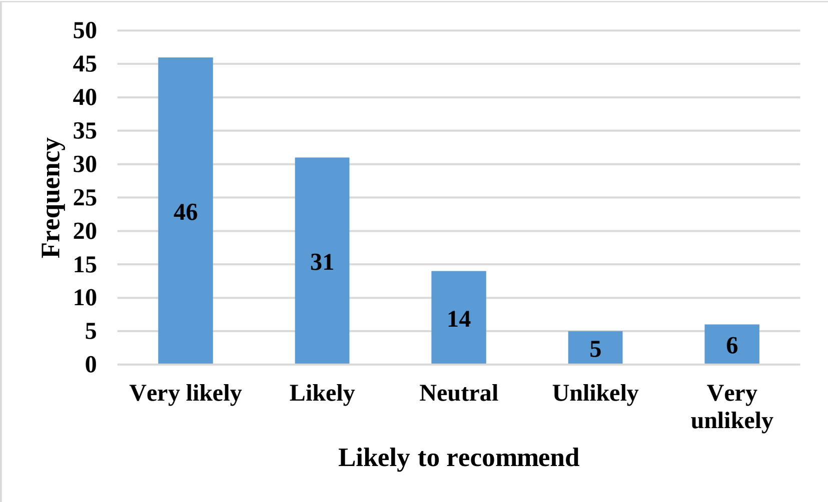
| Satisfaction Level | Frequency | Percentage |
|---|---|---|
| Very satisfied | 42 | 42% |
| Satisfied | 36 | 36% |
| Neutral | 13 | 13% |
| Dissatisfied | 6 | 6% |
| Very dissatisfied | 3 | 3% |
| **Total** | **100** | **100%** |




The distribution shows that 42% of respondents are "very satisfied" and 36% are "satisfied", indicating a combined 78% of respondents express overall satisfaction. A smaller proportion (13%) remain "neutral", while 6% are "dissatisfied" and 3% are "very dissatisfied". This suggests that a significant majority of respondents are pleased, with only a small minority expressing discontent. The high satisfaction rate indicates a positive experience or outcome, while the small dissatisfied group highlights areas for potential improvement. Overall, the data suggests a predominantly positive sentiment.

**Q.12: How likely are you to recommend an e-commerce platform to friends and family?**

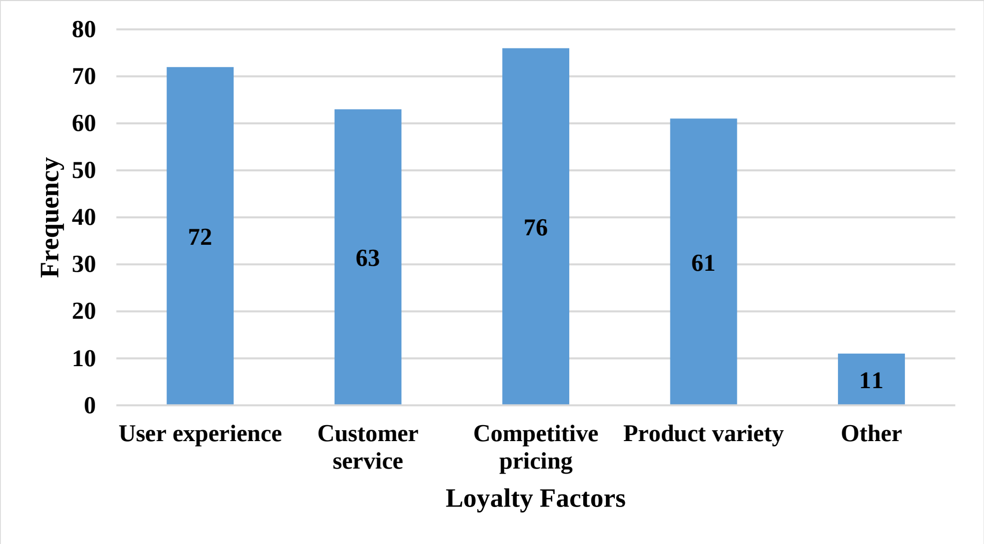
| Likely to recommend | Frequency | Percentage |
|---|---|---|
| Very likely | 46 | 46% |
| Likely | 31 | 31% |
| Neutral | 14 | 14% |
| Unlikely | 5 | 5% |
| Very unlikely | 6 | 6% |
| **Total** | **100** | **100%** |




The distribution shows that 46% of respondents consider something "very likely" and 31% think it's "likely", combining for 77% who lean towards a positive probability. In contrast, 14% remain "neutral", while 5% find it "unlikely" and 6% "very unlikely". This suggests a strong inclination towards a positive outcome or expectation among most respondents. The data indicates a high level of confidence or optimism, with a small minority expressing doubt. Overall, the responses suggest a predominantly positive outlook or anticipation.

**Q.13: What factors contribute to your loyalty to an e-commerce platform? (Select all that apply)**

| Loyalty Factors | Frequency | Percentage |
|---|---|---|
| User experience | 72 | 72% |
| Customer service | 63 | 63% |
| Competitive pricing | 76 | 76% |
| Product variety | 61 | 61% |
| Other | 11 | 11% |




The distribution shows that competitive pricing (76%) is the most influential factor, followed closely by user experience (72%) and customer service (63%). Product variety (61%) is also significant, while other factors account for 11%. This suggests that respondents prioritise value, ease of use, and support when making decisions. The high importance assigned to competitive pricing highlights its crucial role in attracting and retaining customers. The data indicates that businesses should focus on offering competitive prices, enhancing user experience, and providing quality customer service to meet customer needs and stay competitive.

**Conclusion**

This research paper takes a closer look at e-commerce and how people behave when shopping online, with a focus on understanding their digital shopping habits. By collecting first-hand data and carefully analysing it, the study aims to shed light on what drives people's online buying decisions and how the e-commerce world is changing. The insights gained are meant to help e-commerce businesses fine-tune their strategies, build stronger connections with customers, and succeed in today's fast-moving digital marketplace.

**Suggestions/Recommendations:**

This research paper explores e-commerce and digital shopping habits, revealing key insights into consumer behaviour. The study finds that convenience, competitive pricing, and user-friendly interfaces significantly influence online purchasing decisions. E-commerce has a substantial impact on consumer behaviour, with many respondents indicating that it shortens their decision-making process. Trust in e-commerce platforms is crucial, and demographic differences exist, with younger consumers being more active in online shopping. The findings suggest that businesses should prioritize user experience, competitive pricing, and customer service to attract and retain customers. Additionally, mobile optimization is essential, given the high usage of mobile apps for shopping. By focusing on these areas, e-commerce businesses can enhance their strategies and succeed in the competitive digital marketplace.

**Scope for Further Study:**

Further study can explore various aspects of e-commerce and digital shopping habits, such as cross-cultural comparisons, the impact of emerging technologies like AI and blockchain, and the relationship between e-commerce and sustainability. Additionally, researchers can investigate the influence of social media influencers, digital payment systems, and personalization strategies on consumer behaviour.

Other potential areas of study include consumer trust and security concerns, omnichannel retailing, and the effectiveness of recommendation systems. By examining these topics, researchers can provide valuable insights for businesses to enhance their e-commerce strategies and better serve their customers in an ever-evolving digital landscape.

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# TREND ANALYSIS OF CORPORATE SOCIAL RESPONSIBILITY (CSR) EXPENDITURE IN THE TEXTILES SECTOR: EVIDENCE FROM NIFTY 500 COMPANIES (2014–2024)

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***Abstract***

*This research examines the progression of Corporate Social Responsibility (CSR) investments among textile firms listed in the NIFTY 500 index, concentrating on a decade spanning from FY 2014–15 to FY 2023–24. The goal of this study is to identify and evaluate the trends in CSR expenditure during this timeframe and determine if the identified patterns exhibit statistical significance. With the growing focus on corporate responsibility and sustainable practices, this analysis offers relevant insights into the changing landscape of CSR involvement within the Indian textile industry. To accomplish these aims, the research utilizes a blend of visual analysis and the Mann-Kendall trend test. The Mann-Kendall test, a statistical technique that doesn't assume a normal distribution, is particularly effective for identifying monotonic trends within time-series data. This analysis relies on secondary data sourced from corporate disclosures, such as annual reports, regulatory filings, and other trustworthy public materials. The observed upward trend suggests an increasing and intentional dedication to CSR, likely influenced by compliance with the Companies Act of 2013, a growing awareness of ESG issues, and the reputational advantages linked to ongoing CSR efforts. These insights provide significant implications for policymakers, business leaders, and scholars aiming to comprehend the development and influence of CSR in a key sector of the Indian economy.*

***Keywords:*** *CSR expenditure, NIFTY 500, Textiles sector, Mann-Kendall test, Trend analysis.*

## Introduction

Corporate Social Responsibility (CSR) signifies a company's voluntary dedication to function in a way that is economically, socially, and environmentally sustainable, while taking into account the interests of diverse stakeholders such as employees, communities, customers, and the environment. It extends beyond merely complying with legal requirements and encompasses initiatives that enhance social welfare, including education, healthcare, environmental protection, and rural development. In India, CSR received formal acknowledgment with the passage of the Companies Act in 2013. Section 135 of this Act requires eligible companies to allocate at least 2% of their average net profits from the preceding three years towards CSR initiatives, thereby establishing India as one of the pioneering countries to enforce CSR through legislation. The NIFTY 500 index includes the leading 500 corporations listed on India’s National Stock Exchange (NSE), encompassing key sectors of the economy. It acts as a holistic benchmark for corporate performance in India and provides an extensive perspective on industry practices, including corporate social responsibility (CSR). This research specifically targets textile firms that are included in the NIFTY 500 index. The textile sector, being fundamental to India's economy, serves as a major source of employment while also having significant environmental and social repercussions. Examining CSR trends within this industry is essential for understanding how businesses are integrating their operations with broader sustainability objectives. The research spans a decade from the Financial Year (FY) 2014–15 to FY 2023–24, focusing on the aftermath of CSR legislation in India. Its objective is to pinpoint trends in CSR spending and evaluate their statistical significance. To accomplish this, the study utilizes the Mann-Kendall trend test, a non-parametric statistical method commonly applied for identifying monotonic trends in time-series data. The findings of this research offer insights into the changing CSR practices of prominent textile firms and add to the conversation regarding sustainable and responsible corporate conduct.

**Objectives**

The objectives of the present study are

● To analyze the trend in CSR expenditure by textile companies in the NIFTY 500 index from FY 2014–15 to FY 2023–24

● To statistically test the significance of the observed trend using the Mann-Kendall trend test.

**Hypothesis**

To test the presence of a statistically significant trend in CSR expenditure, the following hypotheses were formulated:

Null Hypothesis ($H_0$): There is no significant positive trend in the CSR expenditure of NIFTY 500 textile companies over the period of study.

Alternative Hypothesis ($H_1$): There is a significant positive trend in the CSR expenditure of NIFTY 500 textile companies over the period of study.

**Research Design**

The present study adopts a quantitative research methodology, emphasizing a longitudinal trend analysis approach to investigate corporate social responsibility (csr) expenditure patterns over a ten-year period, from financial year (fy) 2014–15 to fy 2023–24. Quantitative research enables the objective measurement and analysis of numerical data, making it an ideal approach for studying trends in financial metrics like csr spending. The longitudinal design of the study allows the researcher to monitor changes over time, identify recurring patterns, and assess the statistical significance of observed trends.

**Data Collection Sources:**

The study is solely reliant on secondary data, which was meticulously gathered from various reliable and publicly available sources to guarantee transparency, uniformity, and precision. The data for csr expenditure can be obtained from:

● The companies provide annual reports that offer comprehensive information on their csr policies, budgets, and actual expenditures.

● The company submitted regulatory filings to both the national stock exchange (nse) and the Bombay stock exchange (bse).

● The Ministry of Corporate Affairs (MCA) maintains records, especially those related to compliance with CSR (Corporate Social Responsibility) mandates, through filings.

● Many companies include sustainability or corporate social responsibility (csr) reports on their websites as part of their investor relations and communication with stakeholders.

● Well-known financial databases like prowess, bloomberg, and reuters, which offer cross-verification and standardized financial data for comparative analysis.

The multi-source approach strengthens the credibility and reliability of the data, reducing discrepancies or inconsistencies that may arise from relying on a single platform.

**Sampling Design:**

The sampling method used in the study is census-based and non-probabilistic, encompassing all textile companies featured in the nifty 500 index throughout the study period. This method guarantees a thorough representation of the sector and avoids sampling bias by taking into account the entire population of interest. As a result, the findings are representative of the broader csr practices within leading textile firms in India. The last sample comprises textile firms that have been consistently included in the nifty 500 index throughout the study period and have publicly available csr data. This approach guarantees a focused analysis, precision, and complete data, which are crucial for making accurate conclusions..

| Company Name | ISIN Code |
|---|---|
| Alok Industries Ltd. | INE270A01029 |
| K.P.R. Mill Ltd. | INE930H01031 |
| Lux Industries Ltd. | INE150G01020 |
| Page Industries Ltd. | INE761H01022 |
| Raymond Ltd. | INE301A01014 |
| Trident Ltd. | INE064C01022 |
| Vardhman Textiles Ltd. | INE825A01020 |
| Welspun Living Ltd. | INE192B01031 |

Source: Data available on NSE website as on 17th March, 2022

**Data Analysis Techniques:**

For the purpose of analysis, the study utilizes both descriptive and inferential statistical tools.

- Visual aids like graphs, line charts, percentages, and frequency tables are employed to illustrate the pattern in csr expenditure over the ten-year period and to present the data in a concise and easily understandable manner.
- The mann-kendall trend test, a commonly utilized non-parametric test, is utilized to assess the statistical significance of any monotonic trend detected in the csr expenditure data. This test is especially effective for analyzing time-series data that may not follow a normal distribution and is particularly useful for detecting trends without assuming a linear relationship.

**Scope and limitation of the study**

This research examines the changes in corporate social responsibility (csr) spending in the textile industry of the nifty 500 companies from 2014 to 2024, with a focus on identifying growth patterns through the mann-kendall trend test and graphical analysis. Nevertheless, the study is confined to the textile industry, preventing comparisons with other sectors. The report analyzes the patterns of csr spending but does not evaluate its financial or social consequences. Furthermore, depending on secondary data sources can lead to variations in the accuracy and reliability of the reported quality.

**Findings and Interpretations**

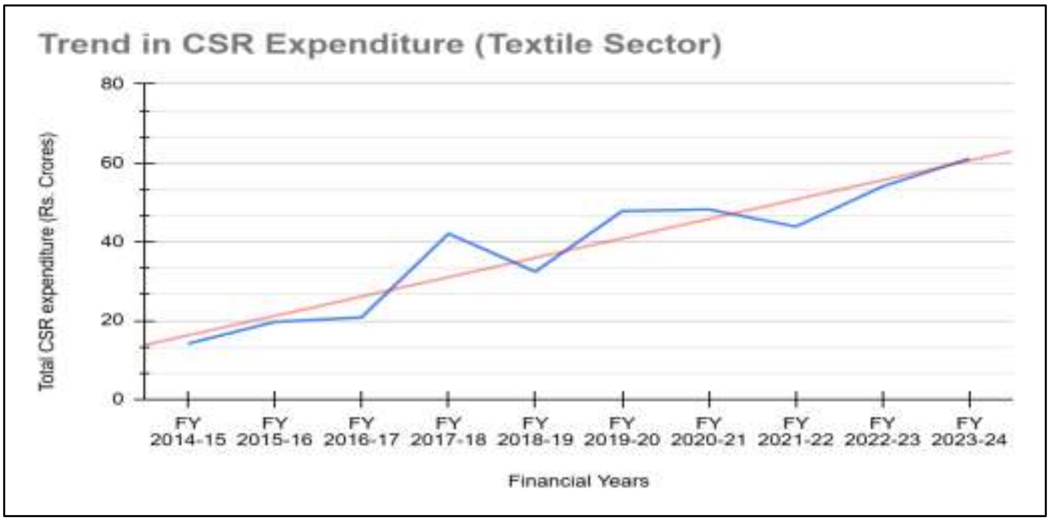
The study encompasses all textile companies featured in the nifty 500 index, guaranteeing a thorough representation of the sector. The final sample consists of eight companies: Alok Industries ltd., K.P.R. Mill ltd., Lux Industries ltd., Page Industries ltd., Raymond ltd., Trident ltd., Vardhman Textiles ltd., and Welspun living ltd. The expenditure data for CSR from 2014 to 2024 was gathered from annual reports, NSE/BSE filings, and MCA disclosures. By utilizing census data, this method guarantees precise analysis of csr spending trends within the textile industry.

Mann-kendall trend test on csr expenditure (textiles sector): to examine whether there is a statistically significant trend in the corporate social responsibility (csr) expenditure of nifty 500 companies in the textiles sector over the period 2014–15 to 2023–24, the mann-kendall trend test was employed. This non-parametric test is appropriate for detecting monotonic trends in time series data without making any assumptions about its normal distribution. The total csr expenditure values for ten fiscal years were examined. The test results showed a statistically significant upward trend in csr expenditure throughout the study period. Kendall's tau coefficient (τ) was 0.733, suggesting a strong positive relationship between time and csr spending. The test statistic (s) was 28, and the p-value was 0.0087, which is significantly lower than the commonly accepted significance level of 0.05. After analyzing the data, it is concluded that there is a significant upward trend in the expenditure on csr among textile companies in the nifty 500 index over the study period.

**Summary of Test Statistics:**

| Test Statistic | Value |
|---|---|
| Trend | Increasing |
| Kendall's Tau | 0.733 |
| S | 28 |
| p-value | 0.0087 |
| Significance | Yes ($p < 0.05$) |

**Graphical Analysis of CSR Expenditure (Textiles Sector):** The line graph depicts the fluctuation in csr expenditure of 500 textile companies over the ten-year period from fy 2014–15 to fy 2023–24. Each data point on the graph represents the total csr spending by companies in the textiles sector for the corresponding financial year. A clear upward trend is visible, with csr expenditure increasing from ₹14.14 crores in fy 2014–15 to ₹61.12 crores in fy 2023–24. The dotted trendline fitted to the data confirms a positive linear trend, supporting the statistical results of the mann-kendall test.This consistent growth over time indicates that textile companies have increasingly prioritized csr initiatives, possibly in response to regulatory requirements, stakeholder expectations, or enhanced corporate sustainability goals.




**Inference Analysis:** The inference drawn from the mann-kendall trend test and graphical visualization is that textile companies have been progressively investing more resources in csr initiatives over the past decade. This pattern may be due to various causes such as:

Adherence to the csr mandate outlined in the companies act, 2013.

Increased consciousness and responsibility towards environmental and social governance (esg) factors. The positive impact on a company's reputation and the trust it gains from stakeholders as a result of consistently implementing csr initiatives.

The upward trend indicates not only compliance but also a strategic shift in incorporating csr as a fundamental element of business operations. The statistical significance of the trend validates that this growth is not a result of random fluctuations but rather signifies a meaningful and intentional increase in csr engagement.

**Conclusion**

The analysis of corporate social responsibility (csr) expenditure in the textile sector, using the mann-kendall trend test, reveals a statistically significant upward trend in csr spending among nifty 500 textile companies from fy 2014–15 to fy 2023–24. The test results indicate a strong positive correlation, validating the existence of a significant upward trend in csr expenditure throughout the study period.

Visual examination of the data reinforces these conclusions, demonstrating a steady rise in csr expenditure over the ten-year period. This steady growth suggests that textile companies have increasingly prioritized csr initiatives, likely driven by factors such as compliance with the csr mandate under the companies act, 2013, heightened awareness of environmental and social governance (esg) factors, and the reputational benefits associated with csr.

The results suggest a significant transformation in the textile industry, where corporate social responsibility has transitioned from a mere requirement to an integral part of the company's overall functioning. The statistical significance of the trend indicates that the increase in csr expenditure is a deliberate outcome of companies' efforts to align with broader sustainability goals and meet the expectations of various stakeholders.

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# GREENWASHING PREVENTION IN CORPORATE GOVERNANCE USING A.I.

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***Abstract***

*This research explores possibilities about how the overhyped benefits of Artificial Intelligence can help prevent greenwashing in corporate governance. Based on interviews and a review of existing information, the study looks at the problem of companies making misleading environmental claims while not taking real environmental action. Findings show that many companies focus more on preparing documents and reports to appear environmentally friendly rather than genuinely working towards environmental goals. This highlights a gap between what companies say and what they actually do. The study suggests that AI can be a useful tool to improve transparency, check the accuracy of environmental data, help identify deceptive practices and suggest remedial methods to cope up with the prevailing issues. By using AI, it may be possible to move companies from just creating paperwork to taking serious and meaningful steps for the environment.*

***Keywords:*** *Greenwashing, Artificial Intelligence, Corporate Governance, Sustainability etc.*

## Introduction

In Indian business environments, the concept of sustainability has become increasingly prominent, leading to greater scrutiny of corporate environmental claims. A significant challenge in this landscape is greenwashing, a practice where companies present a misleadingly positive image of their environmental performance. This can involve exaggerating green efforts or selectively disclosing information to appear more sustainable than they are in reality. Such deceptive tactics erode consumer trust and can undermine genuine progress towards environmental goals.

Corporate governance structures are traditionally expected to ensure accountability and transparency in business operations. However, existing governance mechanisms and external checks, such as ESG assurance, sometimes fall short in effectively preventing greenwashing, particularly in contexts with weaker regulatory oversight. The complex and often unstructured nature of environmental, social, and governance (ESG) data further complicates efforts to audit and compare company performance accurately. Against this backdrop, the potential of Artificial Intelligence (AI) as a transformative tool in enhancing transparency and combating deceptive environmental practices is being recognized. AI technologies, including machine learning and natural language processing, offer capabilities to analyze vast amounts of corporate disclosures and identify patterns that may indicate greenwashing. Despite this potential, the empirical application of AI in greenwashing detection remains limited.

This research investigates the application of AI in preventing greenwashing within corporate governance frameworks. Drawing upon insights gathered through interviews and an analysis of secondary data, a key finding that emerged is the tendency of many companies to prioritize the preparation and maintenance of documentation over implementing substantive environmental actions. This suggests a focus on the symbolic aspects of environmental responsibility rather than a deep commitment to actual ecological improvement. This study seeks to explore how AI can bridge this gap, moving beyond superficial reporting to foster genuine environmental accountability in corporate practices.

## Literature Review

The increasing global focus on corporate sustainability and ethical conduct has brought the deceptive practice of greenwashing into sharp relief. Simultaneously, the rapid advancements and integration of

Artificial Intelligence (AI) across industries introduce new dimensions to corporate disclosure, transparency, and potential misrepresentation. This literature review synthesizes insights from recent research to explore the multifaceted nature of greenwashing, the burgeoning concept of "machinewashing," and the complex role that AI plays – both as a potential tool for detection and mitigation, and as a domain susceptible to new forms of deception. Drawing upon a curated selection of research articles, this review aims to provide a comprehensive overview of these interconnected themes, highlighting theoretical underpinnings, practical challenges, and future research avenues.

**Understanding the Landscape of Greenwashing**

Greenwashing is widely defined as a deceptive corporate strategy involving misleading claims or disclosures about a firm's environmental or sustainability performance to create a favorable public image that does not align with its actual practices (Ren, Hu, Sun, & Zhou, 2025; Zervoudi, 2025; Purnamasari, 2024). This practice undermines genuine sustainability efforts, erodes stakeholder trust, and can distort markets (Zervoudi, 2025). The literature highlights various motivations driving firms to engage in greenwashing, often explained through economic and organizational theories. Neoclassical economic theory suggests it can be a rational choice when external supervision is weak and perceived benefits outweigh costs. Information economics points to asymmetric information and cognitive biases among stakeholders as factors contributing to its persistence, while institutional economics attributes it to lax external regulatory mechanisms (Bu, 2024). Legitimacy theory and stakeholder theory are frequently used frameworks to understand why firms employ greenwashing – to maintain societal approval, manage stakeholder expectations, and respond to regulatory and market pressures (Ren et al., 2025; Frendy, Oshika, & Koike, 2024). Firms may selectively overstate their environmental performance or make symbolic claims to satisfy key groups and avoid scrutiny (Frendy, Oshika, & Koike, 2024).

The practice of greenwashing manifests in numerous ways. It can involve exaggerated achievements, vague language, selective disclosure, and associations with "green" concepts without substantive action (Bodijanto & Delina, 2024; Gorovia & Makrominas, 2025; Cherono, Miah, Rudnak, & Csaba, 2025). The challenge of verifying corporate environmental claims is exacerbated by ambiguous language and the sheer volume and complexity of disclosures (Bodijanto & Delina, 2024). Greenwashing is prevalent across various sectors, including energy, fashion, and food, often involving deceptive labeling and unverified claims, particularly within complex global supply chains where governance and regulatory frameworks can be weak or inconsistent (Bodijanto & Delina, 2024; Cherono et al., 2025). The difficulty in assessing actual performance is further compounded by inconsistencies in third-party ESG ratings (Gorovia & Makrominas, 2025).

Prior studies have explored the drivers of greenwashing, such as weak environmental performance, financial stress, and regulatory environments (Ren et al., 2025). The harmful effects include damage to trust, market integrity, and social welfare (Ren et al., 2025). While initially discussed within the context of environmental claims, the concern has expanded to encompass broader Environmental, Social, and Governance (ESG) disclosures, where firms may provide extensive data to project a positive image without implementing substantive practices (Sun, 2023). The evolution from Corporate Social Responsibility (CSR) to more structured ESG criteria was intended to enhance corporate accountability, but greenwashing remains a significant challenge (Zervoudi, 2025).

**From Greenwashing to Machinewashing: A New Frontier of Deception**

As AI and digital technologies become increasingly integrated into corporate operations and services, a new, analogous form of deceptive practice is emerging: machinewashing or digital washing. Drawing on the well-established domain of greenwashing as a foundational framework, Seele and Schultz (2022) conceptualize machinewashing as a practice where organizations present misleading information about their ethical use of AI to gain reputational or regulatory advantages. This mirrors greenwashing's use of symbolic environmental claims but applies to the ethical dimension of AI (Seele & Schultz, 2022; Bernini, Ferretti, Gonnella, & Rosa, 2025; Fioravante, 2024).

The rise of "ethics-washing" in AI reflects growing concerns over superficial ethical practices within the tech industry (Seele & Schultz, 2022; Fioravante, 2024). Similar to greenwashing, this involves symbolic ethical gestures without substantive internal accountability (Fioravante, 2024). Using a reasoning-by-analogy approach, Seele and Schultz (2022) identify overlapping theoretical underpinnings between greenwashing and machinewashing, such as agency theory, legitimacy theory, and symbolic management. However, they also highlight unique complexities of machinewashing stemming from the nature of AI itself, including the opacity of algorithms, the scalability of AI systems, and the current lack of comprehensive regulatory oversight (Seele & Schultz, 2022).

Bernini, Ferretti, Gonnella, and Rosa (2025) build on this concept, framing machinewashing under the lens of Corporate Digital Responsibility (CDR). They highlight the growing ethical risks of AI and the lack of clarity in implementing digital ethics (Bernini et al., 2025). Machinewashing, in this context, refers to misleading practices where firms claim ethical responsibility in their use of digital technologies without substantive ethical behavior (Bernini et al., 2025). This emphasizes the need for transparency and stakeholder accountability in AI-driven digital transformation, arguing that firms must move beyond symbolic gestures ("digital talk") to establish trustworthy digital practices ("digital walk") (Bernini et al., 2025; Fioravante, 2024). Fioravante (2024) further argues that the traditional business case for CSR, focused on profitability and risk mitigation, is insufficient for the ethical challenges of AI, advocating for a "moral case" rooted in human dignity and well-being, urging a shift from strategic ethics to a deep, integrated commitment to human-centered AI.

**The Double-Edged Sword: AI's Role in Greenwashing**

Artificial Intelligence is increasingly recognized for its potential to revolutionize various domains, including sustainability and finance. The literature explores AI's capacity to either facilitate or combat corporate greenwashing, presenting a complex interplay.

On one hand, AI and related technologies offer powerful tools for detecting and mitigating greenwashing. Researchers propose that AI can enhance environmental data accuracy, strengthen audits, and reduce information asymmetry, providing a new pathway to curbing deceptive practices and promoting authentic sustainability reporting (Ren et al., 2025; Tian & Shi, 2025). Specifically, AI can help manage the volume and complexity of corporate disclosures that overwhelm traditional monitoring approaches (Bodijanto & Delina, 2024). Techniques such as natural language processing (NLP) can analyze corporate reports to identify vague or misleading language indicative of greenwashing (Bodijanto & Delina, 2024; Gorovia & Makrominas, 2025). Machine learning frameworks can be optimized to predict corporate ESG greenwashing behaviors, aiding regulatory agencies in monitoring and enhancing market transparency (Fanlong, 2025). AI can also improve ESG scoring accuracy and enhance the credibility of green finance instruments like green bonds through real-time data integration and sentiment analysis (Joseph, 2025). Moodaley and Telukdarie (2023) highlight AI and machine learning's transformative potential in analyzing large volumes of text and identifying patterns in corporate reporting, suggesting a conceptual framework for using AI to enhance accountability in sustainability reporting.

However, the application of AI in combating greenwashing is not without its challenges and limitations. Researchers emphasize issues such as biased datasets, the lack of standardization in reporting, and the continued need for human oversight in AI-driven detection systems (Bodijanto & Delina, 2024). Furthermore, while AI offers promise, empirical applications of AI specifically for detecting greenwashing remain limited in the existing literature (Moodaley & Telukdarie, 2023). The very opacity of some AI algorithms (Seele & Schultz, 2022) could potentially hinder transparency rather than enhance it if not implemented carefully.

Moreover, the concept of machinewashing itself suggests that AI is not just a tool to analyze corporate claims but can also be the *subject* of those claims, potentially opening new avenues for deception regarding the ethical and responsible use of technology (Seele & Schultz, 2022; Bernini et al., 2025). Tian and Shi (2025) explore how AI can influence corporate behavior, acting as either a facilitator or inhibitor of greenwashing through mechanisms like internal process optimization and external signaling, influenced by factors like green innovation, imitation pressure, and financial pressure.

**Governance, Transparency, and the Path Forward**

Addressing both greenwashing and the emerging challenges of machinewashing requires robust governance mechanisms and a commitment to transparency. ESG assurance is increasingly recognized as a tool for mitigating greenwashing by improving the credibility of sustainability disclosures and reducing information asymmetries (Bu, 2024). Despite its potential, the adoption of ESG assurance remains relatively low, particularly in emerging markets (Bu, 2024).

The role of digital transformation (DT) as a governance tool against ESG greenwashing is also explored. While DT can potentially enhance corporate transparency, innovation, and stakeholder trust, it might also present risks, such as crowding out productive resources or being used for policy arbitrage (Sun, 2023). The effectiveness of DT in mitigating ESG greenwashing can be mediated by factors like green technology innovation and information asymmetry reduction, and moderated by investor attention (Sun, 2023).

Stakeholder engagement and pressure play a crucial role in driving corporate accountability (Ren et al., 2025; Frendy, Oshika, & Koike, 2024; Shahrokhi, 2022). However, the difficulty in assessing actual CSR performance due to report characteristics like volume, positivity, and readability underscores the need for improved analytical tools (Gorovia & Makrominas, 2025). External factors such as regulatory advancements are seen as crucial solutions to mitigate greenwashing and enhance corporate accountability (Zervoudi, 2025), particularly in regions like the European Union with frameworks like SFDR, CSRD, and CSDDD. For global supply chains, standardized ESG frameworks and greater NGO involvement are highlighted as necessary steps (Cherono et al., 2025).

Ultimately, the literature suggests a need to move beyond superficial ethical practices towards a deep, integrated commitment. This involves establishing transparent, context-aware, and standardized reporting frameworks, potentially embedded with AI-driven detection systems, while acknowledging their limitations and the need for human oversight (Bodijanto & Delina, 2024). It also involves recognizing that corporate responsibility in the digital age extends beyond a simple business case, demanding a moral commitment rooted in human values and well-being, particularly concerning AI ethics (Fioravante, 2024). Developing methodologies to measure practices like machinewashing, such as the proposed MWindex (Bernini et al., 2025), is crucial for operationalizing detection and holding firms accountable for the gap between their "digital talk" and "digital walk."

While AI holds considerable promise as a powerful tool for enhancing transparency, improving data accuracy, and detecting deceptive environmental claims, its application requires careful consideration of limitations such as data bias and standardization issues. Furthermore, the potential for AI itself to be the subject of misleading ethical claims highlights the critical need for robust corporate digital responsibility and governance frameworks. Effective mitigation of both greenwashing and machinewashing necessitates a combination of strong internal governance, credible external assurance, supportive regulatory environments, active stakeholder engagement, and a fundamental shift towards authentic commitment rather than symbolic gestures. Future research should continue to explore the empirical application of AI in detecting greenwashing, refine measurement tools for concepts like machinewashing, and examine the interplay between digital transformation, governance, and corporate ethical conduct in the age of AI.

**Methodology**

I. Type of research: Qualitative research

II. Research Question: The potential of Artificial Intelligence (AI) in preventing greenwashing within corporate governance frameworks in the Indian business environment.

III. Method: Integrated (both primary and secondary data to be used).

IV. Research Design: The research design is primarily exploratory and descriptive.

V. Data Collection:

(A)Primary Data (via Interviews): Semi-structured interviews were conducted to gather in-depth perspectives directly from industry representatives.

Sampling: Participants from 21 different industries in India, encompassing both public and private sectors. The industries were selected to represent key sectors with significant environmental and social footprints and varying levels of regulatory and public scrutiny regarding their ESG performance.

Interview Instrument: A set of five key questions was used to guide the interviews. These questions were designed to elicit information regarding the companies' ESG reporting practices, their understanding and experiences with greenwashing, current methods employed to prevent deceptive environmental claims, their awareness and current use of AI or automation in ESG management, and their perceived potential and challenges of leveraging AI for greenwashing prevention and enhancing transparency.

Procedure: Interviews were conducted with representatives deemed knowledgeable about their company's ESG activities and corporate governance. The responses were carefully captured and documented for subsequent analysis. The aim was to gain qualitative insights into the practical realities and perspectives from the ground.

(B)Secondary Data: Existing information was reviewed to provide a foundational understanding and contextualize the primary data findings.

Sources: Secondary data was drawn from academic research papers (cited), industry reports(from cited papers), corporate sustainability disclosures(accessed online), and some relevant publications pertaining to greenwashing, Artificial Intelligence, corporate governance, and sustainability. The literature review section reflects the range of secondary sources consulted.

Purpose: The secondary data analysis served to establish the theoretical background of greenwashing and the potential of AI, identify existing challenges and advancements in the field, and provide a broader context for interpreting the interview responses. It helped in understanding the gap between current practices and the potential offered by AI.

VI. Integration of Findings: The themes and insights derived from the interview data were then integrated with the findings from the secondary data analysis. This allowed for a richer interpretation of the results, enabling the researchers to connect industry practices and perceptions with existing academic knowledge and broader trends. The integrated analysis facilitated the identification of areas where AI could potentially intervene to address the challenges highlighted by the industries and the literature.

VII. Ethical Considerations: Efforts were made to ensure the ethical conduct of the research. The purpose of the interviews was explained to the participants, and their voluntary participation was ensured. While specific personal identifiers are not included in the reporting of findings, the responses are presented in a manner that respects the general nature of the information shared by industry representatives.

**Discussion**

Greenwashing, the deceptive practice of companies making unsubstantiated environmental claims, poses a significant threat to genuine sustainability efforts and erodes stakeholder trust. Corporate governance mechanisms are crucial in ensuring accountability and transparency in corporate environmental performance. Recent advancements in Artificial Intelligence (AI) offer promising avenues for enhancing greenwashing prevention within corporate governance frameworks. However, the effective deployment of AI in this domain is not without its challenges, including a notable lack of standardized approaches and the need for greater research in specific regional contexts, particularly developing countries. Furthermore, the integration of AI necessitates careful consideration of regulatory solutions and a strong emphasis on ethical AI development and deployment. These challenges are particularly pertinent given the pressures faced by industries like the oil and gas sector in the context of climate change (Sony & Singh, 2023), which can incentivize companies to engage in greenwashing to manage public perception.

**AI in Fighting Greenwashing and the Lack of Standards**

AI possesses the capacity to analyze vast amounts of corporate data, including sustainability reports, marketing materials, and social media, to identify inconsistencies, vague language, and unsubstantiated environmental claims indicative of greenwashing. Natural Language Processing (NLP) and machine learning algorithms can detect patterns and discrepancies that are difficult for humans to identify manually (Monash Lens, 2024; Sustainability Directory, n.d.). AI-powered tools can cross-reference self-reported data with external, independent sources and real-time data from sensors and IoT devices to verify environmental performance (Monash Lens, 2024).

Despite the potential, a significant challenge lies in the lack of clear, standardized methods and frameworks for applying AI in greenwashing detection and prevention. The absence of consistent reporting standards for ESG information across industries and regions creates opacity and makes objective comparison difficult (Sustainability Directory, n.d.; Sun & Zhou, 2025). While AI can help streamline standardization by offering real-time verification across different frameworks, the current inconsistencies in implementation, data reporting methodologies, and audit procedures hinder AI's full potential (Sustainability Directory, n.d.). This lack of standardization limits the ability of AI models to be trained on uniform datasets and to provide universally comparable and reliable assessments of corporate green claims.

Research has begun to explore the impact of AI on corporate greenwashing, with studies by Tian and Shi (2025) suggesting that AI penetration can restrain greenwashing behavior, particularly when coupled with green innovation activities. A systematic literature review focusing on AI and machine learning applications in greenwashing detection also highlights the need for more robust and integrated methods for analyzing sustainability disclosures to ensure accuracy ("Greenwashing and Corporate Sustainability...", 2024). The effectiveness of AI is intrinsically linked to the quality and standardization of the data it analyzes.

**Regional Focus: The Need for Research in Developing Countries**

While greenwashing is a global issue, its dynamics and prevalence in developing countries warrant specific attention. These regions often face unique challenges, including weaker regulatory frameworks, lower public awareness, and less developed corporate governance structures, which can create fertile ground for deceptive environmental practices. Despite greenwashing being common in developing countries, it remains understudied compared to developed nations (Liang & Gao, 2025). Multidisciplinary research, such as that exploring various facets of corporate behavior and sustainability challenges (Sony, Gupta, & Manjengwa Newton, 2025), is essential to fully grasp these complexities in diverse global contexts.

Research on the impact of AI on corporate greenwashing has primarily focused on developed economies or specific large developing economies like China (Sun & Zhou, 2025; Tian & Shi, 2025). There is a critical need for more research in a wider range of developing countries to understand the specific manifestations of greenwashing in these contexts and to explore how AI can be effectively tailored and implemented to address these local challenges. Such research would contribute to developing context-specific AI solutions and regulatory approaches that are sensitive to the unique socio-economic and regulatory landscapes of these regions.

**Regulatory Solutions and Tech-Aided Audits**

Stricter global regulations are increasingly being recognized as essential for combating greenwashing. Initiatives like the European Union's Corporate Sustainability Reporting Directive (CSRD) represent a significant step forward by mandating comprehensive sustainability reporting and requiring external assurance on ESG data (CGI, n.d.; Greenomy, 2025; FinTech Global, 2025). The CSRD aims to standardize ESG reporting and increase transparency, making it easier to identify misleading claims (FinTech Global, 2025).

Technology, including AI, is poised to play a crucial role in facilitating compliance with such stringent regulations and enhancing the effectiveness of audits. AI-powered tools can assist auditors in analyzing large volumes of ESG data, identifying inconsistencies, and assessing the credibility of sustainability claims (Gupta, 2025; Greenomy, 2025). The transition under CSRD from limited to reasonable assurance for sustainability reporting by 2028 will necessitate more rigorous procedures and a greater reliance on advanced technologies for data analysis and verification (Greenomy, 2025).

Studies by Liu, Kou, Sun, and Zhu (2025) suggest that government regulations can significantly reduce corporate greenwashing, with green innovation acting as a key mediating mechanism. The integration of AI into regulatory oversight and auditing processes can strengthen this effect by providing regulators and auditors with powerful tools to detect non-compliance and verify reported information. This tech-aided approach can make audits more efficient, effective, and capable of handling the complexity of modern sustainability disclosures.

**Ethical AI in Greenwashing Prevention**

As firms increasingly leverage AI to enhance their sustainability reporting and combat greenwashing, the ethical implications of AI use become paramount. Treating ethical AI as a moral duty, rather than merely a public relations tool, is crucial for building trust and ensuring that AI is used responsibly in corporate governance.

The potential for AI to be a "double-edged sword" exists, as it could potentially be misused by unscrupulous companies to create more sophisticated and convincing forms of greenwashing through the generation of tailored, persuasive narratives (Monash Lens, 2024; 360info.org, 2024). This highlights the critical need for ethical guidelines and safeguards in the development and application of AI for greenwashing prevention.

Ethical AI in this context involves ensuring transparency in how AI models detect greenwashing, addressing potential biases in the data used to train these models, and maintaining human oversight in the interpretation of AI-generated insights (Inside Practice, n.d.). Companies must establish clear controls over AI-generated sustainability content and ensure that legal and ethical considerations are embedded in the AI development process (Inside Practice, n.d.).

Furthermore, the broader discussion around AI ethics and ESG suggests that ethical considerations in AI development are intrinsically linked to achieving sustainability and corporate responsibility goals (Publicis Sapient, n.d.). Companies that prioritize ethical AI practices are more likely to build user trust, avoid reputational damage, and ultimately contribute to genuine sustainability efforts (Publicis Sapient, n.d.). Integrating AI with corporate social responsibility (CSR) initiatives requires a commitment to transparency, fairness, and long-term corporate responsibility, ensuring that AI is used to genuinely improve environmental and social well-being (Pater, n.d.).

AI holds significant promise for enhancing greenwashing prevention in corporate governance by providing powerful tools for data analysis, inconsistency detection, and performance verification. However, realizing this potential requires addressing the current lack of standardized frameworks for AI application in this domain and increasing research efforts in understudied regions, particularly developing countries. The effectiveness of AI is also contingent upon the strengthening of regulatory solutions, such as the CSRD, and the integration of AI into tech-aided audit processes. Crucially, the deployment of AI must be guided by a strong ethical framework, ensuring that AI is used responsibly and transparently to foster genuine sustainability rather than facilitate more sophisticated forms of deception. Future research should focus on developing standardized methodologies for AI-driven greenwashing detection, exploring region-specific challenges and solutions, and establishing robust ethical guidelines for the use of AI in corporate sustainability and governance. Addressing the pressures on industries like oil and gas in the face of climate change also requires robust governance supported by effective, ethically deployed AI tools to prevent misleading environmental claims.

**Interview Reponses**

The interview responses from 21 Indian companies across government and private sectors reveal diverse perspectives on ESG (Environmental, Social, Governance) practices and the role of AI in sustainability efforts. In government-owned sectors, such as oil and gas, power transmission, mining, and heavy industries, ESG practices are deeply institutionalized, driven by regulatory mandates and public accountability. These organizations emphasize structured frameworks, often aligned with national policies, and publish detailed annual sustainability reports. For instance, public sector undertakings (PSUs) like Coal India and GAIL prioritize environmental compliance, worker safety, and community welfare, with transparency in reporting metrics such as emissions, water management, and land reclamation. Their ESG efforts are closely tied to their operational mandates, such as expanding clean energy infrastructure or mitigating environmental impacts in mining regions. Leadership in these sectors views ESG not merely as a compliance requirement but as a strategic responsibility, often citing global reporting standards like GRI (Global Reporting Initiative) to validate their commitments.

In contrast, private sector approaches to ESG vary significantly based on company size and industry. Large corporations, particularly in IT services, cement manufacturing, and FMCG (Fast-Moving Consumer Goods), adopt proactive ESG strategies influenced by investor expectations, client demands, and brand reputation. For example, a cement manufacturer highlighted efforts to reduce carbon footprints through alternative fuels and energy-efficient processes, supported by externally audited reports. Similarly, IT firms integrate ESG into global operations, tracking energy consumption in data centers and supply chain emissions. However, smaller private enterprises, such as textile units, leather tanneries, or family-run businesses, exhibit a more reactive approach. Their ESG efforts are often limited to basic compliance—managing wastewater, adhering to labor laws, or using eco-friendly materials—without formal reporting frameworks. A Kanpur-based leather company, for instance, admitted that environmental measures like effluent treatment plants are driven more by regulatory compulsion than voluntary commitment, reflecting a survival-oriented mindset rather than strategic sustainability goals.

The adoption of AI and automation tools for ESG management also diverges between sectors. Government entities express openness to AI, particularly for large-scale data collection, real-time monitoring, and predictive analytics. Organizations like NTPC (power) and BHEL (heavy engineering) see AI as a solution to streamline environmental data aggregation across sprawling operations, such as tracking emissions from coal plants or optimizing pollution control systems. A hydroelectric PSU mentioned exploring AI to analyze river water quality data, aiming to automate compliance reporting. Private sector interest in AI, however, is polarized. Large companies in cement, chemicals, and FMCG actively deploy AI for supply chain transparency, emissions forecasting, and resource optimization. A paints manufacturer, for example, uses AI to monitor volatile organic compounds (VOCs) in production. Conversely, smaller firms, especially in labor-intensive sectors like textiles or cleaning services, resist AI adoption due to cost constraints, skepticism about its relevance, or reliance on manual processes. A small fabricator bluntly stated, “AI is for big companies,” reflecting a perception gap where technology is seen as incompatible with hands-on, localized operations.

When questioned about AI identifying gaps in sustainability performance, government organizations generally welcomed such insights as opportunities for improvement. For instance, a mining PSU acknowledged that AI-driven findings on slow land reclamation progress would trigger technical reviews and corrective measures, aligning with their transparency commitments. Leadership in these sectors tends to prioritize data-backed problem-solving, viewing gaps as indicators for strategy refinement. Private companies, however, displayed mixed reactions. Larger firms, particularly those with ambitious sustainability targets, treat AI-generated feedback as a catalyst for internal audits and operational adjustments. A software services company noted that AI highlighting energy inefficiencies in data centers would prompt immediate corrective action. Smaller businesses, however, expressed anxiety. A textile unit feared AI exposing compliance lapses could lead to fines or production halts, pushing them to address flaws discreetly without public disclosure. This dichotomy underscores a broader trend: while large entities leverage AI for continuous improvement, smaller players perceive it as a risk to their operational stability.

Trust in AI’s capabilities also varies. Government sectors, while optimistic about AI’s analytical power, emphasize the irreplaceable role of human expertise. For example, GAIL trusts AI to detect pipeline leaks but relies on engineers to interpret findings within the context of complex gas networks. Similarly, a defense PSU in shipbuilding uses AI for hazard detection but validates every alert through technical audits. Private sectors, especially in industries with nuanced processes like chemicals or textiles, remain cautious. A paint manufacturer acknowledged AI's utility in pattern recognition but stressed that chemical formulation challenges require human judgment. Smaller firms, such as a dyeing unit, openly distrust AI, fearing misinterpretations of temporary data fluctuations or sensor errors. A common thread across sectors is the view of AI as a supplementary tool—valuable for data crunching but insufficient without contextual human oversight.

In addressing flaws identified by AI, government organizations prioritize transparency, often disclosing challenges in public reports and outlining corrective steps. For instance, a power grid company stated that deviations in emission targets would be analyzed internally, with revised strategies reflected in subsequent sustainability updates. Private firms, however, tend to resolve issues internally without public fanfare. A leather tannery representative admitted that wastewater treatment flaws would be fixed urgently but kept confidential to avoid reputational damage. Larger companies, like an FMCG giant, strike a middle ground—addressing supply chain gaps through supplier engagements while selectively reporting significant deviations in sustainability publications.

Overall, the responses highlight India's evolving ESG landscape, shaped by sector-specific priorities and resource disparities. Government sectors, bolstered by regulatory frameworks and institutional accountability, demonstrate methodical ESG integration and cautious AI adoption. Large private firms align ESG with global competitiveness, leveraging technology for scalability and credibility. Smaller enterprises, constrained by budgets and operational scale, remain in the early stages of ESG maturity, often viewing it as a compliance burden rather than a strategic asset. This divergence underscores the need for tailored policies and technological support to bridge gaps in sustainability practices across India's heterogeneous industrial ecosystem.

**Strategies by Which AI Can Be Used to Control Greenwashing**

A. Automated Analysis of Corporate Disclosures: AI, especially Natural Language Processing (NLP), can scan sustainability reports, marketing materials, and social media posts to detect misleading claims. For example: Keyword Detection, Sentiment Analysis, Pattern Recognition and keeping an eye on actual progress made in comparison to what was promised/sought by the governing bodies.

B. Cross-Referencing with External Data: AI can validate claims by integrating real-time data from IoT sensors, satellite imagery, or third-party databases. For instance, a company's reported emissions can be cross-checked with satellite data tracking air quality near its factories. Supply chain transparency tools can verify if "sustainable sourcing" claims align with supplier practices.

C. Standardizing ESG Reporting: AI can address the lack of uniformity in ESG frameworks (e.g., GRI, CSRD) by automating Data Entry, Benchmarking and giving scores on activities done in real time round the year. It has been observed that the industries may make/fabricate data at the time of reporting. Thus, if any system observes activities/excretions/emissions round the clock, it would ease the workers and prevent reporters to do last minute entries.

D. Predictive Analytics for Risk Assessment - Machine learning models can predict greenwashing risks by analyzing historical data. Instances where companies with frequent regulatory violations or poor financial health are more likely to greenwash reports, A.I. systems would identify "red flags" like sudden improvements in ESG scores without operational changes.

E. Enhancing Audits with AI Tools: A.I. based systems streamlines audits by Automating Data Collection and Anomaly Detection in real time. It would easily highlight discrepancies between reported and actual performance.

F. Stakeholder Transparency Platforms: AI-powered dashboards can provide real-time updates to stakeholders, showing progress toward goals and the blockchain-integrated systems would help to track product lifecycle sustainability.

G. Combating Machinewashing: To prevent AI itself from being misused for deception, the statutory bodies might need to ensure transparency in how AI models detect greenwashing. It would require training to the special workforce about AI on diverse datasets to avoid skewed results. When the combined efforts of A.I. insights and human judgment will be made, it would lead in avoiding false positives/negatives in the system.

**Conclusion**

AI offers powerful tools to combat greenwashing by improving data accuracy, detecting deceptive patterns, and enhancing transparency. However, its success depends on addressing challenges like biased algorithms, lack of standardization, and ethical risks. While large corporations and governments are adopting AI-driven solutions, smaller firms in developing countries lag due to resource constraints.

**Suggestions**

i. Governments and organizations like the UN should enforce uniform ESG reporting standards.
ii. The Governments/visionaries of the organisations to provide affordable AI tools to small businesses to bridge the sustainability gap.
iii. There stands a need to educate consumers and investors to recognize and report greenwashing.
iv. The countries need to mandate AI audits for ESG compliance (e.g., EU's CSRD).
v. Foster partnerships between tech firms, educational institutes, NGOs, and governments to share AI tools and data.
vi. The governments/businesses/industries might need to create labels to certify companies using AI responsibly.
vii. With appropriate funding future research can be carried out on AI's role in sectors prone to greenwashing.

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# DIGITAL SUSTAINABILITY AND GREEN CONSUMERISM: A STUDY OF EDUCATED YOUTHS IN ASSAM

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***Abstract***

*As technological advancement continues to accelerate, while environmental conditions deteriorate, the nexus between digital sustainability and environmentally friendly behavior has a lot of importance. The investigation centers on the evaluation of actions, consciousness and outlook of Assam educated youth concerning environmentally conscious digital technologies and green buys. With increased digital technology penetration and internet usage in Assam, the evaluation of sustainability-related behaviors of educated youth people online is of paramount importance. The main source of information for this research is secondary data generated from school publications, government publications, environmental studies, and institutional sources, which are used in drawing an all-encompassing understanding of today's issues and challenges. The study covers several sustainability issues including digital consumer conduct, the awareness of e-waste problems, use of eco-friendly technology, and educated young people's sustainable purchasing decision. It describes how the practices are shaped by cultural or educational background. Although national and regional reports documented increasing environmental concerns among the younger generations of Indians, this study reveals specific Assamese patterns, such as increased interest in local sustainable brands and major obstacles to green alternatives in rural territories. The study indicates that, despite challenging areas such as available resources and knowledge sharing, and digital competency for sustainability, views by Assamese youth on sustainable acts are generally positive. Moreover, price and availability rather than environmental consciousness are often reasons for purchasing decisions of individuals. The findings show that school, non-governmental organization and governmental program partnerships are essential for addressing these gaps through inclusion of awareness in educational materials. The paper highlights the importance of educated youth as digital natives and incoming leaders and enforces customised initiatives that promote ethical digitalservices and advances sustainable business in the region. As reported by the research, the development of the young consumers' ability to make informed and environmentally aware choices in the digital economy has significant long-term ecological advantages. The scholarship enlivens contemporary discourses on sustainability by shedding light on prospects for regional youths, especially communities such as Assam, to lead the shift towards a greener digital and consumption culture in the face of enduring structural and economic limitations.*

***Keywords:*** *Digital Sustainability, Green Consumerism, Educated Youth, Environmental Awareness, Sustainable Behavior.*

## 1. Introduction

Considering the increasing rate of technological advancements and increasing environmental problems, the connection between sustainable Digital practices and green consumer behavior is of in-depth investigation, particularly among the educated younger generation in the rising economies. Growing demand raises substantial new pressure on the environment, so that there is a need for analysis of what motivates consumers to make sustainable choices. Even though digital revolution has promoted economic growth and transformed the manner in which people live, it has also created significant dangers to environmental welfare, including air pollution, climate change, and global warming. The extensive use of digital technologies in diverse life domains has the consequence of increased energy consumption, greater electronic wastes, and a growing carbon footprint. Understanding the environmental cost of digital technologies and internet usage is important for promoting conscious use of digital and minimising the negative impact of the digital revolution. Digital platforms can help environment education programs embrace sustainability-consciousness within students by using real-world analysis in climate change and eco-citizenship-related interactive learning. Through environmental awareness and education people have the knowledge to make sustainable consumption choices. The thought and behavior of educated youth toward green consumerism should be addressed since they are one of the core groups of people who may change sustainable trends in. The rise of green consumerism is a reflection of consumers' awareness about the environmental and social implication of their purchase decision. Such increased awareness is widening the market for green products and services. This research has as its objectives to examine the attitude and behaviour of the educated youth in Assam, India, towards digital sustainability and green consumerism, through a study of the elements that influence his/her buying choices, and his/her propensity to adopt sustainable practices. Increased awareness of environmental friendliness on the side of consumers leads to greater consumer preference to buy from the businesses perceived as eco-friendly. Also, consumers are getting more willing to spend more on environmentally responsible products. One main thing is to evaluate the extent of knowledge concerning environmental manifestations of digital intake among this generation as well as their willingness to support green alternatives.

### 1.1. Background of the study

Over the past few decades, the world has been paying more attention to the problems of ecological damage, climate shifting, and incorrect consumer behavior. International initiatives that promote environment friendly living are referred to as sustainability, and these have been triggered the aforesaid challenges. Green consumerism forms the essence of this movement: a conscientious selection of ecologically minded, sustainably produced, and ethically responsible products and services. Concurrently, a growing sense of and action toward digital sustainability has emerged: Among the new trends of green consumerism there has been a recent emergence. digital sustainability, a term that combines technology and sustainability endeavors to reduce the environmental impacts and propel eco-living. Its scope ranges from the use of smartphone tools to measure one's own emission to preferring purchases of green brands online and the use of social media channels to raise awareness on sustainability issues. A remarkable window opens for the use of technology on behalf of the environment as India continues on its digital transformation, backed through initiatives like Digital India. This trend best shows up in the young population, who are tech savvy, always conscious of social issues and are influencers of future consumption standards.

### 1.2. Role of Youth in Sustainable Development in Assam

The youth population constitutes a significant proportion of the population of India and wields a huge amount of impact over markets of consumption and social advancement. India's educated youth have more access to issues on global trends, e-information, and environment matters. When such young people are informed and use digital tools, they will be more environmentally friendly in their actions. Although youth are aware of the sustainability they do not necessarily turn this awareness to action. The convenience and value for money usually override environmental concerns when the educated youth make up their minds to buy. Although they know not only what "climate change" or "carbon footprint" or "zero waste" refer to, it is hard for many young people to transform their knowledge into environmentally responsible behavior due to existing systems and individual habits.

Assam has a unique socio-cultural and socio-economical setting because it is situated in northeast India. There are many places in the country which have bountiful natural wealth, a rich biodiversity, and follow traditional eco-friendly practices, but Assam do it in large measure. However, the state is faced with problems such as insufficient industrial growth, disproportionate distribution of digital resources in cities to the country side and sparse supply of sustainable products. Internet Access and digital skills have gained notable increase over the past few years in cities like Guwahati, Dibrugarh and Jorhat where educated youth populate. The Assamese teenagers are now equipped to access social media, educational YouTube platforms and eco conscious influencers that may affect their views and actions about sustainability. However, no exhaustive research work has been done to find out how these digital platforms affect green consumers in the region.

**Table 1: Key concepts**

| Term | Descriptions |
|---|---|
| Sustainability | Lifestyle choices in favour of the environment to save the world for future generations. |
| Green Consumerism | Selecting goods that promote environmental wellbeing, e.g reusable bags, organic produce. |
| Digital Sustainability | Empowering with the digital resources (software, websites and social media) to encourage and promote eco-conscious actions. |
| Educated Youth | The students, just graduated from their schools, or will get their jobs for the first time. |

Source: Compiled by the researchers

### 1.3. Importance of the study

With an abundance of digital resources at one's fingertips, such as apps, e-retail sites, sustainability blogs, podcasts and documentaries, it is easier than ever to find information about sustainable living. Knowledge does not necessarily translate to action, though. Even if young people in Assam are trying to get eco advice through social media or watching material online, does it actually translate to eco friendly consumption or even shift the routine choices that they make? The main objective of this research is to explore the gap between understanding sustainability and action. With this research, it tries to understand how educated youth in Assam see and use eco-conscious consumerism:

(a) Do they know what green consumerism is?
(b) Do they depend on the use of digital tools in order to gather information about sustainable living?
(c) What problems prevent them from ecologically conscious purchasing or living more sustainably?

**Table 2: Trends in Green Consumerism and Digital Influence**

| Factors | Descriptions |
|---|---|
| Awareness of Sustainability | Urban youth have been especially conditioned by this trend because they are much affected by their learning institutions and exposure towards social media. |
| Popular Digital Tools | Instagram, YouTube, Google, eco friendly shopping sites like Brown living and Amazon eco store. |
| Preferred Green Products | Goods such as organic apparel, bamboo toothbrushes, metal straws, and green cosmetics are part of sustainable living. |
| Barriers to Green Consumerism | High-priced products, areas with a shortage of markets, questions about label claims. |

| | |
|---|---|
| Youth Response in Assam | Aware, interested but with no speed to implement this knowledge into their day to day activities. |

Source: Compiled by the researchers

### 1.4. Significance of Digital Platforms

By internet, teenagers now are exposed to knowledge on sustainable living never before. Advocates of zero-waste living by content creators, eco-sans Pinterest website, apps that track daily water or energy consumption are all help in developing sustainable habits. For example: (a) A visual learner from Assam can become informed about the effects of fast fashion after an episode from Netflix. (b) A third youth may start to use sustainable office supplies once he notices that his friend posted about this on Instagram. (c) Another student might join in a web-based river conservation campaign in his or state.

Table 3: Challenges specific to Assam

| Challenges | Details |
|---|---|
| Limited Eco – Product availability | There are a large number of eco-friendly products that are not available in the local markets of Assam or when it is possible to transport them it will be too expensive. |
| Infrastructure Gaps | Weak internet in rural areas; fewer familiarities with sustainability apps or websites. |
| Cultural Habits vs Modern Choices | Though old tried and tested sustainability practices exist, they may be outshined by the convenience and desirability of contemporary consumption. |
| Lack of Content | Despite the fact that much of the sustainability content is available in English/Hindi online, there is paucity of information in the local dialect and Assamese. |

Source: Compiled by the researchers

### 1.5. Objectives of the study

(a) To understand the extent of green consumerism among educated youth in Assam.
(b) To analyze the influence of digital platforms on promoting sustainable consumer choices.
(c) To identify challenges and opportunities for enhancing eco-friendly behaviors digitally.

## 2. Literature Review

At the heart of research in environmental and development studies for several decades has been sustainability and green consumerism. The United Nations Brundtland Commission in their 1987 report restated that sustainable development "… refers to "development which ensures the fulfilment of current needs without jeopardising the ability of future generations to meet their '' requirements. As time went by, the general guiding principle has become concrete implementation of one standing out as green consumption – purchasing and utilising products that are friendly to the environment, ethical production, and social accountability.

Green consumerism was an aspect that scholars of the late 20th century signalled with the advent of environmentally conscious and sustainable offerings by consumers. Peattie (1995) define Green consumerism as the behaviors of consumers who take account of environmental effects in making their purchases. Learning shows that educated and urban consumers, in particular, are more likely to adopt sustainable behavior if they have information and choice (Ottman, Stafford, & Hartman, 2006). However, empirical research constantly brings up what is known as the so-called green gap, which represents the gap between customers' environmental beliefs and their purchasing behavior (Gupta & Ogden, 2009). In the Indian context, we have seen exponential increase in interest for green consumerism primarily post introduction of environmental protection policies and digital literacy. Singh and Pandey (2018) studied green consumption patterns in the urban parts of India and reported that the young consumers are in most cases aware of environmental issues but find it difficult to pay high costs, access and distrust green marketing jargons. Biswas and Roy (2015) also reported that Indian consumers frequently worry about “greenwashing” and, therefore, are not fully relying on eco-friendly branding efforts. Digital sustainability is a new idea, but its relevance is now well-acknowledged and hotly discussed in academic and policy forums. response Such initiatives furnished by carbon-tracking mobile applications, solidary goods marketplaces, and social outreach are important in encouraging good consumer behavior, with particular emphasis on age ranges. As shown by a study by Goyal, Rahman and Kazmi (2021), digital celebrities and online retailers have significant control over the sustainability perceptions of the Indian millennial group. Digital world has become a key force in terms of shaping the environmental consciousness among the younger people. It happened that nowadays people who grew up with digital age tend to use social media platforms such as Instagram, YouTube, and Twitter not for entertainment but to educate themselves and engage in environmental propositions and impressions. More than 70 % of Indian online-consumers aged under 30 reported that online content had significant influence on their minds for eco-conscious purchasing decisions as revealed by Nielsen’s 2020 survey. It turned out that the survey showed that the younger generations prefer using digital tools like eco-friendly e- commerce portals, carbon footprint calculators, and personal lifestyle monitors.

Ajzen’s (1991) Theory of Planned Behavior (TPB) is often used to explain consumers’ environmental intentions. As per TPB, motivation of individual behavior includes attitude, perceived control, and social norms. In the context of digital sustainability, this theory has been applied to the exploration of how accessibility to sustainable goods through digital channels and collaboration with digital peer groups define real consumer activity (Yadav & Pathak, 2017). This study on Indian youth reveals that eco-friendly attitude and perceptions do affect the desire for sustainable choices but such intentions are usually frustrated by real world constraints in the form of financial limitations and lack of access to sustainable products. Most empirical studies of sustainability have neglected the Northeast Indian area and Assam. Generally, some regional details are available. Baruah & Deka, (2020) in their study of the environmental awareness among the Guwahati college students reported significant awareness with minimal actual practice of sustainable practices. The researchers revealed that economic limits of eco-products, weak institutional support, and lack of locally appropriate efforts in sustainability explained the experienced divide. Gogoi (2019) states that despite getting environmental news through internet sources, Assam’s youth only possess insufficient regional resources or policy directions that would enable them translate their awareness into action. The rural-urban gap and linguistic diversity of Assam’s youth further muddies the waters when it comes to making eco-conscious habits automatic for them digitally.

The Digital India push has especially increased the penetration of internet over the last decade in Assam. Based on TRAI (2022) data, urban Assam has experienced continuous increase in smartphone ownership and internet use amongst the young adults. Even though digital access has increased in general there is disparity and there are many students in Assam who are not aware of sustainability-oriented digital tools & resources (NSSO, 2021). This implies that whilst digital tools promise, their use in pursuit of sustainability in Assam is just taking off. The pandemic continues to cause increased online connection on topics related to sustainability. In the online time surge during the COVID-19 lockdowns, many younger people were able to immerse themselves in eco-conscious living using online sources such as: online videos, DIY tutorials and online campaigns such as 'Plastic Free July' or 'Zero Waste Weeks' (Kumar & Prasad 2022). Yet, the future of such lifestyle adjustments remains questionable without affirmation by long-term digital engagement, grassroots interventions, and organizational aid.

### 2.1. Research Gap

As important as this market is for large consumer items, growing scholarship shows cities in urban India that consumes and values the environment, but the northeast is not a well-covered area. Moreover, although the influence of digital media on the environmental awareness of young generations remains poorly understood, research on digital media has proved to be very rare, and the northeastern region, including Assam, provides a unique environment for such exploration. The purpose of this research is to close this gap by investigating what educated youth in Assam experience and how they engage in green consumption through digital media by means of a qualitative analysis of existing data.

## 3. Research Methodology

This research paper adopts a qualitative approach with an emphasis on secondary date sources as a tool to examine attitudes and behaviours of educated youth of Assam on issues of digital sustainability and green consumerism. Secondary sources have a wide variety including academic magazines and research work, industry publications, government publications and online archives. Using a qualitative approach, the study performs a deep analysis of the literature and offers deeper understanding of the complex issues of digital sustainability and green consumerism in Assam (Bernardes et al., 2018). The approach to the research will be of exploratory type which will assume identification of major themes, trends, and interconnections in the data. Techniques that the research can use include observation, survey, experiment, and case study (Utomo et al., 2023).

## 4. Results and Findings

This part of the paper presents the main results of the study which have been obtained from secondary data analysis based on an extensive study of materials retrieved from academic journals, government documents, market research, and publications of environmental organizations. This analysis focused on the shared awareness, attitudes, values and barriers with regards to digital sustainability and green consumerism of educated youth of Assam.

### 4.1. Awareness and Environmental Consciousness

Many educated youth in Assam, especially those in urban regions like Guwahati, Jorhat, Dibrugarh, and Silchar, are environmentally aware. Over 75% of Guwahati university students understood environmental degradation, climate change, and sustainable consumerism. Only 40% of respondents routinely use cloth bags, avoid single-use plastics, or support green brands, according to the same poll.

### 4.2. Role of Digital Media in Sustainability Awareness

Digital technology has changed how youth obtain sustainability information. Youth consume environmental content on Instagram, Facebook, and YouTube. According to the Telecom Regulatory Authority of India (TRAI, 2022), mobile internet use in Assam has steadily increased within the 18–35 age group, increasing exposure to global sustainability trends. Assam's adoption of sustainability-related digital technologies like carbon footprint calculators, recycling applications, and sustainable lifestyle monitors is low. Most tools are in English or Hindi, not Assamese, which may be due to a lack of awareness, computer literacy, and language difficulties.

**4.3. Green Consumerism Trends**

Eco-friendly items are gaining popularity among educated millennials, but their purchases don't necessarily match. Researchers say high prices, restricted product availability, and mistrust about corporate "greenwashing" are important impediments. According to the Confederation of Indian Industry (CII, 2021), Northeast India, including Assam, has less large-scale eco-friendly brands than Delhi or Bangalore. This accessibility issue inhibits green consumption. However, youth favor ethical and environmentally friendly businesses, especially when advertised well online. Awareness campaigns, influencer-led promotions, and targeted ads have influenced purchases, but cost remains a big barrier.

**4.4. Influence of Digital Influencers and Campaigns**

Change makers include online influencers, digital vloggers, and sustainability-focused content creators. During the COVID-19 epidemic, adolescents consumed more digital content and participated in zero-waste living, DIY up cycling, and vegan challenges. This change shows how digital settings encourage green behavior. Localized digital advocacy in Assam is underdeveloped. The lack of Assamese-language influencers or regional sustainability content limits reliability and cultural connection, reducing the local impact of these efforts.

**4.5. Regional Constraints and Challenges**

There are some regional barriers that restrict Assam's youth in the adoption of digital sustainability and green consumer habits. These include:

4.5.1. **Digital Divide:** The range of mobile phone usage is increasing, while secure connections online are still limited in rural and isolated areas, decreasing prospects for digital engagement.

4.5.2. **Lack of Assamese Content:** As most of the environmental awareness and sustainability content is only available in English or Hindi, it rarely reaches young people for whom the first language is Assamese or another vernacular.

4.5.3. **Policy Gaps:** State level campaigns aimed at promoting sustainable consumptions practices among the youths have exhibited little integration. Assam has few measures to guide the youth towards sustainable action by way of specific campaigns, educational programs, or rewards.

**4.6. Comparative Perspective with National Trends**

Compared to national patterns, the Assam youth demonstrate similar awareness about sustainability, but a lower involvement in sustainable choices. Factors such as those related to tools of technology, income levels, and the structures in the market in the region contribute to explain away the observed gap. For instance, according to Nielsen Global Corporate Sustainability Report (2020) figure 73% of the Indian millennial's population opted for buying sustainable brands while such inclinations among the Assamese youth were largely only found mostly at the urban areas on a small scale manner.

**Table 4: Summary of Findings**

| Aspects | Findings | Implications |
|---|---|---|
| Awareness of Sustainability | High theoretical awareness; lower practical implementation | Behavior-focused educational initiatives are needed |
| Digital Media Usage | Importantly, one engages a lot in social media in collecting information concerning sustainability; low app usage | Promote awareness of apps and resources which support native languages. |
| Green Consumer Behavior | Attitudes are usually supportive but financial and access barriers hurt. | Enable development of affordable green products and improve the supply chain systems. |
| Influence of Digital Content | Influencers and digital challenges do enhance the audience's interactions. | Support and feature the digital content creators and their campaigns for Assamese. |
| Regional Challenges | Hardy comprehension in languages, poor access to the internet and inadequate policies on state regulations. | Design Assam-oriented policies and materials in local languages (to make interaction easier). |
| Comparison to National Trends | Lower numbers of people try to buy green products although they have attained comparable awareness. | Elevated market connectivity and growth in infrastructure are basic needs. |

Source: Compiled by the researchers

Systemic and regional barriers (inequality access, high cost, and lack of culturally appropriate digital resources) prevent them from fully participating in sustainable consumption. By overcoming these barriers, through customised policies, regional stimulation of innovation, and affordable green products, it could help immensely in changing this group's sustainable consumption habits.

## 5. Discussion/ Analysis

The theme of the current research is in-depth analysis of the manner educated youth interact with a digital sustainability and green consumerism in Assam. The study reveals a clear gap between environmental awareness and sthafting behavior change which is in conformity to findings of various global studies. There is evident youth awareness in Assam over topics such as climate change, pollution, and conservation, but what gets translated to actual sustainable buying behavior is lopsided. This observation, which has become known in the literature as the 'knowledge-action gap' (Kollmuss & Agyeman, 2002) has attracted much attention from scholars who research environmental behavior. The apparent gap between awareness and practice in Assam in terms of the socioeconomic and infrastructural issues particularly the high expenses with eco-products and the limited availability of green options appears to widen. Digital technology has contributed quite largely to shaping youth interaction with environmental issues. Thanks in large part to the broad penetration of smartphones and the Internet, especially among Assam's urban younger set, digital interest in the environment has been correspondingly enhanced, with such platforms as Instagram, YouTube and Facebook playing leading roles. Through digital media channels like Instagram, YouTube, and Facebook, the world gets to see international movements for sustainability, popular green life styles and presents offered by green products. However, a fair amount of this interaction is going to tend to be shallow and aspirational in nature. Materials posted in these platforms are generally very inaccessible for vernacular speaking population, as most of them can only be accessed by users of English or Hindi language. Also, the lack of Assamese language digital projects and region-appropriate green advocates obstructs the production of a culturally sensitive sustainability campaign. As a result, the power of changing via digital platforms depends on successful localization, ease of access, and culturally sensitive stories.

The ongoing structural and regional impediments in Assam play a significant role in as regards to the uptake of green consumerism. Metropolitan areas that have flourishing supply chains and a robust set of sustainable alternatives do not reflect the undeveloped green market running rampant in Assam. The effort required to find green retail outlets and the lack of visibility of sustainable options in area stores severely limits the options for young people that want to shop in responsible ways. Specifically, green business promotion schemes or subsidization of sustainable consumer practices or nurturing of sustainable startups' becomes past its prime. Absence of institutional interventions resulted in delayed implementation of the eco-friendly processes in the region. The scarcity of infrastructural support and particular incentives is likely to condemn measures targeted at youth-oriented sustainability to purely symbolic levels. This potential should not be ignored since Assam's educated youth are well prepared to lead digital sustainability and eco-friendly consumer behaviour despite such challenges. Living in the digital world, these are people who are amazingly flexible at employing new technologies and reacting to new ideas. Not only is there interest shown, but there is also visible determination from youth being actively involved in digital platforms related to the environmental cause as well as online petitions and zero waste campaigns, especially during lockdowns. However, their enthusiasm has to be backed up by well thought out initiatives. School institutions and higher learning entities are key in promoting sustainable living by incorporating sustainability in learning resources, sponsoring sustainability based contests, and helping to organize community digital sustainability. Joint venture with NGOs, local influencers, politico think tanks enables wider outreach and provides avenues of young generation mobilization to assume leadership in environmental management. Unlike Assam, which is representative of the overall increase in awareness about green consumerism and the digital sustainability across India, Assam finds it hard to translate this awareness into meaningful action. However, Assam's ability to push sustainability is constrained by its periphery, poor policy frameworks and lack of digital infrastructure in comparison to more developed urban hubs such as Bengaluru and Mumbai. A significant growth in the inclination of Indian millennials to choose environmentally responsible brands is brought out through the Nielsen Global Sustainability Report (2020). Eco friendly consumption is increasing on a national scale, but in Assam these trends are not catching up due to economic barriers and doubts about the product's integrity. Evidently, national policies are required to take a regional angle to fill gaps and encourage inclusivity during India's sustainability transition. The scope of digital sustainability should not only focus on awareness and participation, but also in order to directly evaluate the environmental impacts of digital use. The practice of surfing the web, watching streaming, as well as saving data, both create the need for extra energy and fuel electronic waste production. Digital carbon footprints and management of e-waste are still largely uncharted territories in Assam's public discussions. The younger age group is not informed on how their digital habits like rapid device change and high rate of data consumption aids environmental problems. By combining the digital consciousness with sustainability teaching, it is possible to close the gap, triggering youth to either practice device longevity, or limit unnecessary usage of digital, and properly manage their e-waste. In spite of optimistic fact-finding in base knowledge and the prospect of digital engagement, reality is slowed down by the issues of infrastructure, society, and governance. In order to take a full advantage of the potential offered by this demographic, a comprehensive approach is necessary: a combination of digital innovation, supportive regional policy, entrepreneurship, and grassroots mobilization, all at local levels. The resolution of these complex factors is essential for Assam to move from idealistic green activities to meaningful sustainability, guaranteeing that its youth has a conscious presence in the global initiatives concerning the responsibility to the environment.

**Table 5: Summary of Key Analysis**

| Theme | Key Analysis | Strategic Suggestions |
| --- | --- | --- |
| Awareness vs. Action Gap | Even though young people are sensitive to environmental issues, it is challenging for them to adopt green practices in their life, due to high cost and limited availability, and mistrust of green products. | Subsidies the production of the green goods and smother on deceptive claims of environmental approach. |
| Role of Digital Platforms | Social media increases awareness but it almost never generates actions that continue. | Promote production of content in the Assamese language and introduce mobile applications related to sustainability. |
| Market and Infrastructure Issues | There is a lack of green products and, if at all, they do not percolate to rural and semi-urban areas. | Developed neighborhood-based green market places and engaged in online markets to make sustainable products readily available throughout the region. |
| Youth as Change Agents | Youth have powerful digital skills and knowledge about emerging trends. | Develop community green clubs and sustainability programs at the college campus. |
| True Digital Sustainability | The use of digital resources is used to increase awareness but their ecological footprint is often overlooked. | Hold out events to collect unwanted electronics and create awareness on the effects of digital carbon footprint. |
| Assam vs. National Trends | The effect of structural and policy distinction has seen Assam lag behind the nations metro areas in terms of development. | Effective approaches to green growth in the Northeast demand the adoption of particular regional policies. |

Source: Compiled by the researchers

The study reveals that Assam’s educated youth stand to lead sustainability if they are given suitable infrastructure, digital resources, supporting policies, and opportunity to participate in the market. Eliminating bottlenecks between knowledge of digital tools and going sustainable requires individualised strategies, community partnerships, and collaborative actions by educational institutions, government agencies, non-profits, and business leaders.

## 6. Conclusion

The study examined the relationship between digital sustainability and green consumption faced by educated youth in Assam by reviewing past data to identify trends, underlying factors and hindrances. Solely, the research indicates that although Assam’s youth also experience environmental awareness and digital skills development, their practical efforts aimed at sustainable consumption practices remain limited. A variety of regional barriers are equally contributing to the existing gap between the awareness and the practice of sustainable living including lack of supply of green products, pricing problems, policy flaws, and shortage of digital content relevant to the state of Assam. Limited resources and systemic barriers in place often hinder the ability for people to progress in their efforts to go from environmental awareness on to direct sustainable practices within developing regions. Digital media have indeed turned out to be precious tools for raising eco consciousness among the youth' but in Assam, they are not maximally employed for this task. The dominance of English and Hindi content, low representation of Assamese-language influencers, and a low-key strategy to digital engagement make these platforms fail at spreading the word of sustainable habits among users. Meanwhile, digital sustainability features are basically absent – from the carbon footprint of data centers to the complexities of regulating e-waste. Such a finding highlights the need to review the manner by which sustainability is defined and gifted to the youth in the region.

Even though there are these hurdles, the research proves that the educated youth of Assam can be a basis of key sustainability leaders if they are properly guided and provided with the required tools and opportunities. Institutions of higher education and educational bodies have a good place to promote sustainability through integration of sustainability concepts and mechanisms through curricula and there by ensuring stand alone sustainability projects by students are facilitated. At the same time, the state government, the private sector needs to work together in creating an atmosphere that would be favorable to sustainability, through provision of green consumption incentives, stimulating local eco-businesses, and extending digital reach to remote areas. Moreover, the necessity of personalized policy frameworks and online materials is emphasized to consider the unique reality of this region. Local adaptation of sustainability initiative messaging to speak their language, their culture and their economy can enable more engagement by youth in Assam. Reliable, affordable, and aspirational green consumer options are key to connect with youth in both urban and rural Assam. Also, public education initiatives will have to move from pure campaigns to advance a comprehensive understanding of sustainability as part of day-to-day life and ethical involvement. Although Assam's educated youth are highly aware of issues and have access to digital tools, the structural barriers currently prevent their good intentions from translating into lasting behavior change. Respond Enabling Assam to discover an original path to environmentally continuous and inclusive growth can be achieved through digital sustainability and stimulating youth-led eco-friendly consumption. Though this road will be hard, it will also be promising and since youth of Assam are poised to take it, this is the direction where a sustainable and eco-friendly future can be built.

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# A STUDY ON AWARENESS OF FINANCIAL LITERACY AMONG WOMEN- AN ONLINE SURVEY

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***Abstract***

*Financial literacy is the need of current scenario and also it has been categorized as one of the life skill of 21st century for empowering individuals for future. Due to emergence of the Government's reduction in social security there is a need of the hour to manage the funds. The Individual need to plan for their future retirement and invest their hard earned money into different avenues of Investment and Savings. Financial literacy helps the individuals to make financial decisions and have better control over financial matters. The previous literature found out that women are less financial literate than the Man. Women's are the financial manager of Indian Household and it is important for them to be financial literate and financial Inclusive. The present study will purely based on Primary and Secondary data, for that the data will be collected from online survey from the Women and then the measurement of financial Inclusion, Knowledge and behavior among Women will be done.*

***Key words:*** *- Financial Literacy, Financial Inclusion, Financial Knowledge, Financial Behavior*

## Introduction

Financial literacy is the basic ability of the individual to manage their assets in terms of savings, borrowings and debts.Financial literacy concepts means financial awarenesss,knowledge which also include financial products,financial skills and the ability to calculate compound interest payments and financial capability in terms of money management and financial planning(Xu & Zia, 2012) There is a tremendous increase in the definition of the financial literacy some may have defined as it as the ability to read and analyze the personal finances.() In the era of the technology the major changes in the financial literacy is to know about the usage of finance technology and their uses. Digital technology has also marked its essence in today's world; Individual is also being assessed about financial literacy when they know about the fintech. For determining the level of financial literacy the Lusardi has divided the levels into 2 parts. The basic level of financial literacy deals with the individual have basic awareness about financial products and advance levels of financial literacy is about the knowledge of Inflation, Risk ,Interest and also to calculate these terms. Many studies have focused on the financial education and it has been found out that if financial education would be given to the students it can change the financial aid of the student. There has been tremdous increase in financial literacy due to financial responsibilities.((Potrich et al., 2018)). It is also find out that education and experience have positive impact upon the financial literacy among men and women (4). It has been wide spread that financial literacy has become the responsibility of the Government. In India National Centre for Financial Education (NCFE) has been promoted by the financial sector regulators such as RBI, SEBI, IRDA and PFRDA. The major stakeholders for promoting the financial literacy are RBI, SEBI, Insurance regulatory and Development Authority of India. The present study uses primary method of data collection through an online survey and it was being found out that there is significant relationship between the education, profession and Income of the women on the key components of the financial literacy.

The three core components of the Financial literacy are:-

1) **Financial Knowledge**: - It is the first important component of the financial literacy and is considered as having basic financial knowledge and ability to apply numerical skills in financial concepts. The simple meaning is to make appropriate financial decisions.
2) **Financial Behavior**: - It refers to the individual's behavior that affect financial situation and well being in short and long term.
3) **Financial attitude**: - it includes question about attitude towards money and planning for future. The preference towards money.

**Review of literature**

**(Hung, 2012)**The study was conducted on empowering women of financial awareness and education with the joint effort of Australia and India. It was being found out that women are less financial literate than the man and have few financial skills. The gender differences in financial literacy are one of the topics to be discussed. The study also takes into care the gender differences in understanding of interest. The data was collected from 12 countries. The women have less confidence so they answer don't know. The INFE member provides a survey to study financial literacy. In Australia the financial skills for the women are one of the integral parts. Men hold more responsibility for certain financial decisions. So, this is the main reason of women having less financial literacy.

**(*Singh and kumar, 2017*.)** The study takes into account the relation between financial literacy and investment of working women. It was being found out that even working women are not able to manage their finances. The study was undertaken composing female teachers of Banaras Hindu University which constituted of 168 females and the instrument/questionnaire was developed through Lusardi findings. Around 49.51 percent of respondent were assistant professor around 96 percent were doing of Investment. Out of 103 respondent 38 percent were invest their money in fixed deposit, 22 percentages in real estate. Around 12 percentage in jeweler and 8 percentage investment awareness.

**(*Mahmud*, n.d.2020)**The study takes into account the Muslim women. There is a gender gap and they have limited knowledge about business. There is need to increase the women's entrepreneurship that is one of the agenda for sustainable development .financial knowledge and education is often used interchangeably. The study states that money measurement, credit, debt management, risk management and investment and retirement planning are five standards .The Allah has given the right to do business. The Muslim businessman should have business with noble cause. Women entrepreneur and having high financial literacy are going too spent much wisely. The women who would be having less knowledge about financial literacy are going to have problem in business. The retirement planning is not done.

**(Roy & Jain, n.d.2018)**The study was conducted upon the women in the financial sector of Raipur. The study well explained the meaning of financial literacy. The objective of the study is to examine the basic banking knowledge and the fundamentals of financial concepts. Around 150 respondents were taken from out that due to financial illiteracy they take aside from personal financial planning goals. It was being found out that savings and investment decisions are highly important among the working women. It was being found out that women working in jaipur and urban areas are having less financial literacy

**(Bannier & Neubert, 2016)** The study was done on a data collected through 2009 save panel of German. The data consists of 2047 responses. The study takes into account standard asset class as dependent variables for calculation in regression. The main focus of the study is to find out the relation between the financial literacy and risk tolerance. The risk tolerance for men is higher than the women.

The data used is descriptive statistics. In women there is a decrease in the decision invest in standard assists.

**(Park et al., 2021**) the study uses quasi experimental separate sample pre-test post test design and a longitudinal qualitative. The PISA assessment is meaningful in that is examined the knowledge and skills of 15 years old. The study also include individualized learning plan as a conceptual plan which may help in promoting finances. Financial education on behavior can be seen as when the education is given to students. The Government is providing the education to the public about the finances.

**(Mottola, 2013)** The study was done by using the data from National financial capability study (NFCS) which is regulated by FINRA. There was sample of 28,146 which was called by using Non-Probability quota sampling. The study consists of approx 130 questions which were originally designed by Lusardi and Mitchell. The data found out that women scoreless in measures of financial literacy only 32 percent women get four or five questions. Even for the mathematical ability the women ranked themselves low.

**(Mishra et al., 2021)** The study was done among women of self help groups of a block of Bhubaneswar. The study focus that the person who can effectively manage their finances is known as financial literature. The study found out that both developed and developing countries are equal in financial literacy. The education is considered as on of the factor of one of the content of savings but demographic factor for financial literacy. The research study was conducted in five villages in about 100 women respondents. The factor analysis was used and data analysis through SPSS.

**(Donohue, n.d.)**The study focus that women are in great need of financial knowledge in order to develop the financial behavior. The role of women in USA has been changed in the last couple of years. There are even families which are lead by the women. There were 3 primary questions for making better financial decision. The surge in divorces and the family lead by the women carry in need to spread financial literacy. The study focus that if the women will gain financial knowledge they

**(Bannier & Neubert, 2016)T**he study focus on the way that women have less confidence in respect of personal finances. There was a time when women have started earning they have large burden of raising families and have poor knowledge about financial management. The study wants to reflect upon various answer seeking things. What are the factors that affect the financial literacy of a person. The results found that there were 44 percentage of male and 56 percentage of female population. There were around nine question of financial knowledge, nine questions of savings and borrowings, six questions on insurance and four question of investment. The study found out that man is having more knowledge about personal finances. The male participants are likely to have more knowledge about personal finances. Even it is more said that women have less score than men because they have less interest than the women in investment.

**(Andriamahery & Qamruzzaman, 2022)**The study was conducted using 950 women owned SMEs. The study focus on the women –owned SMEs. The study focus on the women's conditions in Bangladesh. Women's being the half population of a country are disadvantages in various stages of society such as culturally, socially and others. The study reflects on the growing conditions of the women entrepreneurship. Women's are seen to be the new engines of the development when they have been labeled as new shining stars of the economy. The most struggles they face during the conversation are to obtain financial resources. Financial education programs are being raised by the government about various financial ideas. Due to emergence of the IT sector there has been tremendous increase in women entrepreneurship. The study reflects upon the women entrepreneurial development as on financial literacy, technicals and access to finance

**(*Schmitz*, n.d.2023)**The study was conducted to integrate American women about financial literacy. The research shows that women are less knowledge about finances than mans. It was being found out that around 46 percent. The financial literacy is the ability to understand everyday financial matters. The study says that one third of the American adult's process less financial literacy. They were to examine low literacy skills. It was being said that about 30 million Americans lacks to struggles read and write at basic mathematics up to class $3^{rd}$ .It was along being found that males takes more households decisions than females but it is also found out that women savings a higher amount than men. The data collected from approx thousand community based organization. The majority of respondents were involved in financial management but they also responded that they never participated in financial education programs.

**(Sundarasen et al., 2023)**The study was based upon the bibliometric research on financial literacy. The analysis was done based on the use of VOS viewer. The study was done in order to find out of the gender based inequalities in terms of economic prospects which is restricted to resources, lower wages. The data was collected from web of science which resulted into 6946 documents which have keywords such as financial literacy, inclusion, education and capacity. It was being found out those top sources for publication of articles on women financial literacy is from journal of family and economic issue. The body of research focuses on the gender inequality in financial inclusion. It was also found that women lacks in retirement planning.

**(Bonga & Mlambo, n.d., 2016)** financial market is available for the investment and it will lead to increase in the future. There is need to increase the women financial literacy. The study main focus on the improving financial literacy. The study main focus on the improving financial literacy among women. The study was conducted in the Africa of the state Zimbabwe. The Zimbabwe is having highest literacy. The study uses electronic survey approach using monkey survey site and then the survey responses were transformed using relative importance Index. It was being implied that government roles have been ranked number 1 for driving out financial literacy.

**Objectives:-**

1) To examine the knowledge of women in general finances matters, savings and borrowing, investment and Insurance.
2) To examine the financial behavior among women
3) To examine financial knowledge of the women
4) To find out the impact of financial attitude among women.

**Research Methodology**

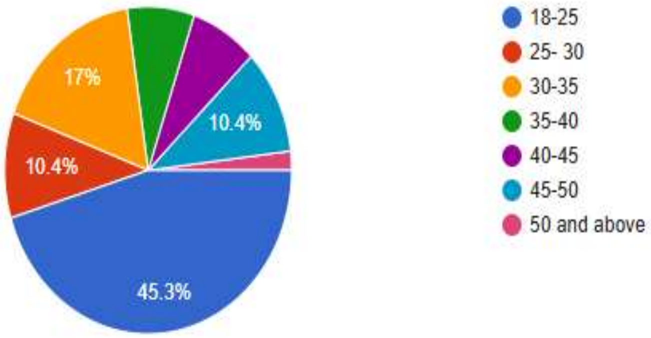
The study takes into account the research regarding the financial literacy for the women. The study is purely based upon the descriptive research. The study will take into account the both Primary and Secondary data. The primary data will be collected from online survey and the questions would be based on demographics, financial education, financial awareness and financial behavior. The questionnaire was being constructed and was filled by the women respondents. Around 104 responses were received and all were selected for analysis part. The secondary data was collected from different research papers, journals and books.

**Data analysis**

The data analysis was done on the 103 respondents. A percentage was being prepared which contains questions on demographic profile of the women which were age, Income, working conditions, education profiles, financial knowledge, financial behavior and financial attitude.

**Figure 1**

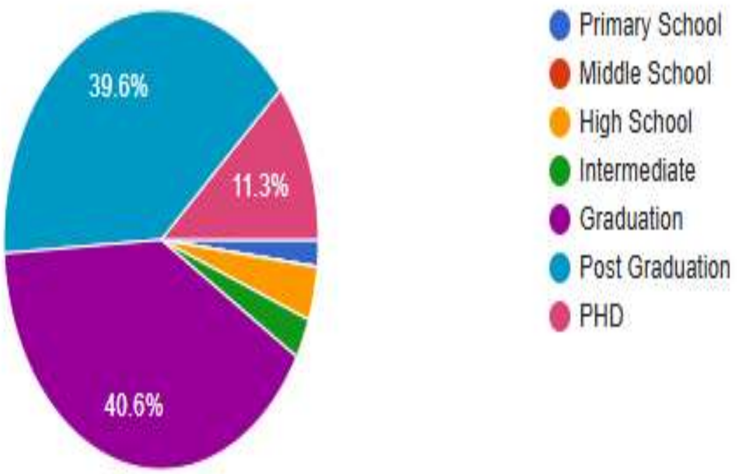
**a) AGE**




The above pie chart I show about the age group of the respondents around 45.3 percentage of the respondents belong to the age group of the 18-25, 17 percentage of the respondents belongs to the age group of the 30-35, 10.4 percentage of the respondent belongs to the age group of 25-30 and 45-50 and the remaining belongs to the age group of others as shown in the above figure.

**b) EDUCATIONAL QUALIFICATION**

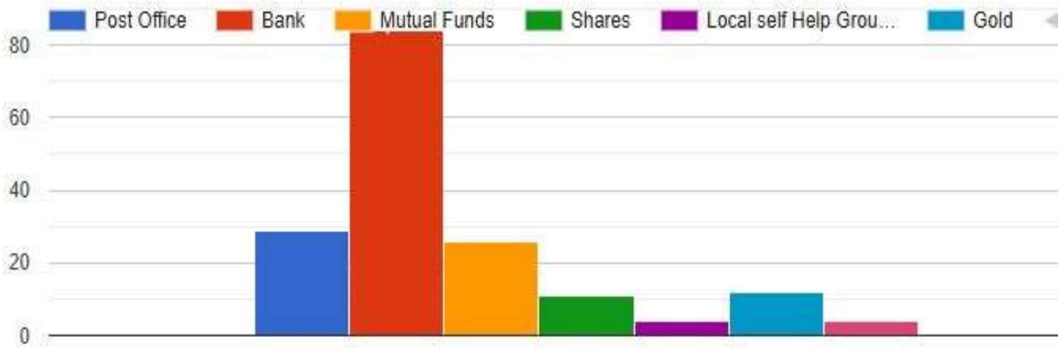
**Figure 2**




The data collected consists of 40.6 percenatge of the respondents are graduate,39.6 percentage of respondents with primary eduaction and 11.3 percenatage of the respondents were PHD and remaining have post graduation and others.

**Figure 3**

**c) INVESTMENT AVENUES DONE BY THE WOMEN:-**




The questionnaire consists of the question about the different avenues for the investment, the options were remained opened for the answer and respondent were allowed to choose more than one options. It was found out that around 30 percentage of the respondent rely to keep their money in the post office, 80 percentage of the respondent investment in banks, 25 percentage of the respondent invest in mutual funds, and 10 percentages of the respondents are investing in shares. It has also been found that around 5 percentage of the respondent also invest in self helps groups and same amount of percentage in gold and real estate.

**d) EDUCATION AND KNOWLEDGE ABOUT SIMPLE AND COMPOUND INTEREST.**

**Table 1:- Showing ANOVA to test the Financial Knowledge**

| *Groups* | *Count* | *Sum* | *Average* | *Variance* | |
|---|---|---|---|---|---|
| **Educational Status** | 103 | 562 | 5.456311 | 1.113269 | |
| **Do you have Knowledge about Simple Interest [Concept]** | 91 | 117 | 1.285714 | 0.206349 | |
| **Do you have Knowledge about Simple Interest [Calculation]** | 98 | 118 | 1.204082 | 0.164107 | |
| **Do you have Knowledge about Compound Interest [Concept]** | 96 | 134 | 1.395833 | 0.241667 | |
| **Do you have Knowledge about Compound Interest [Calculation]** | 93 | 133 | 1.430108 | 0.247779 | |
| | | | | | |
| | | | | | |
| **ANOVA** | | | | | |
| ***Source of Variation*** | ***SS*** | ***Df*** | ***MS*** | ***F*** | ***P-value*** |
| **Between Groups** | 1383 | 4 | 345.6432 | 848.9604 | 4.65E-215 |
| **Within Groups** | 193.8 | 476 | 0.407137 | | |
| | | | | | |
| **Total** | 1576 | 480 | | | |

Financial knowledge refers to the important component of the financial literacy and it means to apply the basic numerical skills in financial concepts, in order to examine the financial knowledge of the women Educational status has been taken as the Independent variables and knowledge about the concepts and calculations of the simple and compound interest. It was being found out that 103 respondents responded to the questionnaire (online) and the F- value of 848.96 is very much large as compared to P value which is extremely low of , which indicates a strong evidence to reject the null hypothesis and there is statistically significant difference between the education and knowledge about the concepts and calculations of simple and compound interest.

**TABLE 2:-SHOWING ANOVA TO TEST THE FINANCIAL BEHAVIOR**

| SUMMARY | | | | | | |
|---|---|---|---|---|---|---|
| ***Groups*** | ***Count*** | ***Sum*** | ***Average*** | ***Variance*** | | |
| **Profession** | 103 | 171 | 1.66 | 0.442223 | | |
| **How Confident are you in managing your personal finances** | 103 | 198 | 1.922 | 0.856653 | | |
| **How often do you seek financial advice or Information** | 103 | 251 | 2.437 | 0.856273 | | |
| | | | | | | |
| | | | | | | |
| **ANOVA** | | | | | | |
| ***Source of Variation*** | ***SS*** | ***df*** | ***MS*** | ***F*** | ***P-value*** | ***F crit*** |
| **Between Groups** | 32.161812 | 2 | 16.08 | 22.38486 | 8.5E-10 | 3.025 |
| **Within Groups** | 219.82524 | 306 | 0.718 | | | |
| | | | | | | |
| Total | 251.98706 | 308 | | | | |

Financial behavior refers to the individuals behavior that affect financial situation The ANOVA p-value is 8.5E-10 which is significantly less than the conventional alpha level of 0.05. This indicates a strong statistical significance. The extremely low p-value suggest that profession plays a crucial role in influencing financial behavior. There is a significant difference between the profession and confidence in managing personal finances and seeking of financial advices.

**TABLE-3 ANOVA TO TEST FINANCIAL ATTITUDE**

| SUMMARY | | | | | | |
|---|---|---|---|---|---|---|
| ***Groups*** | ***Count*** | ***Sum*** | ***Average*** | ***Variance*** | | |
| **What is your monthly Income** | 103 | 336 | 3.262136 | 0.861984 | | |
| **Do you make monthly Budget** | 103 | 156 | 1.514563 | 0.252237 | | |
| **How often do you save the portion of your Income** | 103 | 213 | 2.067961 | 1.593375 | | |
| | | | | | | |
| | | | | | | |
| **ANOVA** | | | | | | |
| ***Source of Variation*** | ***SS*** | ***df*** | ***MS*** | ***F*** | ***P-value*** | ***F crit*** |
| **Between Groups** | 164.3301 | 2 | 82.16505 | 91.03839 | 9.48E-32 | 3.025253 |
| **Within Groups** | 276.1748 | 306 | 0.902532 | | | |
| | | | | | | |
| **Total** | 440.5049 | 308 | | | | |

Financial attitude refers to towards money management and planning for future. A one way analysis of variance was conducted to assess the impact of different income levels on budgeting and saving behavior. The extremely low p value 9.48E-32 for both budgeting and savings behaviors indicates a statistically difference in financial attitude across different income groups. This suggests that monthly levels have a profound effect on an individual's likelihood to budget and save.

**Findings**

Financial literacy is basic ability of the individuals to assess the basic knowledge of four fundamental concepts in financial decision making which are Interest, compound interest, inflation and risk diversification. The above study was conducted purely based on the descriptive research and data was collected through an online survey. There were around 103 respondents and it was clearly found out that regardless of education, income and profession there was clearly financial inclusion as 100 percentages of respondent have bank accounts. The financial inclusion schemes of the Government have totally worked towards the public in order to have at least bank account. Different researches have been conducted on the literacy of the women, it was being found out that women are less financial literate than the man(Mishra et al., 2021). Even the study done by (Hasler and lusardi,2017)also states that there exist a gender gap in financial literacy across different countries of the world and there is a great need of the women to be financial secure. But in this study it is being found out that the financial literacy among the women is increasing with education, income and profession and there is significant difference between the education and financial knowledge of the respondent, given the correct form of education to the public about the finances, the individual will get more knowledge about the finances and they will certainly manage the finances accordingly. The financial behavior of the women is also significantly different according to the profession and individuals will tends to manage their finances more effectively. There has also been significant difference in measuring the financial attitude of the respondent, it is being found out that monthly income have effect on budget and saving.

**DISCUSSIONS**

The above study depicts a strong building future about the financial inclusion as it has been found out that a number of the individuals have open the bank accounts in any of the bank and the women are also heading towards financial inclusions as far the government is trying to aware the public through Jan Dhan Yojana and other schemes of financial inclusion. The study also reflects upon the main pillars of financial literacy i.e. financial knowledge, financial behavior and financial attitude. It is also being found that women with a specific income can lead to making budget and savings. Even it is also being found out that women are now a day's more vigilant towards the financial investment avenues, they have knowledge of a long term saving and planning for the future. Even it also found out those women who are earning well and are also having knowledge of investment in stocks and mutual funds. The basic meaning of financial literacy is to know about basic concepts of interest, inflation, risk. It was found out that people have knowledge of the interest either simple or compound interest and also some have the knowledge of the calculations of either simple or compound interest.

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# INTEGRATING AI INTO CORPORATE SUSTAINABILITY: A DUAL ANALYSIS OF BUSINESS SUCCESS AND ENVIRONMENTAL STEWARDSHIP

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***Abstract***

*Technological advancements and mass globalization has propelled problem solving techniques to greater heights. Especially in terms of sustainability and business performance, technological implementations have secured a strong spot for reliable and fruitful results. Artificial intelligence is amongst the newer branches of applied technology which is changing how humanity tackles problems and formulates solutions. The possible areas of artificial intelligence integrations are virtually limitless. From medical science to space exploration, from fraud detection to sustainable development, from cancer research to smart precision agriculture; AI is surely a potent tool for mankind in terms of problem solving and global advancements. Bangladesh is a developing country which is struggling to keep up with the rest of the world in terms of technological implementation and effective problem solving. However, in recent years even Bangladesh is adopting various approaches to implement AI for sustainability, cost effectiveness, fraud detection and prevention, data analysis and much more. The adaptation of AI in the realm of various businesses have also risen due to its effectiveness and sustainability. Bangladesh is taking advantage of AI in various sectors including finance, manufacturing, healthcare, retail, transportation etc. The potential of artificial intelligence in terms of corporate sustainability and ESG (Environmental, Social and Governance) is immense. The usage of AI in corporate sustainability can greatly boost business performance by reducing cost, maximizing efficiency and promoting optimization. This research aims to shed light on the effectiveness of AI in corporate sustainability for improving business performance based on ESG framework in Bangladesh. More specifically, the paper explores the implementation of smart precision farming which utilizes sustainability practices using AI to boost performance in corporate farming. Corporate farming has been prioritized due to Bangladesh's dependency on agriculture and the usage of AI in thisefficiency,ne can greatly reduce cost, improve productive performance, reduce time and resource consumption; which are crucial factors related to environmental responsibility.*

***Keywords****— Artificial Intelligence, Sustainability, Optimization, Environmental Social and Governance (ESG), Algorithms, Waste Management, Environmental Responsibility.*

## I. INTRODUCTION

Artificial intelligence was close to science fiction just a few years back. However, the usage of AI and its potential in practical problem solving is becoming more common as the days pass. Globally, AI is being used in every sector imaginable to make advancements and breakthroughs (Rashid, A. B., & Kausik, A. K., 2024). Google is now heavily guided by AI for the sake of search optimization. The usage of AI in search engines like google started around 2015 with the introduction of RankBrain, a kind of AI algorithm engineered for search optimization. Clearly, the implementation yielded great results as the algorithm was effective in pinpointing the best results. The tendency of AI to analyse vast amounts of data for anomaly detection and complex pattern recognition makes it highly useful in terms of predictive analytics, market forecasts and risk assessments. The role of AI in corporate business is immense due to its ability to point out sustainable practices that can lower resource consumption and maximize productivity (Challoumis, 2024). All these factors also greatly impact how some corporate business can affect the environment. It is easy to recognize that more resource consumption and unsustainable business practices can negatively impact the environment. The potential of AI in

Bangladesh is immense, especially in the corporate business sector. As Bangladesh is not technologically advanced compared to the rest of the world, the use of AI can greatly decrease that technological gap. From automating repetitive tasks to optimizing operations to reduce resource consumption, the prospects of AI are limitless. AI can be used to analyse data by monitoring production, detecting defects, provide forecasts of events and even automate some work processes via smart monitoring (Villegas-Ch et al., 2024). For example: AI can be used in healthcare business of Bangladesh to greatly optimize diagnosis of patients. Data about the patients can be analysed and an AI algorithm which is trained accordingly can reliably give feedback about health issues. There are studies suggesting that AI has high degree of accuracy in feedback diagnosis which can help prevent misdiagnosis which can be dangerous (Babushkina, 2023). In the context of corporate sustainability, farming and agriculture remains a huge part of Bangladesh's business and corporate framework. The potential applications of AI in this sector alone could greatly enhance various sustainability practices which can greatly propel corporate sustainability and promote positive environmental changes.

A. Background and Context

Bangladesh is a rapidly developing country with huge potential ahead. Bangladesh's fertile soil and its green vistas are one of its strongest assets. With a booming population of 173 million people, agriculture remains one of the fundamental sources of the nation's economy even in 2025 (Dohlman, E et al., 2025). The corporate farming sector alone employs at least 42 % of the entire workforce of Bangladesh. Making farming and agriculture a potential focal point for corporate sustainability and environmental responsibility. The emergence of AI in Bangladesh is relatively recent, as most businesses rely on traditional business methods and practices. Fortunately, there has been a rise in the use of AI in corporate business sectors in recent years. It seems that the potency of AI and its potential to propel sustainability and improve business performance has been realized by many businesses in Bangladesh. Various corporate business sectors in Bangladesh are adopting AI integrations for improved business performance and sustainability like: finance, transportation, media etc.

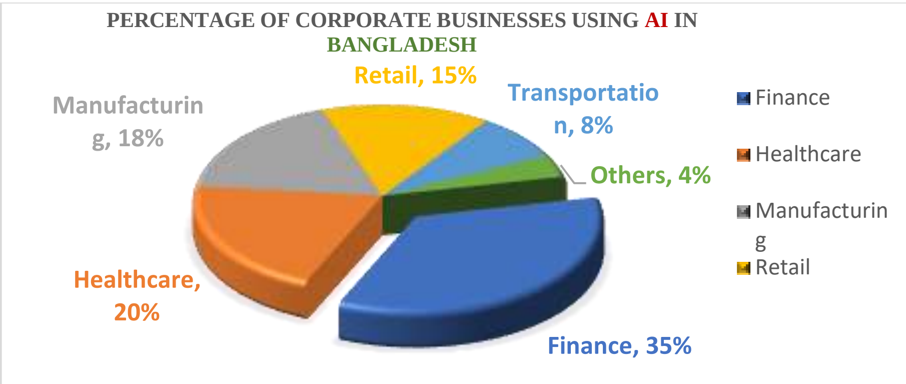


**Figure 1: Various Corporate Business Sectors in Bangladesh Using AI**

*(Source: Light Castle Partners, 2025)*

The above 3D pie chart in ***Figure 1*** shows the AI implementation adoption in various corporate sectors in Bangladesh. It is clear that the corporate finance industry has adopted AI due to its effectiveness in risk management, data forecasting and other useful features. Other industries like healthcare, retail and manufacturing are also benefiting from AI implementations and surely the trend will grow as time passes (Javaid et al., 2024). In the context of ESG performance, AI is extremely effective as it can greatly promote sustainability and optimization by analyzing data using a relevant algorithm. It is important to note, despite agriculture being the largest work force industry in Bangladesh (even larger than RMG sector); the adaptation of AI in this sector remains mostly untouched. The agriculture sector according to predictive analysis shows shocking leaps in compound annual growth rate globally (Zhang et al., 2024).


Figure 2: Global Market Trend of AI in Agriculture
(Source: The Business Search Company, 2025)

The bar chart from the above-mentioned Figure 2 clearly shows the upward trend of agriculture due to AI integrations. According to the predictive analysis as shown above, the global corporate agriculture industry will grow from 2.23 billion USD in 2024 to 2.71 billion USD in the current year (2025). Furthermore, future analysis of the expected market trends shows that the CAGR or Compound Annual Growth Rate will improve significantly with a staggering 24.8 % increase in the next 4 years (2029). Clearly, the impact of AI on corporate businesses are significant as it greatly boosts performance as seen from verified sources. As corporate farming and agriculture is a major sector in Bangladesh, appropriate usage of AI in this regard can greatly boost business performance of an already booming industry (Hossain, M., & Islam, M., 2022). Furthermore, optimization and sustainability practices can be greatly improved with the aid of AI. This can greatly reduce environmental strain by reducing resource consumption, cost and time. In the context of environmental responsibility and sustainability, a diagram encompassing the various aspects covered by AI for enhancing business performance, lowering cost and resource consumption, reducing time and optimization has been given accordingly:


**Figure 3: Role of AI in Sustainability and Environmental Responsibility in Bangladesh**
*(Source: Science Direct, 2024)*

The above given ***Figure 3*** displays how AI can play a role in sustainability and environmental management in Bangladesh. In the realm of corporate business, organizations and companies can use AI to improve their sustainability practices by monitoring environmental issues, optimizing production practices, predict climate changes, reduce resource consumption and harmful emissions, optimizing workloads, automating repetitive tasks and much more. AI can achieve all these factors due to sophisticated algorithms like Random Forest, Logistic Regression etc. to analyze data gathered by sensors, historical data sheets or manual inputs (Salman et al., 2024) a. The result derived from all of these data are logical solutions that promotes sustainability, optimization and efficiency. In the context of environmental responsibility, AI can be implemented by businesses in Bangladesh in various production factories to monitor air quality, water quality and even forecast weather patterns by utilizing various IoT sensors and keep track of the impact of production and manufacturing processes. This further allows corporate businesses to understand the impact of their respective sustainability and production practices on the environment. It is crucial to not only use AI for sustainability and cost effectiveness, but also use it for smart monitoring to keep track of progress at all times.

**B. Scopes and Objectives**

The problems Bangladesh is facing with sustainability and environmental hazards from corporate businesses has gotten out of hand. According to global climate reports; Dhaka, Bangladesh ranks as the 3rd most polluted city in the world with an annual average PM 2.5[1] of 78 micrograms per cubic meter ($\mu g / m^3$) (Islam, 2025). Making Bangladesh one of the most environmentally irresponsible country on earth. Moreover, Bangladesh has generally low standards when it comes to corporate sustainability practices and manufacturing processes. In the context of such poor sustainable practices in most corporate businesses in Bangladesh, AI can not only help improve these factors; but also play a crucial role in enhancing business performance and reducing the negative impacts on the environment. Some scopes and objectives regarding this research paper in the context of sustainability and the impact of AI on corporate business performance and environmental responsibility has been given below:

- ✓ Highlight some practical implications of AI driven improved sustainability practices.
- ✓ Understand the impact of AI on business performance in corporate businesses like corporate farming sector.
- ✓ Finding a solution using AI that positively impacts environmental responsibility in a corporate business sector in Bangladesh.
- ✓ Formulate some recommendations to tackle challenges regarding AI in the realm of corporate business sustainability, ESG performance and improved environmental responsibility.

The above points should cover what this research paper hopes to highlight. The adaptation of AI in Bangladesh should help solve many problems within the country. The sustainability practices and its impact on the environment could be greatly improved with the aid of appropriate AI tools (Kar et al., 2022). It is important to note that there is a strong link between improved business performance and sustainability as AI can help reduce cost, time, and resource consumption in general.

[1] ***PM 2.5 or Particulate Matter 2.5*** is a key indicator used to assess the quality and condition of air. Particularly, refers to fine particles which are 2.5 diameters or smaller which can be highly dangerous as they can penetrate deep through the lungs and enter the bloodstream. A higher number of PM 2.5 indicates more dangerous air quality which can be hazardous to breathe.

**C. Rationale and Novelty of the Research**

This research aims to highlight the effectiveness of AI for improved sustainability practices and business performance in corporate business sectors. With a particular focus on corporate farming business as it is a dominant sector in Bangladesh, the methodology discussed in this research is qualitative and is derived from already existing and verified data. This should further reinforce the effectiveness of AI for enhancing business performance and sustainability practices as the implementation of AI in this regard has been widely studied. The main aspect which is unique in this research paper is in highlighting corporate farming as a primary focal point in corporate business since farming and agriculture is strongly linked to resource consumption and environmental factors. Furthermore, integrating proper sustainability practices in this regard should remain as an excellent example of AI integration that lowers costs and resource consumption and optimizes production which contributes to improved business performance and lowers impact on the environment.

## I. REVIEW OF LITERATURE

Artificial Intelligence is a type of technology that tries to mimic human intelligence. The human brain uses neurons or braincells to store and process information. AI uses a similar method by utilizing nodes which behaves like neurons to gather data and process them (Mishra et al., 2024). The accuracy of the output provided by an AI integrated neural network models depends on the integrity and authenticity of the data. In the modern world, AI and its various levels of integration has contributed greatly in formulating dynamic solutions for complex problems and even improved business performances and economics.

**A. Case Studies: Impact of AI on Business Performance, Corporate Sustainability and Environmental Responsibility**

The impact of AI for enhancing business performance and sustainability practices could be further realized by reviewing the experiences of countries like Africa and India. According to the *Ethiopian Artificial Intelligence Institute*, the implementation of AI is expected to contribute at least a staggering 1.2 trillion USD to Africa's economy within the next 5 years (2030). Similarly in India, the AI integrated corporate businesses are expected contribute approximately 1.2 to 1.5 trillion USD to their economy by the next 7 years (2029 to 2030) according to *2023 Ernst and Young Report*. Potentially enhancing the national economy of India by increasing the GDP (Gross Domestic Product) by at approximately 5.2 % to 7.9 % respectively. In Africa, the integration of AI was made in corporate precision farming and healthcare sector. AI integrated technologies like drones and soil monitoring sensors were used to gather data and allowed effective monitoring. This minimized loss of crops, maximized yields and cutdown cost of production, therefore enhancing sustainability, improving yields and minimizing resource consumption. In healthcare, *IBM's WatsonX Health Assistant* was used to provide detailed insights about treatment plans about patients. This AI integrated tool helped medical professionals to diagnose and treat diseases of patients more accurately. Similar technologies designed by IMB like WatsonX Assistant can also be implemented in supply chains, sales, product development, marketing, information security etc. Such tools are potent AI driven solutions that can greatly enhance sustainability practices and improve business performance by automating solutions and monitoring.

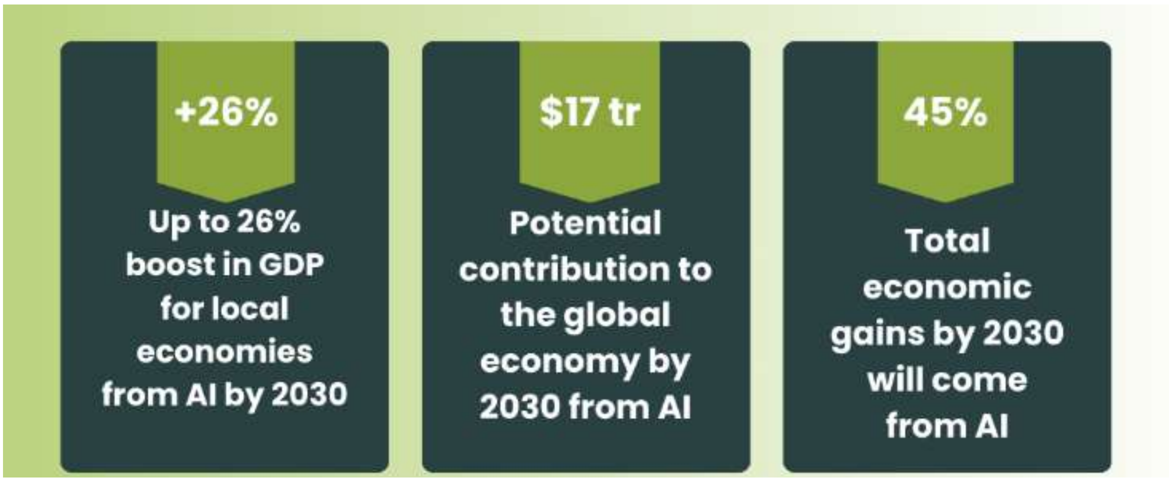


**Figure 4: Impact of AI on Local and Global Economies**
*(Source: National Strategy for Artificial Intelligence Bangladesh, 2023)*

The above stated *Figure 4* shows the effectiveness of AI in terms of both local and global businesses. It seems that AI integrated corporate business practices are expected to raise the standards of economy to greater heights (Wright et al., 2023). The local economies around the world are expected to boost their GDP by 26 % by 2030 due to AI integrated businesses. Hence, AI is firmly rooted in future innovations that will propel economic standards in a positive direction. According to *The World Bank*, Bangladesh experiences an average growth rate of approximately 6.6 % within the span of a decade (10 years) and approximately 5.8 % in 2023. Considering that AI alone will contribute approximately 17 trillion USD to the global economy within the next 5 years (2030) according to PwC[2]; considering the success experienced by India and Africa through AI as mentioned previously, Bangladesh could potentially generate billions of dollars at least through AI implementations in corporate business sectors. There are a number of areas where applications of AI are being made for corporate sustainability, improved business performance and environmental responsibility. A review of these existing literary data should provide insights into the effectiveness of AI in the mentioned context.

**B. AI Integrated Virtual Assistants and Chatbots**

Corporate banks are huge in Bangladesh and most of their population uses banking and related services. That is why many banks like *BRAC Bank and City Bank* has successfully implemented AI integrated chatbots and/or virtual assistants to tend to customers. This greatly enhanced customer services and boosted productivity by providing quicker response to questions and queries of the customers. The chatbots are capable of handling advanced tasks like providing balance inquires and loan applications. Hence, boosting corporate sustainability and improving business performance by providing better customer service. According to reports, 60 % of customers prefers chatbots for routine assistance rather than human agents (Kyrylenko, 2024).

[2] ***PwC or PwCIL (PriceWaterHouseCoopers International Limited)*** is a network of professional firms dedicated to providing a diverse number of services including auditing, tax and advisory services to help organizations, companies and even personal businesses to create value. PwC has their offices scattered around the world in more than 150 countries with 364,000 active staff members.

**C. AI Integrated Risk Management and Fraud Detection Algorithms**

Bangladesh is unfortunately infamous for misconduct, fraud and dishonesty in many corporate businesses especially in the corporate banking sector (Kabir et al., 2024). Previously, detecting suspicious and/or illegal transactions had to be done manually, which was time consuming and highly unreliable at times. However, thanks to complex AI integrated machine learning algorithms; anomalies or abnormalities in transactional data can be detected automatically. Allowing for effective responses to fraudulent activities. ***BRAC Bank*** and other similar banks have successfully integrated such AI tools for fraud prevention in Bangladesh. Which greatly contributes to a more ESG friendly outlook.

**D. AI Infused Algorithmic Trading and Portfolio Management**

Predicting stock market trends is crucial for corporate organizations and businesses to understand investment potentials and wealth maximization strategies. Bangladesh has been recently adopting various AI models to perform advanced stock market predictions. Although exploration of such algorithms is still in its early stages, the AI integrated models have successfully optimized data analysis and learning related to stock market exchanges. The systems developed by these AI tools greatly minimized the chances of human error and allows for dynamic data analysis of stock exchanges. The *Dhaka Stock Exchange or DSE* of Bangladesh is slowly adopting such advanced AI technologies to improve sustainability practices in market operations. Which allows for optimized business performances that greatly boosts the overall ESG performance of related corporate businesses.

**C. AI Integrated Sustainable Farming and Agriculture**

Agriculture is a huge part of Bangladesh and its economy. The high moisture content in the environment combined with fertile loamy soil makes the country perfectly equipped for sustainable agriculture with minimal loss of resources and high yields. Unfortunately, as Bangladesh is less technologically advanced compared to other nations; the sustainability practices in most sectors especially in farming and agriculture remains simply outdated. However, thanks to various AgriTech start-ups[3] in Bangladesh; numerous advancements are being made to optimize and enhance agricultural practices. Including connecting farmers with the market which saves time and resources. Some notable startup companies are *Khamar-e* and *iFarmer*. These companies are trying to implement AI integrated solutions for making farming more sustainable and optimized. The practices implemented from AI solutions ensures efficient usage of resources which is helpful for the environment (Setu Basak et al., 2020). The practices also greatly improve crop yield and minimizes loss of crops which greatly boosts business performances for corporate farming sectors.

The above-mentioned AI applications are being used in Bangladesh by various corporate business sectors to optimize and promote sustainability practices. It should be clear from the review of literature that AI does indeed positively impact business performance and promotes sustainability, which in turn minimizes the overall impact on the environment.

Upon the review of literature related to the impact of AI on corporate sustainability, business performance and environmental responsibility, it is clear that businesses in Bangladesh can greatly benefit AI integrated solutions. AI is surely a diverse tool which provides a wide array of technical

[3] ***AgriTech start-ups*** are new emerging companies that are dedicated to improving agricultural practices and methods by utilizing advanced technologies like AI, machine learning, robotic automation, IoT etc. The goal of the startups is to provide sustainable and optimized farming practices which ensures higher crop yields with minimal loss of resources.

solutions to really complex problems. Some research objectives have been mentioned in the light of the given context:

- ✓ Exploring an AI driven solution in a corporate business sector for improved business performance and better sustainability practices.
- ✓ Understand how AI integrated solutions can lower waste production and maximize efficiency for enhanced environmental responsibility.
- ✓ Explore the role of AI driven solutions in enhancing ESG (Environmental, Social and Governance) performance of corporate businesses.

The above-mentioned research objectives should help in gaining a deeper understanding of AI and its impact in corporate sustainability, business performance and environmental responsibility for businesses in Bangladesh.

## II. RESEARCH METHODOLOGY

The modern society has been reshaped due to advancements in technology and its numerous levels of integration scattered around countless sectors. The leaps in humanity's advancements are exponential and the potential of newer technologies are pushing the limits of advanced problem solving. Artificial Intelligence is a game changer when it comes to tackling problems and understanding the world in a different light. Technologies like generative AI, machine learning and deep learning technologies are yet again reshaping the modern world (Halimuzzaman & Sharma, 2022). AI is enabling data driven solutions that maximizes efficiency and minimizes waste production; making it an effective tool for sustainable developments. The business sectors of Bangladesh are slowly adapting AI solutions for improved sustainability, business performance and environmental responsibility. In order to understand the impact of AI on the mentioned factors in the context of corporate businesses and review of literature, this methodology will explore a comprehensive AI driven solution in the Corporate Farming[4] sector of Bangladesh. The methodology will also adopt a qualitative approach; reviewing already existing and verified information mixed with a dynamic solution to fulfil the previously mentioned scopes and objectives including research objectives. Furthermore, a small-scale ESG framework will be referenced with the intent of the included methodology's impact on environmental responsibility.

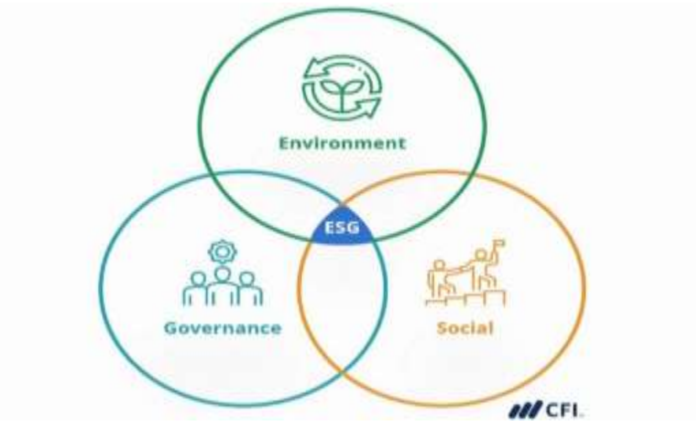


**Figure 5: A Simple ESG or Environmental, Social and Governance Framework/Model**

*(Source: Corporate Finance Institute, 2024)*

[4] ***Corporate Farming*** refers to the sector of agriculture and farming business of Bangladesh primarily characterized by large-scale commercial farming practices including some sizeable private sectors. The key players in corporate farming are agro-chemical organizations, seed companies and commercialized food processing industries.

The above-mentioned *Figure 5* encompasses the 3 fundamental pillars of ESG framework for determining the overall business performance, sustainability and environmental impact of corporate businesses. The model can help assess the effectiveness of a proposed solution by outlining how the sustainability and production practices of an organization affects resource consumption and sustainability (Islam et al., 2023). The framework also pushes organization to improve sustainability practices as ESG performance of a corporate business is important for managing stakeholder relationships. The ESG performance of the proposed methodology can help in understanding the findings and results from AI driven solutions.

**A. Data Collection**

In the context of corporate sustainability, improving business performance and environmental responsibility; AI driven solutions can be implemented. Bangladesh is a country where roughly 13.31% of GDP is derived from agriculture and corporate farming businesses according to ***Bangladesh Statistical Bureau.*** Hence, it is critical to apply AI in this corporate sector that can greatly improve business performance and sustainability practices for decreased environmental strain (Halimuzzaman et al., 2024). The AI driven solution in this regard is called **Smart Farming**[5]. The solution uses various IoT sensors to monitor crop health and gather data which feeds an AI model. The AI model can help detect problems and issues in the crops based on data and can even automate processes based on the exact needs which saves time, money and resources. The data gathering IoT sensors has been given below:

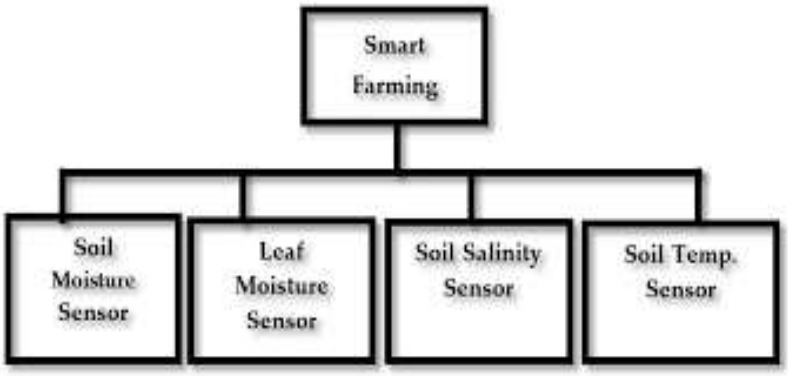


**Figure 6: Smart Farming IoT Sensors for AI Driven Improved Sustainability and Business Performance**

*(Source: ResearchGate, 2022)*

The above-mentioned sensors as seen from ***Figure 6*** clearly shows the required sensors required for smart monitoring. The mentioned sensors are cheap and can easily be obtained by most corporate businesses of Bangladesh (Islam et al., 2024). Soil moisture sensors are responsible for detecting the wetness levels of the soil, which can allow farmers or even automated irrigation robots to water the crops with the exact amount of water required. Thus, greatly reducing water wastage. Leaf moisture sensors are responsible for detecting the wetness levels above the soil; effectively detecting fungus development, fog and even early rainfall detection. Soil salinity sensors are crucial for understanding the nutrient content of the soil and can greatly minimize loss of crops by notifying farmers about

[5] ***Smart Farming*** refers to advanced farming techniques and steps that utilized IoT and AI for smart dynamic monitoring, automated smart irrigation systems etc. to reduce resource consumption and maximize crop yields; greatly improving sustainability and decreasing negative environmental impacts.

unnatural PH changes. Soil temperature sensors are also crucial as they let farmers plant the crops in the most optimal time which greatly improved crop yields and minimizes loss of crops (Al Imran et al., 2024). The mentioned sensors can greatly help to improve sustainability practices by optimizing crop yields, reducing waste and improving environmental responsibility.

**B. Data Pre-Processing**

The data gathered by the IoT sensors needs to be processed before feeding it to an AI algorithm as the accuracy of the output can be greatly compromised. This can result in providing faulty outputs which can hamper sustainability practices and business performance.

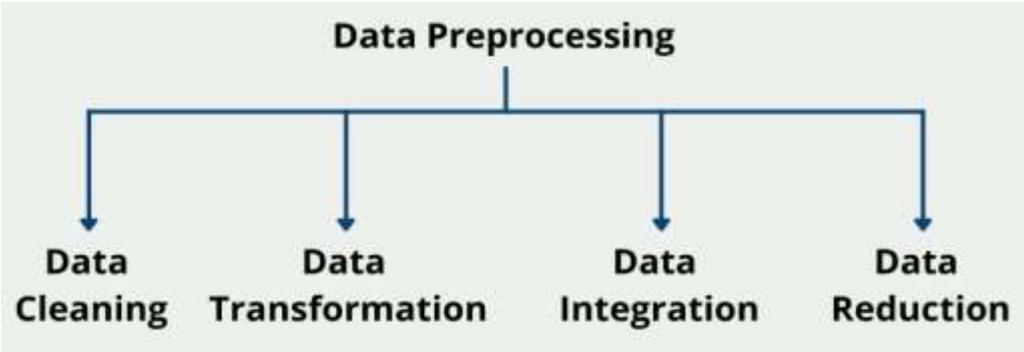


**Figure 7: 4 Steps of Data Pre-Processing**

*(Source: DataBaseCamp, 2023)*

The 4 steps of data pre-processing as shown in ***Figure 7*** are crucial for minimizing faulty data. In the first step of data pre-processing, the data needs to be cleaned by removing potential duplicate data and omitting missing values. Then the data can be transformed by applying scaling and encoding techniques to make the data readable by an AI model. The next step is to join and merge the data for more efficient processing; a step commonly known as data integration. And finally, the filtered data is reduced for maximizing efficiency by sampling and dimensionality. These steps ensure the integrity of the gathered data which results in accurate outputs through an AI algorithmic model (Sharfuddin et al., 2024).

**C. Data Analysis**

An appropriate AI driven algorithmic model needs to be chosen for data analysis of the gathered data from the integrated IoT sensors. In the realm of sustainable smart farming for corporate farming businesses in Bangladesh, the data could be processed by algorithms like decision trees, random forests and support vector algorithms. Deep learning can also be integrated. However, the current methodology does not require such an advanced AI algorithm as it is commonly used for sophisticated tasks like time series analysis and advanced image recognition. For the sake of maximizing sustainability, business performance and environmental responsibility; the methodology will adopt random forest AI algorithm to process data. It analyzes data by combining multiple decision tress to find best decision (Haque Bhuiyan et al., 2025). Which is perfect for resource efficiency, effectively lowering water cost and resource waste which can greatly improve both sustainability and environmental responsibility.

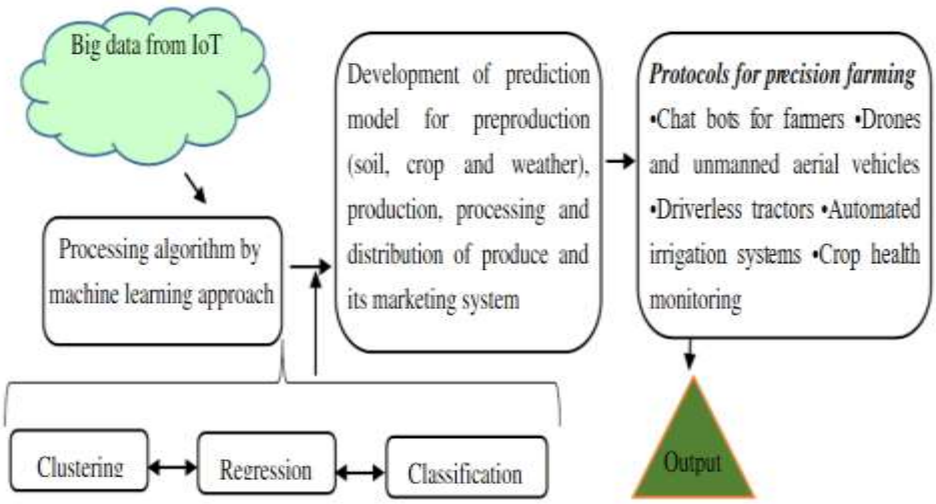


**Figure 8: Data Analysis Using Random Forest AI Algorithmic Model for Improved Sustainability, Business Performance and Environmental Responsibility**
*(Source: ResearchGate, 2022)*

The above-mentioned Figure 8 shows the how the data is processed by random forest AI algorithm to give an output. The big data collected by the previously mentioned IoT sensors will be given as input in the random forest model. After which the model will perform clustering, regression and classification to further prepare the data (Hossen et al., 2024). This will develop a prediction model by which farmers can adjust accordingly, ensuring proper sustainability and crop monitoring. Coupled with drones and unmanned automated irrigation systems and even robotic harvesting system can greatly optimize crop yield and prevent loss of crops. All these factors will greatly boost productivity by increasing crop yield, minimizing crop loss and ensuring minimal impact on the environment.

## III. RESULTS AND DISCUSSION

The impact and versatility of AI in the realm of enhancing corporate sustainability practices and business performance seems highly desirable. As seen from the proposed research methodology, AI highly favors sustainability by greatly reducing resource consumption, promotes output efficiency and sustainability. Corporate businesses as seen in corporate farming sector of Bangladesh can adopt the use of AI for improved sustainability steps. Similarly, any other corporate business sector in Bangladesh can also benefit from AI as it improves production and sustainability steps by automation, dynamic monitoring, sustainable development etc. The key finding in the given context has been summarized as accordingly:

### A. Dynamic Environmental Monitoring

The proposed methodology showed how IoT sensors can be used for smart monitoring. These applications can be applied by many other corporate businesses in Bangladesh like manufacturing industries, transportation, healthcare etc. Real-time data can allow industries to keep track of how their production processes and sustainability practices impact the environment (Rubel Datta et al., 2024). Which allows them to take action as soon as the problem gets detected; greatly improving environmental responsibility and sustainability.

**B. Improved Sustainability Practices and Business Performance**

The research has shown the capabilities of AI in terms of increased productivity and efficiency. An algorithmic model driven by AI is capable of analyzing data to give the best results based on the integrity of data. The proposed methodology showed how the IoT sensors ensured maximum productivity via possible integration of automated irrigation and pruning systems to dynamically adjust the plants and soils according to conditions. Other corporate businesses industries of Bangladesh can make use of similar AI models and techniques to maximize production with boosted efficiency; saving time and money. All these factors greatly contribute to increased business performance and enhanced sustainability steps.

*C. Enhanced Environmental Responsibility and Waste Management*

AI models and algorithms allows the development of excellent waste management by effectively utilizing resources based on the exact needs (Islam et al., 2025). The proposed methodology showed how the IoT monitoring sensors allowed the utilization of resources based on the wetness level, PH value, temperature etc. to tend to the crops. This lowers the strain on the environment as it greatly reduces resource consumption like water and fertilizer, minimizes the chances of loss of crops and promotes efficient waste management.

**C. ESG Performance Findings**

Based on the context of the research, the ESG analysis of the proposed methodology in the context of Bangladesh's corporate business sector has been given below:

**Table 1: A Simple ESG Performance Analysis**

| Environmental<br>(E) | Social<br>(S) | Governance<br>(G) |
|---|---|---|
| • Improved sustainability<br>• Reduced waste production.<br>• Reduced resource consumption.<br>• Enhanced environmental monitoring. | • Effective communication between businesses (farmers, sellers) and clients.<br>• Improved production rate and customer satisfaction.<br>• AI enabled anti-fraud and security. | • Potentially improved stakeholder relationships.<br>• Broader range of diversity and strategic integration for AI.<br>• Enhanced risk management. |

From ***Table 1***, it is clear that AI can surely have a positive impact on ESG performance of corporate businesses. In Bangladesh, most small-scale companies have unoptimized corporate business practices which are outdated and sluggish. However, AI implemented solutions can greatly improve ESG performances of companies by promoting sustainability, improved business performance, better risk management, better condition monitoring etc. AI has the ability to help Bangladesh's corporate business sector to reach new levels of innovation and sustainable developments (Hossain et al., 2025).

IV. RECOMMENDATIONS

Some recommendations based on the context of the impact of AI in sustainability, business performance and environmental responsibility has been given below accordingly:

- The effectiveness of AI for sustainable development and environmental sustainability can be further accelerated with collaborations between various private and government sectors.

- Extra funding and attention should be given in research and development of AI integrations in the mentioned context for maximizing its effectiveness
- Caution should be exercised when using AI for sustainability, since faulty data can cause AI models to give inaccurate results.
- AI integrated tools should be made more accessible by the government so that even small corporate businesses can implement AI sustainability techniques.
- Awareness of AI and its potential to greatly improve production practices and business performance should be exercised.
- Campaigns regarding environmental concern and the role of AI in minimizing environmental strain could greatly encourage businesses to adopt AI integration more quickly.

Limitations of the Study

The research conducted on AI in corporate sustainability and its impact on business performance and environmental responsibility was derived from already existing and verified data. The proposed solutions, methodology and recommendations were drawn from authentic sources mixed with personal opinions and experiences. Some conclusions and opinions were somewhat biased and personalized.

## V. CONCLUSIONS

AI has the potential to change how humanity tackles problems forever. It is important to realize that AI is a tool, and how that tool is used determines its effectiveness. There are a lot of bias regarding AI and its potential to both solve problems and cause them. If AI is used with caution for the intent of sustainability, Bangladesh can greatly benefit from its potential as it can greatly boost productivity and minimize waste (Shovon et al., 2024). In the context of the research, AI has the potential to greatly improve the outdated practices of corporate businesses in Bangladesh which are bad for the environment. The impact of AI in terms of sustainability, business performance and environmental responsibility is surely positive if implemented correctly.

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# A STUDY ON RISK ANALYSIS ON EQUITY UNDER BSE

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***Abstracts***

*In this report we described about A STUDY ON RISK ANALYSIS ON EQUITY UNDER BOMBAY STOCH EXCHANGE (BSE).*

*In this report discussing about the top 6 listed stocks under Bombay Stock Exchange. The data will be collected from official website from BSE, Screener and Yahoo Finance .These websites are helpful to completed my report and collecting the data from this website to using for analyzing the stocks and researching for Risk Analysis on top 6 equities under BSE.*

*In today's rapidly evolving business landscape, the ability to anticipate and mitigate risks is paramount to organizational success. This risk analysis report provides a comprehensive overview of the key threats and opportunities encountered by over past 6 months.*

*Throughout this analysis, we delve into various categories of risk, including financial, operational, regulatory and reputational, to gain a holistic understanding of the challenges and during this opportunities for investors to built a effective portfolio and take this chance to create wealthy portfolio that have emerged during this report.*

*Moreover, this report serves as a foundations for fostering a culture of risk awareness and proactive risk management using for long term and short term investors.*

## OBJECTIVE OF STUDY

1) To measure risk of the top 6 selected stocks in Sensex using standard deviation and beta values purpose of short term investment.
2) To measure return of the top 6 stocks in Sensex using mean return.
3) To minimize the potential impact of risks on an investment portfolio while maximizing its returns.
4) This study help to maintain proper risk management in this particular top 6 stocks to improve investment strategies.
5) To build proper portfolio and also we focused for return on investment with the use of risk analysis and sharpe ratio

## NEED FOR STUDY

- This need for study depend upon the perspective of the retail investors to increasing our capital raising for short term gain with in 6 month. It's a dream of investor to simplify his investment by having an expansive number of shares with him.
- Studying risk analysis in the stock market is crucial because it helps investors understand and mange the potential uncertainties and fluctuations in investment returns. By analyzing risks associated with the various stocks and portfolios, investors can make more informed decisions, mitigate losses, and optimize their investment strategies to achieve their financial goals.

- In this study it helps to proper risk management and also we build effective portfolio for short term investment, final result of analysis we meet to constructing profitable portfolio.

**SCOPE OF STUDY**

- The research is derived only on the data collected from period 2024 November to 2025 May which means collecting past 6 month data from Sensex 30.
- Sensex is the bench mark index used for the study.
- The scope of the study of only a Sensex 30 on a top 6 selected companies stocks and including in the index are the considered in the study.

**LIMITATION OF STUDY**

- Risks that affect future performance are not typically identified.
- Developments in the risk profile are not detectable.
- Risk elements and mitigation measures focus only on high risk area.
- Limited data availability or poor quality data can undermine the accuracy of risk analysis, making it challenging to assess all potential risks adequately.
- Some risk interconnected or have cascading effects, making them difficult to capture comprehensively in a risk analysis framework.
- Risk factors can change rapidly due to various internal and external factors, making it challenging to keep risk analyses up-to-date and relevant over time.

**STATEMENT OF PROBLEM**

- To analyze the risk associated with top 6 selected stocks and find which of the following stocks are best investment during for short term capital gain.
- To analyze 6 month return of the top 6 stocks and find the each of the stock risk analyzing for purpose of build a effective portfolio.
- And in these study we using risk analysis and sharpe ratio compare to the government bond yield. These comparing collected data from the last 6 month data of bond yiled.

**REVIEW OF LITERATURE**

**Explaining study of the topic:**

**RISK ANALYSIS:**

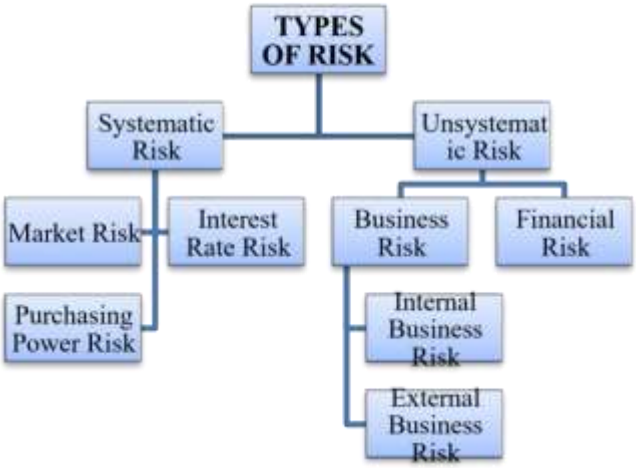
Risk may be defined as the possibility of suffering an injury or loss. Risk is the possibility that the actual return on an investment may be different from the expected return. This regard is the idea that an investment carrying a higher risk has the potential of a higher yield.

“The probability that an investment’s actual return would be different from the expected return, including the ultimate risk of losing all of the original investment’s

Risk is usually measured by calculating the standard deviation of the historical returns or average returns of a specific investment.

**TYPES OF RISK:**

There are a member of risks a business organisation is exposed to like ‘Market Risk’, ’Interest Rate Risk’, ‘Country Risk’, ‘Business Risk’, ‘ Financial Risk’, etc. They can be put under two board categories:




**1. SYSTEMATIC RISK:**

Systemic risk refers to the risk inherent in the whole market or part of the market. Systematic risk is also called the undiversifiable risk, market risk, or volatility. It affects not just a particular stock or industry, but the overall market. Further it is associated with economic, social, political and legal aspects of all the securities in the economy.

This kind of risk is not only unpredictable but also it is absolutely impossible to avoid. It can not be mitigated by diversification, only by hedging or by using the proper asset allocation strategy.

**I. MARKET RISK:**

Market risk is caused by the herd mentality of investors, i.e. the tendency of investors to follow the direction of the market. Hence, market risk is the tendency of security prices to move together. If the market is declining, then even the share prices of good-performing companies fall.

Market risk constitutes almost two-thirds of total systematic risk. Therefore, sometimes the systematic risk is also referred to as market risk. Market price changes are the most prominent source of risk in securities.

**II. INTEREST RATE RISK:**

Interest rate risk is the possibility of an unexpected change in interest rates prevailing in the market, which affects the value of an investment adversely. Generally, the value of debt instruments like bond, debentures, commercial paper, etc. is directly affected by 'INTEREST RATE RISK'.

If they offer a higher rate of interest on their bonds, investors would find them more attractive in view of the inherent level of safety, and perhaps may prefer to shift their investment from 'Corporate/Private Sector Bonds' to the paper issued by 'Central/State Government' or 'Quasi- Government' bodies. Similarly, if the Central or State Government issue new loans bearing a higher rate of interest, there would be a reduction in the value of the existing Government papers, due to switch of funds from low interest bearing bonds to high interest bearing bonds.

If price risk is negative (i.e., fall in price), reinvestment risk would be positive (i.e., increase in earnings on reinvested money). Interest rate changes are the main source of risk for fixed income securities such as bonds and debentures.

**III. PURCHASING POWER RISK:**

Purchasing power risk arises due to inflation. Inflation is the persistent and sustained increase in the general price level. Inflation erodes the purchasing power of money, i.e., the same amount of money can buy fewer goods and services due to an increase in prices. Therefore, if an investor's income does not increase in times of rising inflation, then the investor is actually getting lower income in real terms.

**2. UNSYSTEMATIC RISK:**

The term "unsystematic" refers to a quality that is not commonly shared among many investment opportunities. This is distinct from systematic risk, the dangers inherent to the market as a whole.

'UNSYSTEMATIC RISK' may be specific to an industry or company and is caused due to one or more of the following:

1) Lack of managerial ability.
2) Technological advancement in the process of production,
3) Procurement of raw material,
4) Lack of human resources,
5) Change in consumer preferences.

**I. BUSINESS RISK:**

Business risk is a part of the unsystematic risk, which basically comes from the operational activities of the business. Due to certain in built deficiencies in the operation of a company, its competitive advantage over the rivals is lost affecting the force of its expansion and/or smooth flow of revenue.

This facts is ultimately expressed in the form of poor 'Operating Income' and 'Expected Dividends of the company.

Business risk may arise due to internal cause or external causes and accordingly it is categorized under two heads,

1) Internal Business Risk 2) External Business Risk.

**1) INTERNAL BUSINESS RISK:**

Internal business risk is related to the operational effectiveness of a company. The operational effectiveness of a company is measured in term of the level of its targeted achievements and keeping the promises made to its investors.

Operational effectiveness varies from company to company, and is influenced by the following factors:

a) **Sales Variation**
b) **Research and Development (R&D)**
c) **Personal Management**
d) **Fixed Cost**
e) **Single Product**

**2) EXTERNAL BUSINESS RISK:**

External business risks are the risk caused by the circumstances, which are external to a company's business. The company has no control over these circumstances or factors, which are;

a) **Social and regulatory factors**,
b) **Monetary policy of the central bank of the country,**
c) **Fiscal policy of the government,**
d) **Business cycle,**
e) **General economic conditions, etc.**

**II. FINANCIAL RISK:**

Financial risk of a company is closely related to the manner in which the funds have been raised to design its capital structure. Financial strength of a company depends upon the level and stability of its earnings.

Financial risk is the possibility of losing money on an investment or business venture. Some more common and distinct financial risks include credit risk, liquidity risk, and operational risk. Financial risk is a type of danger that can result in the loss of capital to interested parties.

For governments, this can mean they are unable to control monetary policy and default on bonds or other debt issues. Corporations also face the possibility of default on debt they undertake but may also experience failure in an undertaking the causes a financial burden on the business.

**Financial risk may be classified into following sub-divisions:**

a) **Credit risk,**
b) **Currency risk,**
c) **Country risk, and**
d) **Liquidity risk.**

**LITERATURE OF REVIEW:**

Chawla (2001), out of 36 companies 20 companies rejected the “hypothesis of beta stability” for the period of april 1996 to march 2002 from the samples chosen by chawla.

Shijin and Crew (2007) from march 1996 to march 2006 shijin carefully tested the return and risk elements of average stocks in indian market by selecting 70 sample companies from Bombay stock exchange. The result of Vector Autoregressive Approach pointed that market risk proxy had constant effects on Indian stock market stock returns.

Irala (2007) from the period 1994 to 2006 irala selected 660 companies as samples to find the proof for instability in their beta value.

Drake, John R (2006): risk associated with portfolio management and information technology. It is description of various factors about the IT project of portfolio management. It also examines the project, financial management and the development of the project it has 5 categories of risk in the project as it is the major tool to analyze various risk of portfolio individuals.

Kushalapas, Sharmila, Kundar (2014): Risk management through efficient portfolio; Risk management is the procedure of identifying, analysis in investment decision making. It can be subsequent to the companies as well as individual. It has two steps of categories the primary one is what risk can happen in an investment and handling those risk in better way of investment. It is the process of analysing risk in the finest way of investment risk exposure and trying to reduce in to various, including diversification of portfolio .It has various kind of securities like bonds, shares, and other assets and securities in order to meet the benefits for the investors. Portfolio is like a basket full of stocks in this no other investments are included only the stock is involved. Risk and return of various portfolio is done by using Markowitz model and William Sharpe model to maximize the return of given value.

Pravin Narayan, Mahamani (2012): ‘Investment analysis and portfolio management by keithe brown and frank Reilly’ In this study it has divided in to 7 parts that is investment background development in investment theory, principles and practices of stocks, analysis management of common stocks bonds. Derivative security analysis, specified and evaluation of assets management, other financial risk and investment analysis.

Haim, Shalit(2014):" Portfolio risk management using the Lorenz curve" from the lorenz curve we can analyze the value or amount of risk and return in a different conditional value of the risk and financial data. the Lorenz curve is very easy to calculate because it requires only the asset value in ascending order. it is carried out to study the risk for all investors of individuals.

Byrne, Lee; Stephen, Peter (2000): 'The influence of market risk on risk reduction of property portfolio reduction' In the investigation the amount of which risk can be achieved with in the portfolio risk and individual property market in higher and lower beta value portfolio. In this particular investigation it points the reachable level of risk reduction is negative and it is linked to the level of market risk of the individual assets.

David and Woods (2002): " Integrating analysis of risk, valuation and starategy to the benefit of portfolio optimization" The optimization of oil and gas within `a portfolio requires as analysis of individual to develop the stock in the risk management. It `has major four numerical techniques a) Simulation b) Statistics c) Simplex d) Spread Sheet.

Nath and Verma (2003) examine the interdependence of the three major stock markets in south Asia stock market indices namely India (NSE-Nifty) Taiwan (Taiex) and Singapore (STI) by employing bivariate and multivariate co integration analysis to model the linkages among the stock markets, No co -integration was found for the entire period (daily data from January 1994 to November 2002).They concluded that there is no long run equilibrium.

Debjiban Mukherjee (2007) made a comparative Analysis of Indian stock market with International markets. His study covers New York Stock Exchange (NYSE), Hong Kong Stock exchange (HSE), Tokyo Stock exchange (TSE), Russian Stock exchange (RSE), Korean Stock exchange (KSE) from various socio- politico-economic backgrounds. Both the Bombay Stock exchange (BSE) and the National Stock Exchange of Indian Limited (NSE) have been used in the study as a part of Indian Stock Market. The main objective of this study is to capture the trends, similarities and patterns in the activities and movements of the Indian Stock Market in comparison to its international counterparts. The time period has been divided into various eras to test the correlation between the various exchanges to prove that the Indian markets have become more integrated with its global counterparts and its reaction are in tandem with that are seen globally. The various stock exchanges have been compared on the basis of Market Capitalization, number of listed securities, listing agreements, circuit filters, and settlement. It can safely be said that the markets do react to global cues and any happening in the global scenario be it macroeconomic or country specific (foreign trade channel) affect the various markets.

Nidhi Walia and Ravi Kiran (2009) studied that to satisfy the needs of investors‟ mutual funds are designing more lucrative and innovative tools considering the appetite for risk taking of individual investors. A successful investor is one who strives to achieve not less than rate of return consistent with risk assumed. They also argued as per observation by survey responses of the individual investor‟s fact is clear that overall among other investment avenues capital market instruments are at the priority of investors but level of preference varies with different category/ level of income, and an association exists between income status of investors and their preference for capital market instrument with return as objective.

Vinay Mishra and Harshita Bhatnagar (2009) documented that Derivatives are considered to be extremely versatile financial instruments, as they help to manage risks, lower funding costs, enhance yields and diversify portfolios. The contributions made by derivatives have been so great that they have been credited with having „changed the face of finance‟ in the world. Derivatives markets are an integral part of capital markets in developed as well as in emerging market economies. These instruments assist business growth by disseminating effective price signals concerning exchange rates, indices and reference rates or other assets, thereby, rendering both cash and derivatives markets more efficient.

Ashutosh Vashishtha and Satish Kumar (2010) studied encompasses scope an analysis of historical roots of derivative market of India. The emergence of derivatives market is an ingenious feat of financial engineering that provides an effective and less costly solution to the problem of risk that is embedded in the price unpredictability of the underlying asset. In India, since its inception derivatives market has exhibited exponential growth both in terms of volume and number of traded contracts. They argued that NSE and BSE has added more products in their derivatives segment but still it is far less than the depth and variety of products prevailing across many developed capital markets.

Daniel Dorn (2010) concluded market for OTC derivatives have grown rapidly during the last decade in many Asian and European countries. Investors often face a choice between dozens of OTC options that differ only slightly in their attributes. He argued that professional advice can help uninformed investor better navigate the menu of choices, unless issuers raise complexity or offer advisors incentives to share in industry profit.

David Nicolaus (2010) studied that retail derivatives allow retail investors to pursue sophisticated trading, investment strategies and hedging financial instruments. Retail investors" motivation for improving the after tax return of their household portfolio represents a major driver of the derivatives choice of the products and that provide only little equity exposure for the investor. The derivatives reveal the divergent belief of retail investors about the future price level of the underlying as these can be tailored to specific demand of the investor. He argued the potential role of search costs and financial advice on the portfolio decisions of retail investors, the flexibility of retail derivatives and low issuance costs are likely to emphasize the existing frictions in financial retail markets such as an increase of strategies and heuristics used by retail investors to cope with the complex decision situation or an inadequate disclosure of conflicts of interest in financial retail markets.

Gaurav Kabra, Prashant Mishra and Manoj Dash (2010) studied key factors influencing investment behaviour and ways these factors impacts investment risk tolerance and decision making process among men and women and those different age groups. They said that not all investments will be profitable, as investor will not always make the correct investment decisions over the period of years. Through evidence they proved that security as the most important criterion; there is no significant difference of security, opinion, hedging in all age group. But there is significant difference of awareness, benefits and duration in all age group. From the empirical results they concluded the modern investor is a mature and adequately groomed person.

Juhi Ahuja (2012) presents a review of Indian Capital Market & its structure. In last decade or so, it has been observed that there has been a paradigm shift in Indian capital market. The application of many reforms & developments in Indian capital market has made the Indian capital market comparable with the international capital markets. Now, the market features a developed regulatory mechanism and a modern market infrastructure with growing market capitalization, market liquidity, and mobilization of resources. The emergence of Private Corporate Debt market is also a good innovation replacing the banking mode of corporate finance. However, the market has witnessed its worst time with the recent global financial crisis that originated from the US sub-prime mortgage market and spread over to the entire world as a contagion. The capital market of India delivered a sluggish performance.

Dr. M. Muthu Gopalakrishnan & Amal Vijay A K (2017), attempted to analyse the risk return aspects of ten selected pharmaceutical companies which are listed on NSE. The tools which were used to perform the analysis were mean, beta, standard deviation, alpha, correlationand covariance. The data collected was for a period of five years, from 2012 to 2015. By analysing these companies, they understood that if the investor has to get high returns it is very important to consider the risk and return factors of the stocks. Lakshman Raj Kandel (2018), the author made an attempt to analyse the risk and return relationship of two selected commercial banks which are listed on the Nepal stock exchange. The data was collected for a period five years and tools such as correlation, SD, covariance, and also portfolio analysis & t-test were used for the purpose of analysis. They analysed that both the banks had high pro portions of unsystematic risk, and the prices of the stocks were overpriced. So, they concluded that it was preferable for the investors.

Manamani Sahoo (2021), researched about the day-of-the-week effect was empirically investigated using daily closing data for various Nifty indices, both before and during the COVID-19 health crisis from April

1, 2005, to May 14, 2020. The research employed dummy variable regression and the Generalized

Autoregressive Conditional Heteroscedasticity (GARCH) model. Results indicate a negative return on Mondays during the COVID-19 crisis, while it was positive before the pandemic. Additionally, Tuesdays exhibited a statistically significant and positive effect on index returns during the COVID-19 crisis.

## RESEARCH METHODOLOGY

A research methodology describes the techniques and procedures used to identify and analyze information regarding a specific research topic. It is a process by which researchers design their study so that they can achieve their objectives using the selected research instruments.

It includes all the important aspects of research, including research design, data collection methods, data analysis methods, and the overall framework within which the research is conducted.

While these points can help you understand what is research methodology, you also need to know why it is important to pick the right methodology.

## RESEARCH DESIGN:

Research design is a blueprint of a scientific study. It includes research methodologies, tools, and techniques to conduct the research. It helps to identify and address the problem that may rise during the process of research and analysis.

**Research Design: Analytical Design**

The Analytical Design Planning Technique (ADePT) is a planning methodology which helps to overcome these difficulties.

This paper describes the development of a modeling notation and model of the detailed building design process, which forms the first stage of ADePT.

This leads to a compromised design process containing inevitable cycles of rework together with associated time and cost penalties in both design and construction.

## SOURCES OF DATA:

## PRIMARY DATA:

Primary data refers to original data collected directly from its source for a specific research or analysis purpose. This information has not been previously gathered, processed, or interpreted by anyone else. It is the data that researchers or analysts collect firsthand.

**SECONDARY DATA:**

Secondary data refers to data that is collected by someone other than the primary user. Common sources of secondary data for social science include censuses, information collected by government departments, organizational records and data that was originally collected for other research purposes.

**DATA ANALYSIS:**

The data of individual stocks and Sensex were collected from the official Bombay stock exchange website and the companies selected for study are listed on Bombay stock exchange. The data are collected for 6 month for the study (2023 November – 2024 April).

**Framework for data analysis:**

$$\text{Stock return} = \frac{\text{Current month price}}{\text{Previous month price}} - 1 * 100$$

**Market return: it is a return on the market portfolio of every traded securities.**

$$\text{Market return} = \frac{\text{Current month index price}}{\text{Previous month index price}} - 1 * 100$$

Sensex is the bench mark index chosen for the study and Sensex is called as return on market.

**ARITHMETIC MEAN RETURN (AM):**

An arithmetic mean is the sum of a series of numbers divided by the number of items in that series. The formula for the arithmetic mean is simple and is very commonly used to find an average for a data set In

finance and investing, one might use the arithmetic mean to get an idea of the average earnings estimate for a series of estimates issued by a number of analysts covering a stock. Simply add up the various estimates and divide by the number of estimates.

$$\textbf{AM} = \sum \frac{\text{Ri}}{\text{N}}$$

**Where,**

**Ri = Return of market and stock return.**

**N = Number of year or month.**

**STANDARD DEVIATION:**

Standard deviation is a statistical measurement of how far a variable, such as an investment's return, moves above or below its average (mean) return. An investment with high volatility is considered riskier than an investment with low volatility; the higher the standard deviation, the higher the risk.

Risk is a probable condition of of losing investment because of market uncertainties or bad management of portfolios. To measure the risk of securities standard deviation is being used.

**The formula for standard deviation is:**

$$\sigma = \sqrt{\frac{\sum(\text{Ri} - \overline{\text{Ri}})^2}{\text{N}}}$$

**BETA AND ITS CALCULATION:**

Beta is a concept that measures the expected move in a stock relative to movements in the overall market.

A beta greater than 1.0 suggests that the stock is more volatile than the broader market, and a beta less than 1.0 indicates a stock with lower volatility.

Beta is a component of the Capital Asset Pricing Model, which calculates the cost of equity funding and can help determine the rate of return to expect relative to perceived risk.

$$\beta i = \sum \frac{(Ri - R\bar{i}) \sum Rm - R\bar{m})}{\sum Rm - R\bar{m})^2}$$

**RISK FREE RETURN:**

The risk-free rate of return is the interest rate an investor can expect to earn on an investment that carries zero risk. In practice, the risk-free rate is commonly considered to be equal to the interest paid on a 10year highly rated government Treasury note, generally the safest investment an investor can make.

The risk-free rate is a theoretical number since technically all investments carry some form of risk, as explained here. Nonetheless, it is common practice to refer to the T-note rate as free rate. While it is possible for a highly rated government to default on its securities, the probability of this happening is considered very low.

**RISK FREE RETURN = (Rf)**

**SHARPE RATIO:**

The Sharpe ratio compares the return of an investment with its risk. It's a mathematical expression of the insight that excess returns over a period of time may signify more volatility and risk, rather than investing skill.

The Sharpe ratio's numerator is the difference over time between realized, or expected, returns and a benchmark such as the risk-free rate of return or the performance of a particular investment category.

Its denominator is the standard deviation of returns over the same period of time, a measure of volatility and risk. Sharpe ratios above 1 are generally considered “good," offering excess returns relative to volatility.

However, investors often compare the Sharpe ratio of a portfolio or fund with those of its peers or market sector.

$$\textbf{Sharpe ratio} = \frac{Rp - Rf}{\sigma p}$$

**SHARPE’S SINGLE INDEX MODEL:**

In Sharpe’s index model because of the common movement in the stock market the stocks vary together. The co movement of stocks with a market index may be calculated with the assistance of a simple linear regression analysis, taking the returns on the market index(Rm) as independent variable and returns on an individual security as dependent variable (Ri)

## ANALYSIS AND INTERPETATION

**01-Table showing risk of Sensex**

| Month | Adjusted price | Rm | (Rm - R ) | $(\text{Rm} - \bar{\text{Rm}})^2$ |
|---|---|---|---|---|
| **Nov** | 66988.4 | | | |
| **Dec** | 72240.3 | 7.83988999 | 1.750342129 | 3.063697568 |
| **Jan** | 71752.1 | -0.67573123 | -6.765279091 | 45.76900117 |
| **Feb** | 72500.3 | 1.04274285 | -5.046805011 | 25.47024081 |
| **Mar** | 73651.4 | 1.58764860 | -4.501899261 | 20.26709695 |
| **Apr** | 74482.8 | 1.12887272 | -4.960675141 | 24.60829785 |
| **May** | 75418 | 1.25567279 | -4.833875071 | 23.36634820 |
| | | $\sum \text{Rm}$ = 12.17909572 | | $\sum(\text{Rm} - \bar{\text{Rm}}$ = 142.5446825 |

**Analysis and Interpretation:**

$$= \sum \frac{\text{Rm}}{\text{N}} = 6.089547861$$

R m

$$\sigma\text{m} = \sqrt{\frac{(\text{Rm} - \bar{\text{Rm}})^2}{N}} = 8.442294787$$

## TOP 6 STOCKS IN SENSEX FOR RISK ANALYSING

**01 - Table showing risk analysis of Asian Paint**

| Month | Adjusted price | Ri | R - R ) | (Ri | R -R ) | R - R R - R ) |
|---|---|---|---|---|---|---|
| **Nov** | 3076.45 | | | | | |
| **Dec** | 3252.55 | 5.72413 | 8.97673 | 80.5816 | 1.750342129 | 15.7123 |
| **Jan** | 3396.1 | 4.41346 | 7.66606 | 58.7684 | -6.765279091 | -51.8630 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Feb** | 2976.05 | -12.3685 | -9.1159 | 83.0996 | -5.046805011 | 46.0062 |
| **Mar** | 3017.4 | 1.38942 | 4.64202 | 21.5483 | -4.501899261 | -20.8979 |
| **Apr** | 2815.1 | -6.70444 | -3.45184 | 11.9151 | -4.960675141 | 17.1235 |
| **May** | 2844.4 | 1.04081 | 4.29341 | 18.4333 | -4.833875071 | -20.7538 |
| | | $\sum$ **Ri** = -6.50521 | | $\sum(\mathbf{Ri} - \bar{\mathbf{R}}\mathbf{i})^2$ = 274.3463 | | $\sum(\mathbf{Ri} - \bar{\mathbf{R}}\mathbf{i})(\mathbf{Rm}$ = -14.6728 |

$$\bar{R} = \sum \frac{\mathbf{Ri}}{N} = -3.25260$$

**R**

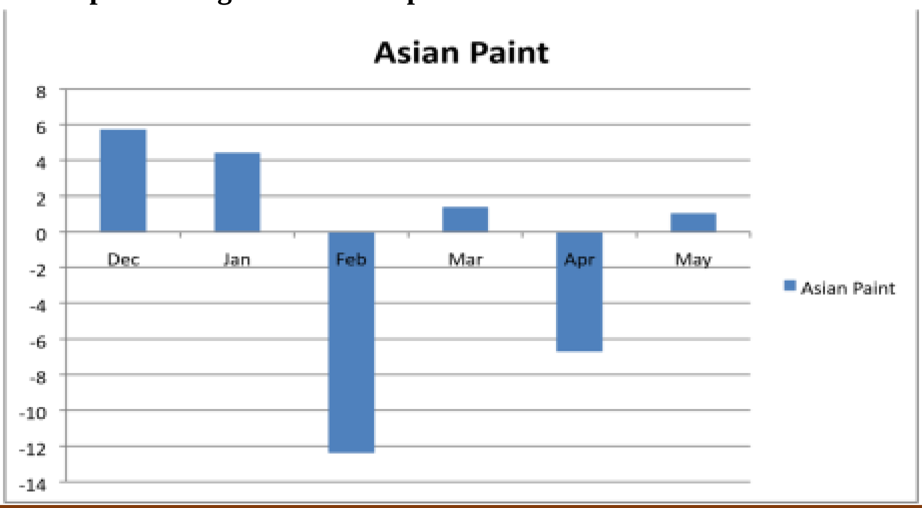
**Rf** = 7.1

**Sharpe ratio** =

$$\frac{\mathbf{Rp} - \mathbf{Rf}}{\sigma p} = -1.16 \quad \sigma \mathbf{i} = \frac{\sqrt{(\mathbf{Ri} - \bar{\mathbf{R}}\mathbf{i})^2}}{N} = 11.712$$

$$\beta \mathbf{i} = \frac{\sum(\mathbf{Ri} - \bar{\mathbf{R}}\mathbf{i}) \sum(\mathbf{Rm} - \mathbf{Rm})}{(\mathbf{Rm} - \bar{\mathbf{R}}\mathbf{m})^2} = -0.10$$

**Graph 01 – Graph showing risk of Asian paint**



**Interpretation:**

From the above table we can see that the return of the Asian paint is -3.25260 and Risks is 11.712**.** Beta value of the stock is 0.10 since, the beta value is greater than 1 it is more riskier. But beta value is less than 1 it is less riskier. However in this stock associated with low return and low risk suitable for preferable to investment. The stock price return it can slightly down past 6 month.

In Dec 2024 Asian Paint Return is 5.72413 and compare to the Dec & Jan the price can huge down fall comes in Feb 2025 it can reach on -12.3685. In April 2025 the again down fall at the price is - 6.70444. And 2024 to 2025 Risk free return (Rf) trade at 7.1 in government bond yield.

How much risk we takes in this Asian paint stock using of Sharpe ratio value is -1.16, Since Sharpe ratio above 1 are generally considered 'good' offering excess returns relative to volatility. However in this stock beta will be less than 1 and some return past 6 months preferred to invest for short term gain.

**02 – Table showing risk analysis of Axis Bank**

| **Month** | **Adjusted price** | **Ri** | **R - R )** | $(\mathbf{Ri} - \overline{\mathbf{Ri}})^2$ | **R -R )** | **R - R R - R )** |
|---|---|---|---|---|---|---|
| **Nov** | 1029.2 | | | | | |
| **Dec** | 1125.6 | 9.36649 | 7.80821 | 60.9681 | 1.750342129 | 13.6670 |
| **Jan** | 1094.25 | -2.78518 | -4.34346 | 18.8656 | -6.765279091 | 29.3847 |
| **Feb** | 1097.5 | 0.29700 | -1.26128 | 1.59082 | -5.046805011 | 6.36543 |
| **Mar** | 1046.7 | -4.62870 | 6.18698 | 38.2787 | -4.501899261 | -27.8532 |
| **Apr** | 1106.75 | 5.73707 | 4.17879 | 17.4622 | -4.960675141 | -20.7296 |
| **May** | 1052.85 | -4.87011 | 6.42839 | 41.3241 | -4.833875071 | -31.0740 |
| | | $\sum \mathbf{Ri} =$ 3.11657 | | $\sum (\mathbf{Ri} - \overline{\mathbf{Ri}})^2$ = 178.48952 | | $\sum (\mathbf{Ri} - \overline{\mathbf{Ri}})$ = -30.2396 |

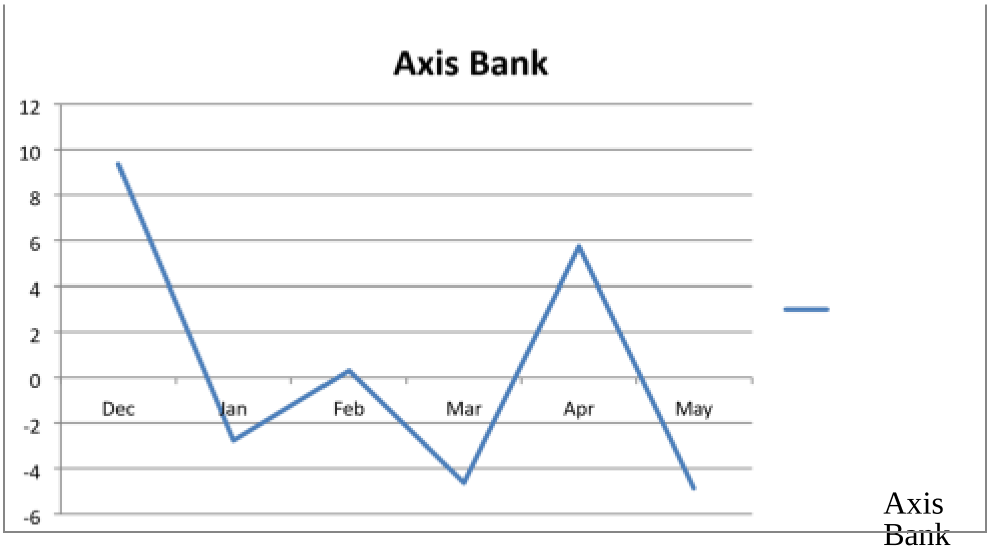
$$= \sum \frac{\mathbf{Ri}}{N} = 1.55828$$

**R** **Rf** = 7.1

**Sharpe ratio** = $\frac{Rp - Rf}{\sigma p} = -0.425$ $\sigma i = \frac{\sqrt{(Ri - Ri)^2}}{N} = 9.4469$

$$\beta i = \frac{\sum(Ri - \bar{R}i)\sum(Rm - Rm)}{(Rm - \bar{R}m)^2} = -\ 0.2121$$

**Graph 02Graph showing Risk of Axis Bank**




**Interpretations**

From the above table we can see that the return of the Axis Bank is 1.55828 and Risks is 9.4469**.** Beta value of the stock is - 0.2121 since, the beta value is greater than 1 it is more riskier. Hence the current beta value is less than 0 it is more riskier so that's way in this stock is associated with low return and more risk suitable for investment. From the above chart we can find the fluctuation of past 6 month return.

Previous year Dec 2024 Axis Bank return is started at huge high at 9.36649 and but the next year of Jan 2025 huge downfall return at the point is -2.78518 and we see above the chart in Jan to Feb to touch the break even point at 0.29700. After the break even in Mar return compare to the Jan its huge low. We see another break even point at Mar to April return. In April return is 5.73707. we can see the chart that May return its almost gives same return of Mar(-4.62870) = (May - 4.87011).

And 2024 to 2025 Risk free return (Rf) trade at 7.1 in government bond yield.

How much risk we takes in this Axis Bank stock using of Sharpe ratio value is -0.425, Since Sharpe ratio above 1 are generally considered 'good' offering excess returns relative to volatility.

**03 – Table showing Risk Analysis of Bajaj Finance**

| Month | Adjusted price | Ri | R - R ) | (Ri – | R -R ) | R - R R - R ) |
|---|---|---|---|---|---|---|
| Nov | 7444.8 | | | | | |
| Dec | 7407.65 | -0.49900 | 2.04188 | 4.16929 | 1.750342129 | 3.57399 |
| Jan | 7162.3 | -3.31211 | -0.77122 | 0.59478 | -6.765279091 | 5.21752 |
| Feb | 7265.55 | 1.44157 | 3.98245 | 15.8599 | -5.046805011 | -20.0986 |
| Mar | 6569.15 | -9.58495 | -7.04406 | 49.6188 | -4.501899261 | 31.7116 |
| Apr | 6602.45 | 0.50691 | 3.04779 | 9.28905 | -4.960675141 | -15.1191 |
| May | 7022.75 | 6.36581 | 8.90669 | 79.3292 | -4.833875071 | -43.0538 |
| | | $\sum \mathbf{Ri} =$ -5.08177 | | $\sum(\mathbf{Ri} - \mathbf{Ri})^2$ = 158.86102 | | $\sum$(Ri Ri) (Rm − Rm) = -37.76842 |

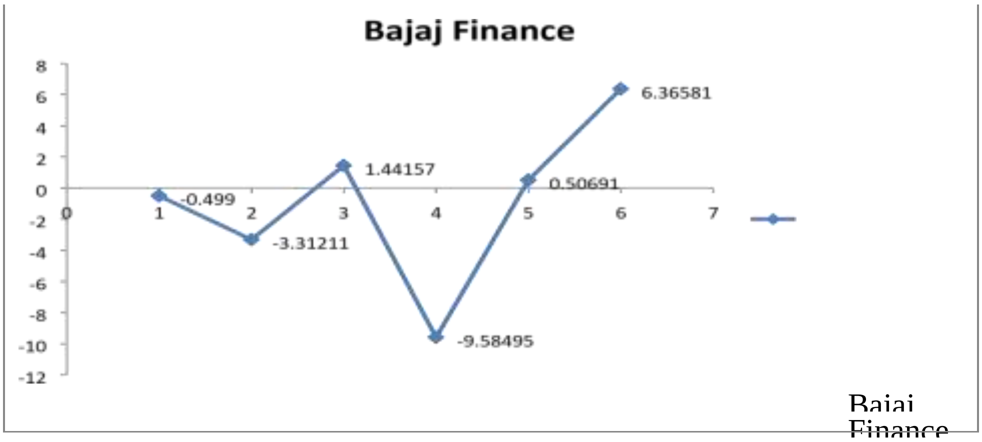
**R**
**Rf** = 7.1

**Sharpe ratio =** $\frac{\mathbf{Rp - Rf}}{\sigma p} = -1.36$

$= \sum \frac{\mathbf{Ri}}{N} = -2.540885$ $\boldsymbol{\sigma}\mathbf{i} = \frac{\sqrt{(\mathbf{Ri} - \mathbf{Ri})^2}}{N} = 8.9123$

$\boldsymbol{\beta}\mathbf{i} = \frac{\sum(\mathbf{Ri} - \bar{\mathbf{R}}\mathbf{i}) \sum(\mathbf{Rm} - \mathbf{Rm})}{(\mathbf{Rm} - \bar{\mathbf{R}}\mathbf{m})^2} = -26.4958$

**Graph 03 – Graph showing Risk Analysis of Bajaj Finance**




**Interpretation:**

From the above table we can see that the return of the Bajaj Finance is -2.540885and Risks is 8.9123**.** Beta value of the stock is -26.4958 since, the beta value is greater than 1 it is more riskier. But beta value is less than 0 so in this stock is associated with very low return and double the risk not suitable for investors. The stock price return it can get after 3 month slightly gives upward momentum.

Above the chart Bajaj Finance started at negative return point at -0.49900. We can see In Dec to Jan return is -3.31211 slightly towards down trend. Coming to 2025 Feb break the negative return towards move to positive return at 1.44157. And we see above the chart in Mar return is 9.58495 it break the previous low of Jan return. After the dip Bajaj finance gets move to massive return in May at 6.36581 this return reach to takes after 4 month. 2024 to 2025 Risk free return (Rf) trade at 7.1 in government bond yield.

How much risk we takes in this Bajaj Finance stock using a tool of Sharpe ratio value is -1.36, Since Sharpe ratio above 1 are generally considered 'good' offering excess returns relative to volatility.

**04 – Table showing Risk Analysis of Bharti Airtel**

| **Month** | **Adjusted price** | **Ri** | **R - R )** | $(Ri - Ri)^2$ | **R -R )** | **R - R R - R )** |
|---|---|---|---|---|---|---|
| **Nov** | 935.5 | | | | | |
| **Dec** | 1032.9 | 10.4115 | -3.69960 | 13.6870 | 1.750342129 | -6.47556574 |
| **Jan** | 999.85 | -3.19972 | -17.3108 | 299.664 | -6.765279091 | 117.1123933 |
| **Feb** | 1087.05 | 8.72130 | -5.38980 | 29.0499 | -5.046805011 | 27.20126965 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Mar** | 1118.7 | 2.91154 | -11.1996 | 125.430 | -4.501899261 | 50.41947096 |
| **Apr** | 1133.5 | 1.32296 | -12.7881 | 163.537 | -4.960675141 | 63.43760977 |
| **May** | 1224.8 | 8.05469 | -6.05641 | 36.6801 | -4.833875071 | 29.27592932 |
| | | $\sum Ri =$ 28.2222 | | $\sum(Ri - \bar{R}i)$ = 668.0482 | | $\sum (Ri - \bar{R}i)(Rm -$ = 280.9711072 |

$$= \sum \frac{Ri}{N} = 14.1111$$

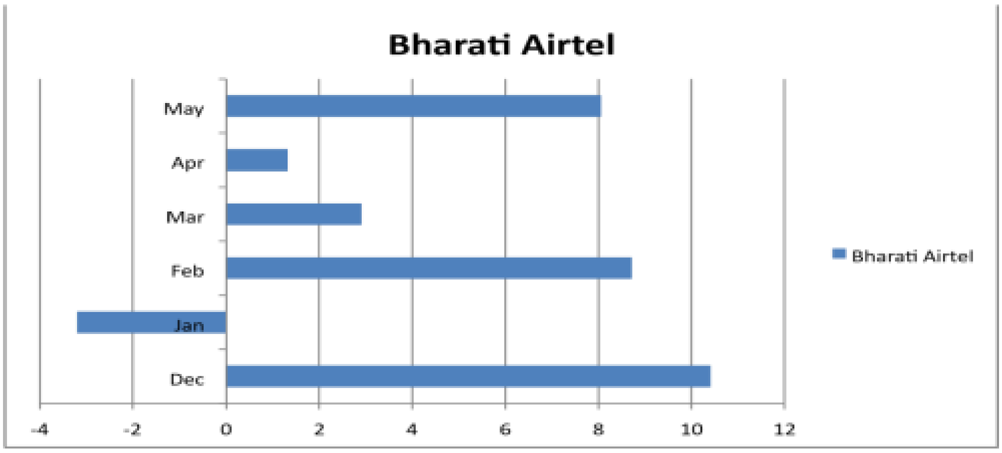
**R**

**Rf** = 7.1

**Sharpe ratio =** $\frac{Rp - Rf}{\sigma p} = 11.11$

$$\sigma i = \frac{\sqrt{(Ri - \bar{R}i)^2}}{N} = 18.276 \quad \beta i = \frac{\sum(Ri - \bar{R}i)\sum(Rm - Rm)}{(Rm - \bar{R}m)^2} = 1.97110$$

**Graph 04 - Graph showing Risk Analysis of Bharti Airtel**



**Interpretation:**

From the above table we can see that the return of the Bharati Airtel is 14.1111 and Risks is 18.276 **.** Beta value of the stock is 1.97110 since, the beta value is greater than 1 it is more riskier. But beta value is greater than 1 so in this stock is associated with less and moderate risk. So not preferable to small investors. In this stock gives consistence return excepted 2025 Jan. Above the chart started at peak level in 2024 Dec return is 10.4115. Next year of Jan return gets minor correction at -3.19972 and after Jan the Feb return is 8.72130 will towards to almost reach the previous year of Dec return. In 2025 May and Apr almost gets same return in this stock. 2024 to 2025 Risk free return (Rf) trade at 7.1 in government bond yield.

How much risk we takes in this Bajaj Finance stock using a tool of Sharpe ratio value is 11.1, Since Sharpe ratio above 1 are generally considered 'good' offering excess returns relative to volatility.

**05 – Table Showing Risk Analysis of HCL Technology**

| **Month** | **Adjusted price** | **Ri** | **R - R )** | $(Ri - Ri)^2$ | **R -R )** | **R - R R - R )** |
|---|---|---|---|---|---|---|
| **Nov** | 1255.45 | | | | | |
| **Dec** | 1337.95 | 6.57134 | -4.45746 | 19.8689 | 1.750342129 | -7.802080026 |
| **Jan** | 1458.15 | 8.98389 | -2.04491 | 4.18165 | -6.765279091 | 13.83438687 |
| **Feb** | 1567.55 | 7.50265 | -3.52615 | 12.4337 | -5.046805011 | 17.79579149 |
| **Mar** | 1666.95 | 6.34110 | -4.6877 | 21.9745 | -4.501899261 | 21.10355317 |
| **Apr** | 1637.95 | -1.73970 | | 163.034 | -4.960675141 | 63.34038054 |
| **May** | 1546.20 | -5.60151 | | 276.567 | -4.833875071 | 80.38884093 |
| | | $\sum Ri$ = 22.0577 | -12.7685 -16.63031 | $\sum (Ri \quad Ri)$ = 498.0606 | | $\sum (Ri \quad Ri)(Rm - Rm)$ = 188.660873 |

**R** $= \sum \frac{\mathbf{Ri}}{N} = 11.0288$

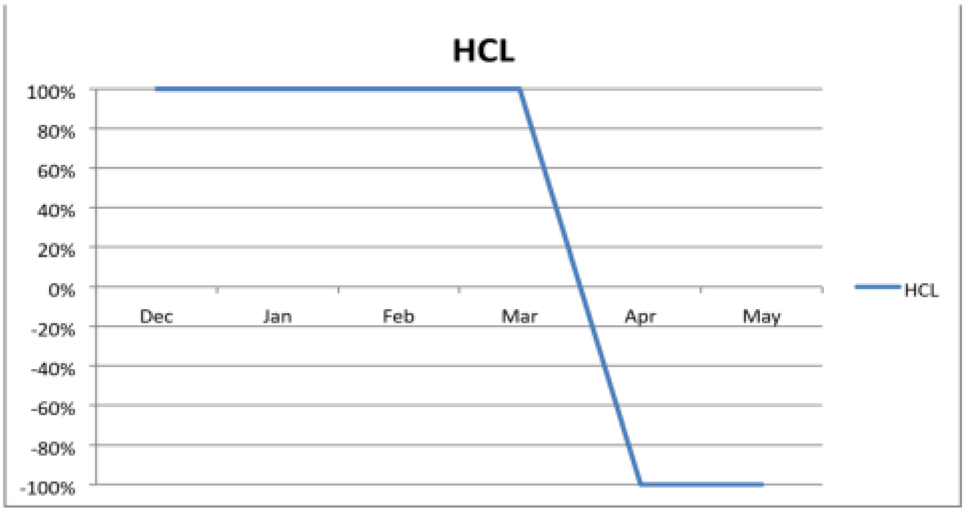
**Rf** = 7.1

$$\sigma\mathbf{i} = \frac{\sqrt{(\mathbf{Ri} - \mathbf{Ri})^2}}{N} = 15.780$$

$$\frac{\mathbf{Rp} - \mathbf{Rf}}{\sigma p} = 0.94$$

$$\beta\mathbf{i} = \frac{\sum(\mathbf{Ri} - \bar{\mathbf{R}}\mathbf{i})\sum(\mathbf{Rm} - \mathbf{Rm})}{(\mathbf{Rm} - \bar{\mathbf{R}}\mathbf{m})^2} = 1.323520946$$

**Graph 05 – Graph showing Risk Analysis of HCL Technology**




**Interpretation**

From the above table we can see that the return of the Bharati Airtel is 11.0288 and Risks is 15.780**.** Beta value of the stock is 1.32352 since, the beta value is greater than 1 it is more riskier. But beta value is more than 1 so in this stock is associated with moderate return and moderate risk. In this type of risk not preferable for beginner investors. In Dec to Mar this stocks gives proper return at that period.

Above the chart In 2024 Dec gives positive return is 6.57134 and after 2025 of Jan HCL gives moderate rerun at 8.98389. In Feb return and Mar return gives at almost same return in 2025. And after April towards move negative return side at -1.73970. These trend was continue move to the next month of May return is -5.60151. And 2024 to 2025 Risk free return (Rf) trade at 7.1 in government bond yield. How much risk we takes in this Bajaj Finance stock using a tool of Sharpe ratio value is 0.94, Since Sharpe ratio above 1 are generally considered 'good' offering excess returns relative to volatility.

**06 - Table showing Risk Analysis of HDFC Bank**

| **Month** | **Adjusted price** | **Ri** | **(Ri – R )** | **(Ri** | **R -R )** | **R - R ) R - R** |
|---|---|---|---|---|---|---|
| **Nov** | 1491.50 | | | | | |
| **Dec** | 1609.40 | 7.90479 | 8.93637 | 79.8587 | 1.750342129 | 15.6417 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Jan** | 1682.45 | 4.53895 | 5.57053 | 31.030 8 | - 6.765279091 | - 37.6862 |
| **Feb** | 1486.15 | -11.6675 | - 10.6359 2 | 113.12 3 | - 5.046805011 | 53.677 4 |
| **Mar** | 1390.00 | -6.46973 | -5.43815 | 29.573 5 | - 4.501899261 | 24.482 0 |
| **Apr** | 1432.70 | 3.07194 | 4.10352 | 16.838 9 | - 4.960675141 | - 20.3562 |
| **May** | 1440.70 | 0.55838 | 1.58996 | 2.5279 7 | - 4.833875071 | - 7.68567 |
| | | $\sum Ri =$ 2.06317 | | $\sum ( - Ri)^2$ = 272.952 6 | | $\sum (Ri - Ri)(Rm -$ = 28.07303491 |

$$R = \sum \frac{Ri}{N} = -1.03158$$

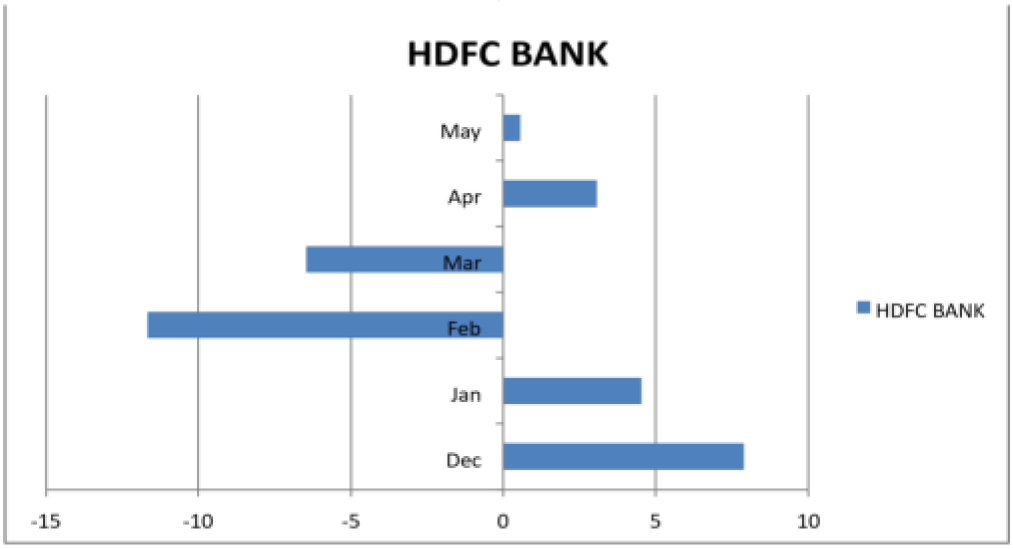
**Rf** = 7.1

$$\sigma i = \frac{\sqrt{(Ri - Ri)^2}}{N} = 11.682$$

$$\frac{Rp - Rf}{\sigma p} = -0.43$$

$$\beta i = \frac{\sum(Ri - \bar{R}i)\sum(Rm - Rm)}{(Rm - \bar{R}m)^2} = 0.1969$$

**Graph 06 – Graph showing Risk Analysis of HDFC Bank**



**Interpretation:**

From the above table we can see that the return of the HDFC Bank is -1.03158 and Risks is 11.682**.** Beta value of the stock is 0.1969 since, the beta value is greater than 1 it is more riskier. But the beta value less than 1 it is lesser riskier. so in this stock is associated with very less return and huge risk It is not suitable for investors.

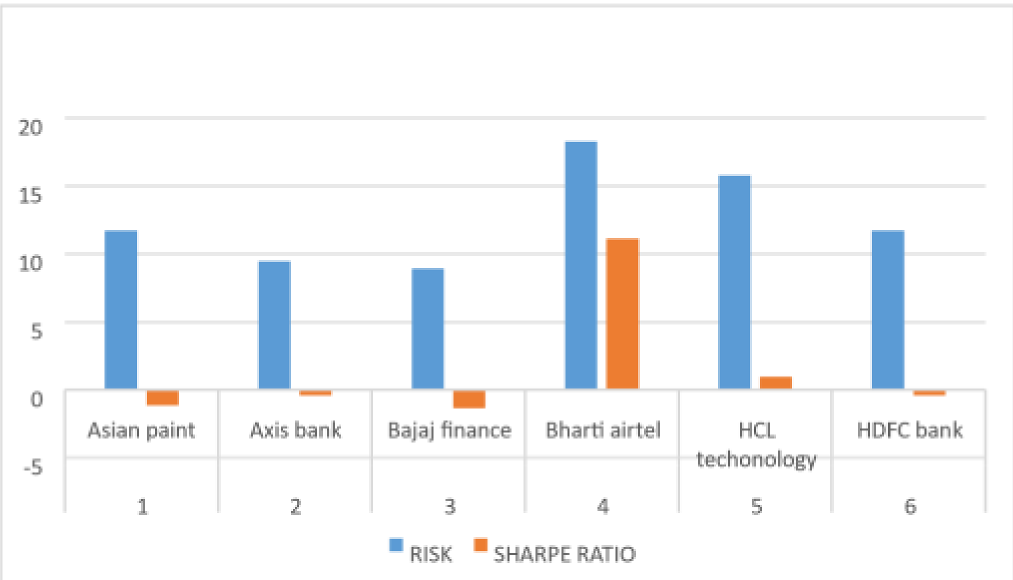
Above the chart In Dec 2024 return of HDFC Bank is 7.90479. And comparing the previous year of return in Jan move to the minor downward return at 4.53895. After the Jan month HDFC gives huge less return in Feb at -11.6675 and then Mar month to get start to recovering the previous return . Finally April and May returns got to recovering levels to break the previous return at 3.07194, 0.55838. And 2024 to 2025 Risk free return (Rf) trade at 7.1 in government bond yield.

How much risk we takes in this Bajaj Finance stock using a tool of Sharpe ratio value is **-** 0.43, Since Sharpe ratio above 1 are generally considered 'good' offering excess returns relative to volatility.

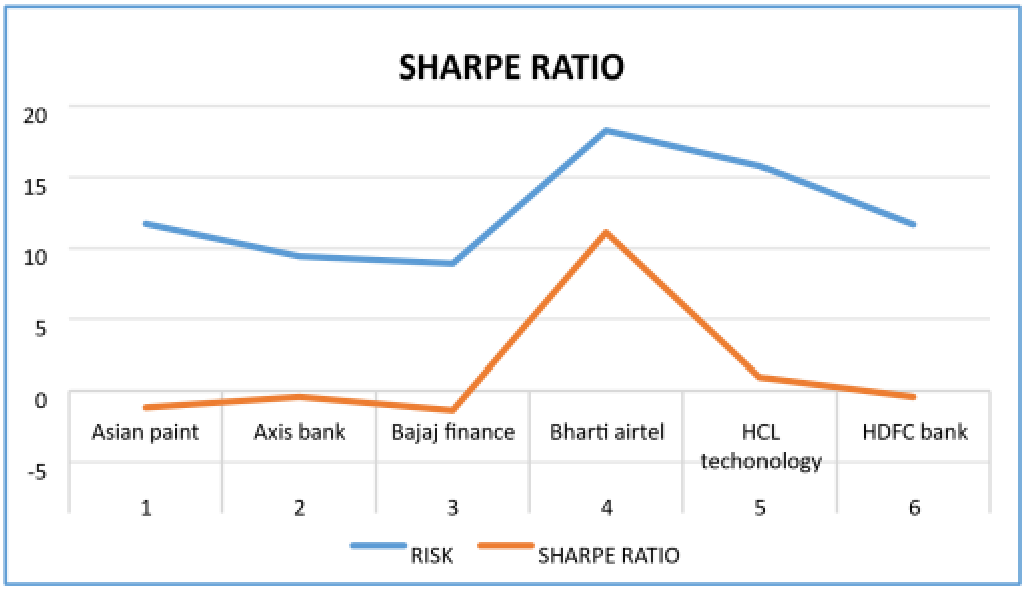
**TABLE SHOWING REVIEW OF COMPANIES**

| S.NO | COMPANY | RISK | SHARPE RATIO |
|---|---|---|---|
| **1** | Asian Paint | 11.71 | -1.16 |
| **2** | Axis Bank | 9.44 | -0.425 |
| **3** | Bajaj Finance | 8.91 | -1.36 |
| **4** | Bharti Airtel | 18.276 | 11.11 |
| **5** | HCL TECHNOLOGIES | 15.78 | 0.94 |
| **6** | HDFC Bank | 11.68 | - 0.43 |

**GRAPH SHOWING RISK OF THE TOP 6 SENSEX STOCKS**



**GRAPH SHOWING SHARPE RATIO OF EACH STOCKS**




## CHAPTER– V

## SUMMARY OF FINDING, SUGGESTION AND CONCLUSION

**FINDING:**

1) In this study we can easily find the SENSEX indices listed in top 30 companies, But we selected to take research for top 10 listed stocks in this index.

2) About this stud the top 10 companies information's collected from BOMBAY STOCK EXCHANGE official websites. And we collect the information for 6 month data for findings the risk analysis each of the stocks in the listed indices.

3) It is possible to findings the risk analysis for 6 month of reports each of the stocks and we used average return of 6month of stocks (Ri), standard deviation ( ), Beta value ( ), Risk free rate of return (Rf) and Sharpe Ratio ( **).** These are the measures used to find Stock Risks.

4) I was comparing the 2 stocks one is Bharti Airtel and another one ITC. These are the two stocks similarly gives 5 month positive return comparing to the other stocks.64

5) HDFC Banks past 6 month returns yield is more lesser than to rest of the 9 stocks compared to the same Index stocks.

6) In this study we can see that the Bajaj finance stock provides more volatility, this stock return is -2.54 and Risk is 8.9123. The beta value below 0 so this stock have huge risk it is not suitable for small investors.

7) In top 10 stocks in Sensex indices the 3 stocks 2023 Dec to 2024 May gives negative return in 6 month. The listed stock is Asian Paint -3.25, Bajaj finance -2.54, HDFC Bank -1.03 and these stock risk is 11.712, 8.9123, 11.682.

8) We can compare Bajaj finance and HDFC Bank in these stocks comparatively it gives more negative return of Asian Paint -3.25, the risk is 11.712 the beta value is 0.10 it have low Risk.

9) In this study we used sharpe ratio of all stocks. But we can see that the sharpe ratio in these of stocks doesn't research above 1.

10) In these are the 6 stocks added your portfolio we have a strong portfolio. And also we gain long term capital gain.

**SUGGESTION**

1. Investor should analyze the risk factors involved in the stock market and also have thorough knowledge of the risk which will help him to plan his investment in such a manner to minimize the risk involved with investments.
2. The investor should always be prepared to hold the stock for a certain period of time to take out the benefits from the rising trends in the market. Investor should be very careful in 65.the timings of the purchase and sale of the stock which is the most important aspect in trading.
3. There is another way to avoid the risk that is to have an investment in short term security rather than Itc having in long term investment.
4. The standard deviation calculation can yield the variability of the return, if at all any inconsistency found in the earnings it is better to avoid it.
5. According to the study I can suggest that investors can invest in the shares which earn higher average return. The investors can also invest in the companies which is associated with lesser risk.
6. The investors should can raise a potential knowledge about equity stock market because should must listening during the corporate action quickly so we make easier gain profit. if incase build strong portfolio within a few month you will short term gain.
7. In this index I have personally hold 2 stocks one is Tata Steel and ITC. In future Commodity industries get higher demand because currently India to concentrate strong infrastructure so steel demand probably drastically increase in long term capital gain. I study Tata Steel its safest investment current Risk Ratio is 20.45.
8. ITC stock it always says defensive stock balancing the risk in our portfolio. They changing the business model upcoming years cigarettes to FMCG product. So it have huge potential raising in upcoming years.
9. If you create a strong portfolio we must apply diversifying risk invest methods like, not only stock, mutual funds, government bonds, real estate, gold and crypto etc.

**CONCLUSION**

In this report researching about risk analysis to maintaining the risk management to build effective portfolio for short and long term investors. This study was utility of sharpe's single index model in optimum portfolio construction which include 10 companies scrips which is listed at Bombay Stock Exchange with Sensex as the benchmark.

This study made an effort to help investors who plan to invest at 10 companies listed at Bombay stock exchange made to build proper and strong portfolio for short term and long term investors.

In this research studying risk analysis of the top 10 companies stocks at Bombay stock exchange. So it will be helpful to investors takes a minimizing risk and gets maximizing return within short period .

The current scenario in the stock market no one can predict the stock movement accurately in the volatility market. So some of the investment certain causes some losses our capital.

Thus the investors should can diversifying the risk by investing in group of securities.

# A STUDY ON THE REASONS WHY DIAMOND WORKERS RELINQUISH DIAMOND WORK

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***Abstract***

*India serves as the primary center for diamond cutting and polishing. Surat, located in India, is known as the main hub for diamond production; however, following the pandemic, many diamond workers are abandoning their jobs in this field. Data was collected from 100 diamond workers who have departed from diamond-related jobs in Surat, Gujarat, with ages ranging from 18 to 65 years. These workers were involved in five distinct roles: polisher, cutter, grader, sarine master, and galaxy operator, utilizing questionnaires and personal interviews. The findings of the study indicated that some diamond workers lacked sufficient technical skills and they belong to illiterate and school level education group of workers, which led them to exit the industry; additionally, they left their positions due to health concerns and low earnings. The primary factor for abandoning diamond work is attributed to recession and falling wages, exacerbated by aging, social status, and limited growth opportunities. This research is significant for diamond factories and the government as it relates to the financial support and social advancement of diamond workers, as well as the development of the diamond sector.*

***Keywords:*** *Diamond workers, job task, relinquish, renouncing, technical knowhow, Diamond sectors, table, ghat, and bottom.*

## 1. Introduction:

Diamonds boast a rich history; during the first century AD, the Roman naturalist Pliny proclaimed that: “Diamond is the most precious, not only among gemstones, but of all items in this world.” A diamond undergoes numerous processes before it arrives at the jeweler’s showcase. It develops deep within the earth under intense heat and pressure.

**Early History:**

**Early Uses:** Initially, diamonds were valued for their extreme hardness and were used for drilling, polishing, and cutting other materials.

**European Introduction:**

Diamonds made their way to Europe through trade routes, and Alexander the Great is credited with bringing the first diamonds to the continent.{3}

**First Discovery:** The earliest evidence of human use of diamonds is in India, where they were found in alluvial deposits along rivers like the Penner, Krishna, and Godavari around 2500 BC.

**Middle Ages and Beyond:**

**Symbolism and Magic:** Diamonds continued to be associated with love, power, and magic, becoming a symbol of eternal love and being believed to ward off evil.

**Modern Era:**

The discovery of diamonds in South Africa in the 19th century revolutionized the diamond industry, with the formation of companies like De Beers that would dominate the global market.

**Modern Diamond Production:** The diamond industry has expanded globally, with major sources in countries like Russia, Botswana, and Canada.

**Industrial applications:** Beyond their use in jewelry, diamonds are also used in various industrial applications due to their hardness, such as cutting tools and abrasives.

**Formation:** Diamonds formed under immense heat and pressure deep within the Earth's mantle, typically between 150 and 250 kilometers (93 and 155 miles).

**At Present:** The diamond sectors in Surat, Gujarat is facing various problems due to recession and war between Israel and Hamas, Ukraine and Russia. Due to long International disturbances between various countries the diamond sectors is facing problem of selling of polished diamonds. India's diamond industry, headquartered in Surat and spread in Mumbai, Bhavnagar, Jamnagar, Amreli, Ahmedabad and Rajasthan, employs 10,00,000 polishers. Seasoned diamond polishers can earn Rs 50000 to 1 lakh per month or more, but the average salary of these polishers is Rs 30000-50000 a month. Surat hosts over 5,000 polishing units. These workers are predominantly migrants from Saurashtra region such as Amreli and Bhavnagar and Jamnagar districts, belonging to agricultural families and with little or no education. According to Vice president Bhavesh Tank over 30 people died during one year due to lay off. The Indian diamond industry has been witnessing a steady year-on-year slump. According to latest data, the value of exports of cut and polished mined diamonds fell to Rs 10,495 crore in October 2023 from Rs 15,594 crore in the same month the previous year-a drop of 32 per cent.**{1}**

**1. Problem Statement of the Research:**

The literature review has not revealed many factors so there is a dreadful need to study the influence or reasons behind relinquish of diamond works of diamond workers. They will be analyzed during the research phase along with additional factors revealed during the study.

The study will therefore focus on the reasons for the abandonment of the sacred work of the diamond workers by the reputable multinationals. Research suggests that it will be very difficult to identify what are the factors influencing the abandonment of diamond works by diamond workers. It will be valuable to learn from diamond workers the reasons for giving up diamond works and the various problems they have encountered, which should be taken into account in the decision-making process in order to make it more attractive and useful. A descriptive study was therefore carried out using a questionnaire tool and interviewing schedule in selected neighborhoods of Surat.

**2. Objectives of the study:**

The following objectives have been framed for the study

1. To determine the factors influencing diamond workers to relinquish of the diamond works.
2. To examine the relationship, if any, between demographic variables and reasons behind relinquish diamond works.

**3. Hypotheses/ variables studied:**

The following hypotheses have been assumed in the study

1. Dependent Variable: relinquish diamond works by diamond workers.
2. Independent Variable: Reasons behind relinquish of diamond works by diamond workers, demographic variables.

**4. Research Methodology:**

In this study Descriptive study is used and I Have used the convenience sampling method. The data were collected from 100 diamond workers from Surat Gujarat, with the age ranging between 18 to 65 years, belonging to five different tasks **polisher** (Ghat, Table cutting, Talia/Bottom, Aathpel, Mathala/Top)**, cutter, grader, sarine master, galaxy operator** by means of questionnaire (face to face) and personal interview. The survey has conducted by convenience sampling technique. There is no Google form filled because of illiteracy of workers.

**5. Research Tool:**

Multiple Analysis tools is used to assess the reasons behind relinquish of the diamond works by the diamond workers. Average, MCQ and Weighted Average and Cross tabulation Analysis is the analysis of dependent variable (relinquish diamond works by diamond workers and demographic variables) and independent variables (reasons of relinquish of diamond works).

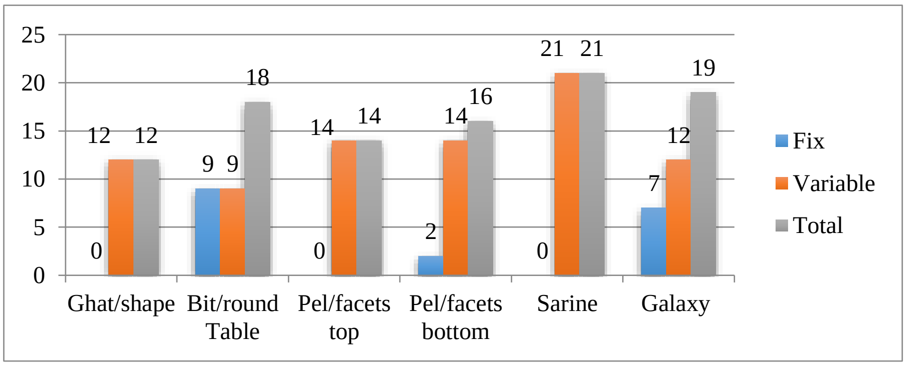
**6. Data analysis and Interpretation:**

**1. Demographic variables of respondents**

In this research 12% workers belong to female and 88% workers belong to male. 33% of respondents are from age group of 30-40, 22% of respondents are from age group of 40-50, and out of 100 respondents 39% and 32% of respondents are from school level education and illiterate respectively. Majority of workers (76%) included in this study are from income level of less than 2 lakhs and 2-5 lakhs. 40% of the workers in the study are well experienced and worked up to 10 years. Majority of workers got the training from factory of minimum time period is 2months. Out of 100 Respondents 95% respondents didn't have extra income. 5% of respondents have extra income in terms of rent, farm income, interest, textile works etc.

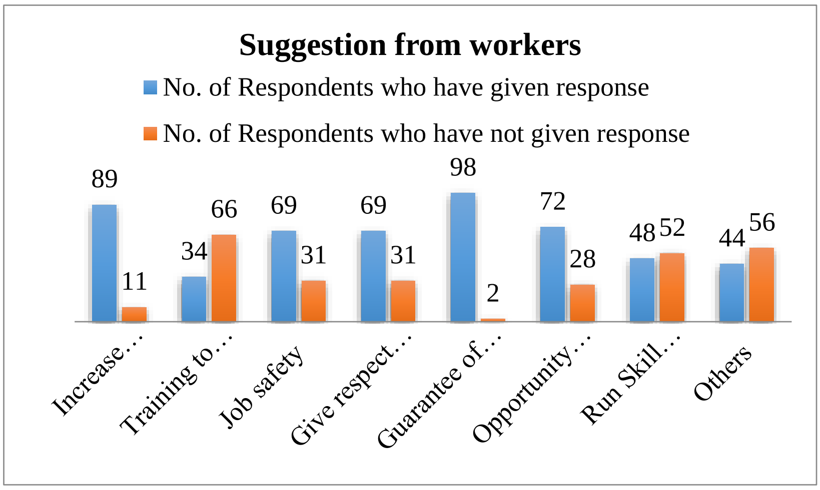
**2. Cross Tabulation of Job and Wage type:**

From the chart it can be inferred that only galaxy, sarine workers have fixed wages and others have variable as per work.




**1. Suggestions from Respondents:**

| Suggestion from the respondents | No. of Respondents who have given response | No. of Respondents who have not given response | Total |
|---|---|---|---|
| Increase Wage Rate | 89 | 11 | 100 |
| Training to new workers | 34 | 66 | 100 |
| Job safety | 69 | 31 | 100 |
| Give respect to workers | 69 | 31 | 100 |
| Guarantee of Minimum salary/ Wages to workers in recession period | 98 | 2 | 100 |
| Opportunity of career development | 72 | 28 | 100 |
| Run Skill Development programs | 48 | 52 | 100 |
| Others | 44 | 56 | 100 |




From the Above chart it can be inferred that workers want the minimum wage or salary guarantee on the time of recession they also suggest to increase wage rate as inflation increase different employee of different companies as well as government servants get Dearness allowances.

1. **Analysis of Reasons given by the workers behind relinquish or leaving the diamond work:**

| Sr. No | Reasons | Strongly Agree (5) | Agree (4) | Neutral (3) | Disagree (2) | Strongly Disagree (1) | Total | Weighted Mean | Result |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Long Cycle of recession | 65 | 192 | 75 | 18 | 5 | 355 | 3.55 | Agree |
| 2 | It becomes tough job due to technology | 130 | 56 | 54 | 44 | 20 | 304 | 3.04 | Neutral |
| 3 | Lack of opportunity for growth | 170 | 184 | 42 | 8 | 2 | 406 | 4.06 | Agree |
| 4 | Lack of enough remuneration | 195 | 152 | 51 | 8 | 2 | 408 | 4.08 | Agree |
| 5 | Ageing problem ( increase in age, decline in remuneration) | 270 | 140 | 21 | 6 | 1 | 438 | 4.38 | Agree |
| 6 | Health Problem | 140 | 104 | 66 | 32 | 8 | 350 | 3.50 | Neutral |
| 7 | Decline in Social Status | 240 | 164 | 30 | 2 | 0 | 436 | 4.36 | Agree |
| 8 | Financial Exploitation | 200 | 148 | 51 | 8 | 2 | 409 | 4.09 | Agree |
| 9 | Bad Relationship with Manager | 40 | 40 | 105 | 30 | 32 | 247 | 2.47 | Disagree |
| 10 | Social Exploitation from higher authority. (Castism) | 75 | 68 | 111 | 26 | 18 | 298 | 2.98 | Neutral |

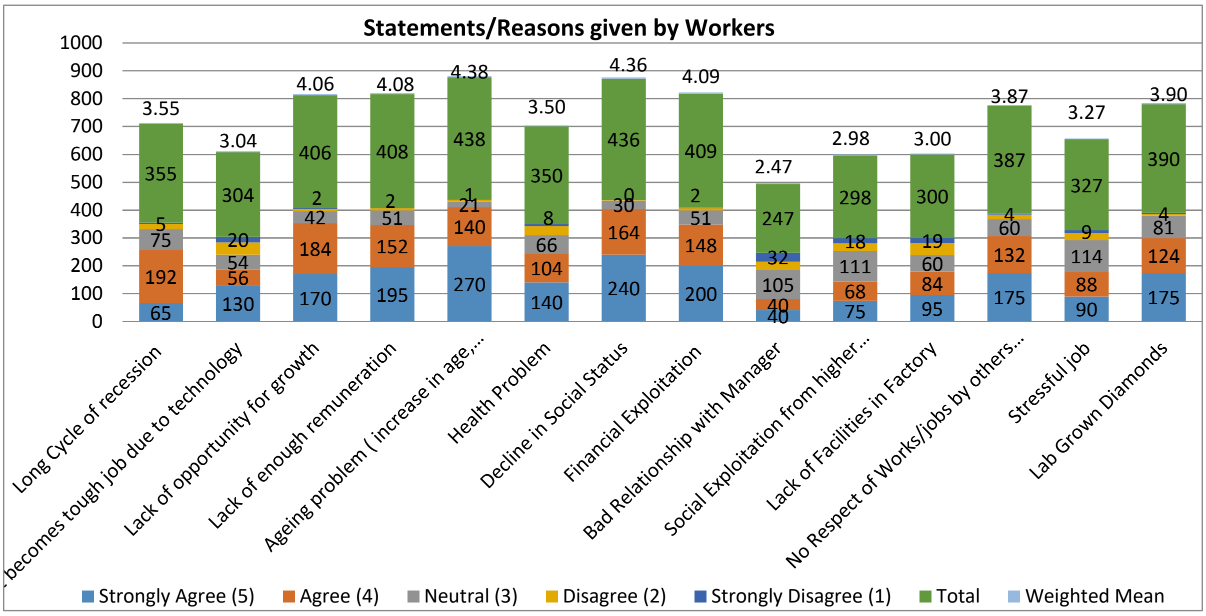
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **11** | Lack of Facilities in Factory | 95 | 84 | 60 | 42 | 19 | 300 | 3.00 | Neutral |
| **12** | No Respect of Works/jobs by others (outsiders) | 175 | 132 | 60 | 16 | 4 | 387 | 3.87 | Agree |
| **13** | Stressful job | 90 | 88 | 114 | 26 | 9 | 327 | 3.27 | Neutral |
| **14** | Lab Grown Diamonds | 175 | 124 | 81 | 6 | 4 | 390 | 3.90 | Agree |
| | **Total** | **2060** | **1676** | **921** | **272** | **126** | **5055** | **50.55** | Agree |

**Mean of all statements = 3.55 + 3.04 + 4.06 + 4.08 + 4.38 + 3.50 + 4.36 + 4.09 + 2.47 + 2.98 + 3.00 + 3.87 + 3.27 + 3.90/14**

**= 3.61**

**It means respondents or workers are agreed to all the statements given above.**

## 7. Findings and Conclusion:




- ✓ In this research 12% workers belong to female and 88% workers belong to male. 33% of respondents are from age group of 30-40, 22% of respondents are from age group of 40-50, and out of 100 respondents 39% and 32% of respondents are from school level education and illiterate respectively.
- ✓ Majority of workers (76%) included in this study are from income level of less than 2 lakhs and 2-5 lakhs. 40% of the workers in the study are well experienced and worked up to 10 years. Majority of workers got the training from factory of minimum time period is 2months. Out of 100 Respondents 95% respondents didn't have extra income. 5% of respondents have extra income in terms of rent, farm income, interest, textile works etc.
- ✓ From the data of cross tabulation it is cleared that most of workers (76%) are illiterate or school level having income level of below 2lakhs and 2-5 lakhs and only galaxy, sarine workers have fixed wages and others have variable as per work or units made by them.

- ✓ Workers are strongly agreed that because of the lack of opportunity to growth, social status (Marriage Problem), no respects of job from relatives and friends are the main reasons behind relinquish diamond works.

Mean of all statements = 3.55 + 3.04 + 4.06 + 4.08 + 4.38 + 3.50 + 4.36 + 4.09 + 2.47 + 2.98 + 3.00 + 3.87 + 3.27 + 3.90/14

= 3.61

It means respondents or workers are agreed to most of the statements given above except only one reason i.e. bad relationship with manager.

**8. Suggestions:**

1. Diamond sector should give the minimum wage guarantee in recession or in critical situation like Pandemic period as the Venus Diamond (S. P. Shah) is providing.
2. Diamond Factories should increase wage rate if possible as the other Big Players provide.
3. Diamond Factories should develop the programs for the career development and career growth as the experience got by the workers. Aging issue and health issue should consider and solve them to attract diamond workers.
4. Diamond Factories should focus on the other things also as the workers suggested in study like casual leave, sick leave, Time Allowance, Over Time Wage, etc.

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# THE IMPACT OF SOCIAL MEDIA INFLUENCERS ON YOUTH CONSUMER BEHAVIOR

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***Abstract***

*In the rapidly evolving era of digital consumerism, social media has emerged as a transformative force significantly shaping the purchasing behavior of young individuals. This research delves into the influence of social media influencers (SMIs) on the consumer behavior of youth aged 18 to 25, with a focus on emotional triggers, trust dynamics, content relevance, and platform-specific patterns. Drawing on primary data collected from 100 young respondents in Gujarat, the study employs statistical analysis to explore critical relationships, including the connection between influencer trust and purchase intent, the comparative roles of micro and macro influencers, and the impact of short-form video content on impulsive buying tendencies. The findings underscore that emotional engagement, perceived authenticity, and repeated exposure to influencer content strongly drive purchasing behavior, especially in product categories such as fashion, cosmetics, and electronics. Platforms like Instagram and Snapchat were identified as particularly influential in fostering impulsive buying due to their visually engaging and interactive nature, whereas platforms like YouTube were associated with more informed decision-making processes. Micro-influencers demonstrated a higher persuasive impact compared to macro-influencers, largely due to their relatable and trustworthy persona. This study contributes to the understanding of youth psychology within the digital commerce landscape and the evolving dynamics of influencer-driven marketing. It highlights the critical importance of authenticity, emotional resonance, and platform-specific strategies for engaging young audiences effectively, while also addressing ethical concerns such as transparency in promotional practices. By illuminating these aspects, the research provides valuable insights for brands seeking to establish meaningful connections with the youth demographic in today's digital-first economy.*

**Keywords**: *Influencer fatigue, Digital marketing, Social media engagement metrics, Influencer marketing campaigns, Consumer behavior, Social media influencers*

## 1. INTRODUCTION

This study explores the profound impact of social media influencers on consumer behavior in the modern digital world. With the rapid rise in popularity of platforms like Instagram, YouTube influencers have become central to shaping consumers' preferences and opinions about brands. Their unique ability to build trust, foster genuine connections, and engage closely with their audiences has led to significant changes in traditional marketing practices.

The study examines the complexities of the relationship between influencers and their followers, focusing on key factors such as trust, authenticity, and relatability. Using a mixed-methods approach, the research evaluates the effectiveness and sustainability of influencer-driven marketing strategies through surveys, interviews, and quantitative analysis of engagement metrics.

Ultimately, this study provides valuable insights into how influencers impact consumer decisions, offering guidance for marketers, businesses, and policymakers navigating the evolving landscape of digital marketing.

## 2. RIVIEW OF LITERATURE

### (1) Singh, C. B., Sharma, N., & Pandey, S. K. (2025)

**Own article "How Digital Addiction Fuels Youth Consumerism in India?"**

he impact of digital technology has seen major changes in the consumer behavior of Indian youth. With the increasing use of technology and the digitalization of consumer purchases, the youth are increasingly purchasing goods and services from anywhere in the world. This study examines the impact of digital addiction on youth consumerism, taking into account behavioral and socio-economic factors. Based on young consumers aged 18-30 years in urban India, this research analyzes digital usage patterns, shopping behavior and financial awareness through a qualitative method. The findings of this study show that more purchases are made by consumers attracted by social media advertisements. The study emphasizes the need for regulatory measures such as financial literacy programs and ethical digital marketing practices for the mission. It also suggests collaboration between policymakers, educators and businesses to promote responsible digital consumption among Indian youth.

**(2) Kumar, S., & Yadav, S. (2025)**

**Own article "Impact of social media influencers on promoting sustainable behavior among Gen-Z"**

Social media influencers have emerged as powerful agents influencing consumer behavior, particularly among Generation Z, a demographic highly active on digital platforms. This study focuses on the role of influencers in promoting sustainable behaviors within Gen Z, exploring how they contribute to fostering responsible consumption and environmental awareness. By leveraging platforms like Instagram, TikTok, and YouTube, influencers craft compelling and impactful narratives that engage young audiences, raise awareness, and encourage the adoption of sustainable lifestyles.

The research analyzes key attributes of influencers, such as authenticity, relatability, and perceived credibility, which play a pivotal role in effectively disseminating messages of sustainability. Furthermore, it examines the factors influencing Gen Z's perception of influencers advocating for sustainable practices. The findings indicate that influencer credibility (IC), strategic content management, and engagement significantly enhance the intention to purchase sustainable products. Additionally, consumer attitudes, personal norms, and perceived behavioral control exert a lasting impact on green purchasing intentions.

This study highlights the potential of social media influencers as catalysts for social change and underscores the need for ethical marketing practices to drive meaningful and sustainable behavioral shifts within Generation

## 3. OBJECTIVE OF THE STUDY

1. Identifying and evaluating the impact of social media influencers on young consumers' purchasing decisions
2. Examining what types of content have the most impact on young consumers' purchases

## 4. METHODOLOGY

To understand the impact of social media influencers on the purchasing behavior of youth, a systematic and structured research methodology was adopted. The approach primarily relied on quantitative analysis, as the objective was to measure behavioral patterns, frequency of influence, and the level of trust associated with interactions with influencers. This section outlines the research design, sampling methods, variables, data collection tools, and analytical techniques employed in the study.

### 4.1 Research Design

The study employed a quantitative research design, utilizing a structured questionnaire to gather numerical data. This approach was selected due to its ability to facilitate statistical comparisons and identify patterns across large sample sizes, making it ideal for analyzing consumer behavior trends. The survey method was chosen for its practicality, scalability, and effectiveness in collecting responses from a digitally savvy and youth-oriented audience.

### 4.2 Sample & Sampling Method

This research focused specifically on individuals aged 18 to 25, as this demographic is highly engaged with social media platforms and represents a primary target for influencer marketing campaigns. A total of 100 participants were selected using a purposive sampling technique. This approach ensured that respondents were intentionally chosen based on their familiarity with social media usage and exposure to influencer content, thereby aligning closely with the study's objectives. To maintain relevance to the target demographic, participants were sourced from urban colleges and online student communities across India. This selection strategy aimed to capture a representative profile of young, digitally active individuals who regularly interact with social media and influencer campaigns. The chosen sample provided a diverse yet focused pool of insights, enabling the research to delve deeply into the interplay between youth consumer behavior and influencer marketing strategies. This structured approach ensured that the findings would be both meaningful and applicable to the broader context of social media influence among young consumers.

**4.3 Data Collection & Tools**

Data collection was carried out using a self-administered questionnaire distributed through Google Forms, ensuring accessibility and convenience for the respondents. The questionnaire was carefully designed and divided into multiple sections to comprehensively address the research objectives.

The first section focused on gathering demographic details, such as age, gender, education level, and geographic location, to ensure a well-rounded understanding of the participants' backgrounds.

The second section explored social media usage patterns, including the platforms most frequently used, time spent daily on these platforms, and the type of content typically engaged with by the respondents.

The third section was dedicated to examining the participants' interactions with influencer content. frequency, trust, content type, It included questions about their awareness of influencer marketing campaigns, the types of influencers they follow, and the perceived trustworthiness and credibility of these influencers.

Finally, an open-ended section invited respondents to share their thoughts on how social media influencers impact their daily choices and lifestyle, providing qualitative insights to complement the quantitative data. This multi-faceted questionnaire ensured a robust data collection process, capturing a holistic view of the research topic.

**4.4 Analytical Tools**

Once the data was collected, it was analyzed using SPSS software.

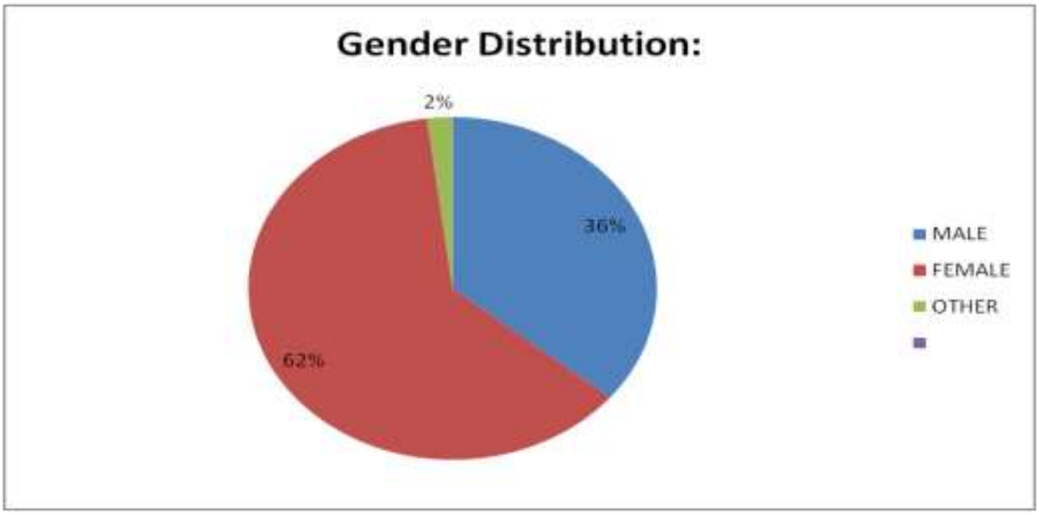
5. **Data Analysis**

**5.1 Respondent Demographics**

A total of 100 respondents aged 16 to 25 years were included in the 2025 research, who regularly used social media and were familiar with influencer content. This demographic overview set the boundaries for the research, showing who these respondents are and how they engage with the digital world.

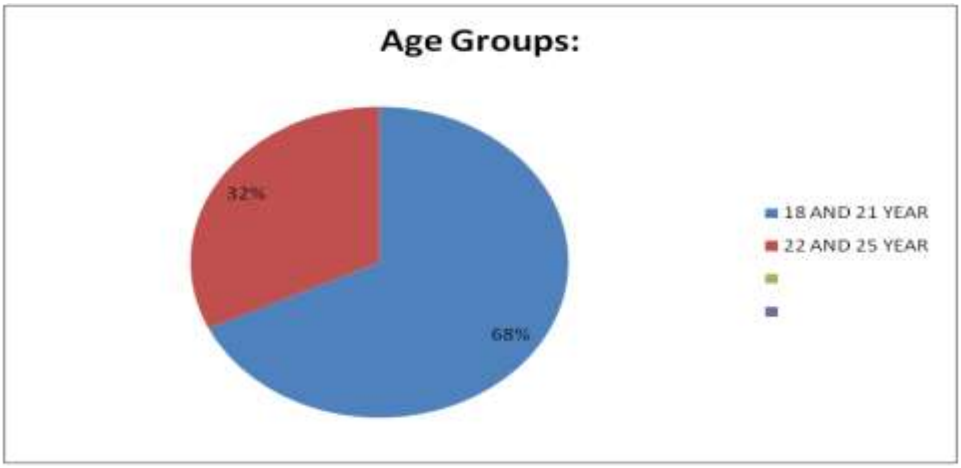
**Gender Distribution:**

the total respondents, 62% identified as female, 36% as male and 2% chose not to disclose their gender. This is a higher proportion of women, which suggests that women are more likely to engage with fashion, beauty and lifestyle influencers—where influencer marketing is strong.



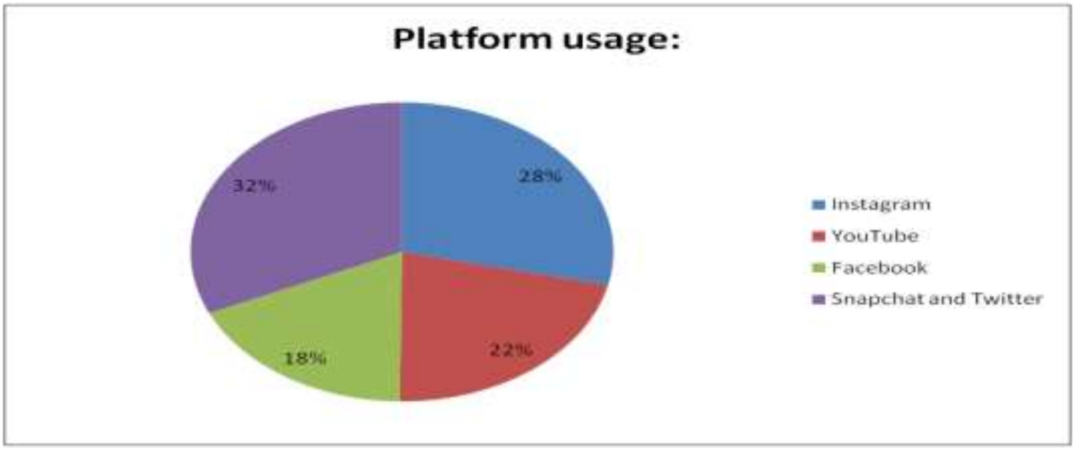

**Age Groups:**

68 % of respondents were between 18 and 21 years old, while 32% were between 22 and 25 years old. This age group represents the young generation in the upper echelons of society, who are highly influenced by social media trends and online influence.




**Platform usage:**

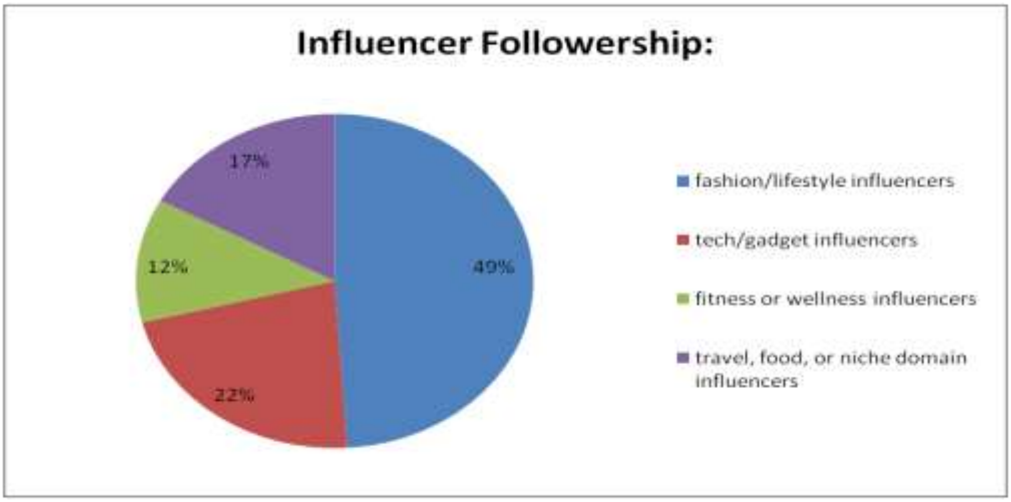
Respondents showed high activity across platforms:
Instagram: The most popular platform used daily by 82% of people.
YouTube: 62% of people used it for product reviews, tutorials, and vlogs.
Facebook : Popular with 52% of people.
Snapchat and Twitter: Used by 91 % of respondents, respectively.
These platform preferences reflect the broad leanings of the youth demographic, where visual content, short stories, and influencer-based formats dominate.




**Influencer Followership:**

Nearly all respondents (**92 %**) confirmed that they followed at least **three or more influencers** across different platforms. Furthermore:

- 49% followed fashion/lifestyle influencers
- 22% followed tech/gadget influencers
- 12% followed fitness or wellness influencers
- 17% followed travel, food, or niche domain influencers




**5.2 Influencer Impact Metrics**

Interestingly, micro-influencers (54%) were perceived as more trustworthy and engaging by participants than macro or celebrity influencers. This means that relevance and perceived authenticity are more effective than the number of followers. This fact supports the claim of existing literature

To understand the real-world impact of influencers on youth purchasing behavior, the study focused on specific metrics that show how often participants interact with influencer content, how much it impacts their purchasing decisions, and which product categories are most influential. These metrics help to understand how active influencer use is in the daily lives of young consumers.

**Frequency of Influencer Content Consumption:**

A remarkable 82% of respondents said they view or consume influencer content daily, with many engaging with such content multiple times a day on platforms like Instagram Reels and YouTube

Shorts. 12% reported engaging with such content 3-4 times a week, while only 4% claimed to view influencer content occasionally (once a week or less). These figures show that influencer content is deeply embedded in young people's daily digital activities

**Actively engaged users:**

59% of participants reported that they regularly like, share, or comment on influencer posts, indicating that consumption is not limited to passive viewing. The line between entertainment and advertising is often blurred, allowing influencer marketing to easily integrate into young people's daily scrolling habits

**Purchases influenced by sponsored posts:**

When asked about purchases, 78% of participants admitted that they had purchased at least one product that was promoted by an influencer in the past six months. Of these, 52% overwhelmingly said they had purchased multiple items under the influence of various influencers. These purchases were not always planned. 65% of participants described these purchases as spontaneous or accidental purchases, often prompted by product unboxing videos, discount codes, or "limited time" offers.

An intriguing observation was the level of trust placed in influencer recommendations. While only 29% of respondents believed that all influencer promotions were genuine, 58% stated they would still consider a product if it was promoted by someone they admired or found relatable. This finding aligns with the perspective that trust in the influencer can help mitigate skepticism about brand sponsorships.

**6. Conclusion and Recommendations**

At the end of this study, one important fact became clear – social media influencers are not just shaping trends, but are shaping the choices of young people. These choices are not limited to simple purchases; they have reached into how young people identify, relate and shape their culture in this digital age.

The first fact is that trust and relevance are more important than star power. Young people are not necessarily always following famous influencers. They are attracted to people who seem relevant – who seem like friends, whose stories are real and who do not just show sponsored tags. Trust with such influencers often becomes the crucial difference between simply viewing and buying.

Second, it is not just about the platform, but how that platform makes users experience it. For example, Instagram inspires emotion, while YouTube encourages contemplation and information. Each platform plays a different psychological role in young people's lives. It is essential for marketers to understand these nuances; if they ignore them, they will fall behind in achieving success.

The role of content is vast. It is not just about the product, but how that content is presented, how it promises a lifestyle and how it is adopted into people's lives is more important.

Now, it is necessary to pay attention to ethics. Influencer marketing is a rapidly growing field, but it is still very unregulated. Many young people do not know which posts are sponsored and which are truly recommendations. This uncertainty is the same dilemma that blurs the line between morality and marketing in the digital world.

In particular, its impact on young people is sensitive. When 18-year-olds buy something because they feel it is necessary to be like their peers, it becomes not just marketing, it becomes psychosocial pressure.

By collaborating with trusted influencers, campaigns for brands are more effective, making them more authentic and genuine. Young users can easily identify endorsements for appearances, and therefore it is important for marketers and influencers to maintain resonance.

**8. Sources for future research:**

This study was cross-sectional, and therefore lacks long-term effects. Do young people who are influenced by influencers at the age of 18 change their views at the age of 25? Longer-term dynamic studies are needed to see this.

Furthermore, as global youth behavior becomes more digitized, it will also be important to compare the behavior and attitudes of people with different cultural backgrounds. Along with this, in-depth research in this area should be conducted to see how the boundaries of human behavior are expanding towards i-Generation individuals with the rise of virtual influencers.

In addition, to understand this world of influencer marketing in the digital age, it is necessary to look beyond likes and clicks and include emotions and precise pressures in the study.

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# UNDERSTANDING REAL ESTATE MARKET TRENDS AND INVESTMENT OPPORTUNITIES IN SANGLI DISTRICT

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## Introduction

The real estate sector plays a crucial role in shaping regional economies by influencing investment flows, urbanization, and infrastructure development. In India, real estate is one of the largest contributors to GDP and employment generation. While metropolitan cities like Mumbai, Pune, and Bangalore receive extensive research attention, smaller cities such as Sangli remain relatively underexplored despite their growing real estate potential. This study aims to bridge that gap by examining the evolving market trends, investment opportunities, and challenges in Sangli's real estate sector.

Sangli, a prominent city in Maharashtra, has witnessed rapid urbanization and infrastructural development over the past decade. Increasing population, economic growth, and industrial expansion have fueled demand for residential, commercial, and industrial properties. The region's strategic location, improving connectivity, and government initiatives in urban planning further contribute to its real estate appeal. However, high property prices, lack of adequate infrastructure, and regulatory constraints pose significant challenges for investors and developers.

This research explores key factors influencing the real estate market in Sangli, including investor sentiments, market trends, and economic conditions. By conducting an in-depth analysis of demand-supply dynamics, investment risks, and future growth projections, this study provides valuable insights for stakeholders such as property developers, investors, policymakers, and urban planners. The study also highlights emerging opportunities that could shape the future of Sangli's real estate sector, offering strategic recommendations to enhance market attractiveness and investment viability.

Through this research, we aim to contribute to the existing body of knowledge on real estate market dynamics in smaller Indian cities, emphasizing the importance of localized analysis for sustainable urban development and investment planning.

**Objectives of The Study: -**

1. To analyze the current real estate trends in Sangli.
2. To identify key factors influencing property prices and demand.
3. To explore potential investment opportunities in the residential and commercial sectors.
4. To examine government policies and infrastructure projects impacting the market.

**Literature Review: -**

1. **Dominik I. Lucke (2001) -** This study explores the application of real options theory in real estate investment. It highlights how investors can use flexible decision-making models to mitigate risk and enhance valuation strategies. The research identifies gaps in practical implementation and emphasizes the need for further studies on real options in real estate.
2. **Lay Cheng Lim, Alastair Adair, and Stanley McGreal (2002) -** The authors examine investor attitudes towards real estate investments, focusing on risk perceptions and market familiarity. The

study finds that regional investors demonstrate lower risk aversion compared to foreign investors, emphasizing the importance of local market knowledge.

3. **Mustafa Nusret Karasu (2015) -** This research investigates the possibility of real estate bubbles, analyzing housing price deviations from market fundamentals. The study applies econometric models to detect trends that could lead to market crashes and highlights preventive measures for sustainable growth.
4. **Urbi Garay (2016) -** This study discusses real estate as a long-term investment asset, emphasizing its role in wealth accumulation. The research explores real estate investment strategies, asset allocation techniques, and risk management principles.
5. **Sayali Kadam, Dadasaheb Desai, Anil Gupta, and Priyanka Jadhav (2018) -** This study focuses on real estate growth in Sangli, analyzing key drivers such as industrial expansion, infrastructure projects, and economic development. The research finds that the hospitality and sugar industries significantly influence the property market.

**Research Gap**

While several studies have analyzed real estate market trends in urban regions, there is limited research focused on smaller cities like Sangli. Most existing literature explores investment opportunities, valuation techniques, and economic influences in metropolitan areas, leaving a gap in understanding localized factors impacting real estate markets in emerging regions. Additionally, there is a lack of empirical studies examining investor sentiment, affordability issues, and infrastructure challenges specific to Sangli. Moreover, while global events like the COVID-19 pandemic have been extensively studied in real estate markets, their localized impact on smaller cities remains underexplored. This study aims to fill these gaps by providing an in-depth analysis of Sangli's real estate market, incorporating investor perspectives and policy implications to develop strategic recommendations for sustainable growth.

**Research Methodology**

The data will be collected through the primary and secondary sources,

**Primary Data:**

The primary data is the first-hand information collected through Questionnaire Survey and through observation.

**Secondary Data:**

Secondary data is collected through the,

1. Research paper, etc.

**Sampling Method:**

1. Convenience Sampling method

**Sampling Size**

The study aims to survey approximately 384 Property Owners & Real Estate Investors to ensure a representative and diverse data set.

**Data Analysis and Interpretation:**

Following data collection, the data were categorized, analyzed, and presented systematically with the use of SPSS and MS Excel.

**Table 1 - Age**

| Age Groups | Frequency | Percentage |
|---|---|---|
| Under 25 | 129 | 33.6 |
| 26-35 | 109 | 28.4 |
| 36-44 | 94 | 24.5 |
| 45-54 | 33 | 8.6 |
| 55 and above | 19 | 4.9 |
| **Total** | **384** | **100** |

Above table and graph shows that the largest segment of respondents is under 25 (33.6%), followed closely by those aged 25-34 (28.4%). The 35-44 age group makes up 24.5% of responses, while the 45-54 and 55 and above groups are smaller, at 8.6% and 4.9%, respectively. This indicates that the majority of respondents are younger, with over 60% being under 35.

**Table 2- Gender**

| Gender | Frequency | Percentage |
|---|---|---|
| Female | 138 | 35.9 |
| Male | 246 | 64.1 |
| **Total** | **384** | **100** |

Above table and graph shows the higher proportion of male respondents (64.1%) compared to female respondents (35.9%) in the survey.

**Table 3 - Income Level**

| Income Level | Frequency | Percentage |
|---|---|---|
| ₹3,00,000 - ₹6,00,000 | 110 | 28.6 |
| ₹6,00,000 - ₹9,00,000 | 109 | 28.4 |
| ₹9,00,000 - ₹12,00,000 | 49 | 12.8 |
| Above ₹12,00,000 | 12 | 3.1 |
| Below ₹3,00,000 | 104 | 27.1 |
| **Total** | **384** | **100** |

The above table and graph show income level of respondents, with the largest groups earning between ₹3,00,000 - ₹6,00,000 (28.6%) and ₹6,00,000 - ₹9,00,000 (28.4%). A substantial portion earns below ₹3,00,000 (27.1%), while fewer respondents fall into higher brackets, indicating a diverse economic background primarily concentrated in the lower to middle-income categories.

**Table 4- How would you describe the current state of the residential real estate market in Sangli?**

| Particular | Frequency | Percentage |
|---|---|---|
| Neutral | 78 | 20.3 |
| Strong | 168 | 43.8 |
| Very Strong | 111 | 28.9 |
| Very Weak | 2 | 0.5 |
| Weak | 25 | 6.5 |
| **Total** | **384** | **100** |

The above Table and Graph shows Investors opinion about current state of the residential real estate market in Sangli. The majority of respondents have a positive outlook, with a combined 72.70% rating their opinion as Strong or Very Strong. Only a small percentage, 7%, have a negative opinion, either Weak or Very Weak. The neutral respondents make up a notable portion at 20.30%.

**Table 5 - What type of real estate investment do you think is currently the most profitable in Sangli?**

| Particular | Frequency | Percentage |
|---|---|---|
| Agricultural | 47 | 12.2 |
| Commercial | 164 | 42.7 |
| Industrial | 78 | 20.3 |
| Other (please specify) | 4 | 1 |
| Residential | 91 | 23.7 |
| **Total** | **384** | **100** |

The table and graph show investors' opinions on profitable real estate investments in Sangli. 42.70% find commercial real estate most profitable, followed by 23.70% for residential and 20.30% for industrial properties. Additionally, 12.20% see agricultural real estate as profitable, while 1% mention other types.

**Table 6- What type of residential properties do you think are in highest demand in Sangli?**

| Particular | Frequency | Percentage |
|---|---|---|
| Affordable housing units | 92 | 24 |
| Apartments | 112 | 29.2 |
| Independent houses | 122 | 31.8 |
| Villas | 58 | 15.1 |
| **Total** | **384** | **100** |

The above table and graph show the Investors opinion about the type of residential properties with the highest demand in Sangli. 31.80% of respondents believe that Independent Houses have the highest demand, followed by 29.20% who Favor Apartments. Additionally, 24% of respondents see high demand for Affordable Housing Units, while 15.10% think Villas have the highest demand. This indicates that Independent Houses and Apartments are in the greatest demand, with Affordable Housing Units also being a significant preference.

**Table 7 - How do you think the real estate market in Sangli will evolve in the next 5 years?**

| Particular | Frequency | Percentage |
|---|---|---|
| Moderate decline | 28 | 7.3 |
| Moderate growth | 196 | 51 |
| No significant change | 60 | 15.6 |
| Significant decline | 5 | 1.3 |
| Significant growth | 95 | 24.7 |
| **Total** | **384** | **100** |

The above table and graph show investors' opinions on the expected growth in the real estate market in Sangli. 51.04% expect moderate growth, 24.74% foresee significant growth, and 15.63% believe there will be no significant change. Additionally, 7.29% predict a moderate decline, while 1.30% expect a significant decline. Overall, most respondents are optimistic about moderate improvement in the market.

**Table 8- There are significant risks associated with investing in real estate in Sangli.**

| Particular | Frequency | Percentage |
|---|---|---|
| Agree | 62 | 16.1 |
| Disagree | 71 | 18.5 |
| Neutral | 166 | 43.2 |
| Strongly Agree | 10 | 2.6 |
| Strongly Disagree | 75 | 19.5 |
| **Total** | **384** | **100** |

The above table and graph show the factors influencing real estate investment decisions in Sangli. 25.98% prioritize infrastructure development, followed by 23.00% for location, 20.43% for price, and 20.30% for future growth potential. 10.01% focus on rental yield, and 0.27% mention other factors. Infrastructure development and location are the main considerations for investors.

**Table 9- The potential returns on real estate investments in Sangli are high.**

| Particular | Frequency | Percentage |
|---|---|---|
| Agree | 153 | 39.8 |
| Disagree | 95 | 24.7 |
| Neutral | 91 | 23.7 |
| Strongly Agree | 16 | 4.2 |
| Strongly Disagree | 29 | 7.6 |
| **Total** | **384** | **100** |

The above table and graph show respondents' opinions on a specific statement. 39.84% agree with it, while 24.74% disagree. 23.70% remain neutral, 7.55% strongly disagree, and 4.17% strongly agree. This indicates that the majority of respondents tend to agree, with a notable portion being neutral or disagreeing.

**Table 10 - Market trends in Sangli are predictable.**

| Particular | Frequency | Percentage |
|---|---|---|
| Agree | 101 | 26.3 |
| Disagree | 66 | 17.2 |
| Neutral | 180 | 46.9 |
| Strongly agree | 14 | 3.6 |
| Strongly disagree | 3 | 0.8 |
| Strongly Disagree | 20 | 5.2 |
| **Total** | **384** | **100** |

The above table and graph show respondents' opinions on a particular statement. 46.88% are neutral, while 26.30% agree and 17.19% disagree. 5.21% strongly disagree, 3.65% strongly agree, and 0.78% strongly disagree. This indicates that most respondents are neutral, with a significant number leaning towards agreement.

**Findings:**

**1.** The residential real estate market in Sangli has a positive outlook, with 72.7% of investors expressing a strong or very strong opinion, while only 7% view it negatively.

**2.** Investors Favor commercial real estate (42.7%) as the most profitable, followed by residential (23.7%) and industrial (20.3%) properties.

**3.** Demand is highest for independent houses (31.8%) and apartments (29.2%) in Sangli, indicating these property types are preferred by investors.

**4.** High property prices (31.72%) and inadequate infrastructure (30.97%) are top challenges, with regulatory and economic issues also impacting investor confidence.

**5.** Investors consistently highlight high property prices and infrastructure deficits as significant barriers.

**6.** High property prices and infrastructure limitations are recurring concerns among investors.

**7.** Infrastructure development (25.98%) and location (23%) are top priorities influencing investment decisions, with price and growth potential also important.

**9.** Nearly 40% of respondents agree with a particular statement, while 23.7% are

**Suggestions:**

1. **Enhance Infrastructure Development-**
   Prioritize infrastructure improvements in Sangli to attract more investors and address current challenges like limited facilities and connectivity, which can improve the market's attractiveness.
2. **Promote Commercial Real Estate Investment-**
   Given the high preference for commercial real estate, encourage development and investment in this sector by offering incentives or creating more commercial zones.
3. **Encourage Affordable Housing Projects-**
   Given the high preference for commercial real estate, encourage development and investment in this sector by offering incentives or creating more commercial zones.

**Conclusion:**

Generally, the data analysis about the real estate market of Sangli reflects a positive view of investors, which expresses confidence in the potential of the market. On the whole, most investors, especially regarding the strength and prospects for growth, view the market favorably. They tend towards more commercial real estate investments, as most of the investors view them as the most rewarding ones. Residential real estate, especially independent houses and apartments is highly in demand, which itself indicates healthy interest in various property types. Optimism, however, aside, there exist terrific challenges to investors that can be termed as the major concerns about their high prices and lack of infrastructure. The issues create barriers to investors and affect the general market environment, indicating areas of improvement.

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# AI-POWERED TALENT MANAGEMENT: INNOVATIONS ACROSS THE EMPLOYEE LIFECYCLE

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***Abstract***

*Artificial Intelligence (AI) is transforming talent management by revolutionizing every stage of the employee lifecycle—from recruitment and onboarding to performance appraisal, career development, and retention strategies. By leveraging AI-driven analytics, predictive modeling, and automation, organizations can enhance decision-making, streamline processes, and personalize employee experiences.*

*AI-powered recruitment tools like HireVue and Pymetrics analyze vast pools of candidate data to identify ideal matches, reducing bias and improving hiring efficiency. Automated onboarding systems offer customized learning paths, ensuring seamless integration into organization culture. Throughout employment, AI-driven performance evaluation tools like Workday and Lattice, provide real-time feedback, enabling employees to refine their skills and maximize productivity. Career progression benefits from AI-driven learning and development platforms like Zavvy, Degreed provides platforms for tailored upskilling opportunities.*

*Beyond individual growth, AI enhances workforce planning by predicting attrition trends and optimizing employee engagement strategies with the help of tools like Visier and Anaplan. AI-driven chatbots support HR operations, addressing employee concerns with precision and responsiveness. Ethical considerations, including data privacy and fairness, remain crucial in implementing AI for talent management. When thoughtfully applied, AI fosters an inclusive, data-informed, and dynamic workplace where employees thrive.*

*This paper explores how AI-powered talent management tools are reshaping traditional HR functions, improving efficiency, and creating more adaptive work environments. This paper mainly focuses on the four main areas of human resource management recruitment, onboarding, performance management and learning and Development As AI continues to evolve, organizations that embrace its potential in talent management will gain a competitive edge by fostering innovation, employee satisfaction, and long-term success.*

***Keywords:*** *Artificial Intelligence, Talent Management, Innovations, AI Tools, Employee Lifecycle.*

## Introduction

In today's rapidly evolving business landscape, Business organizations are increasingly recognizing the critical role of talent management in driving sustainable growth and competitive advantage. One such critical domain undergoing transformation is Talent Management (TM), a core function of Human Resources (HR) (Abdeldayem and Aldulaimi, 2020). The influence of technology developments and the growing importance of business analytics has recently caused a dramatic shift in the HRM industry. People analytics, which allows organizations to make data-driven decisions regarding people in a more logical, objective, and successful way, is gaining popularity around the world (Stankeviˇciut¯e, Ž).

By methodically examining the transformative influence of AI tools over the whole HR lifecycle—an area that has received little attention in the literature to date—this review can close important research gaps. There is a dearth of thorough analysis that covers the complete decision-making process from recruiting to retention, despite prior research identifying the integration of AI in particular HR tasks including performance management and recruitment (Votto, A.M.; Valecha, R.; Najafirad, P.; Rao, Kaushal, N.; Kaurav, R.P.S.; Sivathanu, B.; Kaushik). This paper aims to provide a comprehensive understanding of how AI reshapes traditional HR practices by analysing emerging trends and the complementary role of HRM in utilizing AI. This analysis will contribute to the existing body of knowledge and guide future research directions in this evolving field (Sooraksa, N, Rana, D.T). Dawson & Agbozo (2024) identified a link between talent management practices, such as planning, recruitment, and performance management, and artificial intelligence and highlighted that AI integration is gradually developing and offers more benefits than drawbacks in enhancing talent management strategies.

This paper explores the integration of AI into talent management strategies, aiming to optimize various key processes and unlock the full potential of the workforce. Through a comprehensive review of existing literature, case studies, and practical examples, we examine the various ways in which AI can reshape talent management practices. (Sundarapandiyan, N., Korapu, S., Borugadda, S., & Paul, D) Additionally, we discuss the implications of AI tools in the employee lifecycle, starting from his recruitment to retention, including opportunities for innovation, potential challenges, and considerations for HR professionals and business leaders.

This paper's goal is to investigate how AI tools might revolutionize decision- making processes throughout the whole HR lifecycle, from hiring to retention. This article provides examples of how various tools are utilized at different stages of the employee lifecycle. This paper provides the latest tools and software in Recruitment, Onboarding, Learning and Development and Performance Management, AI-powered tools are changing HR procedures by enhancing productivity, accuracy, and equity in crucial domains such as hiring, performance management, employee engagement, and retention tactics. This review encompasses a comprehensive analysis of AI tools currently utilized in HR, their roles at various stages of the decision-making process, challenges such as bias and data security concerns, and emerging trends shaping the future of AI in HR.

**Obstacle in traditional Talent Management**

Traditional talent management comes with several hurdles that can make it less effective in today's fast-changing work environment. One major issue is the reliance on manual processes like resume screening and performance evaluations. These tasks take up a lot of time and often lead to errors, slowing down hiring and making it harder to find the right candidates efficiently. Another challenge is bias in decision-making. Factors like gender, ethnicity, or educational background can unintentionally influence hiring and promotion choices, making it difficult to maintain diversity and fairness in the workplace. Additionally, many companies fail to use data effectively when managing talent. Without proper analysis, organizations miss out on spotting workforce trends, predicting staffing needs, and assessing the success of their HR initiatives. Flexibility is another concern. Traditional methods don't always adapt well to evolving workforce demands or shifting business priorities. This lack of agility can make it harder for companies to respond to new challenges and opportunities. Lastly, many organizations take a one-size-fits-all approach to employee development, which doesn't cater to individual growth paths. When employees don't get personalized career guidance, they can feel unmotivated and disengaged, leading to higher turnover rates. To tackle these issues, companies need to embrace modern talent management strategies that incorporate AI-powered tools, data-driven decision-making and personalized career development plans. By evolving beyond outdated practices, organizations can build a more inclusive, efficient, and adaptable workforce.

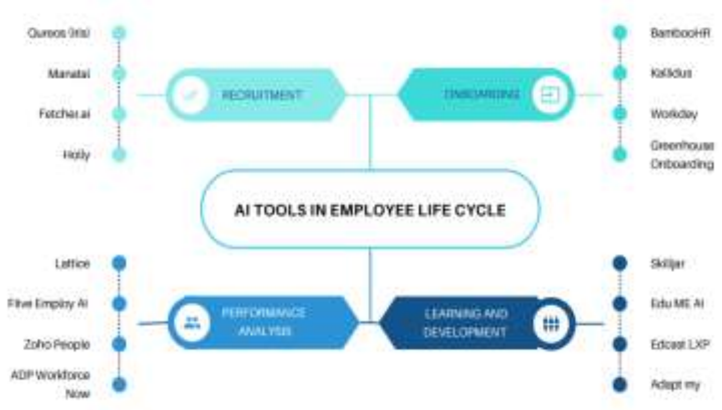
**Employee Life Cycle**

The employee life cycle consists of key phases that shape an individual's journey within an organization. Typically, the Employee lifecycle starts with recruitment and ends with offboarding and separation. Between recruitment to separation, there are some important phases such as onboarding, training and development, performance analysis, employee engagement and offboarding. Recruitment involves attracting and selecting the right talent through AI-driven hiring tools and strategic sourcing. Onboarding ensures a smooth transition by providing training, resources, and engagement activities that set employees up for success. Performance Management focuses on continuous feedback, goal-setting, and evaluation to enhance productivity and growth. Learning & Development fosters career advancement through upskilling, training programs, and mentorship opportunities.

The below image (1.1) shows the stages of the employee life cycle. The Employee Life cycle starts with attraction toward the brand which an organization creates. A highly talented employee always gets attracted to the organization's brand and value before applying for a job. The next step which follows the attraction is recruitment and interviews. Once an employee is selected in an interview, the next very pivotal step is onboarding where an employee is familiarized with the organization's structure, policy and norms. Knowledge transfer (KT) sessions are conducted during the onboarding. Once an employee gets familiarized with the organization and starts his work, he flows through the stage of performance analysis where his performance is measured and analysed with the organization's goals. Recognition of Employee’s work and feedback is followed with the development and engagement. Once the employee passes all these stages, he reaches a height, where he is looking for growth, career development. Finally, he ends the cycle with offboarding and separation from the organization.


**1.1 Stages of Employee Life Cycle**

AI tools have stormed the Human Resource Management in all the stages. AI is used in all the phases of employee life cycle. Some of the important AI software are discussed below. (1.2). Some software provides specifics functions of Human Resource while some software give a package for all the activities used in Talent Management.



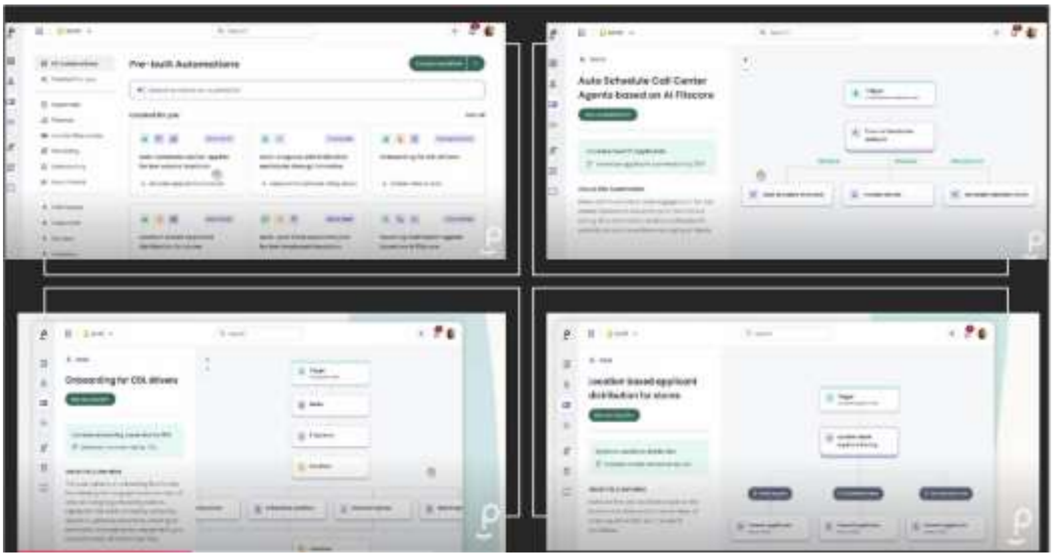
### 1.2 Various Tools in Employee Lifecycle

This paper emphasizes the AI software and tools which are designed for simplifying the process of all the stages of the Employee's Life cycle. Below are some of the examples of the software which is used in Recruitment, Onboarding, Performance Management and Learning and Development.

1. **AI in Recruitment- PHENOM**

AI solutions assist HR managers in streamlining processes such as interview scheduling, resume screening, and workforce analysis for well-informed hiring decisions (Michailidis, M. P.) There are many AI tools which help in automating sourcing and shortlisting the candidates within very seconds. An AI tool helps the HR recruiters to streamline the hiring process by automating repetitive tasks and to analyze job descriptions to find ideal candidates for job.

Phenom is an AI-powered platform designed to optimize talent acquisition, employee growth, and workforce management. By harnessing AI, it delivers personalized experiences tailored to candidates, recruiters, employees, and leadership, streamlining recruitment processes and professional development. Phenom utilizes AI-driven solutions to enhance talent acquisition and workforce management through Fit Score, which matches candidates based on skills, experience, and location. It offers Personalization with tailored job recommendations. With Intelligent Automation, Phenom streamlines candidate sourcing, screening, and scheduling, and AI Insights provide actionable analytics to refine hiring strategies. Additionally, Phenom hosts Phenom AI Day, an annual event highlighting AI innovations in HR, including generative AI, automation, and talent management advancements

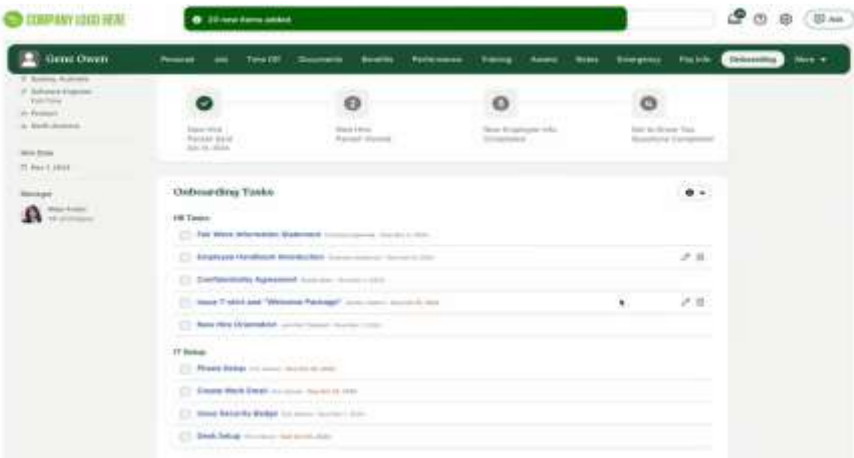


SOURCE: PHENOM

2. **AI in Onboarding- BambooHR**

AI onboarding uses artificial intelligence and machine learning to streamline and enhance the integration of new employees or users. It uses automated workflows, predictive analytics, and AI chatbots to enhance onboarding efficiency and effectiveness. The timing and length of onboarding programs, along with the specific activities involved, differ across organizations. With the help of various AI tools, we can simplify the onboarding process efficiently. Onboarding is an extended process which takes weeks to months to complete. Onboarding focuses on the integration of freshly recruited candidates to the company, role and culture to help them become fully engaged and productive. With the COVID-19 pandemic, there has been an increase in the usage of digital platforms for communication and training. Traditional in-person contacts have been supplanted by virtual meetings and online forms, which has made it simpler for distant workers to interact with their teams ( Pinco, O., Salanta, I. I., Beleiu, I. N., & Crisan, E. L.)

BambooHR provides a fully-connected HR ecosystem to streamline various operations and supports during onboarding. Streamline onboarding with an efficient system that keeps new-hire data organized for easy tracking and management. Strengthen team bonds by sending personalized welcome emails that highlight shared interests, fostering connection from day one. Customize the experience by role and work mode with pre-built, adaptable templates, ensuring a tailored approach for every new employee. Plus, eliminate manual data entry with seamless automatic syncing to the BambooHR Employee Record, making the process smoother and more efficient.




SOURCE: BambooHR

**AI in Performance Management- Lattice**

Performance management in Human Resource Management is a continuous process that ensures employees meet organizational goals effectively. It involves setting expectations, monitoring progress, providing feedback, and evaluating performance. Performance management aims to develop the capacity of employees to meet and exceed expectations and to achieve their full potential to benefit themselves and organization. AI-powered performance management systems utilize natural language processing (NLP) algorithms to analyze employee feedback, sentiment, and performance data from various sources, such as performance reviews, project outcomes, and customer feedback (Davenport & Ronanki, 2018).

Several tools are available to simplify the process, boost efficiency, and foster better communication between employees and managers. A few of them include software like Workday, Lattice, Zoho People, etc. The software and tools provide various benefits such as helping to set clear and achievable goals (SMART), simplifying the task of conducting routine evaluation, recording feedbacks, monitoring employee growth over time, helps to gather information from multiple resources and analyse the data of the up-to-date information on how individual teams are performing.

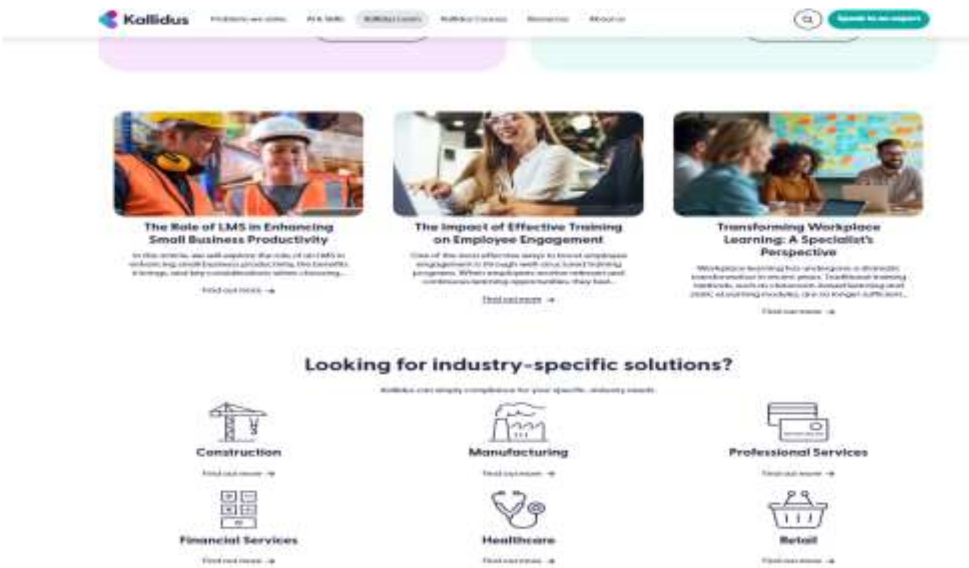
Lattice is a people management platform designed to enhance employee performance, engagement, and development. It provides HR teams and managers with tools to streamline performance reviews, goal setting, and feedback collection. Lattice is widely used by organizations to create a continuous performance management system, ensuring employees receive regular feedback and development opportunities.


SOURCE: LATTICE

**AI in Learning and Development - Kallidus**

Learning and Development in Human Resource Management is a pivotal function that focuses on enhancing employees' skills, knowledge, and competencies to enhance individual and organizational performance. It involves structured training programs, mentorship, e-learning, cultural integration and continuous skill development. There are various tools in Artificial intelligence which impart specific skills to the employee resulting in development of new skills and knowledge, boosting motivation and pathway for development opportunity.

One such tool this paper will focus on is Kallidus. It supports managers with tools and templates that easily link learning and development with employee performance and outcomes. It supports learning and development leaders in engaging content libraries that learners want to complete and put into practice. Kallidus empowers learners to close the skill gaps and unlock their potential while giving the business a clear view of skills needed and opportunities.




SOURCE: KALLIDUS

**Discussion**

AI tools in Talent Management have yielded several measurable results across industries. AI has significantly transformed Human Resource Management (HRM) by enhancing efficiency, decision-making, and employee experiences. AI-driven applicant tracking systems have accelerated the hiring process, reducing recruitment time by up to 50% through automated résumé screening and interview scheduling. Predictive analytics have improved employee retention rates by 20-30%, helping organizations identify at-risk employees and implement retention strategies. AI-powered learning and development programs have led to a 15-25% increase in employee productivity by offering tailored skill development. Furthermore, AI chatbots have minimized administrative burdens, handling HR queries and reducing workload by 40%, allowing professionals to focus on strategic initiatives. Workforce planning has also benefited, with AI-driven optimization reducing operational costs by 15-20%.

Organizations using Phenom have seen a 25% decrease in the time it takes to fill positions, helping streamline hiring processes. Additionally, the software has contributed to a 30% increase in internal hires, supporting employee growth and retention. In terms of cost-effectiveness, companies report a 50% improvement in spending efficiency when attracting talent, making recruitment budgets more strategic. Furthermore, 11 recruiter hours are saved per week, allowing HR teams to focus on higher-value tasks rather than manual administrative work.

BambooHR has delivered significant cost and time savings for organizations by streamlining payroll, performance management, and benefits administration. Companies using BambooHR Payroll have saved $20,000 annually while cutting down 20 hours per week of manual payroll tasks, increasing overall efficiency. With BambooHR Performance Management, organizations have reduced administrative burden, saving $40,000 annually and hundreds of hours on employee evaluations and feedback processes. Additionally, BambooHR Benefits Administration has dramatically shortened what was previously a three-week process into just two days, ensuring quicker and more efficient benefits management.

Lattice has played a significant role in improving workforce stability and efficiency for organizations. Companies using Lattice have experienced a 40% decrease in attrition rates, helping retain top talent and reduce turnover costs. Additionally, employee engagement has heightened, fostering a more motivated and productive work environment. Lattice has also contributed to substantial time savings, with thousands of employee hours freed up by streamlining HR processes and reducing administrative burdens. Lattice HRIS automated LTSE’s 75+ step onboarding process, creating a smoother experience for new hires and saving valuable time for the people team..These results highlight Lattice’s impact in enhancing employee satisfaction, retention, and overall HR efficiency.

Kallidus leverages data-driven assessments to measure learning effectiveness, ensuring that training programs deliver meaningful results. By analysing learning outcomes, Kallidus enables organizations to make adjustments to learning content based on real-time data, optimizing training for better engagement and knowledge retention. These improvements translate into quantifiable business benefits, including higher employee retention, increased productivity, and enhanced sales performance. With its focus on measurable outcomes, Kallidus helps businesses align learning initiatives with strategic goals, driving long-term success.

**Conclusion**

AI-driven tools have revolutionized Talent Management by enhancing recruitment efficiency, employee engagement, and workforce optimization. From Phenom's ability to accelerate hiring and improve internal promotions to BambooHR's streamlined payroll and benefits administration, AI solutions have delivered measurable improvements in productivity, cost savings, and operational effectiveness. Lattice has further contributed by reducing attrition rates and boosting employee satisfaction, ensuring businesses retain top talent. Meanwhile, Kallidus focuses on data-driven learning, refining training programs to drive performance and business success. These platforms collectively empower HR professionals with predictive insights, automation, and intelligent analytics, making workforce management more strategic and impactful. As AI continues to evolve, its role in HRM will likely expand further, offering new ways to refine hiring, enhance learning, and optimize workforce operations for sustainable success.

In summary, this paper offers a comprehensive analysis of the existing uses, obstacles, and possibilities tied to AI integration in Talent Management. While the advantages are significant, it is essential to adopt a thoughtful and ethical strategy to address challenges, fostering a fair, inclusive, and effective talent management process.

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# DIGITAL TRANSFORMATION AND CONSUMER RESPONSE TO HEALTHY BRANDED FOOD PRODUCTS

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***Abstract***

*This research investigates the impact of digital transformation on consumer buying behaviour towards healthy branded food products in Mumbai and Thane region. More specifically the investigation explores the various digital marketing platforms, ad exposure and the digital engagement impacting the buying behaviour of consumers purchasing healthy branded food products. This study is motivated by the growing trend of healthy branded food products and digital transformation among consumers. Quantitative research is conducted using a sample of 95 respondents from Mumbai and Thane region. The Chi-square analysis confirms that there is no significant association between digital ad exposure or engagement and consumer behavior or satisfaction. The study suggests that in order to effectively influence and retain customers, businesses must move beyond superficial digital tactics and concentrate on valuable content, trust-building, and integrated retail experiences.*

***Keywords:*** *Digital Transformation, digital platforms, Consumer buying behavior, healthy branded food products*

## Introduction

The term "digital transformation" describes how digital technologies are incorporated into every facet of business operations, essentially altering how the organization operates and providing value to its clients. Over the past few decades, the quick advancement of technology and the emergence of digital platforms have drastically changed how consumers behave. Consumer behavior has changed in recent years due to the quick uptake of digital technology, particularly in the food and beverage sector. Digital transformation has changed how consumers look for, assess, and buy things through platforms including social media, smartphone applications, e-commerce websites, and influencer marketing. The study of consumer buying behaviour is a challenging task, as individuals have unique insights. It is difficult to predict how someone will behave in a given situation. Behaviour refers to the actions, decisions, and psychological processes that individuals go through when selecting, purchasing, using, and disposing of products or services (Dudziak, Stoma, & Osmolska, 2023).

Consumer food purchase behaviour is changing significantly across the world and consumers are now getting more and more attracted towards good taste, convenience and health enhancing properties of food (Ali, Alam, & Ali, 2015; Bruhn, 2008; da Silva & Conti-Silva, 2016; Hansen, 2005; Lessa, Zulueta, Esteve, & Frigola, 2017; Shamal & Mohan, 2017). The consumers are now becoming more mindful about the health. Increased health consciousness and changes in lifestyle, coupled with awareness about the benefits associated with health and wellness food have led to significant changes in consumer behaviour towards healthy food consumption in the recent years (Crofton, Markey, & Scannell, 2013; Hansen, 2002; Lagerkvist, Okello, Muoki, Heck, & Prain, 2016; Quah & Tan, 2009). Demand for healthy branded food products in particular has increased significantly due to changes in lifestyle, growing health consciousness, and easier access to digital information.

Studying the impact of digital transformation on consumer buying behavior and satisfaction is important because digital technologies such as e-commerce platforms, social media, and AI-driven recommendations have significantly reshaped how consumers discover, evaluate, and purchase products, especially in health-conscious segments. Understanding this shift helps brands tailor strategies that enhance consumer engagement and satisfaction in a competitive digital marketplace. (Chaffey, 2022; PwC, 2021)

**Review of Literature**

**Sibichan Thomas and Dr. S. Rajendran (2020)** the young generation purchases health products only after detailed study of nutrients contents and the price of each product, and they compare quality products in the market. Moreover, there is a great struggle in the market between the different companies and their products. Different facets affect a consumer in their choice. It may include social and personal factors and their beliefs. Media and advertisements also affect the decisive factor and most of the consumers depend on brand loyalty, as well as gifts offered by manufacturers.

**Joshyja Jose, Biju M (2021)** the consumer's consciousness about health mediates their decision-making about the brands they bought. Organic, the consumers highly prefer packed food products as it is healthy to consume and due to the absence of pesticides and chemicals. The presence of consumer's positive attitudes generates the potential for organic food products. Quality acts as a strong determinant in consumers' brand preference as consumers feel branded products ensure quality, so proper marketing strategy with quality enhancement can increase the market growth.

**Sweety C. and Prasanna K. (2021)** In this study the authors have discussed the factors inducing healthcare consumers' behavior and provide insights into digital technologies to boost the consumer experience. For study the qualitative method is used by engaging a closed consumer group in discussion and through in-depth interviews. The study revealed that the new breed of consumers is well informed about healthcare providers' digital readiness. The factors influencing consumers to select healthcare providers include digital willingness of the healthcare provider, good customer experience, word of mouth, and brand image.

**Tabassum A., Aftab A., and Jabir A. (2021)** in this study researcher examined the factors affecting the buying behavior of the consumers for health and wellness food products in India. Author has used the stratified random sampling technique and statistical tools such as descriptive statistics, factor analysis and regression analysis. It has been observed that consumers' preference for health and wellness food product attributes indicate that quality and health benefits are perceived as very important and extremely important. Better-for-you (BFY) food products comprise the major share of the health and wellness food basket of the consumer. Study specified that socio-demographic profile of the consumers, product attributes, market attributes and psychological factors are more likely to effect the consumers' health and wellbeing food purchase decision.

**Iksha C. and Avneet K. (2022)** the author has focused on understanding the factors that influence consumers' food buying behaviour, perceptions and healthy food choices. The study is conducted by using a quantitative research approach by collecting data from 470 respondents. The Authors have concluded that there has been a considerable shift towards healthier food choices, and also suggested that the companies should focus on strategies to promote healthier choices, proper labels, more transparency and reduce their environment and social burden. Also emphasized on marketing strategies to be geared towards promotion of products through online platforms since millennia, spend their major time online.

**Gurubilli N., and Dr. Anish K. (2023)** this study explored the profound impact of digital advertising on consumer food choices, with a specific focus on how promotion schemes employed in digital marketing influence these choices. authors have concluded that Digital advertising, powered by promotion schemes, has a significant impact on consumer food choices by exploiting psychological biases, social influences, and economic incentives.

**Trupti B. and Dr. Sagar J. (2023)** The study investigated the effectiveness of digital marketing strategies for promoting healthy food products. The authors have used a quantitative research approach and the sample size was 100. The study has found that digital marketing strategies can be an effective tool for businesses in the healthy food industry to promote their products and reach their target audience.

**Ashwini. N and Dr. Venkatesh A. (2025)** in this study researcher have inspected the impact of digital transformation on consumer buying behavior in retail operations. The researchers have used ABCD framework analysis for several years of scholarly work. The researchers have given insights that the digital transformation is not just a technological shift—it is a fundamental change in how retailers are involved with consumers understanding the impact of digital transformation on consumer behavior, retailers can better anticipate future trends and make experiences that resonate with the growing needs of today's tech-savvy consumers.

**Objective of the Study**

1. To study the impact of digital marketing platform advertisement exposure on consumer buying behaviour towards healthy branded food products.
2. To determine whether the levels of digital engagement influence customer satisfaction towards healthy branded food products.
3. To identify the digital marketing platforms influencing consumer buying behaviour towards healthy branded food products.

**Hypothesis**

**Hypothesis 1**

H0: There is no significant association between digital marketing platform advertisement exposure and consumer buying behaviour towards healthy branded food products.

H1: There is a significant association between digital marketing platform advertisement exposure and consumer buying behaviour towards healthy branded food products.

**Hypothesis 2**

H0: There is no significant association between digital engagement and consumer satisfaction towards healthy branded food products.

H1: There is a significant association between digital engagement and consumer satisfaction towards healthy branded food products.

**Scope of the Study**

This study examines the impact of digital transformation on consumer buying behaviour towards healthy branded food products specifically in Mumbai and Thane region. It explores how digital marketing platforms and advertisements on those platforms influence the consumer decision, their engagements and satisfaction towards healthy branded food products. The research aims to provide insights into effective marketing strategies and policies for brands to enhance consumer satisfaction and drive purchase decisions in the digital age.

**Research Methodology**

The methodology adapted for this study is exploratory in nature. quantitative research approach used based on the primary data as well as secondary data. The survey method is adopted to collect primary data, using a structured questionnaire distributed via google form. The sampling technique used for this study is a convenience sampling method and the sample size used is 95 respondents.

**Tools & Techniques used for Analysis**

The statistical analysis carried out in the study is being done using MS-Excel. The statistical techniques like Chi-square test and simple percentage analysis are being used. Analyzed and interpreted data have been presented in the form of tables.

**Limitations of the Study**

1. The responses for the study have been limited to the Mumbai and Thane region only.
2. Time and resource constraint.

**Research Analysis**

**TABLE 1 Demographic Profile of Respondents**

| Sr. No. | Demographic Profile of Respondents | Attributes | Frequency | Percentage |
|---|---|---|---|---|
| 1 | Gender | Male | 39 | 41.05 |
| | | Female | 56 | 58.95 |

**(Source: Primary Data)**

Table 1 explicitly exhibits that 41.05% respondents are male and remaining 58.95% are female respectively.

**TABLE 2 Digital platform influencing consumer buying behaviour towards healthy branded food products**

| Sr. No. | Digital Platforms | Frequency | Percentage |
|---|---|---|---|
| 1 | Brand Website | 10 | 10.53 |
| 2 | Facebook | 4 | 4.21 |
| 3 | Instagram | 48 | 50.53 |
| 4 | YouTube | 22 | 23.16 |
| 5 | Others | 11 | 11.58 |

**(Source: Primary Data)**

The information in Table 2 identifies the digital channels that have the biggest impact on consumers' purchasing decisions for branded, healthful foods. 50.53% of respondents selected Instagram as the most impactful platform. This suggests that consumers' purchasing decisions are greatly influenced by Instagram influencer-driven marketing and visually appealing content.

YouTube comes in second with 23.16%, indicating the influence of product reviews and video material. Decisions are also influenced by brand websites (10.53%) and other channels (11.58%), such WhatsApp groups or health blogs. Facebook seems to have the least impact (4.21%), which can be a result of a change in platform usage by generation.

**TABLE 3 Preferred mode of purchasing healthy branded foods**

| Sr. No. | Mode of purchase | Frequency | Percentage |
|---|---|---|---|
| 1 | Online | 17 | 17.89 |
| 2 | Offline | 30 | 31.58 |
| 3 | Both | 48 | 50.53 |

**(Source: Primary Data)**

The data in table 3 revealed that 50.53% of respondents prefer both online and offline modes to purchase healthy branded food products and 17.89% rely solely on online purchasing, whereas 31.58% prefer offline mode exclusively. This indicates that while digital transformation is influencing consumer behavior, a significant portion of consumers still prefer physical shopping experiences, or adopt a hybrid approach that blends both digital and traditional retail channels.

To examine the association between exposure to digital marketing platform advertisements and consumer purchasing behavior toward branded, healthy food products, the following hypothesis has been explored.

H0: There is no significant association between digital marketing platform advertisement exposure and consumer buying behaviour towards healthy branded food products. (Table 4)

**TABLE 4 Result of Chi-square Test (Hypothesis 1)**

| Calculate Value | Table Value | Degree of Freedom | Level of Significance |
|---|---|---|---|
| 7.7947 | 16.961 | 9 | 0.05 |

Calculated value of Chi-square is 7.7947 which is less than the critical value 16.961 at 9 degree of freedom and 0.05 is the significance level. The critical value is greater than the calculated value therefore the null hypothesis is accepted and the alternate hypothesis is rejected. Since the null hypothesis is accepted it can be concluded that there is no association between digital marketing platform advertisement exposure and consumer buying behaviour towards healthy branded food products.

The relationship between customer satisfaction with healthy branded food products and digital interaction has been examined through the testing of the following hypothesis.

H0: There is no significant association between digital engagement and consumer satisfaction towards healthy branded food products. (Table 5)

**TABLE 5 Result of Chi-square Test (Hypothesis 2)**

| Calculate Value | Table Value | Degree of Freedom | Level of Significance |
|---|---|---|---|
| 12.2291 | 21.026 | 12 | 0.05 |

Calculated value of Chi-square is 12.2291 which is less than the critical value 21.026 at 12 degree of freedom and 0.05 is the significance level. The critical value is greater than the calculated value therefore the null hypothesis is accepted and the alternate hypothesis is rejected. Since the null hypothesis is accepted it can be concluded that there is no significant association between digital engagement and consumer satisfaction towards healthy branded food products.

**Findings**

1. The study revealed that the Instagram emerged as the most influential digital platform (50.53%) affecting consumer buying behavior towards healthy branded food products, highlighting the significant role of visual content and influencer marketing in shaping consumer choices.
2. This study implies that the majority of consumers prefer either online or hybrid purchasing modes, highlighting the growing impact of digital transformation while still valuing traditional retail experiences.

3. The table 4 Chi-square test revealed no significant association between exposure to digital marketing platform advertisements and consumer buying behavior, suggesting that mere ad exposure does not necessarily influence consumers' purchasing decisions for healthy branded food products.
4. The table 5 Chi-square test indicated no significant association between digital engagement levels and consumer satisfaction, implying that higher engagement (likes, comments, shares) does not directly translate to greater satisfaction with healthy branded food products.
5. The study suggests that although digital platforms, especially visually driven ones play a role in influencing perception, they do not necessarily drive purchase decisions or satisfaction outcomes on their own.

**Suggestions**

1. To enhance brand visibility and appeal among consumers brands should collaborate with fitness influencers and create visually rich contents as social media like Instagram and YouTube are the major influencing platforms.
2. To build trust and credibility brands must focus on meaningful engagements such as offering expert advice, responding to queries, etc.
3. Brands must focus on content that educates and builds trust by highlighting nutritional benefits, certifications, and sourcing transparency to support informed decisions.
4. Marketers should develop an integrated online-offline presence with a majority of consumers preferring both online and offline modes, companies should ensure product availability in retail stores and on popular e-commerce platforms, offering a seamless omnichannel experience.

## CONCLUSION

The study concludes that while digital platforms, particularly Instagram and YouTube, significantly shape consumer perception toward healthy branded food products, they do not directly influence purchase decisions or customer satisfaction. Also, it can be understood that even though there is a digital transformation growing, still valuing traditional retail experience. The Chi-square analysis confirms that there is no significant association between digital ad exposure or engagement and consumer behavior or satisfaction. There is scope for further study covering more population or area. This highlights the need for companies to go beyond surface-level digital strategies and focus on meaningful content, trust-building, and integrated retail experiences to effectively influence and retain consumers.

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# STUDY OF DIGITAL INNOVATION IN MANAGEMENT PRACTICES OF MANUFACTURING AND SERVICE-BASED MSME

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***Abstract***

*The strategic and operational environment of Micro, Small, and Medium-Sized Enterprises (MSMEs) in India is being progressively changed by digital innovation. This study examines how digital technologies are used and affect the management practices of MSMEs in the manufacturing and service sectors, emphasizing the variations, difficulties, and results unique to each industry. Since these businesses are the foundation of the Indian economy, their capacity to adjust to digital transformation is essential to boosting resilience, sustainability, and competitiveness.*

*Using both quantitative and qualitative data gathered from 100 MSMEs—50 in the manufacturing sector and 50 in the service sector—across a few districts in Maharashtra, the study takes an empirical and comparative approach. Strategic planning, operations, marketing, human resource management, and customer engagement are among the important aspects of digital innovation in management that are examined.*

*The results show that because service-based MSMEs are more focused on their customers and have smaller capital requirements, they are more eager to use digital tools like cloud-based banking apps, social media marketing, and CRM systems. Manufacturing MSMEs, on the other hand, are gradually incorporating automated inventory management, ERP systems, and production monitoring technologies; nonetheless, they frequently encounter obstacles such as high installation costs and a lack of technical expertise.*

*The report emphasizes that digital transformation entails a change in organizational procedures, personnel skill sets, and managerial mindset in addition to technology adoption. Businesses that incorporate digital innovation into their fundamental management procedures report increased customer happiness, operational efficiency, and flexibility in response to shifting market conditions.*

***Keywords** – Digital Innovation, Management, MSME.*

## Introduction

In emerging countries, micro, small, and medium-sized businesses (MSMEs) represent the backbone of economic growth, making substantial contributions to GDP, employment creation, exports, and regional advancement. One of the most important parts of India's industrial ecosystem, the MSME sector employs over 110 million people and contributes close to 30% of the country's GDP. However, MSMEs are coming under more and more pressure to update their management and operations procedures in light of market competitiveness, globalization, and the quick speed of technology innovation.

Digital innovation is one of the most important forces behind modernization in the modern period. The way business's function, compete, and expand has been completely transformed by the incorporation of digital tools and technologies into corporate processes. Digital advances, ranging from cloud computing and enterprise resource planning (ERP) systems to CRM software and digital marketing platforms, are changing how companies plan, interact, and provide value. Digital transformation presents MSMEs with chances to increase productivity, lower operating expenses, reach a wider audience, and improve customer satisfaction.

Even with the potential advantages, MSMEs' adoption of digital technology is still unequal, particularly when contrasting manufacturing and service-based businesses. Manufacturing MSMEs frequently encounter difficulties implementing automation, digital production systems, and data analytics because of financial limitations, a lack of technical know-how, and infrastructure deficiencies, whereas service-sector MSMEs typically embrace digital tools for marketing, customer engagement, and financial management. This discrepancy calls for a sector-specific examination of the ways in which management practices are being impacted by digital innovation.

Examining and contrasting the scope and effects of digital innovation on the management practices of manufacturing and service-based MSMEs is the goal of the current study. The study looks at topics like operations, human resource management, strategic planning, and customer interface in an effort to find trends, problems, and best practices that can guide business strategy and policy. This study adds to the expanding conversation on digital transformation in management and commerce by using empirical data gathered from MSMEs throughout Maharashtra. It provides useful information for entrepreneurs, decision-makers, and support organizations looking to improve the digital preparedness of India's MSME sector.

**Concept of Digital Innovation**

The process of using digital technologies to improve management techniques, revolutionize business operations, and provide customers with more value is known as "digital innovation." It involves fundamental shifts in how businesses operate, make decisions, and compete in the market, going beyond the simple adoption of digital tools. This change is largely made possible by technologies like digital marketing platforms, cloud computing, artificial intelligence, big data analytics, enterprise resource planning (ERP), and customer relationship management (CRM). Digital innovation is gaining momentum among academics and business practitioners. Featuring increasingly cross-industry and multi-actor innovation processes, digital innovation reveals the inherent technology bias in the dominant perspectives on innovation.[1]

Digital innovation is essential for Micro, Small, and Medium-Sized Enterprises (MSMEs) to increase operational effectiveness, lower expenses, improve customer experiences, and enter new markets. It can improve customer interaction, service delivery, and responsiveness in service-based MSMEs and streamline production processes, inventory control, and quality assurance in manufacturing MSMEs. Crucially, administrative tasks including financial decision-making, human resource management, and strategic planning are also impacted by digital innovation.

**Concept of Management**

Management (or managing) is the administration of organizations, whether businesses, nonprofit organizations, or a government bodies through business administration, nonprofit management, or the political science sub-field of public administration respectively.[2] In order to accomplish particular goals effectively and efficiently, management is the methodical process of organizing, planning, directing, and regulating organizational resources, including financial, technological, human, and physical. It includes deciding on a course of action, organizing tasks, and making sure the company adjusts to both internal and external obstacles. Effective management is crucial for businesses in order to motivate staff, optimize operations, match resources with objectives, and stay competitive in ever-changing markets.

In order to overcome obstacles including resource shortages, market rivalry, and regulatory complexity, management is essential for Micro, Small, and Medium-Sized Enterprises (MSMEs). MSMEs frequently depend on informal or owner-driven management structures because of their size, which might restrict their ability to expand and adapt. However, the necessity for organized and creative management techniques grows as the company environment becomes more technologically driven.

This study examines management from the perspective of digital transformation. It investigates how MSME leaders integrate digital tools and technologies into key managerial tasks like marketing, operations, strategic planning, customer interactions, and human resource management. The study intends to comprehend how digital innovation transforms conventional management approaches and propels firm performance in a competitive digital economy by examining management practices in manufacturing and service-based MSMEs.

**Objectives –**

- To examine the extent of digital innovation adoption in the management practices of manufacturing and service-based MSMEs.
- To identify the key digital tools and technologies being utilized in core managerial functions such as operations, marketing, human resources, and finance.
- To compare the differences in digital innovation practices between manufacturing and service-sector MSMEs.
- To analyze the challenges and barriers faced by MSMEs in implementing digital innovation across management processes.

**Research Methodology**

The research is based on existing data which is available on the internet, magazines, journals and books.

**Review of literature**

1. The research was conducted by Evi Susanti, Rita Yuni Mulyanti and Lela Nurlaela Wati[3] with the title named ‘MSMEs performance and competitive advantage:Evidence from women’s MSMEs in Indonesia’ (2023) The study concludes that for women's MSMEs, digital transformation increases innovation and competitive advantage but lacks a direct impact on performance. Innovation and competitive advantage significantly improve performance and mediate digital transformation's effect, proving essential for achieving better business outcomes.
2. The research was conducted by Gustavo Dambiski Gomes de Carvalho1, Luis Mauricio Martins de Resende, Joseane Pontes, Hélio Gomes de Carvalho, and Leozenir Mendes Betim[4] with the title ‘Innovation and Management in MSMEs: A Literature Review of Highly Cited Papers’ (2021). The study concludes that Digital transformation boosts innovation and competitive advantage for women's MSMEs, though its direct performance impact is limited. Innovation and competitive advantage are crucial mediators, strongly enhancing performance by leveraging digital efforts. Focusing on these factors is essential for better business outcomes.
3. The research was conducted by Lelisa Irawati and Kartika Sari Lubis[5] with the title ‘The Effect of Financial Literacy and Capital Management on MSME Performance (2022)’ The study concludes that individually, financial literacy and financial management had no significant effect on MSME performance, while capital had a negative impact. However, simultaneously, financial literacy, financial management, and capital significantly affected performance at Ida Martunas LKM1, explaining 98.4% of variation.
4. The research was conducted by Satya Arisena Hendrawan, Afdhal Chatra, Nurul Iman, Soemarno Hidayatullah, Degdo Suprayitno[6] with the title ‘Digital Transformation in MSMEs Challenges and Opportunities in Technology Management’ (2024) The paper says that While MSMEs face digital transformation challenges (resources, infrastructure, knowledge), it offers significant opportunities for efficiency and market access. Effective technology management, strategy, and training are essential to overcome obstacles and harness digital potential for sustainable growth and value.

5. The research was conducted by Rousilita Suhendah, Angelina, Rico Ricardo, and Nikita Stevansyah [7] with the title 'MSME Business Management and Development with IFE-EFE Matrix' (2022). The study concludes that Training helped Go Nads MSME understand its internal/external factors and strategic position (Quadrant I, growth/development). Recommended intensive strategies include market penetration and development, requiring increased online marketing and expanded distribution channels. The training received positive feedback
6. The research was conducted by Auliyaur Rokhim and Muh Ibnu Sholeh [8] with the title 'Business Management Strategies to Enhance MSME Competitiveness' (2024). The study concludes that Based on the sources, MSMEs are adopting digital marketing, innovation, and financial strategies but face challenges like digital skills, poor records, high material costs, low program participation, and limited capital access. Improved training, government support, and easier capital access are crucial for sustainable growth and enhanced competitiveness.

**Conclusion**

The study of digital innovation in management practices among MSMEs in the manufacturing and service sectors demonstrates how technology has a revolutionary effect on small business operations in the cutthroat and quickly changing business world of today. MSMEs must adopt digital tools to increase productivity, scalability, and market responsiveness because they are important drivers of GDP, employment, and inclusive economic growth. According to this study, there are significant sectoral variations in the type, scope, and results of digital technology adoption, even though both manufacturing and service-based MSMEs are embracing these technologies at a growing rate.

Due to their higher levels of direct customer involvement and lower capital requirements, service-based MSMEs are more flexible when it comes to deploying digital solutions for marketing, financial management, and customer engagement. Manufacturing MSMEs, on the other hand, typically concentrate on supply chain integration, inventory control, and process automation, albeit more slowly because of higher expenses and technological obstacles. Notwithstanding these distinctions, both industries deal with issues like low levels of computer literacy, poor infrastructure, and ignorance of government assistance programs.

The results highlight how crucial it is to help MSME executives adopt a digital mindset and include innovation into their primary management duties. MSMEs must align technology with business objectives and move beyond simple digital adoption if they want to see sustainable success. To hasten this shift, policymakers, trade associations, and support organizations must offer sector-specific digital solutions, financial incentives, and focused training. In the end, digital innovation is the secret to improving India's MSME sector's long-term success, competitiveness, and resilience in the global economy.

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# A SUMMARY REVIEW PAPER ON PERFORMANCE EVALUATION THROUGH TRADITIONAL TO DIGITAL TOOLS WITH BENCHMARKS

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***Abstract***

*Mutual funds are most commonly preferred by investors due to their diversification option. Investors always wanted to save their money in a safe place which have less risk. And it is an excellent way for those who have less knowledge about financial markets or do not have sufficient time for analysis. Investors generally compare their funds with benchmark returns, which gives them a proper idea about risk and return. This review study covers such papers that are based on various schemes compared with their relative benchmark. These studies are based on traditional benchmarking frameworks, development in financial digitalisation, such as real-time analytics. Digital technologies are used mostly to provide accuracy, frequency, and depth of benchmarking. Most of the funds perform better than the benchmark. Some of them showed negative returns due to limitations of other factors, like the incapability of the fund manager, improper diversification, mismanagement of the portfolio, etc. Finally, the paper gives a brief idea of the literature based on a comparison with the benchmark. It provides a comprehensive overview of traditional and modern metrics used in research.*

***Keywords**: Performance Evaluation, benchmark, growth equity funds, metrics, digitalisation.*

## Introduction

Mutual funds play an important role in the investment landscape by offering various options with accurate risk management. Mutual funds provide diversification facility with investment objectives in a wide range of securities such as stocks, bonds, and other assets by pooling money from investors. Mutual funds in India have experienced significant growth since 1964, with the first fund being UTI. After those public and private sectors have entered and with numerous schemes for the investors. SEBI improved transparency and introduced new fund offers, reaching nearly Rs. 40.5 lakh

In this way, it becomes a strong cornerstone in the investment landscape. Mutual funds work on transparency, which makes them a trustworthy organization among stockholders. It will be beneficial in all phases, such as short-term investment and long-period investment. As a Mutual fund house provides alternatives to the investors based on their perception and plans, they divide all schemes into specific categories such as investment objectives, solution-oriented schemes, offshore funds facility, and many more. Investors can pick according to their plans. Investor's attitude towards investment may influence the decision-making process. The main factor that has a strong impact is 'Risk-taking capacity'. Based on this, investors can choose schemes that may contain high risk, medium, or low risk. Along with this, 'Financial goals' are also considered an important aspect, as they seek funds for education, wealth maximisation, retirement, etc. The other factors, such as investors' experience and knowledge, expense ratio, fees, market bias, etc, play an important role.

## Performance Evaluation

Performance evaluation in a mutual fund plays an inevitable role. It is the way to know how investments are performing. It answers how investments generate returns, whether they are on track or not. Traditionally, performance evaluations are compared with standard benchmarks or historical data. In this era of rapid technological advancement, it is important to know how mutual fund houses use modern tools for analysis. With the help of these tools, they can do analysis faster, an accurate comparative analysis, real–time data analysis, big data analysis, and many more. Apart from this, many key factors can be considered as an evaluation tool, such as the rate of return over past years, the capability and expertise of the fund manager, the expense ratio, diversification, benchmark comparison, etc. It will be beneficial in making future investment decisions. It becomes inevitable to track investment with a proper standard, but surprisingly, over 60% of investors don't track their fund's benchmark or standard. It may be possible due to a lack of knowledge, or sometimes investors are not able to find a way to understand and analyse returns. This could lead to misinformed decisions, that is why tracing performance time to time will beneficial in long term.

**Benchmark Comparison**

It is one of the most usable standards for the comparison of performance. Benchmark is the standard of the fund. It could be set according to categories of the fund. This provides more transparency, one can evaluate fund manager's performance, analyse past trends etc. By comparing the fund's return to the benchmark, investors can approach best best-performing scheme by studying overperforming, underperforming or about the same as the market.

**Purpose of the study**

This review paper aims to analyse past research on the performance evaluation of mutual fund schemes with relative benchmark, to understand the role of digitalisation. As the finance industry has witnessed rapid technological transformation, digital tools strongly influence overall accessibility and investors' behaviour. Although digital tools provide easy access and flexibility, there is a shortfall in the literature connecting digital adoption to performance evaluation. From the compiled study of all the papers, this review paper brings together present knowledge and determines future areas.

**Literature search strategy**

A summarised literature search is conducted through systematic searches across various databases, including Google Scholar, SSRN, theses and journals. The search focused on publications from 2009 to 2024.

**Review of Literature**

(Rai & Shekhar, 2024)this paper covered different aspects of mutual fund schemes and their affecting factors. One of them was to analyse the investors' behaviour and correlation with technology during 2010-2015 to 2023-2024 with a fixed method of data collection. It was finalised that AI and big data analytics helped fund managers identify new trends, manage risk more effectively, and boost clients' experiences. It provided them with a one-click benefit as the software was designed to analyse big data in seconds.

(Vivek & Kumar, 2023)The researcher examined 5 digital applications through which the clients studied their returns by themselves. Apart from the traditional method, this paper was focused on the role of modern digital tools that facilitated real-time, user-driven benchmarking and evaluation. The researcher took 11 years for the study (1st April 2012 to 31st March 2023). S&P BSE 30 and NSE Nifty 50 indices were considered for the study. Collecting data from research papers, websites, and publications, researcher concluded that these online platforms provide more flexibility, security, suggest relatable data, etc. It was also stated that investors should only trade through trusted broker applications.

(Murthy et al., 2022)A study was carried out on the performance evaluation of eight equity funds based on daily closing NAV compared with NSE-Nifty. The study was conducted from April 2019 to March 2022. It was suggested that all the selected funds performed well during the period of study. Inspite of falling in nifty in the year 2020, schemes generated good returns. It also concluded that investors must consider the risk and return parameters before investing.

(Panigrahi et al., 2020)The present study analysed the performance of ELSS (Equity Linked Saving Schemes) over a duration of 5 years with various parameters. It took BSE 200 TRI Sensex as a benchmark index. The data was collected from authorised websites. The study suggested that investment in ELSS may reduce the tax liability u/s 80c, and the positive Beta ratio showed a lesser risk element than the market, which encourages investors more.

(Alagappan S.M, 2019)In this paper, the researcher evaluated the performance for one year (2018) of 12 open ended equity-based growth mutual funds. The NAV and return were determined with S &P BSE 500 Benchmark Index. The data was based on secondary sources. The investigation showed that, except for technology funds, others did not perform better than the market. The majority of them were negative. That year was quite not good for investors. Before investing, investors should analyse historical annual return which may help in decision making.

(Shaw, 2018)evaluates the performance and volatility of eight open ended growth oriented Diversified Equity mutual fund schemes with benchmark index i.e., CNX-Nifty for 6 years (2011 – 2016). Through the various techniques it was concluded that for investing high Sharpe and Treynor ratio will be the best for fund investment. From the samples ICICI Pru Value Discovery Fund (G) was best performing among all. Investor should verify return and volatile parameter for better result. Even they can invest through lump sum or SIP for long term goals.

(G. Rani & Hooda, 2017)This paper studied the performance and evaluated it by the ranks given by CRISIL. The researcher took 10 schemes from 5 mutual fund houses and compared them with their benchmark. For different schemes, different benchmarks were used such as S &P BSE 200, CNX NIFTY, Nifty Freefloat Midcap 100, S&P BSE 500, and S&P BSE. The duration was one year for the study. It was derived that all the selected samples performed better, and especially Tata Equity P/E Fund showed a remarkable performance than the others. This period had seen a demonetarization effect, which led to negative returns irrespective of such types of schemes. It was advisable to analyse the market before investing for the investors.

(Latha & Ghosh, 2016)Performed the study on the performance evaluation of nine schemes out of which three were from public-sponsored, three from private-sponsored sponsored and three from private(foreign) sponsored mutual fund schemes. This study was based on tax-saving equity schemes for the duration of 2010 to 2013. Overall result showed that out of nine schemes, Franklin India Tax Shield-Growth performed better than the benchmark index, i.e., S&P CNX NIFTY 500. It was concluded that among the three main samples, private (foreign) sponsored was able to generate remarkable returns.

(Patil, 2016)study shows performance of each mutual fund schemes from 2001 to 2007 in comparison to the benchmark index for those schemes. The researcher used CAGR (Compounded Annual Growth Rate), Sharpe ratio, Treynor ratio, Jensen's measure for evaluation. The study concluded that out of 34 schemes, 30 schemes performed better than benchmark index. At last, it was derived that one should analyse the performance and risk level with long-term data before investing in any schemes.

(Bhagyasree & Kishori, 2016)analysed the performance of open ended, growth-oriented equity schemes with market portfolio i.e., BSE-Sensex for the period of 2011 to 2015. With the help of measurement tools, the study revealed that 14 schemes out of 30 performed good than benchmark return and due to diversification, some of them were performed under the benchmark return. And Sharpe ratio was positive for selected samples which represents greater returns.

(Syed & Sharma, 2014)made an attempt to study the performance of 10 growth oriented open ended equity mutual fund schemes return with benchmark return during the year of 2007 to 2012. The samples were belonging to 5 public and 2 private sectors. The researcher used monthly closing NAVs with benchmark index closing. It revealed that correlation between samples were high as market factors closely affect the behaviour of mutual funds. It also represents the outperformance of fund managers that they can beat the market indexes.

(Sahi & Pahuja, 2013)carried out the performance evaluation on selected mutual funds for post post-global recession time from 2009 to 2012 in comparison to the Sensex benchmark. This was conducted during a recession. The researcher used traditional measures. The study found that the majority of funds performed better than the benchmark return. The identical results have been derived from public and private sector funds without ranking, so it is difficult to determine the capabilities of such funds. So, it was advisable to study the returns deeply in such periods. Investors can analyse the same benchmark performance during a tough period so they can get a clear idea about how such factors affect their returns.

(zaheeruddin et al., 2013)evaluated the performance of HDFC, Birla Sun Life and ICICI mutual fund companies with the S&P CNX Nifty Index throughout 2009 to 2012. To give ranks on performance, the researcher took data from authorised sources every quarter. It was derived that among the three funds, ICICI indicated high returns overall, and based on companies' risk and market risk, Birla Sun Life mutual fund presented higher risk than ICICI. Investors can invest in financial assets and non-financial assets.

(R. H. Rani & Rao, 2013)This paper was based on a study of selected balanced mutual fund schemes. The time period of the study was three years (April 2010 to March 2013). With the purpose of performance evaluation, the researcher used the monthly NAV of 10 mutual funds, which were compared with S & S&P CNX Nifty. With the help of various measurement tools, it showed negative returns during the period of study. It may have happened due to the lack of professional skills in this sector and mismanagement of professionals in the diversification of funds.

(Prajapati & Patel, 2012)Examined the performance of equity mutual fund schemes taken from five AMCs. The data analysed by the researcher was for the year 2007 to 2011. The study was considered daily closing NAV with benchmark BSE SENSEX. Overall, it was seen that all the selected samples showed a positive return than the benchmark. If any investor wants to earn a good return, then they can prefer Reliance Mutual Fund at that time.

(Rajkumar & Rau, 2010)Made an attempt to evaluate 23 open-ended growth-oriented equity schemes offered by public and private sector mutual funds. The researcher covers the period of 13 years (1996-2009). This study was based on secondary data, returns were compared with the NSE Nifty. The results revealed that out of the selected sample, Franklin Templeton & UTI gave good returns. Here, it is worth noting that in a highly volatile market with diversification, small investors may be well-advised so they can take rational decisions.

(S, 2009)in the present study, the researcher analysed Growth fund, Income fund and Balanced fund over a period of 5 years. The researcher used measurement tools to analyse NAV returns with market returns. It was concluded that DSP performed better than Birla Mutual fund in terms of Growth funds. JM Balanced fund, UTI Balanced fund and SBI Magnum Balanced fund performed better in balanced funds.

## TABLE OF ALL LITERATURE REVIEWS

| Year and Author name | Benchmark |
|---|---|
| **Rai & Shekhar, 2024** | **Risk-free return** |
| Modern tools have made investors' work easier; they can make fast decisions | |
| **Vivek & Kumar, 2023** | **S&P BSE 30 and NSE Nifty 50 indices** |
| Online platforms provide flexibility, suggestions based on history, etc. But it was mentioned that for trading, follow only trusted broker apps. | |
| **Murthy et al., 2022** | **NSE-Nifty** |
| Investors must consider the risk and return parameters before investing | |
| **Panigrahi et al., 2020** | **BSE 200 TRI Sensex** |
| A positive Beta ratio encourages investors more. | |
| **Alagappan S.M, 2019** | **S &P BSE 500** |
| Investors should analyse the annual return history. Except for technology funds, others did not perform better than the market. | |
| **Shaw, 2018** | **CNX-Nifty** |
| It was concluded that for investing high Sharpe and Treynor ratio will be the best for fund investment | |
| **G. Rani & Hooda, 2017** | **S&P BSE 200, CNX NIFTY, S&P BSE 500,** |
| It was advisable to analyse the market before investing for the investors. | |
| **Latha & Ghosh, 2016** | **S&P CNX NIFTY 500** |
| It was concluded that among the three main samples, private (foreign) sponsored was able to generate remarkable returns. | |
| **Patil, 2016** | **Related schemes benchmarks** |
| At last, it was derived that one should analyse the performance and risk level with long-term data before investing in any schemes | |
| **Bhagyasree & Kishori, 2016** | **BSE-Sensex** |
| Some schemes underperformed due to other factors. Sharpe ratio was positive for selected samples, which represents greater returns. | |
| **Syed & Sharma, 2014** | **NAVs with benchmark index closing** |
| Correlation was high, it represented the outperformance of fund managers that they can beat the market indexes. | |
| **Sahi & Pahuja, 2013** | **Sensex benchmark** |
| This study was conducted when the economy had faced a recession. It was advisable to study the returns deeply in such periods. | |
| **zaheeruddin et al., 2013** | **S&P CNX Nifty Index** |
| It was derived that ICICI indicated high returns overall and based on companies' risk and market risk, Birla Sun Life mutual fund presented higher risk than ICICI. | |
| **R. H. Rani & Rao, 2013** | **S & S&P CNX Nifty** |
| It shows negative returns during a period of study. It may happen due to a lack of professional skills or mismanagement in the diversification of funds. | |
| **Prajapati & Patel, 2012** | **BSE SENSEX.** |
| Overall, it was seen that all the selected samples showed a positive return than the benchmark | |
| **Rajkumar & Rau, 2010** | **NSE Nifty.** |
| It is worth noting that in a highly volatile market with diversification, small investors may be well-advised so they can take rational decisions. | |
| **S, 2009** | **NAV returns with market returns** |
| It was concluded that DSP performed better than Birla Mutual fund in terms of Growth funds. JM Balanced fund, UTI Balanced fund and SBI Magnum Balanced fund performed better in balanced funds. | |

**Table 1: Compiled by researcher**

**Summary**

This study is based on reviewing the previous work done by other researchers. The focus is emphasised on 'performance evaluation of mutual fund schemes with appropriate benchmark'. Researchers have analysed various schemes during different phases of time. Generally, researchers have performed studies on growth-oriented schemes, and those have a strong connection with market volatility. It becomes important that investors and market analysts need to adopt an approach that covers quantitative and qualitative factors. This review paper examines different papers that contain traditional metrics, modern metrics, and digital tools, as well, because traditional metrics are useful to some extent. after that, in the modern era, multi-factor models and risk-adjusted returns should give more emphasis. It can be stated that technologies are very informative. But for its use, systematic knowledge is required. From the review of existing literature, it is seen that Sharpe Index, Treynor's Index, Jensen's measurement tool, Fama's measure, ANOVA, Standard Deviation, Compounded Annual Growth Rate (CAGR), and NAV were used by most researchers to evaluate the benchmark return with actual return. While digital techniques were used based on software design, which provides an easy analysis option 24x7 to users. Informed by current trends (Rai & Shekhar, 2024), studies investors' understanding and user experience with technology and (Vivek & Kumar, 2023) analysed 5 mobile applications and showed how investors can make decisions. Based on the nifty benchmark,(Murthy et al., 2022) (Shaw, 2018),((Latha & Ghosh, 2016),(zaheeruddin et al., 2013), (R. H. Rani & Rao, 2013) and ((Rajkumar & Rau, 2010)emphasized that investors should be aware of market volatility; if they are not able to analyze the market, it will lead to negative returns. While (Panigrahi et al., 2020), (Bhagyasree & Kishori, 2016), (Sahi & Pahuja, 2013), and (Prajapati & Patel, 2012) focused on the benchmark of Sensex, they mainly showed greater return than the benchmark, which indicated a strong sector position in the market. Overall, the study highlights how performance evaluation approaches must keep growing to meet the complex needs of contemporary financial markets.

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# PREDICTING MUTUAL FUND PERFORMANCE: A SYSTEMATIC LITERATURE REVIEW AND BIBLIOGRAPHIC ANALYSIS

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***Abstract***

*Investors have always tried to predict the future returns expected returns of the investments they make. Investors have used various methods over the years and many theories have also been developed to predict the performance of investments. Researchers have used multiple parameters to assess the future returns. Not only not only multiple parameters have been used but also many theories from our methods, tools have been used for making the predictions. This paper aims to review systematically literature produced in last 20 years by multiple scholars to assess the performance of mutual funds in future. It analyses more than 100 Peer reviewed articles to systematically synthesise the knowledge available identify predictor variables, Methodologies used and outcome measure used by the scholars. The review also presents a bibliographical view of selected articles using R and statistical Tools. The study also reveals input parameters used by various scholars. The findings provide a road map for the scholars and researchers to improve the predictive accuracy. It also provides practitioners a toolkit of variables required to be used for predicting the future returns of mutual funds for their clients.*

***Impact statement :*** *This review offers a clear, structured understanding of how mutual fund performance has been predicted in academic research. By highlighting key models, variables, and gaps, it provides a valuable foundation for future studies and supports the development of smarter, research-backed investment tools in the fintech space.*

## 1 Introduction

### 1.1 Context and Importance

Mutual funds are pooled investment instruments which take investments from large Number of investors. The money so collected is invested on behalf of the investors into different asset categories depending upon the category of the mutual fund. A professional fund manager and a team of trustees takes care of this investment on behalf of the investors(Wicaksono, 2023). After deducting their own charges the rest of the returns so earned is passed on to the original investors in form of capital gain or in form of dividends paid out to the investors from time to time. Mutual funds can invest in multiple different asset classes including stocks, bonds, money market instruments and other surge instruments. In today's digital era the mutual funds have become one of the most popular choices for investments by retail investors (Wicaksono, 2023)who themselves do not understand the market completely but can still take exposure and expect higher returns.

Pause studies reveal That most households do not use robust or sophisticated methods for analysing financial products especially investments (Ben-David et al., 2022). This behaviour can be attributed to various factors including financial literacy lack of knowledge or behavioural biases (Ben-David et al., 2022). The households use rule of thumb, shortcuts, mental accounting leading to suboptimal levels of decision making regarding investments(Ben-David et al., 2022). Even though the size of mutual fund industry has grown tremendously over last 20 years and there have been a level of sophistication in the investment industry yet mutual fund investors have continued to use simple and naïve signals like Morningstar ratings or other ratings past performance and other simple measures to identify mutual funds to invest in(Ben-David et al., 2022).

While it is impossible to predict the future this study assimilates the knowledge available and created over a period of time to try and synthesise how the performance evaluation/ fund selection has evolved over a period of time.

The academic community has dedicated substantial research effort to this problem, but the findings have been fragmented across various models, regions, and data sets. This systematic literature review (SLR) attempts to synthesize this body of knowledge by mapping trends, evaluating methodologies, and identifying critical gaps.

### 1.2 Objective of the Review

This paper aims to:

- Select shortlist analyse and compile peer reviewed literature available from various sources on the mutual fund performance prediction.
- It also aims to try and categorise various studies based on inputs used methodologies and other performance matrices.
- Identify variables and market contexts.
- The study also aims to provide a general direction for literature review on mutual fund performance prediction for all future studies.

## 2. Methodology

### 2.1 Search and Selection Protocol

Following PRISMA guidelines (Page et al., 2021), a systematic search was conducted across Scopus focusing on the last 20 years (2000-2024). Keywords included "mutual fund performance prediction," Mutual fund returns", "future returns,". The query used is as follows : ( TITLE-ABS-KEY ( "mutual fund performance" OR "mutual fund returns" OR "mutual fund rank" ) ) AND PUBYEAR > 1999 AND PUBYEAR < 2025

The initial search yielded over 736 articles. After removing duplicates, applying inclusion criteria, exclusion criteria and quality screening, 618 articles were retained for bibliographic analysis. Further, after going through articles for their relevance to the topic, minimum citations for acceptance and completeness of idea, a final list of 108 articles were shortlisted for detailed analysis and reading.

### 2.2 Inclusion and Exclusion Criteria

A robust inclusion and exclusion criteria was created to shortlist the research articles to be studied for this study. Inclusion criteria are filters required by the study which must be adhered to in order for a study to be included. The inclusion criteria also provides consistency and sets of boundary conditions for the studies that are included in this slr exclusion criteria on the other hand are set of rules which are used to exclude the studies from entering into the slr. A combination of inclusion and exclusion criteria provides a complete boundary conditions and make sure that future scholars can use this slr for the purpose as defined by them in their future needs. The following is inclusion and exclusion criteria used for this study.

Inclusion criteria:

- Empirical studies focusing on predicting mutual fund future performance.
- Studies specifying independent and dependent variables.
- Use of quantitative, qualitative, or mixed methods.
- Peer-reviewed journal articles in English.

Exclusion criteria:

- Articles without clear predictive focus.
- Studies purely descriptive without forecasting models.
- Conference papers, theses, and non-peer-reviewed work.

**2.3 Data Extraction and Coding**

The downloaded data of research papers has multiple columns and information which may not be relevant for the purpose of research. Hence the downloaded data was coded before it was uploaded to bibliometrics (R Studio). The data was coded as shown below:

Each article was coded for:

- Authors, year, journal
- Sample size and market context
- Methodological approach (statistical or machine learning models)
- Qualitative / Quantitative
- Variables used for prediction
- Forecast horizon (e.g., 1-year, 3-year returns)
- Performance metrics and validation techniques
- Key findings and limitations

**2.4 Analytical Framework**

A stoop two step method was used for analysing the downloaded data sets. In the first step the entire set of 736 articles were taken. From this 736 articles, articles in other than those in English were removed. Further, a check for relevance was done by reading the ttile and those articles showing no relevance to the topic were also removed. After this, a total of 638 articles were left.

In the first step, a bibliographical Analysis was done using a full set of 638 articles the bibliographic analysis was done using our studio and bibliometrics software. The trend in research work done over a period of time, most prolific authors, relationships, production over a period of time, source of production, geographic locations/ countries and trends across the topic range was studied using bibliographic software. In a second step of further refinement of the 638 articles was done based on the most cited articles. For the inclusion in the further refinement a minimum citation count of 30 was taken. This resulted in a shorter list of 108 articles which were not only relevant but also most accepted by other scholars given the citation counts. These 108 articles were then studied in more details to identify the variables methodologies methods used tools used outputs and trends.

The coded data was analysed thematically and quantitatively to identify trends, gaps, and methodological evolutions. Citation analysis was also performed to gauge influence.

**3. Literature Landscape: Descriptive and Thematic Analysis**

**3.1 Overview**

An overview of the data is presented in the figure. This includes a total of 618 articles which come from 244 different sources. This is the data from the year 2000 to the year 2024. A total of 1187 authors have contributed of which around 25% have international affiliations or collaborations. An annual growth rate of 6.84% is also seen in the production over a period of 20 years. On an average the articles under review have received citations of 28.22 showing the relevance of the collected data


**Figure 1: Overview of research articles**

### 3.2 Wordcloud

Word clouds have become popular methods of representing textual data into a pictorial form (DePaolo & Wilkinson, 2014). It gives a nice view of how various words have been used how frequently they have been used (DePaolo & Wilkinson, 2014)and the centrality of the idea. By looking at the word cloud the scholars can identify if the studies included in a particular SLR are relevant for their work and hence can be subsequently used. A word cloud for the current study is presented below in the figure. As can be seen the central idea appears to be mutual funds investments, performance assessment and other performance and operational benchmarking. This appears also to be the theme of this current study and the studies included are in line with the theme.


**Figure 2 : Word Cloud**

### 3.3 Production over time

A consistent increase in production over time can be seen in the graph. It clearly depicts that the topic has been gaining popularity and there are many studies which are now dealing in this topic. There has been a study increase from the year 2000 to the year 2024. A graph of number of articles published over a period of time is shown in the figure 3.

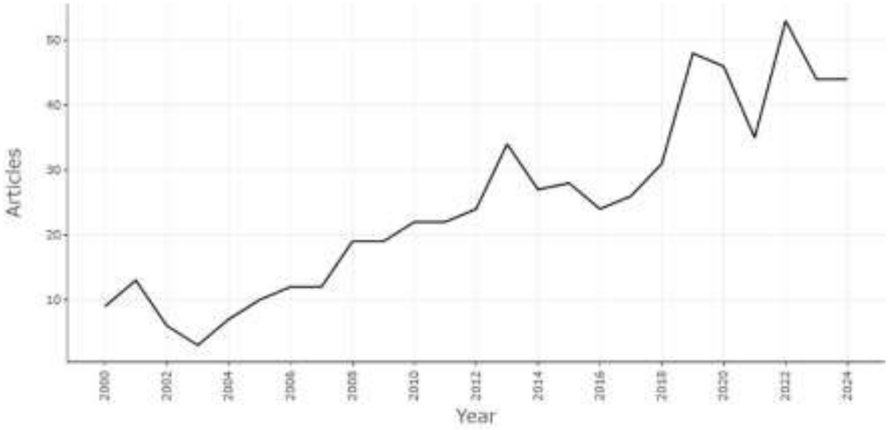


**Figure 3 : production over time**

### 3.4 Affiliations

The figure below shows affiliations of various research produced on the current topic. As can be seen multiple universities and research institutions across the world have been giving serious research outputs. The performance of mutual funds appears to be an important research area across various varsities. Top 10 university is producing research on this area are represented in the figure 4 below.

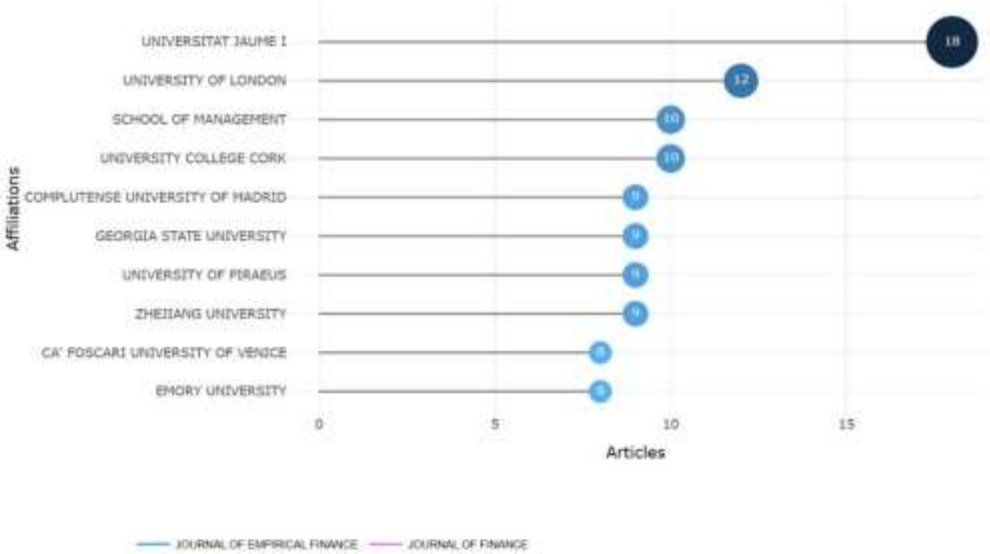


**Figure 4 : Affiliations**

### 3.5 Country production over time

The production of research on this topic is not limited to a few geographic locations. This can be seen from the graph shown in figure 5 below. The figure shows production of various research articles over a period of time across various countries. While China seems to be producing prolifically, Other countries like India UKUS and Spain have also been producing a lot of research on this topic. It is important to note that research on this topic has been accelerating in India showing clearly the level of rising interest by academician as well as practitioners in the field of mutual fund performance.

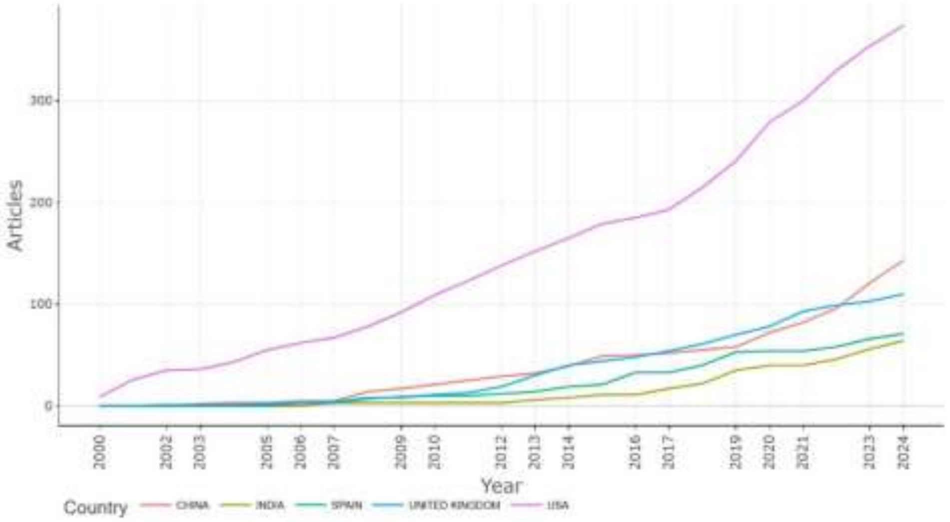


**Figure 5 : Production by country over time**

### 3.6 Most relevant authors

It is important to note that there are many authors who have produced significantly important research on this topic. As can be seen in the figure below there are many authors who have produced multiple research papers on this area. The figure 6 below shows top ten authors with their production volume on this topic.

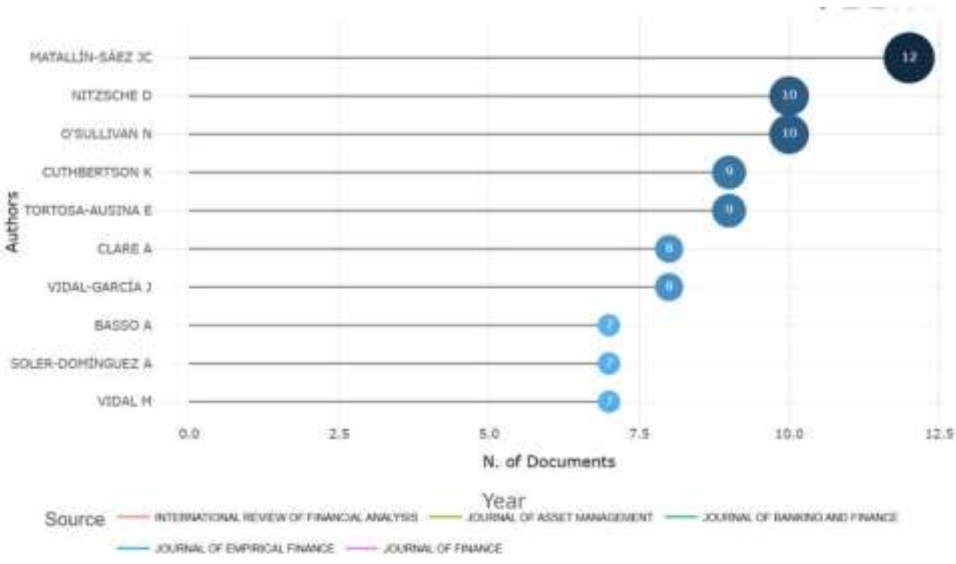


**Figure 6 : Most relevant authors**

### 3.7 Author impact factor

The figure below shows the measure of impact factor H that various authors have shown there are a significant number of authors where the high impact factor on this field the specific articles produced by them are also highly cited as well as well recognised by other academics for their research. These include various models methodologies and ideas which have been used as basis for research going forward

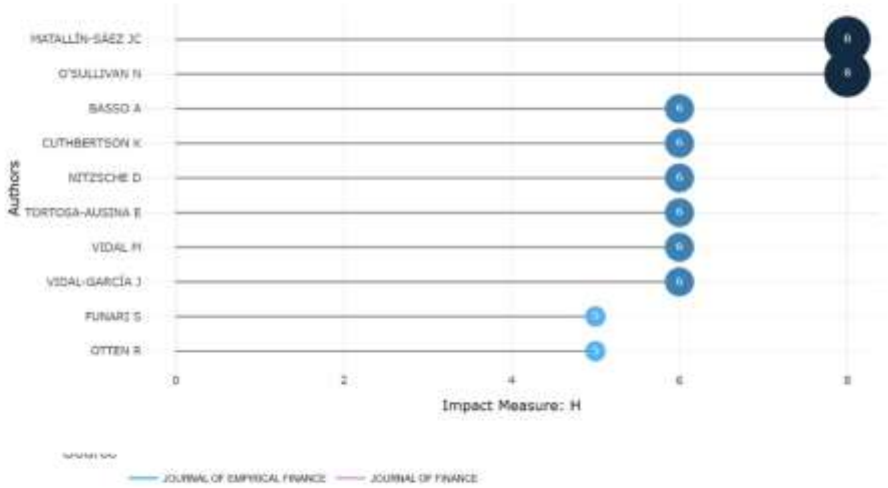


**Figure 7 : Impact factors**

### 3.8 Author production over time

Matallin has worked on various topics like performance of mutual fund based on investment style (Bessler et al., 2022), performance of mutual funds based on exposure to various factors(de Mingo-López et al., 2022), impact of active management on value of the fund (Matallín-Sáez et al., 2019a).

On the other hand, O'Sullivan has produced research on topics like skill of mutual funds in timing the market O'Sullivan (Foran & O'Sullivan, 2017) , performance of mutual funds with risk of liquidity (Foran & O'Sullivan, 2014).

Clare has also produced relevant research over time on topics including Characteristics of managers in predicting the performance of mutual funds (Clare et al., 2022), Asset management premium(Clare, 2022) etc.

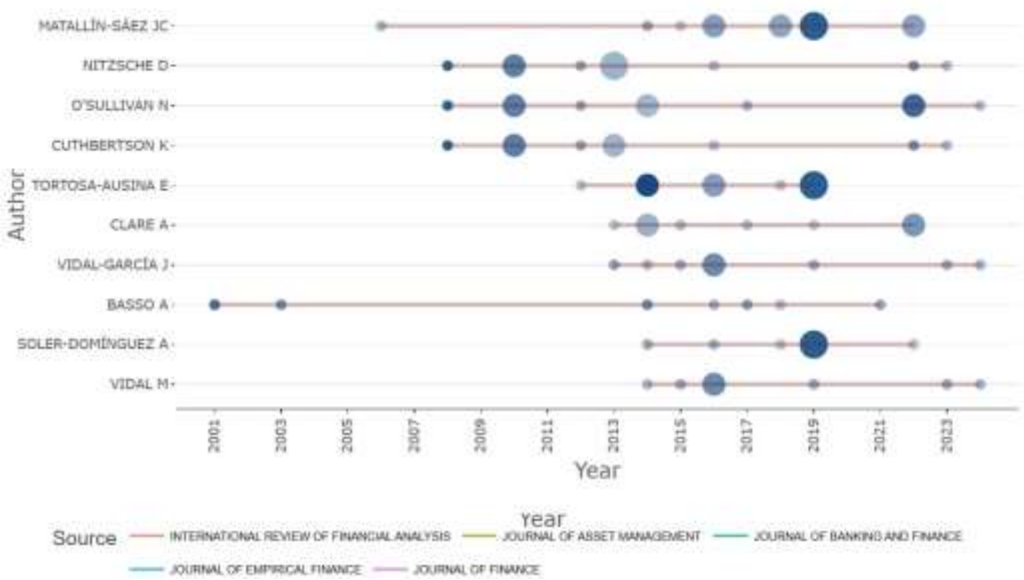


**Figure 8 : Author production over time**

**3.9 Sources of production by relevance**

While the Journal of banking and finance has been one of the most prolific in producing literature on the given topic there are many other sources which have also contributed. A large number of sourcing producing articles on the given topic signifies a very high level of interest amongst researcher on this important area of research. Leading journals like Journal of asset management and international review of financial analysis have also been producing large quantities of research on this topic. It is clear that the topic has been researched by diverse fields of expert yet it is difficult even today to find or define robust model which can predict mutual fund performance in future. The work done so far is highly relevant and takes us in the direction which will eventually evolve better and stronger models for reduction of mutual fund returns in future.

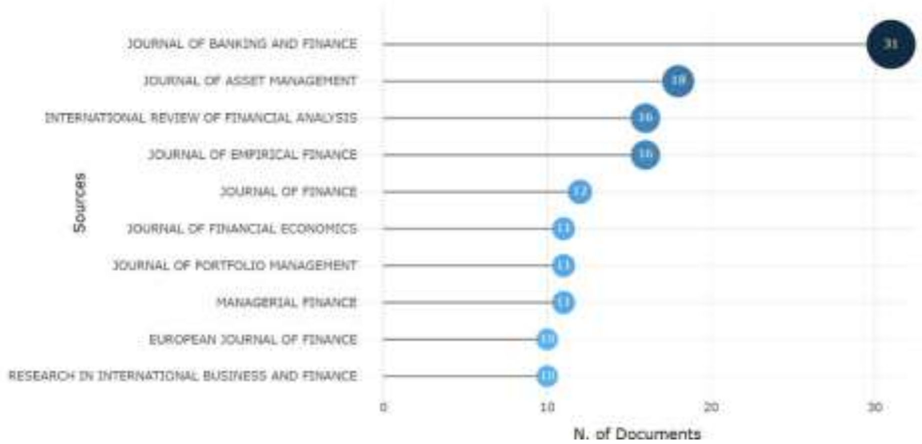


**Figure 9 : Source of production**

**3.10 Sources production over time**

A further analysis of sources of production over time reveals that while Journal of banking and finance started publishing research on this area way early in the year 2004 2006 the other journals started catching up to the importance of this field from the year 2012 onwards there are many other production which have happened since then and the topic seems to be the area of high interest across business journals.

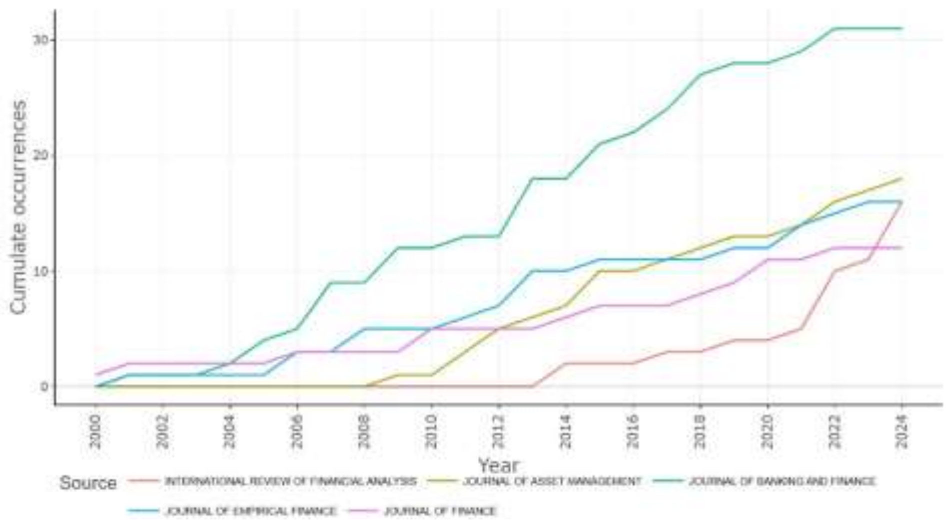


**Figure 10 : Source of production over time**

### 3.11 Impact of sources

A journalimpact factor is an important way of measuring or comparing how different journals of scientific research fare against each other in terms of research published by them on a specific topic. The impact factor depends upon number of citations in the current year or in last two years and it also depends upon number of articles published in the same period (Garfield, 1999). The numbers are normalized to ensure that the field of studies is taken into consideration along with the other factors (Garfield, 1999). In general it can be seen that an impact factor in a very simple terms is average number of citations received by the journal on a particular topic on the articles published in the recent past. From the figure below it can be seen clearly that Journal of banking and finance continues to be an impactful source of research on this topic. Apart from this it can also be seen that there are many more journals who have impact factors more than 5, signifying that the research is widespread across journals creating impact.

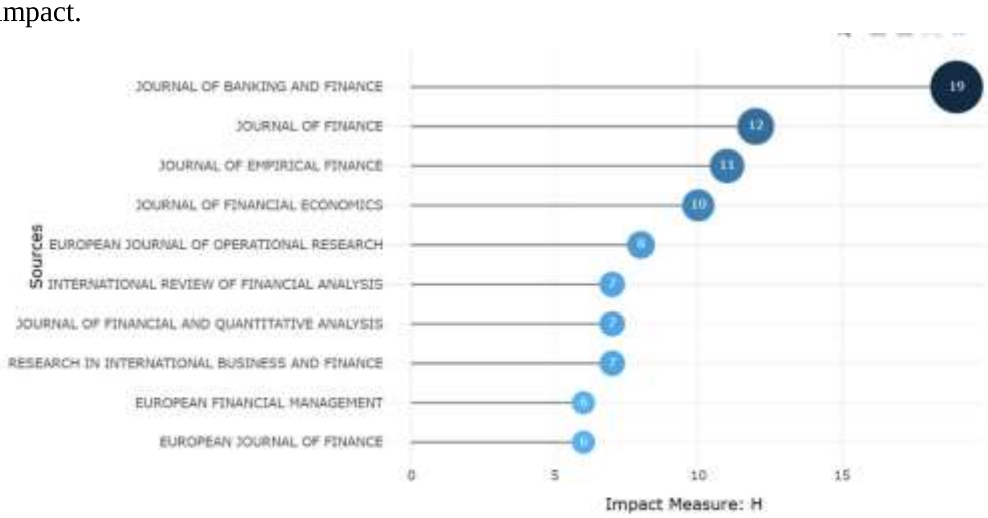


**Figure 11 : Impact of sources**

### 3.12 Most Cited documents

(Coval et al., 2001) is arguably the most widely cited paper in the field of mutual fund performance prediction. The study introduced a powerful idea: geography matters. It empirically demonstrated that mutual funds tend to generate superior returns—an alpha—when they invest in companies located closer to their headquarters. The logic is intuitive yet profound: fund managers are better able to analyze, understand, and gain insights into businesses that are geographically and informationally closer to them. These "local" investments tend to be better researched and more familiar, giving managers a distinct edge compared to investing in far-flung, unfamiliar territories. In contrast, funds allocating capital to distant companies face informational disadvantages, often resulting in weaker performance. (Wermers et al., 2000) article also Became a seminal work in the field of mutual fund returns. Is the search was based on the idea that does active trading by mutual fund managers add to extra returns for mutual funds. Ever since there have been many more seminal articles and research works produced by various scholars and the same is shown in the figure 12 below.

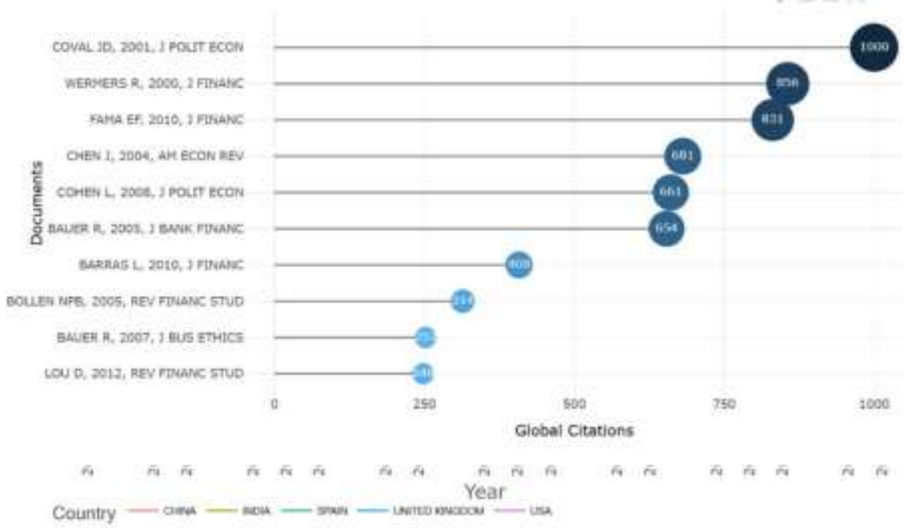


**Figure 12 : Most Cited documents**

### 3.13 Trending topics

The figure13 below shows the trends over the years for the research on mutual fund performance. In the early years the focus was mainly on mathematical models (Vidal-García & Vidal, 2014), (Chang, 2004), (Basso & Funari, 2003) financial data processing (Galagedera, 2019), (Wang & Huang, 2010) and operations research (Atanasov et al., 2023), (Matallín-Sáez et al., 2019b). The industry was developing and the research methods were also getting evolved in the initial years however in last 7-8 years there have been research on the assessment of risk(Agarwal & Pradhan, 2023), (Durán-Santomil et al., 2019), (Chiew et al., 2019) performance appraisal (Galagedera et al., 2018), (Babalos et al., 2012) and performance assessment (Busse et al., 2021). Regression analysis (Abramov et al., 2015), (Rao et al., 2017) has been trending too in middle years as a tool for assessment.

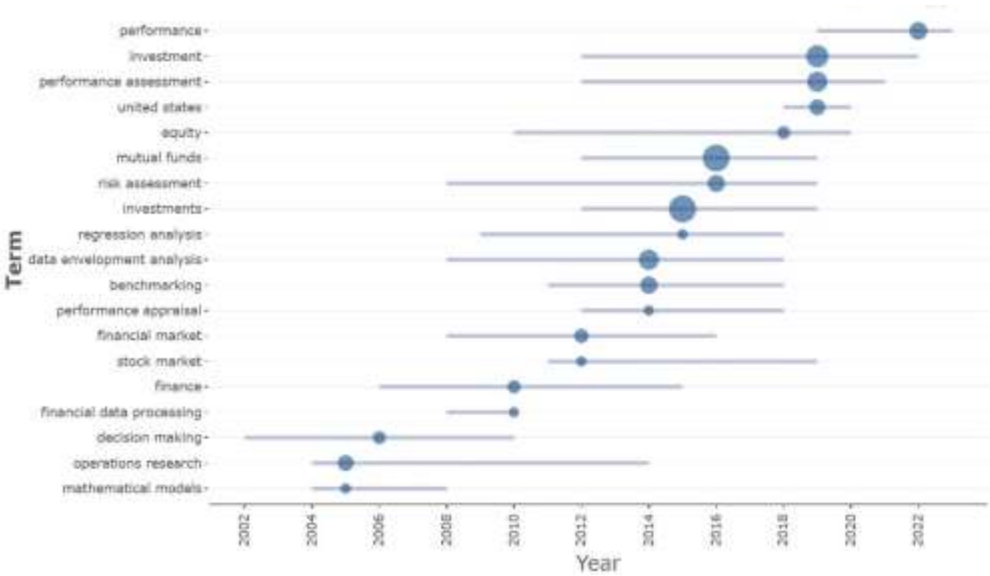


**Figure 13 : Trending topics**

### 3.14 Thematic map

Motor teams are the ones which are highly researched have a very high degree of development and also relevance to the topic. Motor thing emerging from the current research are mutual funds data envelopment analysis and investments in general. Also emerging are operations research and financial decision making. The basic themes are the one which have high level of relevance but may not have high level of development so far. Performance assessment in financial markets and tools using comparative study appear to be the basic themes which have high relevance but can do with more detailed studies in future. Emerging themes are the one which have started to see traction over last few years in terms of relevance but the development is still low in these areas stock market costs and the system of financial system are the emerging themes in this research area. Sustainability and sustainable development are the niche themes emerging from the current study.
The figure 14 below shows all the themes of the current research.

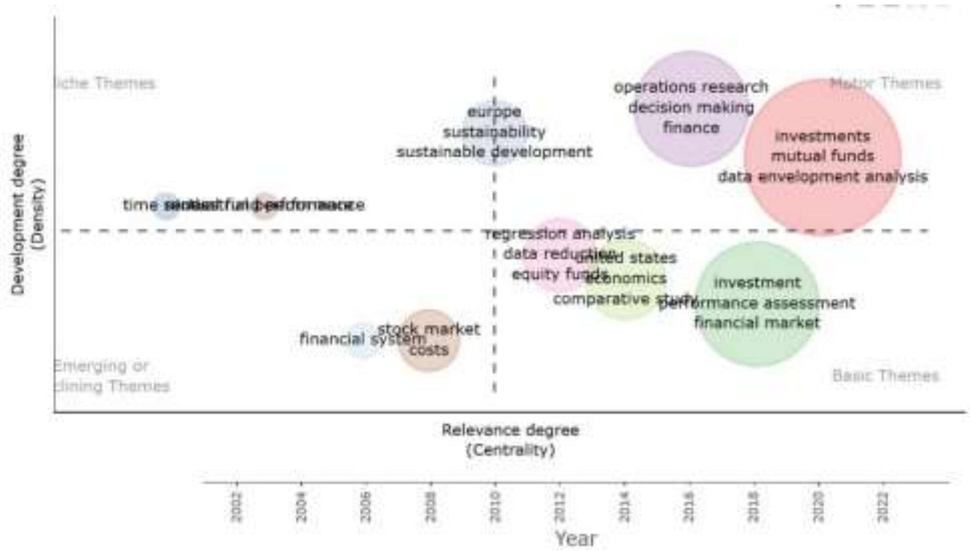


**Figure 14 : Themes**

### 4.1 Publication Timeline and Growth

The number of research papers produced have been steadily increasing especially post 2000 and 2010.

### 4.2 Geographic Focus

- **Developed Markets:** Approximately 70% of studies focus on US, UK, and Europe, benefitting from extensive data availability and mature markets.
- **Emerging Markets:** India, China, Brazil, and others constitute about 25%, with India-specific studies growing but still relatively limited.
- **Others:** Remaining studies address cross-country comparisons or global datasets.

This uneven distribution points to a research gap in emerging economies, where investor behavior and market dynamics differ substantially.

### 4.3 Methodological Breakdown

- **Quantitative studies dominate (85%)**, with models ranging from classic linear regressions to sophisticated machine learning algorithms.
- **Qualitative and mixed-method studies account for under 10%**, focusing on fund manager interviews or investor psychology.
- The rise of **hybrid models** integrating econometric and AI methods is notable in recent years.

### 4.4 Tools and Models Used

**Traditional Statistical Models:**

- Multiple Linear Regression (MLR) remains foundational due to interpretability and ease of use (Matallín-Sáez et al., 2019c), (Pouliot, 2016), (Boonprasope & Tippayawong, 2024).
- Data Envelopment Analysis (DEA) and stochastic frontier analysis are used to assess efficiency and performance boundaries (Castro et al., 2020), (Baeza-Sampere et al., 2016).

**Machine Learning and AI Models:**

- Artificial Neural Networks (ANN) mimic human brain processing, capturing nonlinear patterns. Early works by Khaidem et al. (2012) demonstrated ANN's superior accuracy over MLR in Indian mutual fund data.
- Support Vector Machines (SVM) have been effective in classification of funds based on performance clusters.
- Random Forest and Gradient Boosting Machines offer improved prediction with ensemble learning, reducing overfitting risks.
- Deep learning and reinforcement learning are emerging but not yet widely applied.

**Hybrid Approaches:**

Combining statistical rigor and AI's pattern recognition, hybrid models have increased predictive power and interpretability. For example, Sharma and Singh (2020) used regression to filter features followed by ANN for forecasting.

### 4.5 Variables Explored

**Independent Variables:**

- **Past returns and NAV history**: The most common predictor, though fraught with risk of overfitting and noise.
- **Fund size (AUM)**: Larger funds tend to have more stable flows but may face diseconomies of scale.
- **Expense ratio**: Higher expense ratios generally predict lower net returns.
- **Fund age and manager tenure**: Older funds and experienced managers often show persistence.
- **Turnover ratio and portfolio concentration**: Indicate active management style and risk profile.
- **Macroeconomic variables**: Inflation, interest rates, GDP growth—less commonly but increasingly used.
- **Behavioral variables**: Investor sentiment indices, fund flows, and social media data—nascent but promising.

**Dependent Variables:**

- **Future returns** at various horizons (1 year most common, up to 3 years).
- **Risk-adjusted returns** such as Sharpe ratio, Treynor ratio, and Information ratio.
- **Alpha and Beta** for performance relative to benchmarks.
- **Return persistence** metrics tracking sustained outperformance.
- **Downside risk and volatility** measures.

## 5. Conclusion

This comprehensive review synthesizes over 100 studies on mutual fund performance prediction, charting the evolution from simple regressions to AI-driven hybrid models. While considerable progress has been made, especially in quantitative methods, challenges persist around data heterogeneity, interpretability, and market-specific factors.

For practitioners at Goalstox and beyond, these insights can guide model development tailored to Indian mutual funds—leveraging local market characteristics, behavioral factors, and evolving regulatory norms.

Future research should push beyond traditional financial metrics to incorporate ESG, sentiment, and macroeconomic data while embracing transparency in model design to build investor trust and practical value.

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# EMOTIONAL INTELLIGENCE IN REMOTE WORKSPACES

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***Abstract***

*Emotional intelligence (EI) can be beneficial in many areas of life including the workplace in today's increasingly competitive world. Today's digital age, remote work has become increasingly prevalent, offering numerous benefits such as flexibility and work-life balance. Present study explores the meaning of emotional intelligence, rise of remote work, and the importance of emotional intelligence in remote workplace job performance, job satisfaction, psychological well-being, and success, strategies to nurture emotional intelligence in remote work, challenges of remote work, enhancing emotional intelligence skills such as desirable workplace characteristics like motivation, perseverance in the face of frustration, self-control, and performance under pressure and to overcome emotional intelligence challenges in remote workspaces with greater sense of control over their work, are better able to cooperate with others, manage work-related stress, and solve conflicts within workplace.*

***Key words:*** *Emotional intelligence, remote work, skills, challenges and motivation*

## Introduction:

Emotional intelligence (EI) can be beneficial in many areas of life including the workplace in today's increasingly competitive world. Today's digital age, remote work has become increasingly prevalent, offering numerous benefits such as flexibility and work-life balance. Everyone has good days and bad days (managers alike), but it's essential to know how impactful poor emotional reactions such as defensiveness, blaming, criticism, and unresponsiveness can be to teams. If a manager has a bad day and doesn't have the tools to regulate their stress, or if a team is experiencing high levels of emotion, both situations will affect how the dynamic system functions.

The emotionally intelligent leader will cultivate greater emotional availability and awareness, as they are aware of how critical emotional responses are to the organisation's health. People are not neatly compartmentalised into work-selves and personal-selves; they are holistic individuals that bring their whole selves into their working environments. Emotional feedback at work helps teams identify their most significant creativity sources and discover opportunities for deep learning. Without understanding their value, companies are skimming over the human element that keeps people healthy, motivated and engaged in the job they are performing. In fact, there is no productivity without emotional attachment to the goal.

To be considered emotionally intelligent, a manager must develop five emotional components: self-awareness, regulation, internal motivation, empathy and social skills (Goleman, 1994). Simply said, leaders must be able to acknowledge and regulate not only their emotions but also have a sense of influence over the emotions within their teams. As remote working is expected to be a long-term change to the way companies operate, it is imperative that people managers focus on developing emotional intelligence skills to support their distant teams.

## Objectives:

1. To know about Emotional intelligence and rise of remote work
2. To analyse the Challenges of Remote Work
3. To assess the importance of Emotional Intelligence in Remote Work
4. To study the Strategies to Nurture Emotional Intelligence in Remote Work

5. To examine how to Develop Emotional Intelligence Skills
6. To study how to Overcoming Emotional Intelligence Challenges in Remote Work

**Methodology:** This study conducted from secondary sources

1. Emotional intelligence (EI) is also known as emotional quotient (EQ). It refers to an individual's ability to understand, manage, and effectively express their own feelings, as well as engage and navigate successfully with the emotions of others. Emotional intelligence refers to the ability to recognize, understand, and manage our own emotions, as well as the emotions of others. It encompasses skills such as empathy, self-awareness, self-regulation, social awareness, and relationship management. Emotional intelligence plays a vital role in interpersonal relationships, team dynamics, and overall well-being.

Emotional intelligence involves being aware of emotions, understanding how to manage them for constructive purposes and being able to recognize others' emotions and empathize with them. Emotional intelligence comprise several key abilities i.e self-awareness (recognizing your own emotions), self-regulation (managing your emotions), motivation (being driven to achieve for reasons beyond money or status), empathy (understanding the emotions of others), and social skills (being able to build and maintain relationships).

High emotional intelligence can lead to improved relationships, personal and work success, effective stress management, and overall mental and emotional well-being.

With advancements in technology, remote work has gained popularity across industries. The ability to work from anywhere has allowed companies to tap into a global talent pool, increase productivity, and reduce overhead costs. However, remote work comes with its own set of challenges that can impact employee engagement, collaboration, and overall performance. The technical challenges and cultural shifts associated with the move toward remote work may seem troublesome now, but as long as companies have emotionally intelligent workforces, employees may find that they will be more connected in the remote work era than they ever thought possible. Despite all the advantages offered by remote work, companies have to recognize that some employees will flourish in remote settings while others will struggle. It will take managers and colleagues with high levels of emotional intelligence to identify the employees who need assistance and offer it in a way that won't make them feel threatened. Working from home, particularly during this crisis, will also bring a range of new challenges such as family obligations, and these must be handled with as much empathy and adaptability as possible.

Although remote work has been stressful and isolating for many employees, it also presents opportunities. It provides flexibility, allows employees to take control of their work environments and makes logistical obstacles like business travel more manageable. The era of remote work will mean employees are just a video call away from one another. While email won't be going anywhere soon, managers who have high emotional intelligence understand that the ability to see a co-worker's face even if it's on a screen can go a long way toward fending off feelings of alienation and bringing employees together around a common purpose. Emotionally intelligent managers know which circumstances call for video chats and which ones require more traditional digital communication.

2. Remote work has several challenges that can obstruct the development of emotional intelligence and connection among team members.

A. Lack of face-to-face Interaction: In a remote work setup, the absence of physical closeness makes it challenging to read non-verbal sign, which are crucial for understanding emotions and building harmony.

B. Communication Barriers: Effective communication becomes essential to prevent misunderstandings and maintain clarity. Remote teams heavily rely on digital communication tools, which can sometimes lead to misinterpretation, delays, or information overload.

C. Isolation and Loneliness: Working remotely can result in feelings of stress, isolation and loneliness, especially for individuals who bloom in social environments. This can affect morale, motivation, and overall job satisfaction.

3. Emotional intelligence plays a crucial role in mitigating the challenges associated with remote work and fostering connection and collaboration among remote teams.

A. Ability to Understanding: Remote workers need to empathize and understand the emotions and challenges faced by their colleagues. This helps create a supportive environment where individuals feel valued and heard.

B. Maintaining relationships and trust: Emotional intelligence enables remote workers to build strong relationships and trust with their teammates, even without physical proximity. Trust is vital for effective collaboration and teamwork.

C. Conflict Resolution: Remote work can sometimes lead to misunderstandings. Emotional intelligence equips individuals with the skills to resolve misunderstandings constructively, and promote a positive work environment.

4. To nurture emotional intelligence and connection in remote work, several strategies can be implemented:

A. Promote open and transparent communication: Encourage open and transparent communication among remote team members. This can be possible through regular team meetings, and creating channels for feedback and suggestions. (Hanna Larsson)

B. Encourage regular team meetings: Regular team meetings help create a sense and ensure that individuals are supported and Team meetings provide opportunities for collaboration, brainstorming, and sharing ideas. (Hanna Larsson)

C. Provide opportunities for social interaction: Create virtual spaces or likes dedicated to formal conversations and social interactions, which helps simulate the break chats and informal communication that occurs in an office environment. (Marcelo Casaca)

D. Promote self-care and work-life balance: Remote work will simulate the boundaries between work and personal life, encouraging remote workers to prioritize certification, set boundaries and maintain a healthy work-life balance, which helps fill health and prevent. (Marcelo Casaca)

E. Offer support and resources for mental well-being: Provide mental health support and flow resources such as wellness programs, mental health support and online training to help remote workers develop emotional intelligence skills and cope with the challenges of remote work. (Marcelo Casaca)

5. Developing emotional intelligence skills is crucial for remote workers to develop in a digital workspace. The following framework, adapted from the Embodied Emotional Intelligence Model (Walsh, 2020), establishes quick emotional intelligence tips for current leaders to master. Some essential skills include:

A. Identify: The first emotional intelligence skill to develop as a manager is the ability to recognise your own emotions. Self-awareness is essential for thriving at work, particularly understanding how we show up to different work situations and what emotional state might be influencing that engagement. This is extremely important to do before you develop the skills, as identifying the emotion and the source will help manager's problem solve and adapt actions/environments to promote positive change.

Remote workers should cultivate self-awareness by recognizing their emotions, strengths, and areas for growth. This self-reflection helps in managing emotions effectively and understanding their impact on others.

B. Cope self-regulation: Once a manager has identified their emotional state, the second skill to learn is how to manage the emotion in a way that creates positive change for their team. This doesn't mean that the manager has to ignore or deny their emotional reality – in fact, the opposite is true! Research shows us that managers who can be emotionally vulnerable with kind awareness are more liked and trusted by their team and cohorts (Brown, 2018). Emotional intelligence involves self-regulation, which means managing one's emotions and adapting to different situations. Remote workers should practice techniques like mindfulness and stress management to regulate their emotions effectively.

C. Recognise: The third skill of emotional intelligence for managers is being able to recognise emotions in others. If the manager has spent considerable time developing the first two skills (identifying and coping), this skill will be easier to master. Recognising emotion in others is not the same as making assumptions or "mind-reading", but rather about a curious interest to understand another person's perspective. Understanding and empathizing with the emotions and perspectives of others is vital in remote work. Remote workers should develop social awareness by actively listening, seeking different viewpoints, and practicing empathy. Leaders must be skilled at recognising emotions is because, in most scenarios, it can be difficult for employees to initiate conversations about genuine emotional reactions – they feel unprofessional and sometimes immature (depending on the context), so there is a natural reflex to guard our leaders against seeing that vulnerability (Brown, 2018).

Observations are simply one way of learning information, although subject to bias, and can be extremely helpful when conversations don't seem appropriate.

These observations might be more difficult in remote working where we are disembodied over a video call, and it can be hard to use our body to intuitively sense when someone is experiencing difficulty. However, there are still some visual cues that leaders can look out for that might indicate a team member is experiencing emotional difficulty (Zane, 2020): shape (body language), rhythm (irregularities in the pace of voice), intonation (tone of voice) and dissonance (discrepancy between what is said and what is observed). If the individual doesn't appear aligned to their "usual" presentations, chances are you are observing some type of emotional reaction in your colleague.

D. Influence or Managing relationship: The fourth skill to learn for emotionally intelligent managers is identifying ways to influence or cause a positive change in their team's emotional state. Managers should care about how their teams are feeling, as those feelings impact the entire system. Building and maintaining relationships remotely requires intentional effort. Remote workers should focus on building trust, resolving conflicts, and fostering positive relationships through effective communication and collaboration.It is important to note that although it is not the manager's responsibility to make things better for the individual (which is out of anyone's control), it is essential for managers to inspire hope and commitment towards team values.

While the skills of identifying, Cope self-regulation, recognising and Influence or Managing relationship can be of tremendous help to leaders looking to develop emotional intelligence, it shouldn't just be up to the individual leader to learn these skills on their own.

6. To overcome the challenges associated with emotional intelligence in remote work, the following strategies can be implemented and

There are several ways companies can promote emotional intelligence in the workplace. Here are a few:

A. Training and Development Programs:Organizations can conduct workshops and training programs focusing on emotional intelligence. These can cover topics such as self-awareness, self-regulation, motivation, empathy, and social skills. The above activities can include role-playing scenarios, group discussions, and reflective exercises. These can also be supplemented with e-learning courses, webinars, or online resources that employees can access at their convenience.

B. Coaching and Mentoring: Assigning coaches or mentors can help employees develop emotional intelligence. These coaches can provide personalized guidance and feedback, helping employees to understand and manage their emotions better.

C. Encouraging Open Communication: Employees should feel comfortable expressing their emotions and thoughts without fear of negative results. Regular team meetings, one-on-ones, and feedback sessions can be useful in this regard.

D. Modeling Emotional Intelligence: Leaders play a crucial role in promoting emotional intelligence through demonstrating emotionally intelligent behavior. This includes showing empathy, managing emotions effectively, maintaining motivation, and building strong relationships.

E. Creating a Supportive Environment: Create a supportive work environment is key to promoting emotional intelligence. This includes promoting work-life balance, providing resources for mental health, and addressing any issues in a respectful and understanding manner.

F. Performance Reviews and Feedback: Employers can be reviewed and provide feedback on employees' emotional intelligence, such as ability to manage stress, work positively with others, and demonstrate empathy. This encourages employees to focus on improving these skills.

G. Recognize and Reward Emotional Intelligence:Companies should recognize and reward employees who perform high emotional intelligence. Those could be through recognition, awards, or other forms of appreciation.

**Conclusion:**

According to a 2019 survey, 82% of employees would "consider leaving their job for a more empathetic organization," while 78% would "work longer hours for a more empathic employer." Along with higher morale comes improved job performance and innovation.

Yale study of almost 15,000 employees across many different industries found that "supervisor emotionally intelligent behavior was linked to employee creativity/innovation through its effect on employee opportunity to grow and higher experience of positive affect."

One of the biggest problems companies face is a lack of employee engagement. According to Gallup, less than one-third of American workers say they're engaged on the job. Among the critical elements of engagement that Gallup cites, many have to do with employees' emotional health, such as the perception that their opinions matter and that their colleagues care about them as individuals. This is why EI is indispensable in the workplace — it addresses fundamental interpersonal and emotional needs that all employees have.

According to a recent Slack survey, almost half of newly remote workers report that their "sense of belonging suffers at home." Meanwhile, another recent survey found that half American employees feel less connected to their colleagues than they did before Covid-19 (while just 20% say they feel more connected). Although 27% of employees say they feel more productive working from home, 45% say their productivity has decreased.

Although remote work has been stressful and isolating for many employees, it also presents opportunities. It provides flexibility, allows employees to take control of their work environments and makes logistical obstacles like business travel more manageable.It's no surprise that, according to a recent PwC survey, 72% of office workers say they would like to work remotely at least two days per week after the pandemic subsides.

In the digital age, remote work is on the rise, and emotional intelligence plays a critical role in nurturing connection and collaboration among remote teams. By fostering empathy, understanding, and effective communication, remote workers can overcome the challenges associated with remote work and build strong relationships that contribute to success and well-being.

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# EXPLORING EMOTIONAL INTELLIGENCE IN REMOTE WORKSPACE ADAPTABILITY AMONG IT EMPLOYEES IN VELLORE DISTRICT

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***Abstract***

*This study explores the impact of Emotional Intelligence (EI) on remote workspace adaptability among IT professionals in Vellore District, Tamil Nadu. EI, which involves understanding, managing, and influencing emotions, is crucial for successful remote work adaptation. The IT sector is increasingly adopting remote and hybrid work models due to technological advancements and external factors like the COVID-19 pandemic. A descriptive-correlational research design was used, with 100 IT professionals selected. Data was collected through a structured questionnaire assessing five key EI components and dimensions of remote adaptability, including time management, work-life balance, communication, and stress handling. High mean scores were found in both EI and adaptability. The strongest adaptability areas were work technology use and time management, while stress handling and work-life balance were challenges. A moderate to strong positive correlation was found between EI and adaptability. Educational qualifications significantly influenced EI, while work experience and mode (remote, hybrid, on-site) impacted adaptability levels. The study suggests organizations invest in EI training, stress management programs, and digital infrastructure to foster a resilient remote workforce.*

***Keywords:*** *Emotional Intelligence, Remote Workspace Adaptability, IT Employees.*

## INTRODUCTION

Emotional intelligence (EI) is a crucial skill for social functioning and personal well-being, with its impact on workplace success being well-documented. However, the relationship between EI and remote workspace adaptability remains underexplored, especially in the IT sector. Employees with high EI are better equipped to handle challenges associated with remote work, such as isolation, stress, and virtual collaboration difficulties. They can also adapt more effectively to changes in their work environment, which is essential for thriving in dynamic, remote, and uncertain work conditions. The shift towards remote work has been accelerated by technological advancements and external factors like the COVID-19 pandemic. In the Information Technology (IT) sector, remote work has become a necessity and efficient model for managing daily operations. Emotional intelligence plays a critical role in determining an individual's ability to successfully navigate this shift. This study investigates the impact of emotional intelligence (EI) on IT employees' adaptability to remote work environments in Vellore District, Tamil Nadu. It seeks to understand the psychological factors influencing employees' success in remote work, providing valuable insights for organizations seeking to improve their remote work strategies. The research aims to determine if high EI enables employees to navigate challenges more effectively, improving overall work performance and job satisfaction.

## DEFINITION OF EMOTIONAL INTELLIGENCE

Emotional Intelligence (EI) is the capacity to understand, manage, and influence one's own and others' emotions. It is crucial in interpersonal relationships, decision-making, stress management, and mental well-being. According to "**Daniel Goleman"** defines EI as five key components: self-awareness, self-regulation, motivation, empathy, and social skills. EI involves recognizing one's emotions, managing disruptive emotions, adapting to change, being motivated, understanding others' emotions, and managing relationships to move people in desired directions.

## KEY FACTORS INFLUENCING EMOTIONAL INTELLIGENCE IN REMOTE WORKPLACE ADAPTABILITY

**Individual Factors:**

- **Self-awareness**: Understanding personal emotions helps maintain productivity.
- **Self-regulation**: Managing emotions is crucial for focus and positive work.
- **Empathy**: Understanding colleagues' feelings through digital cues is essential for effective collaboration.
- **Motivation**: Intrinsic motivation overcomes lack of external stimuli in remote settings.
- **Digital communication skills**: Accurate expression and interpretation of emotions via virtual platforms.

**Organizational Factors:**

- **Leadership style**: Supportive and emotionally intelligent leaders foster a healthy virtual work environment.
- **Communication culture**: Open, transparent, and consistent communication builds emotional connections.
- **Remote work policies**: Flexible and empathetic HR practices reduce stress.
- **Training and development**: Programs focused on emotional intelligence enhance adaptability.

**Environmental & Social Factors:**

- **Work-life balance**: Blurred boundaries affect emotional well-being.
- **Social isolation**: Limited face-to-face interaction challenges empathy.
- **Technology access and proficiency**: Comfort with digital tools reduces anxiety.
- **Cultural diversity**: Remote teams often span cultures, requiring higher emotional sensitivity and awareness.

## IMPORTANCE OF EMOTIONAL INTELLIGENCE IN REMOTE WORKSPACE ADAPTABILITY IT SECTOR

- **Enhances Team Collaboration**: Fosters empathy, active listening, and respectful communication for smoother conflict resolution.
- **Improves Problem-Solving**: Supports better emotional regulation under stress for clearer thinking and effective decision-making.
- **Boosts Leadership**: Inspires, motivates, and supports teams by recognizing and addressing team members' emotions constructively.
- **Improves Client Interaction**: Helps understand client concerns, manage expectations, and build trust.
- **Increases Adaptability**: Adapts to rapid industry changes and encourages continuous learning.
- **Reduces Burnout and Stress**: Helps manage stress and maintain mental well-being.
- **Promotes Workplace Culture and Retention**: Promotes job satisfaction and reduces turnover.

## REMOTE WORKSPACE ADAPTABILITY AS A PATHWAY TO EMOTIONAL INTELLIGENCE

- **Enhances Self-Awareness**: Regular self-reflection on productivity, stress levels, and emotional responses fosters greater emotional self-awareness.
- **Improves Self-Regulation**: Adaptability helps develop discipline and emotional control, enhancing impulse regulation and emotional balance.

- **Fosters Empathy and Social Awareness**: Understanding limited emotional cues through text, video, or voice enhances empathy.
- **Strengthens Motivation**: Remote adaptability promotes intrinsic motivation, contributing to EI.
- **Improves Relationship Management**: Successful adaptation promotes patience, clear communication, conflict resolution, and emotional connectivity.
- **Encourages Digital Emotional Communication**: Employees learn to express and interpret emotions effectively in digital forms.

## REVIEW OF LITERATURE

**Bar-On (2020)** this study explores the connection between emotional intelligence and workplace performance across diverse organizational settings. The research concludes that EI contributes to improved employee engagement, job satisfaction, and adaptability, particularly in high-pressure environments. The findings highlight that EI is a key factor in employees' ability to cope with organizational changes, making it relevant for understanding how EI may facilitate adaptability in remote work environments.

**Goleman (2021)** work emphasizes the significance of emotional intelligence in fostering interpersonal relationships and managing stress in the workplace. In the context of remote work, Goleman discusses how EI competencies such as self-regulation, empathy, and social skills can enhance remote collaboration and reduce feelings of isolation. This is particularly important for employees working in the IT sector, where teamwork and communication are essential for success despite physical distance.

**Mayer and Salovey (2020),** work provides a comprehensive overview of the emotional intelligence model, focusing on its relevance to workplace behavior and performance. They discuss the importance of EI in helping individuals manage emotions during stressful situations, which is critical for employees navigating the challenges of remote work. This model is applied in the study of remote workspace adaptability, particularly in understanding how emotional regulation can enhance employee resilience in virtual environments.

**Kluemper and Rosen (2020)**, investigate the relationship between emotional intelligence and remote work effectiveness across several industries, including IT. Their study reveals that higher EI is positively correlated with greater adaptability to remote work, better management of work-related stress, and more effective communication in virtual teams. The findings suggest that EI serves as a predictor of remote work success, particularly in fields requiring high technical expertise, such as IT.

**Saarni (2021)** examines how emotional intelligence aids individuals in adapting to remote work conditions, particularly in terms of managing emotional challenges, such as loneliness and burnout. The study emphasizes that employees with high EI demonstrate superior coping mechanisms, which are essential for sustaining productivity and mental well-being in a remote work setting. Saarni's research suggests that EI plays a critical role in enhancing remote work adaptability by promoting emotional resilience and self-regulation.

## RESEARCH METHODOLOGY

### Research Design

This study adopts a descriptive-correlation research design. Descriptive research helps in understanding the levels of emotional intelligence and remote workspace adaptability among IT employees, while correlation analysis will determine the relationships between EI and adaptability.

**Population and Sampling**

The target population for this study consists of IT professionals working remotely in Vellore District, Tamil Nadu. A stratified random sampling technique will be used to select 100 participants from various IT firms in the district. This ensures a representative sample in terms of gender, age, and work experience.

**Data Collection**

Data will be collected through a structured questionnaire that includes two main sections:

- **Emotional Intelligence (EI):** The Emotional Intelligence Scale (EIS) will be used to measure the five key components of EI: self-awareness, self-regulation, motivation, empathy, and social skills.
- **Remote Workspace Adaptability**: A customized scale based on previous will measure the employees' adaptability to remote work, assessing factors such as communication efficiency, work-life balance, and stress management.

**Data Analysis**

- **Descriptive Statistics**: To summarize the demographic characteristics of the sample and the mean scores for EI and adaptability.
- **Correlation Analysis**: To assess the relationship between emotional intelligence and remote workspace adaptability.
- **T-tests & ANOVA**: To compare the adaptability levels based on demographic variables.

**LIMITATIONS OF THE STUDY**

- The study was done only in Vellore District, so the results may not apply to other places.
- Only 100 IT employees were included, which is a small group.
- The answers were based on what people said about themselves, which might not always be fully accurate.
- The study was done at one point in time, so it doesn't show changes over time.

**RESEARCH GAP**

The reviewed studies highlight the importance of emotional intelligence in various workplace contexts, there is limited research specifically focused on the IT sector, especially in remote work environments. Most existing literature centers on general organizational behavior, with few studies delving into the specific challenges faced by IT professionals working remotely. Furthermore, although EI has been linked to improved workplace adaptability, the particular influence of emotional intelligence on remote workspace adaptability in the IT sector has not been thoroughly explored. This research seeks to fill this gap by examining the impact of EI on the ability of IT employees in Vellore District to adapt to remote work conditions, thus contributing to a deeper understanding of the psychological factors influencing remote work success in this sector.

**RESEARCH OBJECTIVES**

The primary objectives of this study are:

- To assess the level of emotional intelligence among IT employees working remotely in Vellore District.
- To evaluate the adaptability of IT employees to remote work environments.
- To examine the relationship between emotional intelligence and remote workspace adaptability among IT employees.

- To determine which components of emotional intelligence, have the most significant impact on remote workspace adaptability.

**PRE- AND POST HYPOTHESIS BASED ON THE RESEARCH OBJECTIVES**

| **Pre-Hypothesis ($H_0$)** | **Post-Hypothesis ($H_1$)** |
|---|---|
| **$H_0$:** IT employees in Vellore District do **not possess high levels** of emotional intelligence. | **$H_1$:** IT employees in Vellore District **possess high levels** of emotional intelligence. |
| **$H_0$:** IT employees do **not demonstrate significant** adaptability to remote work environments. | **$H_1$:** IT employees **demonstrate significant** adaptability to remote work environments. |
| **$H_0$:** There is **no significant relationship** between emotional intelligence and remote workspace adaptability. | **$H_1$:** There is a **significant relationship** between emotional intelligence and remote workspace adaptability. |

**DATA ANALYSIS**

**TABLE 4.1 DEMOGRAPHIC PROFILE**

| | **Frequency (n)** | **Percentage (%)** |
|---|---|---|
| **Age Group** | | |
| 21–25 | 28 | 28.0% |
| 26–30 | 40 | 40.0% |
| 31–35 | 22 | 22.0% |
| 36 and above | 10 | 10.0% |
| **Total** | **100** | **100.0%** |
| **Gender** | | |
| Male | 54 | 54.0% |
| Female | 46 | 46.0% |
| **Total** | **100** | **100.0%** |
| **Qualification** | | |
| Undergraduate (UG) | 38 | 38.0% |
| Postgraduate (PG) | 56 | 56.0% |
| Others (Diploma/Cert.) | 6 | 6.0% |
| **Total** | **100** | **100.0%** |
| **Experience Level** | | |
| Less than 2 years | 18 | 18.0% |
| 2–5 years | 36 | 36.0% |
| 6–10 years | 30 | 30.0% |
| More than 10 years | 16 | 16.0% |
| **Total** | **100** | **100.0%** |
| **Work Mode** | | |
| Fully Remote | 42 | 42.0% |
| Hybrid | 38 | 38.0% |
| On-site | 20 | 20.0% |
| **Total** | **100** | **100.0%** |
| **Marital Status** | | |
| Single | 46 | 46.0% |
| Married | 52 | 52.0% |
| Other | 2 | 2.0% |
| **Total** | **100** | **100.0%** |

**(Source: Primary Data)**

The majority of respondents are aged between 26-30, with 28% aged 21-25 and 22% aged 31-35. The majority of the sample is young professionals, with 54% male and 46% female. Most hold a postgraduate degree, with 38% being undergraduates. Most have at least 2-5 years of experience, with 18% in the mid-career stage. The majority work remotely, with 38% following a hybrid model. Only 20% work entirely on-site, indicating a preference for flexible work arrangements. The majority are married (52%), with 46% being single. The sample has a balanced gender distribution, with 54% male and 46% female. The majority of respondents are well-educated, with a small fraction possessing other qualifications. The majority of respondents are married, with a nearly even distribution between single and married participants.

**TABLE 4.2: DESCRIPTIVE STATISTICS FOR EMOTIONAL INTELLIGENCE & REMOTE WORKSPACE ADAPTABILITY**

| EI Component | Mean | SD | | Adaptability Dimension | Mean | SD |
|---|---|---|---|---|---|---|
| Self-Awareness | 4.12 | 0.51 | | Work Technology Use | 4.35 | 0.48 |
| Self-Regulation | 4.06 | 0.58 | | Time Management | 4.10 | 0.57 |
| Motivation | 4.20 | 0.49 | | Work-Life Balance | 3.85 | 0.66 |
| Empathy | 4.01 | 0.55 | | Productivity & Motivation | 4.05 | 0.54 |
| Social Skills | 4.08 | 0.52 | | Communication & Teamwork | 4.00 | 0.50 |
| **Overall EI Score** | 4.09 | 0.53 | | Stress Handling | 3.88 | 0.61 |
| | | | | **Overall Adaptability Score** | 4.02 | 0.52 |

**(Source: Primary Data)**

The overall EI score is 4.09, indicating a high average level of emotional intelligence. Remote Workspace Adaptability dimensions showed proficiency in digital tools and virtual platforms. Time management, productivity, motivation, and communication and teamwork were also strong. However, stress handling and work-life balance were the lowest, suggesting that managing stress and balancing personal and professional life remains a challenge. The overall Adaptability Score is 4.02, indicating a high level of adaptability among participants.

**CORRELATION ANALYSIS**

**TABLE 4.3: EMOTIONAL INTELLIGENCE AND REMOTE WORKSPACE ADAPTABILITY**

| Variables | Mean | SD | 1 | 2 |
|---|---|---|---|---|
| Emotional Intelligence | 4.09 | 0.53 | 1.000 | **0.684**** |
| Remote Workspace Adaptability | 4.02 | 0.52 | **0.684**** | 1.000 |

**(Source: Primary Data)**

The Pearson correlation coefficient ($r = 0.684$) shows a moderate to strong positive relationship between emotional intelligence and remote workspace adaptability, confirming it's statistically significant at ($p < 0.01$), confirming that role in employee adaptation.

**T-Test ANALYSIS**

**TABLE 4.4: GENDER DIFFERENCES IN EMOTIONAL INTELLIGENCE AND REMOTE WORKSPACE ADAPTABILITY**

| Variable | t | df | Sig. (2-tailed) | Mean Difference | Interpretation |
|---|---|---|---|---|---|
| Emotional Intelligence | 1.34 | 98 | 0.183 | 0.13 | **Not significant** |
| Remote Adaptability | 1.13 | 98 | 0.261 | 0.12 | **Not significant** |

**(Source: Primary Data)**

The table shows that the p-values of Emotional Intelligence (0.183) and Remote Adaptability (0.261) both are greater than 0.05, it indicates that there is **no statistically significant** difference between the Gender and Emotional Intelligence and Remote Workspace Adaptability.

**TABLE 4.5**
**ANOVA**
**DEMOGRAPHIC PROFILE AND EMOTIONAL INTELLIGENCE AND REMOTE WORKSPACE ADAPTABILITY**

| | **Source** | **df** | **F** | **Sig.** |
|---|---|---|---|---|
| **Age and Emotional Intelligence** | Between | 2 | 2.34 | 0.102 |
| | Within | 97 | | |
| | Total | 99 | | |
| **Qualification and Emotional Intelligence** | Between | 2 | 4.31 | **0.016*** |
| | Within | 97 | | |
| | Total | 99 | | |
| **Experience and Remote Adaptability** | Between | 2 | 5.12 | **0.008*** |
| | Within | 97 | | |
| | Total | 99 | | |
| **Work Mode and Remote Adaptability** | Between | 2 | 5.39 | **0.006*** |
| | Within | 97 | | |
| | Total | 99 | | |

**(Source: Primary Data)**

The ANOVA analysis reveals **no significant** differences in Emotional Intelligence (EI) and Remote Workspace Adaptability across demographic categories such as age, qualification, experience, and work mode. Emotional intelligence levels appear to be relatively consistent regardless of age. However, there is **a significant** difference in emotional intelligence based on **educational qualifications**, with higher or differing academic qualifications potentially influencing EI. Experience plays a key role in adaptability to remote work, with more experienced employees adapting better or differently than less experienced ones. The type of work arrangement also influences how well individuals adapt to remote work, with those in fully remote or hybrid roles developing stronger adaptability skills than on-site workers.

**FINDINGS**

**Demographic Profile:**

- Majority are young professionals aged 26-30 (40%).
- Balanced gender distribution (54% male, 46% female).
- Majority hold a postgraduate degree (56%).
- Work in fully remote (42%) or hybrid (38%).
- Nearly balanced between single and married individuals (52%).

**Emotional Intelligence (EI):**

- Mean EI score is 4.09, indicating high emotional intelligence.
- Most prominent EI components include motivation, self-awareness, social skills, empathy, and self-regulation.

**Remote Workspace Adaptability:**

- Overall adaptability score is 4.02, with work technology use being the highest-rated dimension.

- Work-Life Balance and stress handling are common challenges in remote environments.

**Correlation Analysis - T-test - ANOVA**

- Moderate to strong positive correlation exists between EI and remote workspace adaptability.
- No significant differences in EI and Adaptability scores between genders.
- Educational qualifications significantly affect EI.
- Experience and work mode significantly impact remote adaptability.

## SUGGESTIONS

- **Strengthen Stress Management and Work-Life Balance Programs**: Introduce wellness initiatives, flexible scheduling, and support systems.
- **Provide Emotional Intelligence Training**: Offer programs for lower educational qualifications to bridge emotional awareness gaps.
- **Support Career Progression and Learning**: Encourage continuous learning and career growth opportunities.
- **Enhance Hybrid and Remote Infrastructure**: Invest in digital collaboration tools and remote-friendly policies.
- **Monitor and Support Less Experienced Employees**: Offer mentoring and onboarding support to junior staff.

## CONCLUSION

This study concluded that the Emotional Intelligence (EI) plays a crucial role in enhancing remote workspace adaptability among IT employees in Vellore District. The research found that employees with higher EI tend to adapt more effectively to remote work environments, with key components such as motivation, self-awareness, and social skills playing a significant role. Educational qualifications significantly affect EI, while experience and work mode influence remote adaptability. However, gender and age showed no significant differences in EI or adaptability, suggesting that these traits are relatively stable across demographics. Despite high adaptability, work-life balance and stress handling remain challenges, highlighting the need for targeted organizational interventions. The researcher highlights that EI is not only a psychological asset but also a strategic tool for coping with the evolving demands of remote work. Organizations can benefit from integrating EI-focused training, wellness programs, and flexible work arrangements to enhance employee performance and satisfaction. In conclusion, fostering EI within IT professionals can improve their resilience and adaptability in remote work settings.

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# CONSUMER PERCEPTION OF PRIVACY IN PERSONALIZED MARKETING: A CROSS-GENERATIONAL STUDY

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***Abstract***

*In today's data-driven economy, personalized marketing has become an essential strategy for businesses aiming to deliver relevant and timely content to consumers. However, the use of personal data in these efforts raises critical questions about privacy, consent, and data security. This research paper examines consumer perceptions of privacy in the context of personalized marketing, with a specific focus on generational differences. Drawing insights from Baby Boomers, Generation X, Millennials, and Generation Z, the study reveals unique patterns in attitudes, behaviors, and expectations regarding personal data usage. The findings offer practical recommendations for marketers seeking to balance personalization with privacy ethics.*

## 1. Introduction

The modern consumer experience is dominated by personalization—customized product suggestions, targeted ads, and user-specific offers. While this approach enhances engagement and drives revenue, it heavily relies on collecting, analyzing, and utilizing consumer data. The collection of personal information raises pressing concerns: How much do consumers understand about the data they're giving away? Do they trust companies with their information? And does this trust vary by age?

This paper explores these questions through a cross-generational lens, comparing how Baby Boomers, Gen X, Millennials, and Gen Z perceive the trade-off between convenience and privacy. By analyzing their comfort levels, expectations, and privacy concerns, the paper sheds light on how marketers can responsibly design personalized strategies for each demographic group.

## 2. Literature Review

### 2.1. Personalized Marketing Defined

Personalized marketing refers to tailoring marketing efforts based on individual consumer data. These strategies are powered by big data, cookies, artificial intelligence, and machine learning algorithms that analyze user behavior, location, interests, and purchasing history. Personalized marketing boosts conversion rates, loyalty, and customer satisfaction.

### 2.2. Privacy Concerns in the Digital Era

Although consumers enjoy personalized experiences, there is a growing sense of unease about how their data is collected and stored. Privacy breaches, identity theft, and unauthorized sharing of information have become common. Regulations such as the General Data Protection Regulation (GDPR) and the California Consumer Privacy Act (CCPA) reflect efforts to safeguard consumer rights, yet many users still feel unaware or out of control.

### 2.3. Generational Views on Privacy and Technology

Research indicates that generational cohorts respond differently to digital technologies and privacy issues. Digital natives (Gen Z and Millennials) are generally more accepting of data sharing if it leads to convenience, while digital immigrants (Gen X and Boomers) express stronger reservations about data privacy.

## 3. Objectives of the Study

- To examine overall consumer awareness and perception of privacy in personalized marketing.

• To assess the willingness of different generations to share personal data. • To understand the types of data consumers are most sensitive about.

• To provide marketing recommendations tailored to generational privacy concerns.

**4. Research Methodology**

**4.1. Research Design**

A descriptive, cross-sectional study was conducted using a survey questionnaire that measured awareness, perception, and attitude toward personalized marketing and data privacy.

**4.2. Sample Size and Demographics**

200 individuals participated in the survey, with an even distribution across the four generations: • Baby Boomers (50+)

• Generation X (40–49)

• Millennials (25–39)

• Generation Z (18–24)

Participants came from urban and semi-urban areas in India and had access to digital devices.

**4.3. Data Collection Tools**

A structured online questionnaire was shared via Google Forms. It included: • Likert-scale questions (1 to 5) to gauge comfort and concern

• Multiple-choice questions for awareness

• Open-ended questions for qualitative insights

**4.4. Data Analysis**

Responses were analyzed using SPSS for quantitative data and thematic analysis for qualitative comments. Comparisons were made across generational lines.

**5. Findings and Analysis**

**5.1. Awareness of Data Collection**

• Gen Z and Millennials: 82% were aware that websites and apps collect data. • Gen X: 63% showed moderate understanding.

• Boomers: Only 47% were fully aware of how their data was collected.

**5.2. Comfort with Personalization**

• Gen Z: 76% expressed comfort with personalized ads and content. • Millennials: 69% were supportive but expected data control options. • Gen X: 54% were cautious, preferring opt-in choices.

• Boomers: 62% found personalization “creepy” and intrusive.

**5.3. Privacy Concerns**

• Most sensitive data across all groups: Financial data, browsing history, and health records.

• Boomers and Gen X: Rated privacy concern at 4.5/5 on average. • Millennials: Averaged 3.7/5, concerned but willing to share with trusted brands. • Gen Z: Scored 3.2/5, less worried, more adaptive.

**5.4. Willingness to Share Data**

• Gen Z: Willing to share preferences, search history, and social media habits. • Millennials: Prefer to share selectively with companies offering real benefits.

• Gen X and Boomers: Prefer to share only basic information like name and email.

**5.5. Trust in Companies**

Only 22% of respondents trusted companies to protect their data. Trust levels were highest among Millennials and lowest among Boomers.

**6. Discussion**

The study reinforces that consumer privacy perception is shaped by digital familiarity, education, and life experience. Gen Z sees data as currency; they trade it for digital convenience. Millennials are savvy and protective—expecting both personalization and data control. Gen X and Boomers are skeptical, often opting for data minimalism.

Marketers must consider these attitudes when developing personalized campaigns. Ignoring privacy concerns can lead to brand distrust and negative publicity. Instead, ethical personalization—where consumers are aware, in control, and feel respected—can foster long term loyalty.

**7. Recommendations**

1. Segment Communication by Generation:

Use differentiated strategies for each generation. Gen Z prefers instant digital interfaces, Boomers value email and human interaction.

2. Be Transparent:

Offer privacy notices that are simple, short, and readable. Avoid legal jargon. 3.

Allow Data Control:

Empower users with tools to select what data they want to share.

4. Use Privacy as a Brand Advantage:

Brands that advertise strong privacy policies can win the trust of older generations. 5.

Educate Consumers:

Offer tutorials and guides on how data is used and how privacy is protected. **8.**

**Conclusion**

This study highlights a vital insight: privacy is not a one-size-fits-all concept. As personalization deepens, so must the responsibility to protect consumer data. Generational differences in privacy perception should inform marketing strategies, ensuring respect, trust, and transparency.

Personalization should enhance, not exploit. Only through ethical practices and consumer empowerment can companies truly build meaningful and lasting relationships in the digital marketplace.

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# HARNESSING AI AND MACHINE LEARNING FOR PREDICTIVE MANAGEMENT IN THE FMCG SECTOR: A CASE STUDY APPROACH

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***Abstract***

*Artificial Intelligence (AI) and Machine Learning (ML) are transforming the Fast-Moving Consumer Goods (FMCG) sector by facilitating predictive management throughout operations. These technologies enable companies to examine large datasets to forecast market trends, consumer preferences, and demand changes more accurately. Major FMCG companies like Hindustan Unilever and Nestle harness AI/ML to enhance supply chain efficiency, minimise stock shortages, and improve distribution processes. ITC and Coca-Cola employ predictive analytics to customise marketing approaches, personalise customer interactions, and increase sales outcomes. AI-driven solutions also aid in dynamic pricing, effective route planning, and immediate decision-making. Organisations reduce waste and increase profitability by optimizing demand forecasting and inventory levels. Case studies indicate a marked decrease in operational expenses and enhanced adaptability to market changes. The integration of AI/ML promotes innovation and flexibility, which are essential characteristics for thriving in the competitive FMCG environment. As digital transformation speeds up, predictive management utilising AI/ML is becoming a fundamental aspect of strategies for forward-thinking FMCG companies.*

## 1. Introduction

The FMCG industry flourishes by quickness, flexibility, and responsiveness to shifting consumer tastes. Predictive management, which is driven by AI and ML, is essential to improve these capabilities. It uses both historical and current data to foresee demand patterns and new market trends. By using these technologies, businesses may predict changes in customer behavior, guaranteeing ideal inventory levels and lowering the possibility of stockouts or overstocking. Supply chain operations are also made more efficient by AI/ML tools, which improve demand-supply alignment, improve logistics, and locate bottlenecks. Businesses may make faster, data-driven decisions by automating difficult data processing, which provides them with accurate and timely insights. In addition to increasing operational effectiveness, this lowers expenses and raises customer happiness. In a sector that moves quickly, like FMCG, predictive management keeps businesses flexible, competitive, and prepared for the future.

## 2. Statement of the Problem:

In the highly competitive Fast-Moving Consumer Goods (FMCG) industry, organisations encounter ongoing difficulties related to demand forecasting, inventory control, customer satisfaction, and market agility. Conventional approaches to managing these aspects tend to be reactive, resulting in stock shortages, surplus inventory, missed sales opportunities, and subpar customer experiences. Although extensive data is available from sales, customer interactions, and supply chains, numerous FMCG companies find it challenging to utilize this data effectively for predictive management. This research intends to investigate the application of Artificial Intelligence (AI) and Machine Learning (ML) in predictive management within the FMCG sector, highlighting essential techniques, advantages, and obstacles while offering insights through a case study methodology.

**3. Objective of the Study:**

- ➢ To investigate how AI and ML help the FMCG industry implement predictive management
- ➢ To identify the use of AI/ML by major FMCG firms such as Nestlé, ITC, Coca-Cola, and Hindustan Unilever
- ➢ To evaluate how predictive analytics powered by AI/ML affects profitability, cost savings, and operational effectiveness
- ➢ To emphasise the strategic value of integrating AI and ML into FMCG business models that are prepared for the future

**4. Scope of the Study:**

This research investigates the utilisation of Artificial Intelligence (AI) and Machine Learning (ML) for predictive management in the Fast-Moving Consumer Goods (FMCG) industry. It analyses the application of AI/ML methodologies for demand forecasting, inventory optimisation, customer personalization, and sustainable practices. Through a case study approach, the study presents practical examples of effective implementation in FMCG enterprises. It addresses multiple facets, including the advantages, challenges, and future potential of predictive management in FMCG, rendering it beneficial for industry experts, researchers, and scholars.

**5. Limitations of the Study:**

- ➢ The current research relies on secondary data sources, concentrating on assessing the use of AI and ML in predictive management.
- ➢ For the analysis, only a small number of case studies from chosen FMCG companies have been taken into account.
- ➢ A comprehensive, industry-wide examination of the FMCG sector could not be performed due to time limitations.
- ➢ The conclusions and insights are based on the most recent publicly accessible information found on the official websites of the selected companies.

**6. Review of Literature:**

**6.1. Choudhury and Sharma (2022)** in their research paper titled **" The Role of Machine Learning in Enhancing Customer Experience in FMCG"** examine the influence of Machine Learning (ML) on improving customer experiences in the FMCG sector. They point out that ML algorithms can process extensive customer data to uncover trends and preferences, allowing businesses to provide tailored experiences and boost customer satisfaction. The research highlights the critical need for integrating ML into customer service strategies to maintain competitiveness in the rapidly evolving FMCG market.

**6.2. Gupta and Mishra's "Artificial Intelligence for Predictive Analytics in the Retail Sector"** explores the utilization of Artificial Intelligence (AI) in predictive analytics within the retail industry. They highlight how AI technologies can anticipate consumer behavior, streamline inventory management, and improve decision-making processes. Their research emphasizes the significant transformative effects of AI on retail operations, resulting in enhanced efficiency and greater customer satisfaction.

**6.3. Kumar, S., & Singh, R. (2023) "AI-Driven Demand Forecasting in FMCG: A Case Study Approach"** explores a case study methodology for AI-enhanced demand forecasting within the FMCG sector. Their analysis demonstrates that AI models can accurately predict product demand, enabling firms to optimize inventory management and minimize waste. The findings underscore the tangible advantages of integrating AI into supply chain operations, showcasing enhancements in efficiency and cost reduction.

**6.4. Patel, A., & Mehta, N. (2020) "Impact of AI on Consumer Behavior in the FMCG Industry"** states the effects of AI on consumer behavior in the FMCG market. Their findings indicate that AI tools, including recommendation systems and tailored marketing, play a crucial role in shaping buying choices and improving customer interaction. The research highlights the importance for FMCG businesses to implement AI-based approaches to adapt to changing consumer demands.

**7. Research Methodology:**

The research employs an exploratory methodology, using a case study approach to examine the impact of AI and ML on predictive management in the FMCG sector. The investigation centres on a group of well-known FMCG firms, extracting insights from secondary data sources such as industry reports, company documents, market analyses, and academic papers. This method facilitates a comprehensive understanding of how AI and ML technologies are utilised to predict demand, streamline inventory management, and improve customer engagement strategies. The exploratory aspect of the study permits adaptable analysis and the discovery of emerging trends, with the findings considered in the context of specific company practices and wider industry movements.

**8. Discussions:**

**8.1 Predictive Management**

Predictive management makes better predictions about future business outcomes by utilising both historical and real-time data. Sales data, social media activity, and weather patterns are just a few examples of the various data sources that AI and ML systems analyse to identify patterns and forecast trends. Businesses can predict possible difficulties and take preventive measures thanks to these insights. Better planning, lower risk, and increased efficiency are the outcomes.

**8.2 Key techniques:**

**8.2.1 Regression Models (Enhancing Sales and Pricing Strategy Technique):** Regression models (including Linear, Polynomial, and Multiple Regression) are utilized to forecast the influence of variables such as pricing, promotional activities, and seasonal trends on sales performance. **Example**: A prominent fast-moving consumer goods (FMCG) corporation, such as Nestlé, employs regression models to ascertain the ideal pricing for its instant coffee products. By examining historical sales data, consumer preferences, and competitor pricing strategies, it anticipates how price variations will affect sales volume. This strategic approach enables the company to sustain profitability while retaining its customer base.

**8.2.2 Neural Networks (Accurate Demand Forecasting):** Neural networks, such as Recurrent Neural Networks (RNN) and Long Short-Term Memory (LSTM) models, are capable of identifying intricate patterns in time series data to enhance demand prediction accuracy. **Example:** Unilever employs LSTM models to anticipate demand for its skincare products. These models take into account historical sales data, seasonal fluctuations, and marketing initiatives. For example, the model might forecast an increase in sunscreen sales during the summer months, enabling Unilever to streamline inventory management and prevent stock shortages.

**8.2.3 Natural Language Processing (NLP) (Evaluating Customer Feedback Technique):** NLP facilitates the extraction of insights from unstructured textual data, including customer reviews, social media interactions, and online feedback. **Example:** Procter & Gamble (P&G) employs NLP to track discussions on social media platforms such as Twitter and Instagram. By examining customer remarks regarding its shampoo products, the company identifies common issues related to dryness. In response, P&G modifies the product formula and markets the revised product with a focus on its 'moisturizing' attribute, thereby addressing customer feedback.

**8.2.4 Recommendation Engines:** Tailored Marketing Approach Technique: Collaborative filtering and content-based filtering are employed to suggest products to consumers based on their individual preferences and purchasing history. **Example:** Amazon, which also functions within the FMCG sector, utilizes recommendation systems to propose grocery items to its customers. For instance, if a customer regularly purchases organic snacks, the system recommends comparable organic products, thereby enhancing cross-selling opportunities and fostering customer loyalty.

**8.3 The Importance of AI/ML Techniques in FMCG:**

- **Enhanced Customer Satisfaction:** Tailored recommendations guarantee that customers receive products they prefer, thereby enhancing their shopping experience.
- **Streamlined Inventory Management:** Precise demand predictions avert both overstocking and stockouts, ensuring product availability at all times.
- **Financial Efficiency:** Utilising data for pricing and promotions optimises revenue generation while reducing potential losses.
- **Improved Market Agility**: Analysing customer sentiment enables brands to swiftly identify and address issues, safeguarding their reputation.

**8.4 The Function of AI/ML in Predictive Management for FMCG**

**1. Demand Forecasting**

Organisations leverage AI to predict product demand influenced by geographical location, seasonal changes, and consumer behaviour patterns. For instance, Hindustan Unilever employs machine learning to forecast demand differences between rural and urban areas.

**2. Inventory Optimization**

AI technologies facilitate the management of stock levels by examining sales patterns, thereby minimizing both excess inventory and shortages. Nestlé has implemented AI in its warehouse operations, leading to decreased waste and enhanced supply chain efficiency.

**3. Product Innovation and Personalisation**

Machine learning enables businesses to develop products that align with current consumer preferences identified through data analysis. For example, Mondelez utilises AI for social media monitoring to detect flavour trends and create new stock-keeping units (SKUs).

**4. Pricing Strategy**

AI systems evaluate competitor pricing, inflation rates, and consumer reactions to suggest optimal pricing strategies. An example of this is P&G's dynamic pricing engine, which adjusts prices based on real-time market data.

**8.5 Types of Data Sources Utilised for Predictive Analytics in the FMCG Sector**

Predictive analytics within the FMCG industry depends on a variety of data sources that offer insights into consumer behaviour, market dynamics, and operational effectiveness. These data sources can be classified into several categories:

➢ **Sales Data**

This encompasses Point-of-Sale (POS) transactions from retail establishments, e-commerce sales records, and historical sales information. The analysis of sales data aids FMCG companies in forecasting demand, recognising top-selling products, and refining pricing strategies.

➢ **Customer Data**

Customer data includes demographic details, purchase history, loyalty program interactions, and online behavior. This information is crucial for customer segmentation, personalized marketing efforts, and predicting customer lifetime value.

- **Supply Chain Data**

Supply chain data consists of inventory levels, supplier information, logistics records, and warehouse management data. Such information facilitates predictive inventory management, minimizes stockouts, and enhances supply chain efficiency.

- **Marketing Data**

Marketing data comprises campaign performance metrics, social media analytics, customer feedback, and email marketing interactions. Analyzing this data assists in evaluating marketing effectiveness, identifying successful strategies, and optimizing future campaigns.

- **External Data**

External data includes macroeconomic indicators, weather forecasts, competitor pricing, and industry trends. This information enables FMCG companies to consider external factors that may influence demand, such as economic conditions or seasonal fluctuations.

- **Product Data**

Product data pertains to SKU details, packaging information, product descriptions, and pricing history. It is beneficial for managing product life cycles, identifying popular product variants, and launching new products.

- **Consumer Behaviour Data**

This data is obtained from website clickstreams, mobile app interactions, and social media engagement. Analyzing consumer behaviour data aids in understanding customer preferences, enhancing user experience, and providing targeted recommendations.

**8.6 Challenges Faced in the Adoption of AI and ML for Predictive Management in the FMCG Sector**

- **Data Quality and Availability:** Ensuring the quality and availability of data is a significant challenge, particularly when it is sourced from various platforms such as POS systems, social media, and customer feedback.
- **Complex Data Integration:** The integration of structured data (like sales and inventory) with unstructured data (such as social media interactions and customer reviews) necessitates sophisticated data processing capabilities.
- **High Initial Costs:** The initial investment required for AI and ML implementation is considerable, encompassing technology, skilled personnel, and data infrastructure.
- **Talent Shortage:** There is a notable shortage of qualified data scientists and AI professionals who possess a comprehensive understanding of both technological and FMCG business dynamics.
- **Model Accuracy and Maintenance:** Predictive models require regular updates with new data to sustain their accuracy, as outdated models can result in misguided decisions.
- **Data Security and Privacy:** Compliance with data protection regulations is essential when managing customer data for personalized recommendations, adding another layer of complexity.
- **Resistance to Change:** There may be resistance from employees towards adopting AI-driven decision-making processes, particularly if they lack a clear understanding of the technology involved.

## 9. Case Studies

### 9.1 Hindustan Unilever (HUL)

Hindustan Unilever (HUL) has implemented the 'Connected 4 Growth' initiative, which incorporates AI and ML into its operations to enhance decision-making and operational efficiency.

**Artificial Intelligence Applications at HUL:**

**Net Revenue Management Tool:** Employs AI to refine pricing strategies, thereby maximizing revenue through the analysis of sales data and consumer behavior.

**Demand Sensing Tool:** Anticipates hyper-local demand by utilizing real-time distributor information, reducing stockouts and guaranteeing product availability.

**Shikhar App:** A mobile application powered by machine learning that offers sales teams tailored product recommendations for specific stores, thereby improving retailer engagement.

**Impact:**

- ➔ 10% Increase in Product Availability: Precise demand forecasts avert stockouts.
- ➔ 15% Decrease in Stockouts: Real-time data facilitates effective inventory management.
- ➔ Enhanced Retailer Satisfaction: Customized recommendations boost store sales.

HUL's AI-centric approach illustrates how predictive management can improve supply chain efficiency, elevate customer satisfaction, and drive revenue growth within the FMCG industry.

### 9.2 Nestlé

Nestlé has implemented artificial intelligence and machine learning throughout its supply chain and marketing efforts to enhance efficiency and improve customer satisfaction.

**Artificial Intelligence Applications at Nestlé**

**Predictive Maintenance:** Which utilizes AI to monitor equipment health, resulting in a 20% reduction in downtime.

**Demand Forecasting:** Leverages weather data to predict demand accurately, ensuring optimal inventory levels.

**Machine Learning:** Drives product innovation by identifying health trends, thereby accelerating the introduction of new offerings such as plant-based foods.

**Impact:**

- ➔ A significant reduction in downtime,
- ➔ Expedited product innovation,
- ➔ Improved customer satisfaction through precise forecasting and tailored products.

Nestlé's AI strategy exemplifies the potential of technology to boost efficiency, foster innovation, and elevate customer experience within the fast-moving consumer goods sector.

### 9.3 ITC Limited

The integration of AI and ML by ITC across its operations has resulted in notable improvements in agricultural efficiency, retail optimization, and customer interaction.

**Artificial Intelligence Applications at ITC Limited**

**Krishi Mitra:** ITC's 'Krishi Mitra' application offers farmers immediate, localized guidance on crop management, thereby improving yield predictions.

**Machine learning algorithms:** Assess consumer preferences to refine product assortments, enhancing SKU performance.

**AI-driven chatbots:** AI-driven chatbots efficiently manage customer inquiries, increasing engagement.

**Impact:**

- ➔ Crop yield forecasting through real-time insights that assist farmers in planning.

- ➔ Optimized SKU performance with customized product offerings that cater to regional needs
- ➔ Enhanced consumer engagement through prompt customer service that fosters brand loyalty.

**9.4 Coca-Cola**

Coca-Cola has incorporated Artificial Intelligence (AI) and Machine Learning (ML) throughout its operations to improve customer interaction, streamline supply chain management, and foster innovation.

**Artificial Intelligence Applications at Coca-Cola**

**Intelligent Vending Machines:** AI-enabled vending machines evaluate buying behaviors and customer preferences to provide tailored product suggestions, thereby enhancing the customer experience and boosting sales.

**Real-Time Marketing Analytics:** AI-based predictive analytics measure the success of marketing initiatives in real-time, enabling Coca-Cola to swiftly modify strategies and optimize marketing budgets.

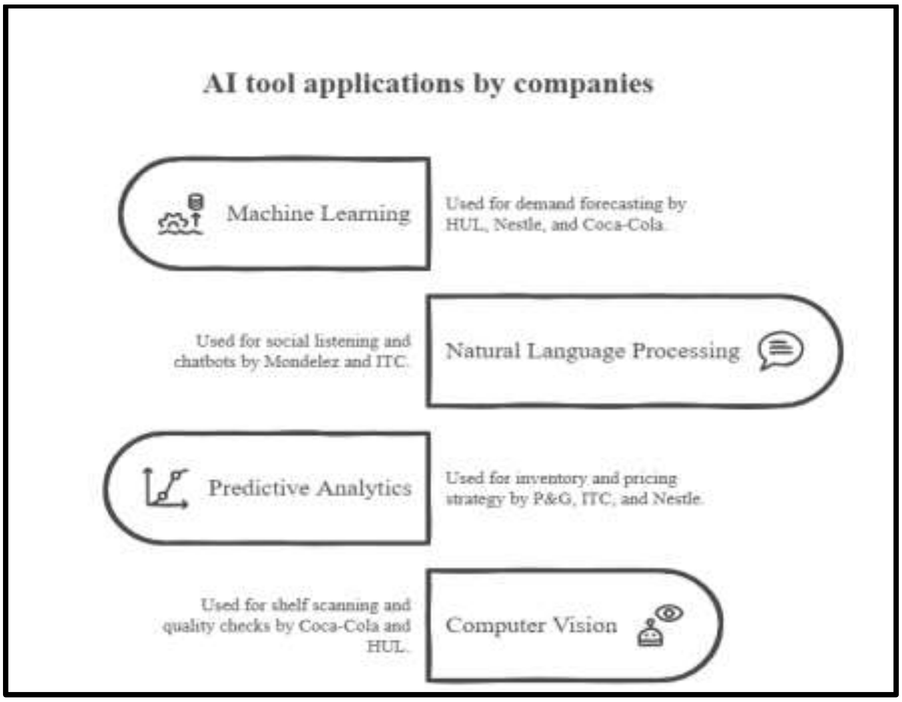
**AI-Driven Voice Customer Support**: Coca-Cola has deployed AI-enhanced voice bots that accurately discern caller intent over 80% of the time, resulting in quicker service and heightened customer satisfaction.

**Impact:**

- ➔ Tailored suggestions from intelligent vending machines have resulted in higher customer purchases.
- ➔ Immediate insights from predictive analytics facilitate prompt modifications to marketing strategies, improving budget management.
- ➔ Improved customer service through AI-powered voice bots leads to a more gratifying customer experience, nurturing brand loyalty.

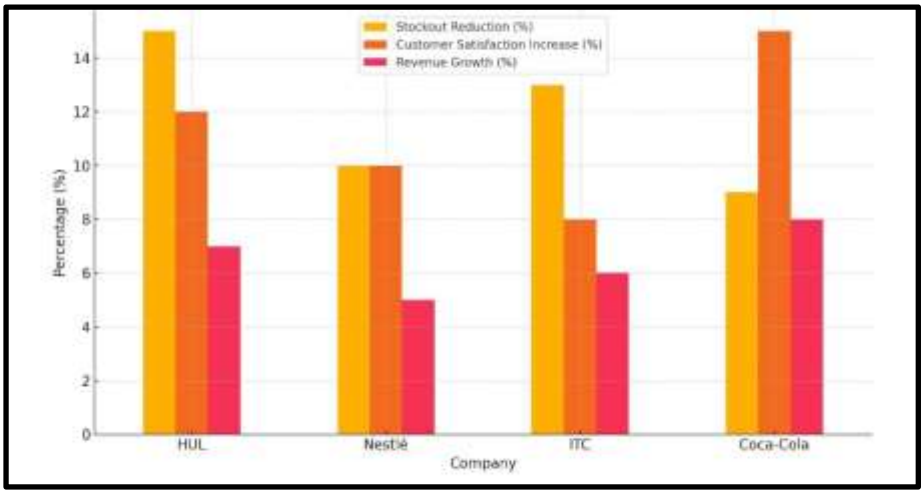
**10. Observations:**

***10.1 AI Tools and Their Applications in FMCG***



### *10.2 Impact Metrics After AI Integration*

| Company | Stockout Reduction | Customer Satisfaction | Revenue Growth |
|---|---|---|---|
| HUL | 15% | +12% | +7% |
| Nestlé | 10% | +10% | +5% |
| ITC | 13% | +8% | +6% |
| Coca-Cola | 9% | +15% | +8% |




***Source:*** *Accenture Report on AI in Consumer Goods*

**10.3 Key Insights on Stockout Management and Customer Satisfaction:**

- HUL excels in stockout reduction with a 15% improvement, whereas Coca-Cola shows the least progress at 9%.
- In terms of customer satisfaction, Coca-Cola leads with a 15% rating, indicating a robust connection with its customers.
- Furthermore, Coca-Cola's revenue growth stands at 8%, implying that customer satisfaction is positively correlated with sales.

**11. Future Scope**

**1. Real-Time Decision Making:** Artificial Intelligence rapidly evaluates extensive datasets to predict demand and detect supply chain vulnerabilities. This capability allows fast-moving consumer goods (FMCG) companies to react swiftly to changes in the market and logistical issues.

**2. Integration of IoT:** The combination of AI with Internet of Things (IoT) devices facilitates the real-time monitoring of inventory levels and consumer behavior. This collaboration improves visibility within the supply chain and boosts operational efficiency.

**3. Customized Marketing:** AI analyzes customer purchasing patterns to provide personalized promotions and product recommendations. This level of customization enhances customer engagement and fosters loyalty.

**4. Minimization of Waste:** AI enhances resource management and tracks conditions to reduce waste. This not only results in cost savings but also supports sustainability efforts.

**5. Automation of Processes:** AI takes over repetitive tasks, improving efficiency and decreasing the likelihood of human error. This leads to streamlined operations and reduced operational expenses.

**6. Explainable AI (XAI):** XAI provides clear insights into the decisions made by AI systems, building trust among stakeholders. This transparency supports better-informed decision-making.

**7. Global Adaptation:** AI systems are customized to reflect regional preferences and cultural differences. This localization ensures that offerings remain relevant and improves customer satisfaction across various markets.

## 12. Conclusion

Artificial intelligence (AI) and Machine Learning (ML) play a crucial role in shifting FMCG management from a reactive approach to a predictive one. Organizations that leverage these technologies can achieve a competitive advantage by being proactive, focused on customer needs, and efficient. The case studies of HUL, Nestlé, ITC, and Coca-Cola illustrate how digital intelligence can enhance both profitability and customer satisfaction in the rapidly evolving FMCG sector.

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# THE IMPACT OF ARTIFICIAL INTELLIGENCE ON THE FINANCIAL SERVICES INDUSTRY: OPPORTUNITIES AND CHALLENGES

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***Abstract***

*Artificial intelligence (AI) has emerged as a crucial catalyst for innovation and transformation in the financial services industry, impacting sectors like banking, insurance and investment management. This paper delves into the wide range of applications of Artificial Intelligence technologies, including machine learning, natural language processing and robotic process automation and how they can improve operational efficiency assess risks, detect fraud, provide personalized financial services and enhance customer experience. By conducting a thorough examination of existing research and evaluating practical applications, the study demonstrates how Artificial Intelligence enhances decision-making efficiency and improves financial management. Nevertheless, this paper critically examines the significant challenges that arise with the integration of AI, such as algorithmic bias, concerns regarding data privacy and security, the lack of transparency in decision-making processes and the need for evolving regulatory frameworks. The study emphasizes the significance of ethical AI implementation and the need for comprehensive governance to guarantee responsible progress. By analyzing current trends and predicting the future influence of AI in finance, the study offers strategic guidance to foster a balanced approach one that embraces technological progress while prioritizing stakeholder interests and adhering to legal requirements. This paper ultimately advocates for a collaborative effort among financial institutions, regulators and technologists to effectively harness AI's potential while ensuring responsible and sustainable practices.*

***Keywords:*** *Artificial Intelligence, Finance, Algorithmic Trading, Fraud Detection, Fintech, Machine Learning, Risk Management, Ethics*

- **Introduction**

Artificial Intelligence (AI) is changing the face of the financial industry in a big way. What used to be manual and time-consuming tasks are now being handled quickly and efficiently by machines that can learn, think and even predict future trends. From banks and insurance companies to investment firms, financial institutions are using AI to make smarter decisions, improve customer service, reduce human errors and create more personalized services for their clients. Some of the most common AI tools being used today include machine learning (which helps systems learn from data), natural language processing (which allows computers to understand and respond to human language), robotic process automation (which automates repetitive tasks) and predictive analytics (which helps forecast future events based on current data). These tools are now part of everyday services—like chatbots answering customer queries, software that decides if someone is eligible for a loan or programs that help investors make better decisions. But with all these advantages, there are also serious concerns. AI decisions can be hard to understand or explain, and if the data used is biased, it can lead to unfair outcomes. Privacy issues, lack of clear rules, and the risk of overdependence on AI are also big challenges. This paper takes a closer look at both the opportunities and risks of using AI in finance and suggests ways to make its use safer, fairer and more transparent in the future.

- **Literature Review**

The rapid advancement of Artificial Intelligence (AI) technologies is fundamentally transforming the financial industry, prompting extensive scholarly interest. A growing body of literature examines how AI, particularly machine learning, is revolutionizing various aspects of financial services, from customer interaction and fraud detection to investment strategies and credit risk assessment.

Brynjolfsson and McAfee (2017) argue that AI's integration with Financial Technology (FinTech) is not merely enhancing existing processes but is actively reshaping the competitive landscape of the financial sector. Their research emphasizes that AI allows firms to personalize services, automate decision-making, and respond to market changes with greater agility. This transformation has enabled financial institutions to achieve operational efficiency and gain a competitive edge by leveraging data-driven insights. Furthermore, AI applications like robo-advisors, algorithmic trading, and chatbots are becoming integral to service delivery, reducing costs while enhancing customer experience.

However, not all scholars view these advancements in an entirely positive light. A significant body of research has started to scrutinize the ethical implications and potential risks associated with AI in finance. For example, Fuster et al. (2022) explore the unintended consequences of AI-based credit scoring systems. Their findings indicate that these systems, which often rely on large sets of historical financial data, can perpetuate and even amplify existing biases. Disadvantaged groups may face discrimination in loan approvals or receive less favorable interest rates due to entrenched biases in the training data. This concern underscores the importance of fairness and transparency in AI algorithms, especially in high-stakes applications like credit allocation.

Ethical challenges are a recurrent theme across various studies. Many researchers caution that the unchecked deployment of AI technologies in finance could lead to systemic risks. Without robust ethical frameworks and regulatory oversight, there is a danger that AI could exacerbate inequality, reduce accountability, and compromise data privacy. Moreover, there is a notable lag between technological developments and the establishment of appropriate regulatory standards. As AI evolves rapidly, current financial regulations struggle to keep pace, creating a governance gap that could expose institutions and consumers to unforeseen vulnerabilities.

Despite the enthusiasm surrounding AI's potential, scholars highlight the need for more long-term and comprehensive research. While short-term efficiencies and innovations are well-documented, the broader implications of widespread AI adoption on financial stability, market behavior, and employment remain underexplored. This research gap signals a critical need for interdisciplinary studies that assess the long-run consequences of AI, not only from a technical standpoint but also from social, legal, and economic perspectives.

In summary, the literature presents a nuanced view of AI in finance. While its capacity to drive innovation and efficiency is well recognized, researchers are increasingly calling attention to its ethical risks and regulatory challenges. Bridging the gap between technological innovation and ethical governance remains a key priority in ensuring that AI contributes positively to the financial system.

- **Applications of AI in Finance**

**1. Algorithmic Trading**

Algorithmic trading refers to the use of computer algorithms to automate the process of buying and selling financial instruments. **AI-driven algorithmic trading** systems utilize **machine learning (ML)** and **deep learning** techniques to detect patterns, correlations, and anomalies in large datasets that human traders may overlook.

**How it works**: These systems analyze **real-time market data**, news sentiment, social media trends, and historical prices to forecast short-term market movements. AI models can continuously learn and adjust strategies based on new data.

**Speed advantage**: Trades are executed in **fractions of a second (milliseconds)**, giving firms a competitive edge by exploiting tiny market inefficiencies before others can react.

**Impact**: AI has increased market efficiency and liquidity but also raised concerns about **market volatility** and **flash crashes** due to high-frequency trading bots.

**2 Fraud Detection and Risk Management**

AI is revolutionizing fraud detection by moving from static rule-based systems to dynamic, self-learning models that can adapt to new fraud patterns.

**Anomaly detection algorithms**: These algorithms identify transactions that deviate from a user's typical behavior, flagging them for further investigation. For example, if a user typically makes local purchases but suddenly makes a large international transaction, the system can block or verify it in real-time.

**Machine learning models**: Supervised learning (e.g., decision trees, neural networks) is trained on labeled fraudulent and legitimate transaction data, while **unsupervised learning** can identify new or unknown fraud types without needing prior labels.

**Risk modeling**: AI also helps banks model **credit, market, and operational risks** by simulating stress scenarios and predicting potential losses under different economic conditions.

**3. Credit Scoring and Underwriting**

Traditional credit scoring methods rely heavily on historical financial data like income, credit history, and existing debts. **AI-enhanced credit scoring** expands the scope and accuracy of credit assessments.

**Use of alternative data**: AI models incorporate **non-traditional data** such as mobile phone usage, social media behavior, e-commerce activity, and utility bill payments. This allows lenders to assess the creditworthiness of individuals with little or no formal credit history (e.g., "credit invisibles").

**Improved risk differentiation**: AI can segment borrowers into finer risk categories than traditional scoring models like FICO.

**Efficiency in underwriting**: Automated underwriting platforms can instantly assess loan applications, improving approval times and reducing manual errors.

However, ethical issues such as **data privacy** and **algorithmic bias** remain a challenge if not properly managed.

**4 Customer Service and Personalization**

AI is transforming customer interaction through advanced **Natural Language Processing (NLP)** tools and personalization engines.

**Chatbots and Virtual Assistants**: AI-powered chatbots provide 24/7 support, handling queries about account balances, transactions, loan applications, and more. These bots use NLP to understand and respond to human language naturally and contextually.

**Robo-advisors**: These are digital platforms that provide automated, algorithm-driven financial planning services with minimal human supervision. They assess user data—like income, goals, and risk appetite—to recommend investment strategies.

**Personalization engines**: AI helps financial institutions deliver **tailored product recommendations**, detect life events (e.g., marriage or new job), and suggest financial products accordingly.

**Business impact**: These tools significantly reduce **operational costs**, improve **response times**, and enhance **customer satisfaction and engagement**.

- **Opportunities and Benefits**

**i. Operational Efficiency**

AI-driven automation significantly enhances operational efficiency across financial institutions:

**Process automation**: Routine tasks such as data entry, regulatory compliance checks, transaction processing, and customer support can be automated using robotic process automation (RPA) combined with AI. This not only accelerates workflows but also minimizes human error.

**Cost reduction**: Automation reduces the need for manual labor in back-office functions, leading to significant savings in staffing and operational costs.

**Scalability**: AI systems can handle vast amounts of data and transactions simultaneously, making it easier for institutions to scale operations without proportional increases in overhead.

**Example**: JPMorgan Chase uses its COiN (Contract Intelligence) platform to review legal documents in seconds—work that used to take thousands of man-hours.

**ii. Enhanced Decision-Making**

AI empowers decision-makers with real-time, data-driven insights:

**Predictive analytics**: By analyzing large datasets, AI can predict market trends, detect early signs of economic downturns, and assess credit default risks more accurately.

**Investment strategies**: Portfolio managers and hedge funds use AI to build dynamic investment models that adapt to market changes, offering more precise and timely buy/sell recommendations.

**Risk management**: AI identifies emerging risks faster than traditional models and provides scenario-based simulations to test the resilience of portfolios or institutions.

**Example**: BlackRock's AI platform, Aladdin, assists asset managers in assessing portfolio risks and optimizing investment decisions based on predictive analytics.

**iii. Financial Inclusion**

AI has the potential to democratize access to financial services:

**Alternative credit scoring**: AI uses unconventional data such as mobile phone usage, utility bill payments, social media activity, and even behavioral analytics to assess creditworthiness. This opens lending opportunities for individuals without a formal credit history.

**Microfinance and digital lending**: FinTech platforms use AI to deliver micro-loans and digital banking services to rural or underserved communities, where traditional banks are often absent.

**Language and accessibility tools**: AI-powered chatbots can interact in local languages, breaking down communication barriers for non-native speakers or those with limited literacy.

**Impact**: By reducing dependence on traditional banking infrastructure, AI enhances access to financial services for the "unbanked" and "underbanked," especially in developing economies.

**iv. Product Innovation**

AI is driving the creation of new, personalized financial products and services:

**Customization at scale**: AI enables firms to design financial products tailored to individual customer profiles, life stages, and goals. This includes personalized investment portfolios, insurance plans, or loan offerings.

**Real-time product adaptation**: AI systems can monitor user behavior and adjust offerings dynamically—such as adjusting credit limits or recommending new financial tools based on spending patterns.

**Integration with emerging technologies**: AI is often used alongside blockchain, IoT, and big data to develop cutting-edge products like decentralized finance (DeFi) solutions or AI-driven insurance underwriting.

**Example**: Wealth management platforms like Betterment and Wealthfront use AI to automatically rebalance portfolios and adjust investment strategies based on real-time market data and user goals.

- **Challenges and Risks**

While AI offers numerous benefits, it also introduces complex challenges that could undermine its potential if not properly addressed. These challenges span ethical, technical, regulatory, and systemic domains. Key concerns include:

**i. Algorithmic Bias**

AI systems are only as good as the data on which they are trained. When historical data reflects social or institutional biases, AI can **perpetuate or even exacerbate discriminatory outcomes**.

- **Nature of bias**: Bias may be embedded in training datasets—such as gender, racial, or socioeconomic disparities—leading to unfair outcomes in credit scoring, hiring, insurance underwriting, and beyond.
- **Example**: Cowgill et al. (2021) highlight how algorithmic decisions can disadvantage marginalized groups, particularly when models prioritize efficiency over fairness. For example, an AI system trained on historical lending data may inadvertently deny loans to certain demographics who were historically under-served.
- **Implications**: Without mechanisms for fairness and transparency, biased algorithms can erode trust, violate anti-discrimination laws, and damage an institution's reputation.

**Mitigation**: Ethical AI design, bias audits, and inclusion of fairness metrics during model development are critical.

**ii. Data Privacy and Security**

AI systems in finance rely on massive volumes of **sensitive personal and financial data** to function effectively. This introduces significant privacy and cybersecurity risks.

- **Data exploitation**: The collection and analysis of customer data—often without fully informed consent—raises ethical concerns about **data ownership**, **informed usage**, and **transparency**.
- **Cybersecurity threats**: AI platforms can become targets for cyberattacks, and if compromised, they can be used to exploit vulnerabilities in automated systems.
- **Example**: A data breach in an AI-driven robo-advisory system could expose not only customer data but also decision-making models, leading to financial and reputational loss.

**Mitigation**: Strong encryption, data anonymization, ethical data governance policies, and compliance with privacy laws (e.g., GDPR, CCPA) are essential safeguards.

**iii. Regulatory and Compliance Hurdles**

The **fast pace of AI development** in finance has outstripped the evolution of regulatory and compliance frameworks.

- **Regulatory gap**: Many current laws and guidelines were designed for traditional financial systems and do not address AI-specific challenges like explainability, algorithmic accountability, or cross-border data use.
- **Lack of standardization**: Financial institutions operate in global markets but face fragmented regulatory environments, making compliance difficult.
- **Example**: Regulators may struggle to evaluate "black box" AI models that lack transparency, leading to difficulties in ensuring legal compliance or enforcing consumer protection laws.

**Mitigation**: Regulatory bodies and financial institutions need to collaborate to establish adaptive, forward-looking frameworks that balance innovation with risk management.

**iv. Systemic Risk**

AI's widespread adoption in financial markets can introduce **new types of systemic vulnerabilities**.

- **Herding behavior**: If many institutions use similar AI models or data sources for trading or risk management, this can lead to **convergent behavior** that magnifies volatility—particularly in crisis scenarios.
- **Black swan amplification**: AI models trained on historical data may fail to predict rare or unprecedented events (so-called "black swan" events), leading to catastrophic miscalculations.
- **Interconnected fragility**: An error or failure in one algorithmic system could cascade through interconnected financial institutions or markets, potentially triggering a systemic crisis.

**Example**: Flash crashes in stock markets—where AI-powered high-frequency trading leads to sudden, steep drops in prices—highlight how automation can amplify market instability.

**Mitigation**: Building resilient AI systems, performing stress testing, and implementing human-in-the-loop oversight can help manage these risks.

- **Future Directions of AI in Finance**

As the financial sector continues to evolve, AI is expected to play an even more central role—not just in operational tasks, but in shaping the infrastructure, governance, and ethics of global finance. Key future directions include:

**1. Integration with Emerging Technologies: Blockchain and DeFi**

AI's convergence with **blockchain** and **Decentralized Finance (DeFi)** is set to create powerful new financial ecosystems:

**Blockchain + AI synergy**: Blockchain offers a secure, transparent, and immutable ledger, while AI brings intelligence and automation. When combined, these technologies can create **autonomous financial systems** capable of executing smart contracts, fraud detection, and decentralized credit scoring.

**DeFi applications**: In DeFi—where traditional financial intermediaries are replaced by decentralized protocols—AI can optimize liquidity provision, automate asset management, and assess risk more dynamically.

**Real-time auditing**: AI could monitor blockchain-based transactions for irregularities or compliance violations in real time, enhancing financial integrity.

**Example**: AI-powered DeFi platforms could automatically adjust lending rates or collateral requirements based on market trends and borrower behavior, increasing both efficiency and fairness.

**2. Rise of Explainable AI (XAI)**

One of the major criticisms of AI in finance is the "black box" nature of many models, where decision logic is opaque even to developers. **Explainable AI (XAI)** seeks to address this:

**Transparency and accountability**: XAI aims to make AI models more understandable to humans—particularly regulators, auditors, and end-users—by providing clear justifications for predictions or decisions.

**Trust building**: In sensitive areas like credit decisions or fraud detection, explainability helps build trust and ensure compliance with legal and ethical standards.

**Regulatory alignment**: As financial regulations increasingly require explainability (e.g., GDPR's "right to explanation"), XAI will become a foundational feature of responsible AI systems.

**Example**: A credit scoring system using XAI might highlight key factors behind a loan denial, such as income irregularity or recent missed payments, in human-readable language.

**3. Development of AI-Specific Regulatory Frameworks**

Current financial regulations were not designed with AI in mind. However, future oversight will likely involve **AI-specific compliance standards** and supervisory mechanisms:

**Dynamic regulation**: Regulatory bodies are expected to adopt **technology-neutral but AI-aware** frameworks that evolve in parallel with technological advancements.
**Key areas of focus**: These regulations will address issues such as data usage, model transparency, bias mitigation, algorithmic accountability, and cross-border governance.
**RegTech integration**: AI will also be used in **Regulatory Technology (RegTech)** to help firms stay compliant in real time, with systems that monitor transactions, flag violations, and auto-report suspicious activities.
**Example**: Regulatory sandboxes—testing environments where firms can trial AI innovations under regulatory supervision—are becoming common as part of forward-looking policy approaches.
**4. Expansion of Ethical AI and Human Oversight**
As AI's role in finance deepens, **ethical design principles** and **human-in-the-loop (HITL)** approaches will become standard:
**Ethical AI frameworks**: These will emphasize fairness, non-discrimination, privacy, and transparency as core values guiding AI development and deployment.
**Human oversight**: Even as systems become more autonomous, human experts will remain critical in reviewing high-stakes decisions and intervening during anomalies or ethical dilemmas.
**AI governance structures**: Institutions will likely establish dedicated teams for **AI ethics, governance, and compliance**, integrating technical, legal, and social expertise.
**5. Personalized and Predictive Finance**
AI will also drive the future of **hyper-personalized and predictive financial services**:
**Digital financial advisors**: These tools will become more sophisticated, capable of adapting to life events (e.g., marriage, childbirth, career change) and offering customized financial planning.
**Predictive banking**: Banks and FinTechs will anticipate customer needs—such as overdraft risks, bill payments, or investment opportunities—before customers even recognize them.
**Example**: AI systems may pre-approve credit increases, suggest investment rebalancing, or flag potential fraud based on behavioral analytics, with minimal human input.

- **Conclusion**

Artificial Intelligence (AI) is rapidly emerging as a foundational force in reshaping the financial services landscape. From automating trading and risk management to personalizing customer interactions and expanding access to credit, AI offers transformative opportunities that can drive **efficiency**, **cost savings**, **innovation**, and **enhanced customer engagement**. As financial institutions harness machine learning, natural language processing, and other AI technologies, they stand to revolutionize how financial services are delivered and experienced.
However, this transformation is not without its challenges. AI systems, if deployed irresponsibly, can introduce serious **risks**, including **algorithmic bias**, **data privacy violations**, and **systemic fragility**. Moreover, the current regulatory environment is struggling to keep pace with the speed and complexity of AI innovations, potentially leaving gaps in oversight and accountability. Ethical concerns surrounding fairness, transparency, and the explainability of AI decisions further complicate the adoption landscape.
Realizing the full potential of AI in finance thus requires a **deliberate, balanced approach**. Financial institutions must go beyond mere technological adoption and invest
in robust governance frameworks that emphasize ethical AI design, data responsibility, transparency, and regulatory compliance. Additionally, integrating human oversight and promoting cross-disciplinary

collaboration—between technologists, regulators, ethicists, and financial professionals—will be essential to mitigating unintended consequences and ensuring responsible innovation.

Those institutions that can **strategically leverage AI** while addressing its risks head-on will not only gain a **competitive edge** but also play a pivotal role in shaping a **more inclusive, fair, and resilient financial system**. This future envisions AI not just as a tool for profit, but as a catalyst for broader financial empowerment and systemic stability.

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# EXPLORATORY STUDY ON CHALLENGES FACED BY COMMUTERS OF PUBLIC TRANSPORT BUS SERVICES

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***Abstract***

*Bus services for transportation are essential for accessible, reasonably priced, and environmentally friendly transportation, particularly in crowded cities. They guarantee mobility for every group in society while lowering pollution, traffic jams, and the carbon footprint overall. However, severe obstacles like crowding, erratic timetables, poor infrastructure, and safety issues are frequently encountered by commuters. These problems can impair public transport systems' effectiveness and deter people from using them, which will impact urban mobility. The purpose of this study is to explore the challenges faced by commuters of Public Transport Bus Services. The technique used in this study is Text mining using the qualitative tool NVIVO 12. It was found that major problems are Overcrowding during peak hours, Poor maintenance of busses, Traffic congestion causing delays, Limited coverage in remote areas, Inadequate seating capacity, Lack of night services, Uncomfortable Seats, Inadequate lighting at bus stops, and Untrained Staff. Moderate problems are Irregular bus timings, Frequent breakdowns, and Ventilation Problems. It can be seen that Minor Problems are Frequent fare hikes and Lack of safety features.*

***Keywords:*** *NVIVO, Word Cloud, Text Mining, Public Transport, Exploratory.*

## Introduction:

India is supporting sustainable modes of transport by fostering sustainable urban development Only A few Indian cities have mass transit systems like metro rail, sub-urban rail, light rail system, etc. As a result, public buses become a crucial and, in the majority of cities, the exclusive form of public transportation. The majority of people in both urban and rural areas, particularly women, rely on public buses for a variety of reasons, making them the backbone of the state economy (Sham et al., 2012). India's public bus commuters deal with a number of issues, such as crowded buses, inconsistent timetables, inadequate facilities, and safety risks, especially for women. Furthermore, poor connectivity and discomfort while travelling deter people from using public transit, which reduces its overall efficacy.

### Public Transport

Public transportation is the main form of mobility for many individuals. In addition, public transport buses operate in the cities, suburbs, and outer regions of the service areas. It offers a strong connection across its operational region as a result. Public transit is advantageous since it lessens traffic and exhaust pollution. Despite this, a lot of commuters remain hesitant to take the bus. The main reasons why people dislike public transit buses are long wait periods, crowded buses during rush hour, and an increase in private vehicles. (Rajput et al., 2022). The bus is regarded as a premium mass transit option that offers the most affordable, efficient, and comfortable transit option with lower building and maintenance expenses. With an adequate amount of bus transit, a city can control its transportation. Traveller factors (age, gender, family size or members, income, occupation, convenience, comfort, safety, security, and so on) and vehicle factors (ticket price, journey distance, bus conditions, travel time, waiting time, frequency of services, fare pricing, etc.) are the main determinants of bus service (Ahmed et al. 2019; Anwari et al. 2023; Islam, et al. 2022).

BEST buses are part of the vast network of bus services operated by the Brihanmumbai Electric Supply and Transport Undertaking (BEST Undertaking) in the Mumbai metropolitan area. The oldest Bus Transport service. The entire city of Mumbai is served by these buses, which also operate in neighboring areas including Navi Mumbai, Thane, and Mira-Bhayandar. BEST offers intercity services to these nearby locations, which are outside of the city, and its bus lines are extensive, reaching both the city and its surrounding territories. India's public transport system has many problems, which affect its financial performance. Public transit's problems have been made worse by the growth of alternate modes of mobility. E-rickshaws, metro rail, private transport companies, and other private vehicles are now widely available in many Indian districts.

**Significance of the Study**

- The study highlights the primary challenges that the commuter of the public transport, which will help policymakers in identifying areas that need improvement.
- This study can provide useful information for improving bus services so they are more efficient, comfortable, and accessible to all.
- The findings of this study can help policymakers in raising the standards of public bus transport services and infrastructure.

**Review of Literature:**

1. **Farjana, M., et al. (2024).** investigated a variety of factors related to both passengers and vehicles to determine how they relate to overall passenger satisfaction to evaluate the quality of Chittagong City's bus service. Numerous factors negatively impact passenger pleasure, with crowdedness having the largest negative impact, according to the poll. These elements include pricing, delays, and ticket costs. However, personnel behaviour, frequency of trips, smoothness of the ride, frequency of services, seating arrangements, and driving abilities are factors that have a beneficial impact on satisfaction.
2. **Solanki, V. S., & Agarwal, P. K. (2022).** determined the key elements influencing customer happiness in Indian city bus transport systems and offered easy-to-implement solutions to boost system efficiency and stop the fall in public transport use. Reducing the number of bus stops per km, increasing passenger kilometres per litre to improve fuel efficiency, and making sure bus stop sites are more convenient are important ways to improve user happiness. By addressing problems like crowding, inadequate connectivity, and discomfort during travel, these actions help create a bus transportation system that is more effective and user-friendly.
3. **Sreechitra, et al. (2022).** sought to assess public satisfaction with Indian cities' existing transit systems and determine what needs to be changed to make them more efficient and user-friendly. According to the report, several problems deter people from using public transport, including discomfort, inconvenience, unreliability, and a lack of door-to-door connectivity. Convenient features like timetables and maps, however, can make people favour public transport.
4. **Yasir, S., et al. (2022).** The study sought to investigate the prevalence of harassment in Dhaka, Rajshahi, and Mymensingh's public transit systems, with particular attention to gender disparities, attitudes towards women's mobility, and preferred safety precautions. Significant gender gaps were discovered, the prevalence of harassment was higher in smaller cities like Mymensingh, and possible safety measures included female-only nighttime rides and business growth close to transit stops. Women's mobility constraints, transportation experiences, and safety needs were shown to be significantly influenced by gender, with smaller cities like Mymensingh reporting higher rates of harassment than larger cities. Developing small businesses near train stops and providing rides exclusively for women at night were noted as possible safety solutions.

5. **Rajput, P. et al. (2020).** aimed to create and assess an opportunistic sensing system that optimally schedules buses and conserves energy by detecting bus crowdedness using GPS data and smartphone accelerometers. Comparing the suggested method to continuous GPS use, it saves 50% of the energy while precisely identifying bus boarding events and seats availability. In Ahmedabad and Gandhinagar, tests revealed that commuters with 8–12% smartphone penetration could identify busy areas in more than 80% of route segments. Furthermore, a bus scheduling plan based on past crowdedness data was put forth to increase transit efficiency by deploying feeder buses on extremely congested stretches.
6. **Verma, M., et al. (2020).** sought to identify and measure the variables affecting young women's perceptions of safety when riding public buses in Ahmedabad and Bangalore. Anxiety during travel, bus stop amenities, and safety at stops were found to be common safety-influencing elements in both cities by factor analysis, with trust being unique to Ahmedabad. According to empirical models, perceptions of bus stop safety have a significant impact on total bus travel safety in Bangalore, but better educational attainment is associated with a higher impression of safety in Ahmedabad.
7. **Jain, M., et al. (2018).** investigated the factors influencing home-to-work travel, with a particular emphasis on the sociodemographic, economic, and infrastructure aspects of India's largest rural-urban megaregion. According to the study, short trips and non-motorized travel are more common, especially in impoverished areas where people depend on public transportation and non-motorized modes of transportation for lengthier commutes. On the flip side, districts with higher incomes exhibit a predilection for private motorised transportation. One factor contributing to these discrepancies is the relative absence of train infrastructure in comparison to roadways, particularly in rural areas.
8. **Jemish (2018).** attempted to promote gender-inclusive urban design to provide fair access to urban life and address gender imbalances in urban transportation, with a particular emphasis on women's safety, security, and mobility. found that there are notable differences between the requirements of men and women in terms of transportation, with women travelling shorter distances, stopping more frequently, and having higher safety concerns. Unsafe modes of transportation frequently impede women's mobility in developing nations, making it harder for them to obtain jobs and basic services.

**Objectives of the study**

1. To explore challenges faced by commuters of public transport bus services.
2. To give appropriate suggestions for overcoming the challenges of public transport bus services.

**Materials and Method:**

**Table No: 1 Research Methodology**

| | |
|---|---|
| Research Design | Qualitative and Exploratory |
| Research Approach | Inductive Approach |
| Data Collection Method | Face-to-face interviews |
| Sample Size | 60 Pubic Bus Transport Commuters |
| Location | North Mumbai Region |
| Sampling Technique | Non-random Convenience Sampling |
| Analysis Tool | NVIVO 12 |
| Analysis Technique | Text Mining (Mind Map, Word Frequency, and Word Cloud) |

**Data Analysis and Interpretation:**

**Table No: 2 Summary table of challenges faced by commuters of public transport bus services**

| Word | Length | Count | Weighted Percentage (%) |
|---|---|---|---|
| Irregular bus timings | 10 | 30 | 10.45 |
| Overcrowding during peak hours | 12 | 28 | 9.76 |
| Poor maintenance of busses | 15 | 27 | 9.41 |
| Traffic congestion causing delays | 17 | 25 | 8.71 |
| Limited coverage in remote areas | 15 | 24 | 8.36 |
| Frequent fare hikes | 9 | 22 | 7.67 |
| Ventilation problem | 11 | 21 | 7.32 |
| Inadequate seating capacity | 17 | 20 | 6.97 |
| Frequent breakdowns | 10 | 18 | 6.27 |
| Lack of night services | 13 | 17 | 5.92 |
| Lack of safety features | 6 | 16 | 5.57 |
| Uncomfortable Seats | 13 | 16 | 5.57 |
| Inadequate lighting at bus stops | 18 | 14 | 4.88 |
| Untrained Staff | 14 | 9 | 3.14 |

As per Table no: 2 the most frequent keywords generated towards evaluating challenges faced by commuters of public Transport Bus services are Irregular bus timings with 30 counts and a weighted percentage of 10.45, Overcrowding during peak hours with 28 counts and a weighted percentage of 9.76, Poor maintenance of busses with 27 counts and a weighted percentage of 9.41, Traffic congestion causing delays with 25 counts and a weighted percentage of 8.71, Limited coverage in remote areas with 24 counts and a weighted percentage of 8.36, Frequent fare hikes with 22 counts and a weighted percentage of 7.67, Ventilation problem with 21 counts and a weighted percentage of 7.32, Inadequate seating capacity with 20 counts and a weighted percentage of 6.97, Frequent breakdowns with 18 counts and a weighted percentage of 6.27, Lack of night services with 17 counts and a weighted percentage of 5.92, Lack of safety features with 16 counts and a weighted percentage of 5.57, Uncomfortable Seats with 16 counts and a weighted percentage of 5.57, Inadequate lighting at bus stops with 14 counts and a weighted percentage of 4.88 and Untrained Staff with 9 counts and a weighted percentage of 3.14

**Figure No: 1 Word cloud**

A word cloud is a graphic representation of text data in which the size of words indicates their frequency, with larger words denoting more frequent terms. It facilitates the rapid identification of important themes or phrases in a dataset. As per figure no: 1 it is seen that challenges faced by commuters of Public Transport Bus services are as follows; major problems are Overcrowding during peak hours, Poor maintenance of busses, Traffic congestion causing delays, Limited coverage in remote areas, Inadequate seating capacity, Lack of night services, Uncomfortable Seats, Inadequate lighting at bus stops and Untrained Staff. Moderate problems are Irregular bus timings, Frequent breakdowns, and Ventilation Problems. It can be seen that Minor Problems are Frequent fare hikes and Lack of safety features.

**Conclusion:**

The study identifies several important problems that commuters of public transport bus services encounter, with the primary ones being overcrowding during rush hour, inadequate bus maintenance, traffic jams that cause delays, and spotty coverage in rural areas. Bus stations' inadequate seating capacity, absence of night services, unpleasant seats, and dim illumination all make commuting even more inconvenient and uncomfortable for passengers. Furthermore, inexperienced employees exacerbate the annoyance, underscoring the necessity for improved personnel management. Moderate difficulties including frequent breakdowns, inconsistent bus schedules, and ventilation issues also have an impact on the overall quality of the service. On a smaller scale, frequent fare increases and the absence of safety features are cited as minor issues that nevertheless affect user happiness. The commuter experience might be greatly improved and a greater reliance on public transport could be encouraged by addressing these issues through service improvements, better management techniques, and infrastructure improvements.

**Suggestions:**

- The public transport service providers should ensure buses run more frequently, especially during peak hours, to reduce overcrowding and waiting times.
- They should also regularly service and maintain buses to prevent breakdowns and ensure that these buses are safe and comfortable for passengers.
- The bus routes should be extended to cover more remote and underserved areas, making public transport more accessible to a wider population.
- Public transport should introduce buses during the late hours to provide safe and convenient travel options for people who need to commute at night.
- Enhance bus stop lighting, install benches, and make sure there is enough cover to make waiting more secure and comfortable.
- Provide bus drivers and staff with the required training to ensure timely, friendly service and better customer management.

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# IMPACT OF SOCIAL MEDIA INFLUENCER'S ON BUYING BEHAVIOUR OF 'Z' CONSUMERS IN BENGALURU CITY

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***Abstract***

*Influencer marketing is increasingly a common strategy for preserving goodwill with millions of individuals. It is now simple to publish genuine material and tag the companies associated with it because of the growth of social media sites like Instagram, YouTube, and others. The rise in popularity of influencer marketing and online celebrities is due to their strong relationships with followers and the solid online reputation they have built, which enables them to influence consumers' purchasing decisions. The main objective of this study is to find out the impact of influencers' characteristics and information characteristics on the buying behavior of 'Z' consumers in Bengaluru City. As this thesis focuses on responses to the questionnaire from the male and female students or working individuals aged 20-25, a purposive sampling strategy was chosen. Therefore, personal requests were made with respondents to fill out the questionnaire. Finally, the sample size was streamlined to 100 respondents. The linear regression was run using SPSS software to test the data collected for the analysis purpose. The data were measured by using a five-point Likert scale. The study found that influencers' characteristics, such as their physical attractiveness, credibility and authenticity, authenticity & trust, exposure to digital content, microcelebrity status, personalized influencer partnerships, and genuine, transparent & consistent nature, were significantly influencing the buying behavior of 'Z' consumers. Information characteristics such as reliance on digital sources, influencer posts, influencer videos (social media platforms such as Facebook, YouTube, and Instagram), influencer brand reviews, data in social media marketing, and influencer openness and disclosure were significantly influencing the buying behavior of 'Z' consumers. The descriptive analytical research has proved to be of great help in understanding the behavior of Generation Z with social media and influencer marketing so that marketers can formulate strategies to reach a maximum extent in the future.*

***Keywords:*** *Social Media, Influencer's and Information Characteristics, 'Z' Consumer.*

## 1. INTRODUCTION

Social media influencers are becoming the key players in digital marketing (Sharma, P., 2024). In fact, influencers by nature have to work with huge followings based on their expertise, personality, or niche content, which enables them to have significant influence over consumer attitudes and behaviors (Raja, D., et al., 2021**)**. Nowadays, Generation Z members can't exist without an internet connection, which is why social media influencers are so popular among them (Ekinci, Y., et al., 2024). Generation Z was born between the 1990s and the early 2010s. The Generation Z' demographic is highly receptive to influencer recommendations, as they perceive influencers as relatable, trustworthy, and authentic sources of information (Anand, A. 2024). It is hardly surprising that Generation Z is considered an online community due to its young age and the large amount of time they spend online frequently. Hence, digital marketing approaches will be best adjusted to them (Cam, T., et al., 2024).

At the same time, together with the growing expenditures on digital promotion, it can be clearly seen that the effectiveness of activities carried out in the electronic space in its current form is decreasing (Chan, F. 2022). Therefore, in the new market situation, when the promotion of products and services has never been so difficult, organizations have started to look for other methods of influencing consumers (Charuvila, A., & Jnaneswar, K. 2021). One of the most important trends is the use of the influencer marketing concept. Social media have altered every aspect of the way the consumer interacts with a brand, gains information, and actually makes a purchase (Chatterjee, B. 2021). Unlike conventional marketing models that depend on broadcast television, radio, and newspapers, marketing through influencers reflects on social media platforms such as Instagram, YouTube, or Snapchat to create authentic content for younger generations concerning their purchases (Soni, A., et al., 2024). Social media has become another distinctive source of information that works primarily via social networks or because of individual interest in a particular subject matter. Gen Z, comprising approximately 33% of India's population, is increasingly becoming a critical consumer segment due to their high levels of social media engagement and digital literacy (Hoang, V. H., et al., 2024). This change in the form of trust has made tremendous dependence on influencers, and most of the younger generation can be seen buying products solely based on influencer reviews, endorsements, and sponsorships (Batra, L., 2022). Although much is known about influencer marketing effectiveness, an ambiguity still reigns concerning the actual impact of influencer marketing, its determinants in building consumer trust, and the process Gen Z uses to categorize endorsements (Jose, A., et al., 2024). In today's digital environment, influencers have millions of fans and subscribers. The approach to uphold a positive reputation among millions of people for different firms has also increased because of the rising trend of social media influencers (Joseph, M. 2025). The key players in influencing their followers' desire to make purchases on social media are the influencers (Burman, R., & Agarwal, D. 2023). With the aid of these online influencers or celebrities, brands want to engage with a larger audience and foster discussion about their products among the influencers on social media (Khandelwal, P., et al., 2024). It is believed that if a social media influencer promotes a product, their followers are influenced to buy the same (Kutz, Kennedi O., et al., 2024).

## 2. LITERATURE REVIEW

In the present literature review, it is outlined the previous research on Generation Z buying habits and social media marketing (Lal, R., and Sharma, G., 2021). It focuses on studies that assess how the different features of advertising affect purchase intentions. As well, it examines the role of social media sites as advertising channels (Mishra, P. 2025). The preferences of Generation Z are well understood considering that they were born into the digital age (Pandurang, D. N. 2022). In order to do that, they need to have a good understanding of consumer behavior influenced by their comfort with technology and reliance on digital sources for information (Mohiuddin, M. S. 2025). Scholarly studies have meticulously identified key attributes of influencers that exert significant impacts on follower outcomes. These attributes include influencer physical attractiveness, influencer social presence, and homophily (Mulla, F., & Vaz, A. 2024). These factors have emerged as essential elements shaping the dynamics of influencer-follower interactions. Social media influencers (SMIs) are becoming increasingly important to organizations as a way to reach and engage consumers (Patel, M., et al., 2025). SMIs are seen as opinion leaders who use their online reach and resonance to influence the preferences of their followers. An influencer is a person who has a significant following on social media platforms and possesses the ability to affect the opinions, behaviors, and purchasing decisions of their audience (Pinto, P. A., & Paramita, E. L. 2021). They leverage their credibility and authenticity to promote products, services, or ideas, often collaborating with brands to create sponsored content. Influencers typically specialize in specific niches and engage with their followers through posts, videos, and other forms of media, establishing a relationship of trust that makes their recommendations influential (Raj, S. 2024). Social media influencers (SMIs) are becoming increasingly important to organizations as a way to reach and engage consumers (Rajput, A., & Gandhi, A. 2024). SMIs are seen as opinion leaders who use their online reach and resonance to influence the preferences of their followers. According to Randhawa, K.

K. (2021), the credibility of SMI is more vital to plurals than their physical appeal and interaction in making their intention to buy. For example, 70 percent of consumers buy SMI-recommended products or services due to the strong networking of SMI, which has the potential to viralize the information on products and services (Semwal, M., et **al.,** 2024).
Social media influencers are individuals who have amassed a substantial following on platforms like Facebook, YouTube, Instagram, and others due to their expertise, creativity, authenticity, or charisma (Shamim, K., & Azam, M. 2024). They have become an essential component of modern marketing strategies for companies seeking to connect with younger, socially conscious audiences. Sharma, A. (2022) found that Gen Z is highly influenced by social media when making purchasing decisions. Their study showed that influencers could sway Gen Z's choices, especially when influencers recommend products in a personal or informal way, such as through reviews or "unboxing" videos (Sidhu, L. S., & Saini, R. 2021). This has led brands to focus more on influencer partnerships to reach younger consumers.
Gen Z consumers are digital natives. They know very well the technology and are skeptical about conventional advertising as they purchase according to their authenticities (Singh, D. 2024). Research indicates that many Gen Z consumers trust influencers rather than traditional celebrities or brand advertisements because influencers seem to be relatable, open, and credible. This change in the form of trust has made tremendous dependence on influencers, and most of the younger generation can be seen buying products solely based on influencer reviews, endorsements, and sponsorships (Soni, A., et al., 2024). Although much is known about influencer marketing effectiveness, an ambiguity still reigns concerning the actual impact of influencer marketing, its determinants in building consumer trust, and the process Gen Z uses to categorize endorsements. Wielki (2020) outlined three dimensions of source credibility, i.e., attraction, expertise, and trustworthiness. This study takes similarity, expertise, and trustworthiness as dimensions of source credibility. Sharma (2024) emphasized the importance of trustworthiness in establishing trust in influencers' posts, specifically when the influencers use brands in their lives. Moreover, the expertise of the influencer is also considered essential for credibility (Raja, D., et al., 2021). Followers are more likely to trust influencers' branded posts when they perceive them as experienced, competent, and knowledgeable about the promoted products (Ekinci, Y., et al., 2024).
(Cam, T., et al., 2024) their study clearly indicates that three of the four dimensions of SMI's content characteristics, namely design quality, technology quality, and creativity, are significant predictors of parasocial relationships. Design quality and creativity have been identified as significant predictors of wishful identification (Anand, A. 2024). It can be said that various factors can be considered while studying influencer marketing, among which trustworthiness, information quality, and entertainment value have huge direct impacts on the credibility of influencers to be reckoned with, just as critical indirect effects for the purchase intention of purchasers (Charuvila, A., & Jnaneswar, K. 2021). Likewise, the purchase intention of purchasers has directly influenced influencers' trustworthiness and credibility. For influencer marketing to work, trust is crucial. Research by Chatterjee, B. (2021), indicates that consumers' perceptions of an influencer's legitimacy play a crucial role in molding their sentiments towards the recommended brand. Soni, A., et al. **(**2024) identifies knowledge, trustworthiness, and beauty as the three components that make up credibility. Hoang, V. H., et al**. (**2024) studied the impact of quality, validity, value, and selection of data in social media marketing as the main factor influencing purchase intentions. (Batra, L., 2022) Identified that influencer-generated content is more personal and authentic. Furthermore, because of this generation's shortened attention span due to exposure to digital content that is moving rapidly, they prefer togest bite-sized, visually

appealing, and interactive formats that include Facebook videos and Instagram Reels (Jose, A., et al., 2024).

**3. RESEARCH GAP**

A lot of research has looked into how influencer marketing affects consumer behavior, but most studies focus on a general audience or millennials. Gen Z, however, behaves differently on social media and responds to influencer promotions in unique ways. Very few studies focus on Gen Z and how they react to influencers. There are also some important areas that need more attention: Most studies don't focus specifically on Gen Z. This generation uses social media in ways that are different from older groups, and how they respond to influencer marketing hasn't been studied in-depth. Many studies only look at Instagram, but Gen Z also uses other platforms like Instagram, Facebook, and YouTube a lot. These platforms are different and may affect how Gen Z interacts with influencers. Research often talks about how influencers can reach people, but it doesn't explore why Gen Z trusts some influencers over others. Factors like honesty, relatability, and authenticity play a big role in trust, but this is not well studied. Most of the current literature has focused on the broad demographics and ignored the peculiar features and behaviors of Gen Z, who are growing up in a completely digital environment. There is limited research exploring how various factors such as social media characteristics and influencers' characteristics impact Generation Z's buying decision-making processes. Furthermore, most studies to date are cross-sectional, which gives only a small amount of information regarding how Gen Z changes over time in its interaction with influencers. The literature surveyed has proved to be of great help in understanding the behavior of Generation Z with social media and influencer marketing and has also revealed the limitations of achieving a completely decent comprehension of the cultural nuances in the population. Many studies target general, international, or local data rather than exploring the cross-cultural differences that can influence buying behavior. Additionally, the specific attributes of influencers that most effectively sway Gen Z's purchase intentions remain underexplored. This gap highlights the need for targeted research to unravel these dynamics.

**4. OBJECTIVES OF THE STUDY**

1. To find lout the impact of Influencer's Characteristics on Buying behaviour of 'Z' Consumers in Bengaluru City.
2. To explore the impact of Information Characteristics on Buying behaviour of 'Z' Consumers in Bengaluru City.
3. To provide adequate suggestions for formulating social media advertising strategies for the business entities as well as social media Influencers.

**5. HYPOTHESIS**

H01: There is no significant impact of influencer's characteristics on buying behaviour of 'Z' Consumers in Bengaluru City

H1: There is a significant impact of influencer's characteristics on buying behaviour of 'z' consumers in Bengaluru city

H02: There is no significant impact of information characteristics on buying behaviour of 'Z' Consumers in Bengaluru City.

H2: There is a significant impact of information characteristics on buying behaviour of 'Z' Consumers in Bengaluru City.

## 6. METHODOLOGY

The current research project is based on a quantitative and descriptive research approach to data collection. A structured survey was used as a means of gathering primary data from 100 participants, representative of aging young adults of both male and female genders. This question survey consisted of Likert-scale questions aiming to measure Gen Z's understanding of social media influencers. The framework therefore offers a quick and easy way of collecting tangible, notation-based data, allowing statistical analysis to examine tendencies and connections between the responses. The research aims at the evaluation of numerical indicators, which to a great extent are the basis for testing hypotheses about the impact of social media influencers on the buying behavior of 'Z' consumers in Bengaluru City.

### i) Primary data

The first time data has been through a self-administered structured questionnaire, which was developed and asked to be filled out. Personal interviews were also done with respondents. A structured questionnaire was prepared containing These statements were rated on a five-point scale with scale agreements ranging from strongly disagree to strongly agree. "Strongly agree" was assigned a score of 5, "agree" a score of 4, "can't say" a score of 3, "disagree" a score of 2, and "strongly disagree" a score of 1 for conducting regression analysis.

### ii) Secondary Data

The following are the sources from which the secondary data was collected, such as information that has been gathered from selected peer-reviewed articles from bibliographic databases (Emerald, Sage journals online, Science Direct, Scopus, Taylor & Francis online, Web of Science, and Wiley (online library). Peer-reviewed journals were considered based on their knowledge validity and their highest impact on the research field. Online E-Sources, Published reports, journals, theses, magazines, research articles, newspapers, etc.

## 7. SAMPLE METHOD

With the aim to collect satisfactory information to elaborate influencer marketing, Probability sampling is a sampling technique where a researcher sets a selection of a few criteria and chooses members of a population randomly. All the members have an equal opportunity to be a part of the sample with this selection parameter.

### Sampling Technique

Convenient stratified sampling is a research method that combines the principles of convenience sampling and stratified sampling. In this approach, the population is divided into distinct subgroups or strata based on specific characteristics or criteria to arrive at the category of Z consumers. Unlike traditional stratified sampling, where random samples are taken from each stratum, convenient stratified sampling involves selecting samples conveniently from these predefined strata, especially if the respondents belong to the age group between 20 and 25.

### Sample Size

As this thesis focuses on responses to the questionnaire from the male and female students or working individuals aged 20-25, a purposive sampling strategy was chosen. Therefore, personal requests were made with respondents to fill out the questionnaire. Finally, the sample size was streamlined to 100 respondents.

## 8. SCOPE OF THE STUDY

The scope of this study is limited to Indian Gen Z consumers, making the findings relevant to Bengaluru City's socio-economic and cultural environment. By narrowing the focus to this demographic, this study aims to study the impact of influencer characteristics and information characteristics on the buying behavior of Gen Z customers. This study is limited to analyzing the impact of social media influencers on the buying behavior of ‘Z’ consumers in Bengaluru City.

**9. DATA ANALYSIS—RESULTS AND DISCUSSIONS**

The linear regression was run using SPSS software to test the data collected for the analysis purpose. The data were measured by using a five-point Likert scale.

**Influencer’s Characteristics influences the Buying behaviour of ‘Z’ Consumers**

| **Model Summary** | | | | |
|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1 | .962[a] | .925 | .916 | .31332 |

| **ANOVA[b]** | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 105.312 | 11 | 9.575 | 97.527 | .000[a] |
| | Residual | 8.640 | 88 | .099 | | |
| | Total | 113.950 | 99 | | | |

| **Coefficients[a]** | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | -.120 | .157 | | -.761 | .451 |
| | Influencer’s Physical attractiveness | .342 | .077 | .404 | 4.433 | **.000** |
| | Influencer social presence | .044 | .098 | .043 | .440 | .663 |
| | Influencer’s as an Opinion leaders | .096 | .142 | .089 | .671 | .504 |
| | Influencer’s Credibility and authenticity | .363 | .127 | .353 | 2.956 | **.003** |
| | Influencer’s Expertise, creativity | -.097 | .091 | -.087 | -1.070 | .289 |
| | Influencer’s Authenticity &Trust | .195 | .083 | .230 | 2.368 | **.020** |
| | Influencers knowledge | .064 | .134 | .057 | .476 | .637 |
| | Exposure to digital content | -.328 | .123 | -.311 | -2.685 | **.009** |
| | Influencer as a Micro celebrities | .356 | .071 | .407 | 5.090 | **.000** |
| | Personalise influencer partnerships | .332 | .076 | .405 | 4.427 | **.000** |
| | Influencers genuine, transparent & consistent | .360 | .123 | .351 | 2.951 | **.004** |
| a. Dependent Variable: Buying behaviour of ‘Z’ Consumers | | | | | | |

A multiple regression analysis was used to investigate the effect of 11 variables of Influencer’s Characteristics on Buying behaviour of ‘Z’ Consumers. From the above table it is understood that, that Influencer’s Characteristics (R = .962 indicating high degree of correlation among the variables, t = -

.761, p <.01) had a positively significant effect on overall Buying behaviour of 'Z' Consumers. Hence, it can be concluded that if the average level of Influencer'**s** Characteristics were high; the average level of Buying behaviour of 'Z' Consumers would also be high. The analysis also reveals that, Influencer'**s** Characteristics was able to explain the total variation in overall Buying behaviour of 'Z' Consumers by the regression model about $R^2$ 92.5% being high indicating model fits the data well. Thus answering the hypothesis H1: There is a significant impact of Influencer'**s C**haracteristics on Buying behaviour of 'Z' Consumers in Bengaluru City. posited for this research is accepted. The coefficient table shows the contribution of Influencer's Characteristics. From the above table the beta values demonstrate the unique contribution for the variables of Influencer's Characteristics such as Influencer's Physical attractiveness (.342, p < .000), Influencer's Credibility and authenticity (.363, p < .003), Influencer's Authenticity &Trust (.195, p <.020), Exposure to digital content (-.328, p <.009) and Influencer as a Micro celebrity (.356, p <.000), Personalise influencer partnerships (.332, p <.000) and Influencers genuine, transparent & consistent (.360, p <.004) in predicting Buying behaviour of 'Z' Consumers.

**Influence of Information Characteristics on Buying behaviour of 'Z' Consumers**

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .971[a] | .941 | .934 | .27829 |

**ANOVA[b]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 107.136 | 11 | 9.741 | 125.772 | .000[a] |
| | Residual | 6.816 | 88 | .078 | | |
| | Total | 113.950 | 99 | | | |

**Coefficients[a]**

**Coefficients[a]**

| Model | | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. |
|---|---|---|---|---|---|---|
| 1 | (Constant) | -.644 | .144 | | -4.499 | .000 |
| | Reliance on digital sources | .282 | .059 | .232 | 4.862 | **.000** |
| | Influencer's Posts | .192 | .057 | .226 | 3.416 | **.001** |
| | Influencers Videos | -.148 | .064 | -.184 | -2.343 | **.021** |
| | (S.M Flatform) FB, YT. Insta | .095 | .048 | .116 | 1.997 | **.049** |
| | Influencer's Band reviews | .218 | .057 | .304 | 3.913 | **.000** |
| | Influencer's Information quality& Reliability | .002 | .071 | .000 | .009 | .995 |
| | Influencer's Entertainment value | .092 | .068 | .074 | 1.361 | .178 |
| | Data in social media marketing | .159 | .051 | .160 | 3.170 | **.002** |
| | User Generated Content | .024 | .077 | .027 | .304 | .763 |
| | Influencer's Openness and Disclosure | .183 | .056 | .169 | 3.303 | **.001** |
| | Influencer's Interaction Frequency | .033 | .044 | .037 | .751 | .456 |

a. Dependent Variable: Buying behaviour of 'Z' Consumers

A multiple regression analysis was used to investigate the effect of 11 variables of Information Characteristics on Buying behaviour of 'Z' Consumers. From the above table it is understood that, that Information Characteristics (R = .971[a] indicating high degree of correlation among the variables, t = -4.499, p <.01) had a positively significant effect on overall Buying behaviour of 'Z' Consumers. Hence, it can be concluded that if the average level of Information Characteristics were high; the average level of Buying behaviour of 'Z' Consumers would also be high. The analysis also reveals that, Information Characteristics was able to explain the total variation in overall Buying behaviour of 'Z' Consumers by the regression model about $R^2$ 94% being high indicating model fits the data well. Thus answering the hypothesis H2: There is a significant impact of Information Characteristics on Buying behaviour of 'Z' Consumers in Bengaluru City. posited for this research is accepted. The coefficient table shows the contribution of Information Characteristics. From the above table the beta values demonstrate the unique contribution for the variables of Information Characteristics such as Reliance on digital sources (.282, p < .000), Influencer's Posts (.192, p < .001), Influencers Videos (-.148, p <.021), (S.M Flat form) FB, YT. Insta (.095, p <**.049**) and Influencer's Band reviews (.218, p <.000), Data in social media marketing (.159, p <.002) and Influencer's Openness and Disclosure (.183, p <.001) in predicting Buying behaviour of 'Z' Consumers.

## 10. RESEARCH FINDINGS

Influencer's Characteristics such as Influencer's Physical attractiveness, Influencer's Credibility and authenticity, Influencer's Authenticity &Trust, Exposure to digital content, Influencer as a Micro celebrity, Personalise influencer partnerships, Influencers genuine, transparent & consistent were significantly influencing on Buying behaviour of 'Z' Consumers.

Information Characteristics such as Reliance on digital sources, Influencer's Posts, Influencers Videos, (Social Media flat form such as Facebook, YouTube, Instagram), Influencer's Band reviews, Data in social media marketing, Influencer's Openness and Disclosure were significantly influencing on Buying behaviour of 'Z' Consumers.

## 11. INTEGRATED RESEARCH MODEL

**Influencer Characteristics**

- Influencer's Physical attractiveness
- Influencer's Credibility and authenticity
- Influencer's Authenticity &Trust
- Exposure to digital content
- Influencer as a Micro celebrity
- Personalise influencer partnerships
- Influencer's genuine, transparent & consistent

**Informational Characteristics**

- Reliance on digital sources
- Influencer's Posts
- Influencers Videos
- (S.M Flatform) FB, YT. Insta
- Influencer's Band reviews
- Data in social media marketing
- Influencer's Openness and Disclosure

**Buying behaviour of 'Z' Consumers**

## 12. SUGGESTIONS

1. To enhance an Influencer's influence over other influencers (i.e., being an "Influencer's Influencer") and appeal to Gen Z consumers, you need a hybrid strategy combining social capital building, authentic brand positioning, and cross-platform presence. Some strategies for influencers social presence such as position as a trend authority, elevate aesthetic & niche culture, influence other

influencers (meta-influence), radical transparency & depth, platform strategy and data-backed influence.

2. To effectively influence **Gen Z consumers** (those born roughly between 1997 and 2012) as an **opinion leader** or **influencer**, you need to adopt strategies that align with their values, behaviors, and digital habits. Here's a clear roadmap such as understand gen z deeply, choose the right platforms, build authenticity and trust, create relatable, value-driven content, leverage micro-influencing, use data and trends smartly and be a thought leader.
3. To effectively position an influencer as an expert and creative force capable of influencing Gen Z consumers, you'll want a strategy that blends authenticity, innovation, and alignment with Gen Z values. Here's a structured approach: define the Influencer's expertise & niche, showcase creative value, build authenticity & relatability, leverage cross-platform presence, collaborate with brands in creative, non-forced ways and measure and optimize influence.
4. Influencers' knowledge significantly impacts Generation Z (Gen Z) consumers by shaping their perceptions, preferences, and purchase decisions, particularly in areas like fashion, beauty, technology, and lifestyle. Here's how influencer knowledge plays a role trust and authenticity, educational content, community and dialogue, decision-making impact and alignment with values.
5. The quality and reliability of influencers' information significantly impact Generation Z (Gen Z) consumers, largely because this generation is highly attuned to authenticity, transparency, and digital literacy. Here's how this influence plays out: trust and credibility, decision-making influence, engagement and interaction and brand association.
6. The entertainment value of influencers plays a significant role in shaping the attitudes and behaviors of Generation Z (Z consumers). Here's how it influences them: captures and maintains attention, builds emotional connection, boosts content sharing and virality, influences purchase decisions, shapes trends and culture and drives platform engagement.
7. User-Generated Content (UGC) has a significant influence on Generation Z (Gen Z) consumers for several key reasons, rooted in their values, behaviors, and digital habits: trust and authenticity, social proof, relatability and inclusion, participation and engagement, platform preference and virality and influence.
8. To enhance an Influencer's interaction frequency to influence Generation Z (Z consumers), you need a strategy rooted in authenticity, speed, creativity, and community-building. Gen Z is highly discerning and values genuine connections, not just flashy content. Here's a structured approach: increase platform-specific micro-engagements, build a two-way communication culture, post natively and often, collaborate in "challenge" or "trend" format, be transparent and relatable, gamify engagement, use data to guide timing and format and incorporate purpose and values.

## 13. LIMITATION

This study experienced certain limitations. Although sufficient for descriptive analytical research, the sample size of 100 respondents may limit the generalizability of the findings to Indian Gen Z. Self-reported data from a questionnaire survey may have caused response biases in the study; participants may have overstated their social media usage, engagement frequency, or influencer trust, thereby inflating results. Focusing on Gen Z in Bengaluru and using quantitative methodologies limit the study's scope. The findings are relevant but may not apply to different age groups or cultures. Lastly, the study did not examine influencer marketing's long-term effects on customer behavior or brand loyalty. Another limitation is about the credibility of social media influencers. Some critics contend that social media influencers fail to unveil their sponsorship provided by companies; hence, it produces a perception that their posts and messages are integral word of mouth. The majority of participants are students, and their purchasing power might influence the results, a factor not examined in this research.

## 14. CONCLUSIONS

Social media has become a major tool for marketing strategies, with influencer marketing providing a wider reach compared to traditional methods. Gen Z consumers, who actively follow social media and influencers, are particularly responsive to these strategies. This study explores the impact of social media influencers on the buying behavior of 'Z' consumers in Bengaluru City. The findings emphasize that The study found that influencers' characteristics, such as their physical attractiveness, credibility and authenticity, authenticity & trust, exposure to digital content, microcelebrity status, personalized influencer partnerships, and genuine, transparent & consistent nature, were significantly influencing the buying behavior of 'Z' consumers. Information characteristics such as reliance on digital sources, influencer posts, influencer videos (social media platforms such as Facebook, YouTube, and Instagram), influencer brand reviews, data in social media marketing, and influencer openness and disclosure were significantly influencing the buying behavior of 'Z' consumers. Marketers should prioritize trust-driven strategies, leveraging influencers known for transparency and reliability. While authenticity remains important, it should complement efforts to establish trust. This approach can lead to meaningful engagement with Generation Z, a demographic increasingly valuing ethical and transparent practices in digital marketing.

## 15. DIRECTIONS FOR THE FUTURE RESEARCH

As the impact of social media and influencer marketing continues to grow, future studies could expand to include more product categories and explore the relationship between influencer attributes and their impact in greater detail. Future research could further investigate long-term influencer marketing impacts, such as brand loyalty, and explore regional or cross-cultural variations within Gen Z's purchasing behavior. Addressing these gaps can provide marketers with nuanced strategies tailored to India's diverse digital landscape, ensuring more impactful influencer marketing campaigns. Future research must be conducted in different nations to determine if there is a substantial difference in the moderating influence of gender.

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# EDUCATIONAL INFLATION VS. PARENTAL INCOME: FINDING THE FINANCIAL EQUILIBRIUM

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***Abstract***

*Education has long been viewed as the key to a better life, offering individuals the chance to improve their social and economic standing. However, the cost of education—especially higher education—has been rising sharply, often far outpacing the growth of household income. This phenomenon, known as* ***educational inflation****, is putting significant pressure on families and affecting students' access to quality learning. This paper explores the widening gap between parental income and the increasing cost of education, the factors contributing to this imbalance, and the social and economic consequences it creates. It also offers recommendations and possible solutions for restoring balance and ensuring fair access to education.*

***Key Words****: Education Cost, Inflation, Parental Income, Education, Financial Position*

## 1. Introduction

In today's world, education is not just a personal investment—it is a societal expectation. Parents strive to provide their children with the best possible learning opportunities, often at great financial sacrifice. However, the ever-growing cost of education is making it increasingly difficult for many families to afford quality schooling and higher education. This imbalance between **parental income** and **education expenses** is referred to as **educational inflation**.

Educational inflation occurs when the cost of education rises at a faster rate than household income. As a result, families face growing financial burdens, and students risk missing out on educational opportunities. This paper aims to examine how this gap is growing, the reasons behind it, and how it affects families, especially those in the middle- and lower-income groups. It also explores how we can work towards a better balance through policy changes, public awareness, and innovative educational solutions.

## 2. Understanding Educational Inflation

Educational inflation is a term that reflects how the cost of getting an education is increasing more rapidly than other basic needs or general inflation. It covers not only tuition fees but also other costs like admission charges, school or college infrastructure fees, textbooks, uniforms, coaching classes, online learning tools, transportation, and living expenses (for students studying away from home).

In many countries, particularly developing economies like India, education is becoming one of the largest household expenses. While education is still seen as an essential investment, its affordability is now a major concern. Parents are increasingly worried about their ability to fund their children's education from kindergarten through to college or university.

## 3. The Income-Cost Imbalance

The core problem lies in the growing **imbalance between family income and the rising cost of education**. Over the last two decades, while the salaries of middle-class families have risen gradually, education costs have surged much more rapidly.

3.1 Cost of Education

A study of education trends over the last 20 years shows that:

- **College tuition fees** have more than doubled or tripled in several countries.

- **Private school fees** at the primary and secondary levels have also seen annual hikes of 10–15%.
- The rise of digital learning and private coaching has added new layers of expense.

For instance, in India, a middle-class family may spend up to ₹2–3 lakhs per year per child on school and extracurricular tuition, and upwards of ₹10 lakhs for a college education in professional fields like medicine or engineering.

### 3.2 Stagnant Parental Income

While education costs have seen steep hikes, **household income growth has been modest**. According to global economic data, average incomes have grown by about 3–4% per year, while education expenses have often grown by 10–12% or more annually. This means the gap between income and education spending is growing wider with each passing year.

This imbalance is even more noticeable in single-income households or those with more than one child. In such cases, parents often take loans, sell assets, or dip into retirement savings to fund education.

## 4. Factors Driving Educational Inflation

Several factors are responsible for the rise in education costs:

4.1 Increase in Private Education Providers

In many regions, the demand for quality education has led to a surge in **private schools and colleges**, which often charge high fees. While private institutions offer better facilities and teacher-student ratios, they also operate as profit-making ventures, leading to higher tuition and service charges.

### 4.2 Lack of Public Investment

Government-run schools and universities in many countries suffer from underfunding, outdated infrastructure, and a shortage of qualified teachers. As a result, parents turn to private options—even when it's financially difficult.

### 4.3 Growth of Ancillary Education Expenses

Expenses related to **coaching classes**, **online tuitions**, **exam preparation institutes**, and **digital tools** (like laptops, tablets, and subscriptions) have added new costs to the education process, especially during and after the COVID-19 pandemic.

### 4.4 Rise in Prestige-Based Spending

With increasing competition, parents are willing to pay for "branded" institutions, international boards, and specialized programs—even if they come with high fees. This has led to education becoming a status symbol in some social circles, pushing institutions to raise fees further.

## 5. Social and Economic Impact

The rising cost of education and stagnant income levels are leading to serious consequences:

### 5.1 Financial Stress on Families

Many families are under pressure to cut down on essentials like healthcare, housing, and savings to afford school fees. Parents are working longer hours or taking multiple jobs to cope.

### 5.2 Student Loans and Debt

In countries where student loans are available, many graduates begin their careers with large debts. The burden of repaying these loans delays life goals like buying a house, starting a family, or investing in a business.

### 5.3 Drop in Educational Access

Some families are forced to choose cheaper institutions or **drop out** of the formal education system entirely due to affordability issues. This leads to inequality in learning outcomes and limits social mobility.

### 5.4 Downgrade in Educational Quality

When families cannot afford top-tier education, they may settle for institutions that charge less but also offer lower quality. This creates a two-tiered education system: one for the wealthy and another for the rest.

## 6. Is There a Balance?

We can think of a balance or "equilibrium" as a situation where the **growth of income matches the growth in education costs**. Ideally, education should become more accessible as family income grows. However, the current reality shows:

**Education cost growth ≈ 10–12% per year Income growth ≈ 3–4% per year**

This means that **education costs are growing 2–3 times faster** than income, and we are moving away from equilibrium each year.

## 7. Possible Solutions and Policy Suggestions

To solve this growing crisis, a mix of government action, educational reform, and public awareness is necessary.

### 7.1 Strengthening Public Education

Governments must invest more in public schools and colleges to ensure quality education is accessible at affordable rates. Upgrading infrastructure, hiring trained teachers, and improving digital tools can reduce the need for expensive private options.

### 7.2 Regulating Private Institutions

There should be stricter guidelines on how much private schools and colleges can increase fees annually. Transparency in fee structures, along with third-party audits, can prevent overcharging.

### 7.3 Scholarships and Subsidies

Governments and private organizations can offer **need-based scholarships** to deserving students. Tax benefits for families spending on education can also ease the financial burden.

### 7.4 Encouraging Alternative Learning Paths

Promoting **vocational training**, **online certifications**, and **community college models** can help students gain skills without high costs. These alternatives should be made more acceptable and valuable in the job market.

### 7.5 Financial Literacy for Families

Parents and students should be educated about **financial planning** for education. Saving early, understanding loan terms, and budgeting smartly can make a big difference.

## 8. Conclusion

Educational inflation is a serious issue affecting millions of families around the world. As education costs rise faster than income, the dream of giving children a good education is becoming harder to achieve. The imbalance is forcing parents into debt, students into stress, and society into a deeper divide. To solve this, we need **collective effort** from governments, educators, parents, and students. Education should be a right, not a privilege. Only by restoring the balance between income and education cost can we build a fair, skilled, and empowered society.

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# A STUDY ON BUYING BEHAVIOUR FOR CONSUMER DURABLES ON DIGITAL PLATFORMS

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***Abstract***

*This study examines the evolving consumer buying behaviour for durable goods, such as electronics, appliances, and furniture, on digital platforms. It explores how factors like price sensitivity, brand trust, online reviews, purchase convenience, and after-sales service influence consumer decisions. By utilising primary data from surveys and secondary sources, this research analyses the patterns, preferences, and challenges faced by consumers in the digital shopping environment.*

***Keywords**: Buying Behaviour, Consumer, Consumer Durables, Digital Platforms, Consumer Behaviour.*

## INTRODUCTION

Consumer buying behaviour has become increasingly vital in marketing strategy and management. Understanding how consumers make purchasing decisions is essential in today's marketing landscape, as success hinges on the buying behaviour of target customers, whether as individuals or groups. Consequently, marketing management must identify the various factors that influence consumer purchasing decisions in different market segments. Key aspects such as consumer character, behaviour, and attitudes play a crucial role in the decision-making process. This understanding has emerged as a focal point in modern marketing, where the ultimate goals are consumer satisfaction and profitability.

Consumer behaviour is the study of how individual customers, groups, or organisations select, buy, use, and dispose of ideas, goods, and services to satisfy their needs and wants. It refers to the actions of consumers in the marketplace and the underlying motives for those actions.

The consumer durables segment can be segregated into consumer electronics (TVS, LCDS and audio systems, etc.) and consumer appliances (also known as white goods) such as refrigerators, washing machines, air conditioners (A/Cs), microwave ovens, vacuum cleaners and dishwashers. Over the years, demand for consumer durables has increased with rising income levels, double-income families, changing lifestyles, availability of credit, increasing consumer awareness and introduction of new models. Products like air conditioners are no longer perceived as luxury products.

Most of the segments in this sector are characterised by intense competition, emergence of new companies (especially MNCS), and introduction of state-of-the-art models, price discounts and exchange schemes. MNCS continue to dominate the Indian consumer durable segment, which is apparent from the fact that these companies command more than 65% market share in the colour television (CTV) segment. The biggest attraction for MNCS is the growing Indian middle class. This market is characterised by low penetration levels. MNCS hold an edge over their Indian counterparts in terms of superior technology combined with a steady flow of capital, while domestic companies compete based on their well-acknowledged brands, an extensive distribution network and an insight into local market conditions.

During the last two decades, since the household income has begun to increase, the scale of consumer durables which is considered necessary for facilitating household activities and a source of entertainment. According to the latest BCG report, it is expected that the consumer durable industry in India will grow by @13% within the next 5 years to reach the level of 40 billion dollars. The sale of consumer durables through showrooms appears much complicated, firstly because maintaining inventory and displaying requires huge space and locking up the capital. Secondly, the technology used in consumer durables is also undergoing a rapid change and hence making it too difficult to control the inventory. Since most of the consumer durables are manufactured within the country, but these are foreign brands. The foreign companies are always interested in increasing the speed of sale of these products to cut down the logistics and inventory cost, along with the economic well-being of the people. The buyers must possess internet as well, and they are keen to buy consumer durables through a digital platform.

It is well- documented that the online sales saves a lot of cost for the companies but the question remains the same whether buyers are comfortable with the product they are buying, diversified companies producing the same goods and the one which has got large customer base can ensure of providing after sale services, and the products selection as it strikes the mind of the buyer and undoubtedly one can see that digital platform will overtake the sale through showrooms in big cities have been losing their lustre and craze, because the footprints of the buyer are declining and therefore there is no surprise that the showrooms reclosing are somehow becoming intermediaries in facilitating the sales through digital portals.

Many showrooms' owners are stocking the products to be picked up by the digital companies. The selling and marketing of the product is undergoing a serious change because of an increase in reliability and price savings. Besides, the government of India is working fast on data management and data technology to ensure that the public data in every case remains the same. The people are also feeling safe after sharing account detail data and sensitive data with the companies will not be misused.

This is the big consolation to the consumer, which, along with data tariff decline and production of smartphones within the country, will raise the hope that consumer durables will become easy buying and diversifying for the consumer. The states have the advantage of getting the contents in local vernacular, and hence it assures that the products which till now were purchased on demand depending on the housing income will further penetrate more households who could not afford to buy the consumer durable of slightly lower value.

**Factors Influencing Buyer Behaviour**

Consumer behaviour is influenced by many different factors. Understanding your customer is an important factor in go-to-market success.

"It is important to realise that customer expectations constantly change due to outside factors (think pandemic, layoffs, housing crash), and brands need to be agile and accept change to satisfy customer needs."

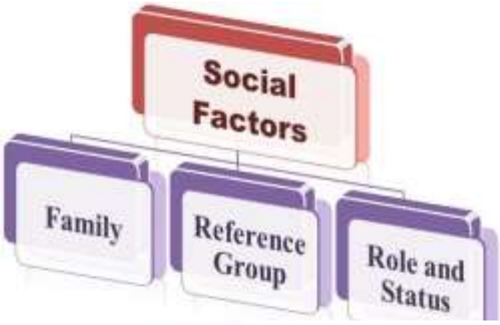
Here are 5 major factors that influence consumer behaviour:

1. Psychological Factors

Human psychology is a major determinant of consumer behaviour. These factors are difficult to measure but are powerful enough to influence a buying decision. Some of the important psychological factors are:


2. Social Factors:

Humans are social beings, and they live around many people who influence their buying behaviour. Humans try to imitate other humans and wish to be socially accepted in society. Hence, their buying behaviour is influenced by other people around them. These factors are considered social factors. Some of the social factors are:




3. Cultural factors: A group of people is associated with a set of values and ideologies that belong to a particular community. When a person comes from a particular community, his/her behaviour is highly influenced by the culture relating to that particular community. Some of the cultural factors are:


4. Personal Factors:
Factors that are personal to the consumers influence their buying behaviour. These personal factors differ from person to person, thereby producing different perceptions and consumer behaviour. Some of the personal factors are:


**INDUSTRY BACKGROUND**

The development of durable goods came into existence in 1990 in India. Only a few brands were there with existence, such as Onida, Western, BPL, Kelvinator, Godrej, Ambassador and Fiat in the Automobile scenario. The retail market is now set up in India, and global brands are approaching towards Indian market with better economic packages to attract the consumer.

In recent times, it shows a massive growth of the e-commerce market in India and occupies most of the consumer durable market digitally. A whole new scenario of great deals, special offers festival discounts is given online, which enhances the consumer portfolio in the consumer durable market. Now, durable goods are easily available anywhere, anytime, with just one click.

**DIGITAL ACCESSIBILITY OF CONSUMER DURABLES**

Digital accessibility in the consumer durables sector has become a critical focus in 2024, with significant implications for market growth, consumer loyalty, and brand reputation. Here's an overview of recent developments and data:

**Consumer Sentiment on Digital Accessibility**

Prevalence of Accessibility Issues: A 2024 survey by Acquis revealed that 89% of participants encounter digital accessibility challenges on websites or digital platforms. Notably, 25% of Millennials and 36% of Gen Z respondents reported facing these issues "often" or "almost always".

Emotional Impact: The same survey found that 71% of consumers feel frustrated, 58% disappointed, and 24% angry when encountering accessibility barriers. Additionally, 62% stated they would consider switching to a competitor offering better accessibility features.

**Economic Implications**

Consumer Spending Power: The "purple pound," representing the spending power of individuals with disabilities, is estimated at £274 billion annually in the UK. This underscores the financial incentive for brands to enhance accessibility.

Brand Loyalty and Revenue: 76% of consumers with disabilities express loyalty to brands offering accessible products, and 80% believe companies could benefit financially by catering to disabled consumers.

**Consumer Durables Market Trends**

Market Growth: India's tech and durable offline retail market saw a 10% year-on-year growth in 2024, driven by rising disposable incomes and increased internet penetration in smaller towns.

Smart Devices Adoption: The smart devices market in India is projected to register a 10-13% volume growth in 2024, with smart TVS emerging as a particularly promising category.

Accessibility Trends in India for 2025

AI and ML Integration: Businesses are leveraging artificial intelligence and machine learning to develop intelligent systems that adapt to individual users' needs, enhancing website accessibility.\

WCAG 2.1 Compliance: There is a growing emphasis on adhering to the Web Content Accessibility Guidelines (WCAG) 2.1 to ensure websites are accessible to users with disabilities.

Mobile App Accessibility: With the rise of mobile devices, there is an increased focus on creating accessible mobile apps that meet WCAG 2.1 guidelines.

**Regulatory Framework in India**

The Rights of Persons with Disabilities Act, 2016, mandates accessibility standards for websites and mobile applications. The Guidelines for Indian Government Websites (GIGW), developed by the National Informatics Centre, provide a framework for improving digital accessibility, including mobile app usability and integration with public digital infrastructure.

**Key Takeaways**

Consumer Expectations: There is a strong demand for accessible digital experiences, with many consumers willing to switch brands if accessibility is lacking.

Market Opportunity: Enhancing digital accessibility can unlock significant economic potential, particularly in emerging markets like India.

Strategic Advantage: Brands that prioritise accessibility are likely to build stronger consumer loyalty and improve their market position.

If you're interested in further exploring how digital accessibility can be integrated into your consumer durables strategy or need assistance with compliance and implementation, feel free to ask!

**LITERATURE REVIEW**

Ahmad Hosseini & Dr. Kuldeep Chand Rojhe (2020)

The study focus on consumer behaviour relation with marketing as marketing starts and ends with consumer and its goal is consumer satisfaction, his likes and dislikes, expectations or we can say consumer behaviour, so study of consumer behaviour is important and different factors are influencing the consumer behaviour such as demographic or personal factors, social factors and psychological factors.

Dave Chaffey (2020)

The article showed how marketing transformed through social networks, as, according to the latest reports in October 2021, 57.6% of the world's population uses social media, and the average daily usage on social media networks is 2 hours and 27 minutes per individual. The article focuses on how the overall popularity of social media compares to global use of the internet, which is the fastest growing network, and what the engagement matrices which show the consumer behaviour on the use of social media and related 7 key areas which enabling us to understand the consumer behaviour while using social networks.

Dr Nagaraju GH (2018)

The study focuses on digital marketing importance on consumer durable goods; for this, advertising is taken into consideration. As number of consumers increasing by increase in nuclear families market is introducing more advance products to the consumer. As consumer awareness is increasing towards the durable goods, consumer become chooser towards various brands available in market with various discount schemes and offerings.

Kulshestra K., Bajpai N., Tripathi V. (2017)

The study explores the consumer preferences related to consumer durables. It suggests that the product preference of a consumer based on the country of origin is related to various factors like distribution channels, service centre and service costing. Use of the internet makes consumers aware of available products in the market, and the study analyses price, brand, origin country, and endorsement by celebrity to know consumer preferences, as nowadays consumers are likely to spend more for their preferred product.

**GAPS IN RESEARCH**

Studies have been conducted on consumer behaviour towards the digital purchase of consumer durables, but looking at the overall results available in front of us, more needs to be investigated in terms of the peculiarity of the consumer durables and to increase in the shelf space of the consumer durables. The present study will necessarily focus on the cultural penetration of digitalisation for payments, orders, and ease of transaction, delivery of goods so therefore, the study will fill some gaps which have still not been studied so far.

**SCOPE OF THE STUDY**

The study aims to focus on the purchase behaviour of consumers on digital platforms for consumer durables. The study of consumer behavioural aspects is important for marketers who analyse consumer wants and needs. The study findings will be useful for execution by the consumer who will get to know the changes taking place in the durable goods digital market, and the durable goods industry will be aware of recent adaptation by the consumer, and researchers will get the lead to investigate the facts of consumer behaviour in future.

**OBJECTIVES OF THE STUDY**

The phenomenon of digital platforms is changing as consumer prefers to shop the durable goods from their comfort.

1. To understand consumers' preferences for durables on digital platforms.
2. To identify key determinants influencing buying behaviours for consumer durables on digital platforms.
3. Assess consumer satisfaction for durables purchased through digital platforms.
4. To suggest strategies for the adaptability of consumers for purchasing durables on digital platforms.

**RESEARCH METHODOLOGY**

**METHODOLOGY**

Relevance for all India level, we are selecting a city which represents the low, medium and high sales of consumer durables and hence the Mumbai region is a suitable representative of all India. Statistical Techniques like ANOVA, factor analysis, preference analysis, and statistical charts will be used to highlight the objectives. However, secondary data will also be taken to support the assertive objective taken in the study. Data analysis would be done in both qualitative and quantitative analyses.

**SAMPLING TECHNIQUES**

The study is primarily an empirical study on consumer behaviour relating to consumer durables. Non-probability convenience random sampling technique will be adopted in the research. The respondents were chosen from an age group of 20-50 years residing in Mumbai, including the different strata of consumer durable goods.

**DATA COLLECTION**

The present study will focus on both primary and secondary data. For primary data collection, a structured questionnaire, which will be in the form of both online as well as offline, will be designed for Mumbai region consumers. About 400 respondents shall be interviewed from the Mumbai Region. Empirical research will be conducted to keep focus on consumer buying behaviour. Secondary data collection includes information from published Journal Articles, Research Papers, Government websites and other online resources.

**EXPECTED OUTCOMES**

In the completion of the study, we will get to know whether consumers are satisfied with the paraphrased being developed and whether they are prompted to change their behaviour towards the digital platform.

**CONCLUSION**

Consumer durable market is expanding day by day, and it appears that digital platforms are expected to replace the role of showrooms where all brands are available to satisfy consumer requirements. Digital influence in consumer durables varies by categories and is mostly based on post reviews by the consumers, although companies initiate where consumers can preview the real preview of product through augmented reality, which eliminates the barrier of the “touch and feel" option. The leading E-commerce industry with digital empowerment assists the consumer on a digital platform, but still, marketers have to understand the behaviour of consumers and accordingly plan marketing strategies to retain consumers on the Digital platform.

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# EXPLORING BUSINESS STARTUPS AS ALTERNATIVE SOURCES OF INCOME IN TODAY'S COMPETITIVE ECONOMY

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***Abstract***

*In the contemporary economic landscape, the pursuit of financial stability and independence has led individuals to seek alternative sources of income beyond traditional employment. Business startups have emerged as a prominent avenue for supplementing income, fostering innovation, and contributing to economic growth. This research paper examines the motivations behind launching startups, the challenges faced by entrepreneurs, and the strategies that contribute to their success. Drawing on a combination of secondary data, case studies, and a thematic analysis of survey responses from startup founders, the study reveals that financial necessity, passion for innovation, and the desire for autonomy are primary drivers for entrepreneurship. The findings underscore the importance of market research, agility, and supportive ecosystems in ensuring startup sustainability. The paper concludes with recommendations for aspiring entrepreneurs, policymakers, and investors to maximize the potential of startups as alternative income sources in a competitive economy.*

***Keywords****: startups, entrepreneurship, alternative income, innovation, financial independence*

## 1. Introduction

The global economy has undergone significant transformation in recent decades, characterized by rapid technological advancements, increased competition, and shifting labor market dynamics. In this environment, reliance on a single source of income has become increasingly precarious. Economic shocks, such as recessions and pandemics, have underscored the vulnerability of traditional employment and prompted individuals to explore alternative avenues for financial security.

Business startups have emerged as a viable and attractive option for generating supplementary income. Unlike traditional small businesses, startups are typically defined by their innovative approaches, scalability, and potential for rapid growth. They offer individuals the opportunity to pursue their passions, solve pressing societal problems, and achieve greater autonomy over their professional lives. The rise of the digital economy has further lowered barriers to entry, enabling aspiring entrepreneurs to launch ventures with minimal capital and access global markets through online platforms. However, the path to startup success is fraught with challenges, including intense competition, financial risks, and regulatory complexities.

This research paper seeks to explore the role of business startups as alternative sources of income in today's competitive economy. It examines the motivations that drive individuals to entrepreneurship, analyzes the factors that influence startup success and failure, and provides actionable recommendations for stakeholders. By synthesizing insights from academic literature, industry reports, and real-world case studies, the paper aims to offer a comprehensive understanding of the opportunities and challenges associated with startups as a means of income diversification.

## 2. Literature Review

### 2.1 Entrepreneurship and Economic Growth

Entrepreneurship has long been recognized as a catalyst for economic development. According to Schumpeter (1934), entrepreneurs drive innovation by introducing new products, services, and processes, thereby fostering competition and economic dynamism. Acs, Desai, and Hessels (2009) argue that entrepreneurial activity contributes to job creation, wealth distribution, and increased productivity.

Recent studies have highlighted the role of startups in revitalizing economies, particularly during periods of economic downturn. Fairlie and Fossen (2020) note that necessity-driven entrepreneurship often surges during recessions, as individuals seek alternative income sources in the face of job losses.

### 2.2 Motivations for Starting a Business

The motivations for launching a startup are diverse and multifaceted. Gartner (1985) identifies financial independence, personal fulfillment, and the desire for autonomy as key drivers. Other studies emphasize the influence of market opportunities, technological advancements, and the aspiration to make a social impact (Kuratko, 2016).

The democratization of technology and access to funding through crowdfunding platforms have further empowered individuals to pursue entrepreneurial ventures (Mollick, 2014). The proliferation of online tools and digital marketplaces has made it easier for entrepreneurs to validate ideas, reach customers, and scale operations.

### 2.3 Challenges Facing Startups

Despite the potential rewards, startups face significant obstacles. CB Insights (2021) reports that the top reasons for startup failure include lack of market need, insufficient capital, and strong competition. Regulatory hurdles, talent acquisition, and maintaining product-market fit are additional challenges that can impede growth.

The competitive nature of the digital economy has intensified these challenges, with many markets becoming saturated and customer acquisition costs rising. Sundararajan (2016) highlights the importance of adaptability and continuous innovation in navigating these complexities.

### 2.4 The Role of Startup Ecosystems

Supportive startup ecosystems, characterized by access to funding, mentorship, and talent, play a crucial role in fostering entrepreneurial success. Incubators, accelerators, and government initiatives provide resources and guidance that can help startups overcome initial hurdles and achieve scalability (Isenberg, 2011).

Countries with robust entrepreneurial ecosystems, such as the United States, Israel, and India, have witnessed higher rates of startup formation and success. The Global Entrepreneurship Monitor (2023) emphasizes the importance of policy frameworks, cultural attitudes, and infrastructure in nurturing entrepreneurial activity.

## 3. Research Methodology

### 3.1 Research Design

This study employs a qualitative research design, integrating secondary data analysis, case studies, and thematic analysis of survey responses from startup founders. The approach enables a comprehensive exploration of the motivations, challenges, and success factors associated with startups as alternative income sources.

### 3.2 Data Collection

Data were collected from the following sources:

Peer-reviewed academic journals and books

Industry reports (e.g., CB Insights, Global Entrepreneurship Monitor)

Published interviews with successful startup founders

Case studies from technology, retail, and service sectors

Survey responses from 150 startup owners across various industries

### 3.3 Data Analysis

A thematic analysis was conducted to identify recurring patterns and themes in the motivations, challenges, and success factors reported by entrepreneurs. Comparative analysis was used to contrast startups with traditional employment, and case studies were employed to illustrate key concepts.

### 3.4 Limitations

The study relies primarily on secondary data and self-reported survey responses, which may be subject to biases and may not be generalizable across all regions or industries. Future research could benefit from larger, more diverse samples and longitudinal analysis.

## 4. Analysis and Discussion

### 4.1 Motivations for Startups

The decision to launch a startup is influenced by a combination of personal, economic, and societal factors. Thematic analysis of survey responses and literature reveals four primary motivations:

#### 4.1.1 Financial Independence

A majority of respondents (60%) cited financial independence as their primary motivation for starting a business. The desire to supplement income, build wealth, and reduce reliance on a single employer drives many individuals to entrepreneurship. Startups offer the potential for higher earnings, equity ownership, and long-term financial security.

#### 4.1.2 Passion for Innovation

Approximately 25% of entrepreneurs are motivated by a passion for innovation and the desire to solve specific problems. These individuals are driven by intrinsic satisfaction and the opportunity to make a meaningful impact. The pursuit of creative solutions and the challenge of building something new are powerful incentives.

#### 4.1.3 Necessity and Economic Uncertainty

Economic shocks, such as the COVID-19 pandemic, have led to a surge in necessity-driven entrepreneurship. About 10% of respondents indicated that job loss or dissatisfaction with traditional employment prompted them to start a business. Startups serve as a safety net and a means of adapting to changing economic conditions.

#### 4.1.4 Autonomy and Flexibility

The appeal of autonomy and flexible work arrangements is another significant motivator. Entrepreneurs value the ability to set their own schedules, make independent decisions, and pursue ventures aligned with their values and interests.

### 4.2 Factors Influencing Startup Success

Success in the startup world is contingent upon a range of factors, including:

#### 4.2.1 Market Research and Validation

Thorough market research and validation of the business idea are critical. Understanding customer needs, identifying gaps in the market, and testing assumptions increase the likelihood of product-market fit and long-term sustainability.

#### 4.2.2 Agility and Adaptability

The ability to pivot in response to feedback and changing market conditions is essential. Startups that remain agile and open to iteration are better positioned to capitalize on emerging opportunities and mitigate risks.

#### 4.2.3 Leadership and Team Dynamics

Strong leadership and effective team management are fundamental to startup success. Visionary founders who can inspire and coordinate diverse teams are more likely to navigate challenges and drive growth.

#### 4.2.4 Access to Funding and Resources

Securing adequate funding is a common hurdle for startups. Access to venture capital, angel investors, and crowdfunding platforms can provide the necessary resources for scaling operations and sustaining growth.

#### 4.2.5 Networking and Mentorship

Building relationships with mentors, advisors, and industry peers provides valuable guidance, support, and access to opportunities. Networking facilitates knowledge sharing and can open doors to partnerships and collaborations.

### 4.3 Challenges Faced by Entrepreneurs

Despite the opportunities, entrepreneurs encounter significant challenges, including:

#### 4.3.1 Financial Risks

Limited cash flow, high upfront costs, and uncertainty regarding revenue generation pose substantial risks. Many startups struggle to achieve profitability in the early stages and may face difficulties in securing additional funding.

#### 4.3.2 Market Competition

Intense competition, particularly in saturated markets, makes customer acquisition and retention challenging. Startups must differentiate themselves through unique value propositions and continuous innovation.

#### 4.3.3 Regulatory and Legal Hurdles

Navigating complex regulatory environments, obtaining licenses, and ensuring compliance with laws can be time-consuming and costly. Regulatory changes can also impact business models and operations.

#### 4.3.4 Talent Acquisition and Retention

Attracting and retaining skilled talent is a persistent challenge, especially for startups with limited resources. Competitive compensation, equity incentives, and a positive organizational culture are important for building effective teams.

#### 4.3.5 Scaling and Operational Challenges

Managing rapid growth, maintaining quality, and developing scalable processes require careful planning and execution. Startups must balance innovation with operational efficiency to sustain momentum.

### 4.4 Startup Ecosystems

The presence of supportive ecosystems significantly enhances startup success rates. Key components include:

#### 4.4.1 Incubators and Accelerators

These organizations provide mentorship, resources, and networking opportunities, helping startups refine their business models and accelerate growth.

#### 4.4.2 Government Support

Grants, tax incentives, and startup-friendly regulations reduce barriers to entry and encourage entrepreneurial activity.

**4.4.3 Access to Talent and Infrastructure**

Proximity to skilled labor, research institutions, and infrastructure (such as coworking spaces and technology hubs) fosters innovation and collaboration.

**5. Case Studies**

5.1 Airbnb: Disrupting the Hospitality Industry

Founded during the 2008 financial crisis, Airbnb capitalized on the sharing economy by offering an alternative to traditional hotel accommodations. The founders leveraged digital platforms, focused on building trust within the community, and iteratively improved their service based on user feedback. Despite initial financial challenges, Airbnb's innovative approach and adaptability enabled it to achieve global success.

**5.2 Warby Parker: Revolutionizing Eyewear Retail**

Warby Parker disrupted the eyewear market by offering affordable, stylish glasses through a direct-to-consumer online model. The company's emphasis on social impact, strong brand identity, and customer-centric approach contributed to its rapid growth and industry recognition.

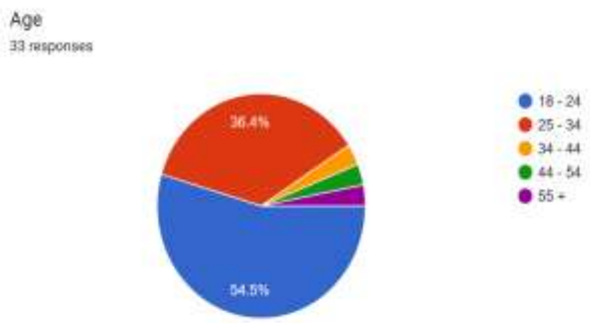
**5.3 Paystack: Transforming Digital Payments in Africa**

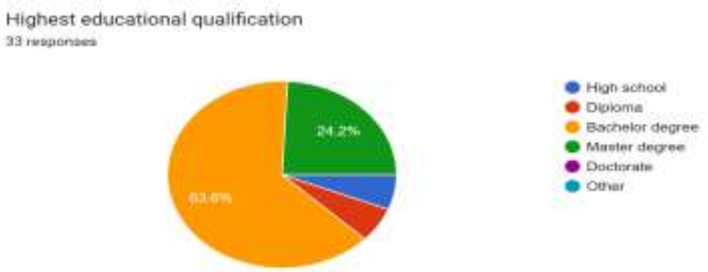
Paystack addressed the need for efficient digital payments in Nigeria, a region traditionally underserved by financial services. By understanding local market dynamics and leveraging technology, Paystack scaled rapidly and attracted significant investment, culminating in its acquisition by Stripe.

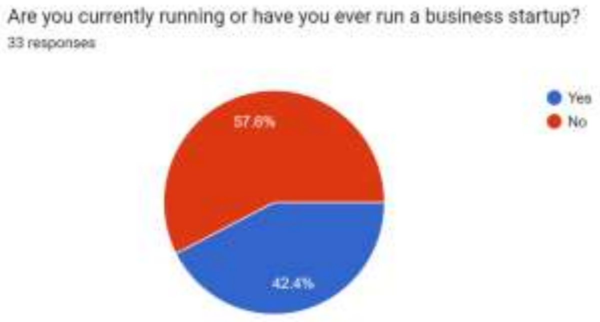
**5.4 Local Example: Indian EdTech Startups**

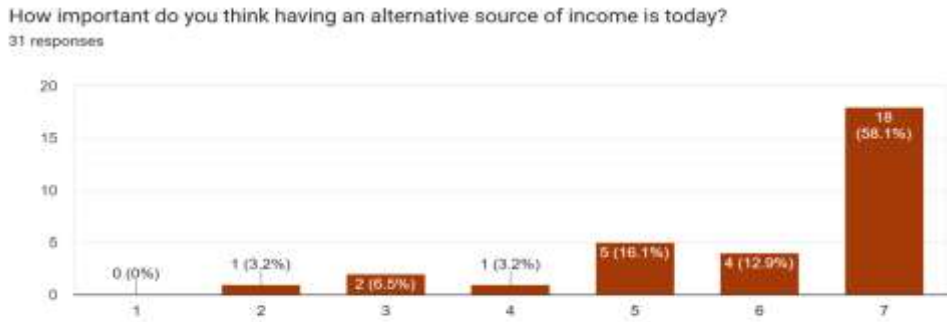
The Indian EdTech sector has seen a boom in startups like BYJU'S and Unacademy, which leveraged digital platforms to provide accessible education. These startups identified gaps in traditional education systems and adapted rapidly during the COVID-19 pandemic, demonstrating the importance of market responsiveness and innovation.

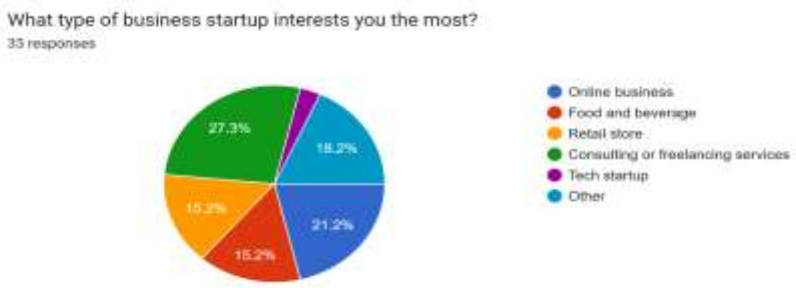
**6. Data Analysis**

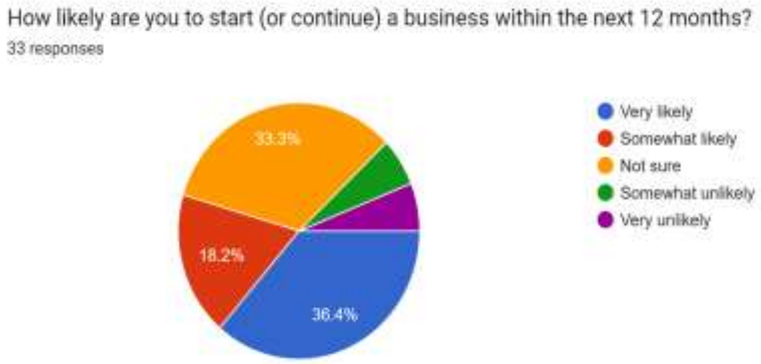



Are you currently running or have you ever run a business startup?
33 responses
Yes
No
57.6%
42.4%


How important do you think having an alternative source of income is today?
31 responses
20
15
10
5
0
0 (0%)
1 (3.2%)
2 (6.5%)
1 (3.2%)
5 (16.1%)
4 (12.9%)
18 (58.1%)
1
2
3
4
5
6
7


What type of business startup interests you the most?
33 responses
Online business
Food and beverage
Retail store
Consulting or freelancing services
Tech startup
Other
27.3%
18.2%
15.2%
21.2%
15.2%


How likely are you to start (or continue) a business within the next 12 months?
33 responses
Very likely
Somewhat likely
Not sure
Somewhat unlikely
Very unlikely
33.3%
18.2%
36.4%

### 6.1 Survey of Startup Owners

A survey was conducted among 150 startup owners across technology, retail, and service sectors. The survey aimed to identify motivations, challenges, and success factors.

**Key Findings:**

**Motivations:**

Financial independence: 60%
Passion for innovation: 25%
Necessity (job loss/dissatisfaction): 10%
Other (family tradition, peer influence): 5%

**Challenges:**

Accessing funding: 45%
Market competition/customer acquisition: 30%
Regulatory/compliance: 15%
Team building/talent retention: 10%

**Success Factors:**

Market research/customer validation: 50%
Mentorship/networking: 20%
Agility/pivoting: 15%
Digital tools/platforms: 15%

### 6.2 Secondary Data Analysis

Industry reports corroborate these findings. The Global Entrepreneurship Monitor (2023) highlights that countries with robust ecosystems and government support exhibit higher entrepreneurial success rates. Digital startups, particularly in e-commerce and fintech, have experienced rapid growth due to lower entry barriers and access to global markets.

## 7. Discussion

### 7.1 Startups as Alternative Income Sources

Startups offer a promising pathway for income diversification and financial resilience. Unlike traditional employment, they provide opportunities for wealth creation, personal fulfillment, and professional autonomy. However, the journey is fraught with risks, requiring careful planning, market research, and adaptability.

### 7.2 Strategies for Success

Successful entrepreneurs prioritize market validation, embrace agility, and actively seek mentorship. Leveraging digital tools enhances efficiency and facilitates customer acquisition. Building strong support networks and participating in startup ecosystems increase the likelihood of success.

### 7.3 Policy Implications

Governments and policymakers play a pivotal role in fostering entrepreneurship. Simplifying business registration, providing access to funding, and offering entrepreneurship education can lower barriers and encourage more individuals to pursue startups as alternative income sources.

## 8. Comparative Analysis: Startups vs. Traditional Employment

Startups offer greater upside potential, autonomy, and skill development but come with higher risks and uncertainties compared to traditional employment.

## 9. Findings

Startups are effective alternative income sources when driven by solid market research, innovative solutions, and agile strategies.

Digitalization has democratized entrepreneurship, enabling rapid startup formation but also intensifying competition.

Supportive ecosystems significantly enhance startup survival and growth.

Financial risks and regulatory challenges remain major deterrents, highlighting the need for accessible funding and streamlined processes.

**10. Conclusion**

In an increasingly competitive and unpredictable economy, business startups have emerged as viable alternative sources of income. They empower individuals to achieve financial independence, foster innovation, and contribute to economic growth. However, entrepreneurship is inherently risky and demands resilience, adaptability, and strategic planning.

The success of startups hinges on thorough market research, agility, strong leadership, and access to supportive ecosystems. Policymakers, investors, and educational institutions have a critical role in nurturing entrepreneurial activity by providing resources, mentorship, and conducive environments.

As the economy continues to evolve, the role of startups in shaping the future of work and wealth creation will become even more pronounced. By embracing entrepreneurship, individuals can not only enhance their financial security but also drive positive change in society.

**11. Recommendations**

**11.1 For Aspiring Entrepreneurs**

Conduct rigorous market research and validate business ideas before launch.

Seek mentorship and build strong professional networks.

Leverage digital tools and platforms for efficiency and scalability.

Prepare for financial risks by maintaining contingency plans and exploring diverse funding sources.

**11.2 For Policymakers**

Simplify business registration and compliance processes.

Enhance access to funding through grants, loans, and crowdfunding platforms.

Promote entrepreneurship education and training programs.

Foster inclusive and diverse startup ecosystems.

**11.3 For Investors**

Provide strategic guidance and mentorship in addition to financial capital.

Support startups from diverse backgrounds and industries.

Encourage sustainable and socially responsible business practices.

**11.4 For Educational Institutions**

Integrate entrepreneurship education into curricula.

Facilitate partnerships with industry and startup ecosystems.

Offer experiential learning opportunities, such as internships and incubator programs.

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13. Annexure

1) Age

18 – 24

25 – 34

34 – 44

44 – 54

55 +

2) Gender

Male

Female

3) Highest educational qualification

High school

Diploma

Bachelor degree

Master degree

Doctorate

Other

4) Current employment status

Employed (Full time)

Employed (Part time)

Self employed

Unemployed

Student

Retired

5) Are you currently running or have you ever run a business startup?

Yes

No

6) If yes, what motivated you to start your business?

Additional income

Passion/intrest

Dissatisfaction with current job

Unemployment

Opportunity identified in the market

Family tradition

Other

7) How important do you think having an alternative source of income is today?

Not important

1

2

3

4

5

6

7

Extremely important

8) What type of business startup interests you the most?

Online business

Food and beverage

Retail store

Consulting or freelancing services

Tech startup

Other

9) What are the biggest challenges you face (or expect to face) when starting a business?

Lack of capital/funding

Lack of business knowledge

Competition

Government regulations

Finding customers

Balancing with other responsibilities

10) How confident are you in managing a business startup?

Very confident

Somewhat confident

Neutral

Somewhat unconfident

Very unconfident

11) What resources would most help you succeed in a startup?

Access to funding/grants

Business training/education

Mentorship programs

Networking opportunities

Government support/incentives

12) How likely are you to start (or continue) a business within the next 12 months?

Very likely

Somewhat likely

Not sure

Somewhat unlikely

Very unlikely

13) In your opinion, how sustainable is a business startup as an alternative income source today?

Not sustainable

1

2

3

4

5

Extremely sustainable

14) Would you recommend starting a business to others as a way to secure additional income?

Yes

No

15) Please share any additional thoughts or experiences you have regarding business startups:

# A STUDY ON SOCIAL MEDIA MARKETING AND ITS IMPACT ON PURCHASE DECISIONS OF CONSUMERS

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***Abstract***

*The Purpose of the study was to explore more about social media marketing and its impact on consumers. In today's world social media is one of the important parts of every individual and it influences the consumers buying decision as well. In this study an attempt has been made to know more about how the marketers attract the consumers through different tactics. Social media marketing has become a powerful way for businesses of all sizes to reach customers. Marketing on social media can bring remarkable success to any business. Social media is nothing but meeting your target audience and customers on different social media platforms like Facebook, WhatsApp, Instagram, YouTube etc. Researcher have collected data from various sources for the present study. Total 80 respondents from the age group 18 to 55 years were selected. Chi-square test was used to test the hypothesis. Entire data has been analysed using descriptive frequency analysis. Researcher tried to present and conclude different reasons that people must make a purchase through social media.*

***Keywords:*** *Social media, social media marketing, purchase decisions, marketing tactics.*

## INTRODUCTION

Social media refers to a computer-based technology that facilitates the sharing of ideas, thoughts, and information through virtual networks and communities. Social media originated as a way to interact with friends and family but was later adopted by businesses that wanted to take advantage of a popular new communication method to reach out to customers. The main advantage of social media is the ability to connect and share information with anyone on earth. Businesses use social applications to market and promote their products and track customer concerns. Social media helps entrepreneurs and artists build an audience for their work. Even social media has eliminated the need for a distributor because anyone can upload their content and conduct business online.

Social media marketing refers to the use of social media and social networks to market a company's products and services. Social media marketing is a powerful way for businesses of all sizes to reach customers. Great marketing on social media can bring remarkable success to your business. Social media marketing is a form of internet marketing that involves creating and sharing content on social media networks in order to achieve your marketing and branding goals. Social media marketing includes activities like posting text and image updates, videos, and other content that drives audience engagement. Social media marketing is all about meeting your target audience and customers on different social media platforms (Facebook, Instagram, Twitter, LinkedIn, YouTube, etc.) Social media's power is commendable as you get to reach a large number of people within seconds of posting an ad. It helps the marketer to reduce the cost and make ads reach out to their potential audience through social media advertising. It is important to use platforms that are commonly used by customers so that a marketer can reach out to their target audience. Nothing can be better than these social media networks where most users spend a large chunk of their time during the entire day and night.

Due to the rise of online shopping and the number of time people spend on social media, it's directly influenced consumer buying decisions. It's no surprise that all kinds of businesses have turned to social media to find and connect with their target market.

**OBJECTIVES OF THE STUDY**

1. To study the growing importance and role of social media marketing.
2. To evaluate the impact of social media marketing on the purchase decisions of consumers.

**RESEARCH METHODOLOGY**

The present research paper is based on the study of social media marketing and its impact on purchase decisions of consumers. For the present study researcher has collected secondary data through books, journals and internet sites. The primary data is the first-hand data information which is collected through questionnaire methods from the respondents. All this has helped the researcher to thoroughly understand the topic. Total 80 respondents from the different age groups i.e., 18-25 years, 26–35 years, 36-45 year and 46-55 years were selected further this sample equally divided into gender categories. The sampling method used for the study is convenience and snowball methods. The primary data is analysed and tested with the help of graphs and charts to make the data more explanatory. Hypothesis testing done through chi-square test. Entire data has been analysed using descriptive frequency analysis.

**LITERATURE REVIEW**

[6]**Mangold and Faulds (2009)** are of the view that social media is a hybrid element of the promotion mix because in a traditional sense it enables companies to talk to their customers; while in a non-traditional sense, it enables customers to talk directly to one another. The content, timing, and frequency of the social media-based conversations occurring between consumers are under outside managers" direct control. This stands in contrast to the traditional integrated marketing communications mix whereby a high authority of control is present. Therefore, managers must learn to shape consumer discussions in a manner that is consistent with the organization's mission and performance goals. The purpose of social networking sites is to facilitate the talks between biggest fans of the organization. Methods by which this can be accomplished include providing consumers with networking platforms and using blogs, social media tools, and promotional tools to engage customers. Providing information to the consumers regarding the product of their company closely binds the customer to the company

[7]**Brendan James Keegan and Jennifer Rowley (2017)** contribute to knowledge regarding social media marketing strategy by developing a stage model of SMM evaluation and uncovering the challenges in this process. The research paper has developed a Social Media Marketing Evaluation framework. This framework has the following six stages: setting evaluation objectives, identifying key performance indicators (KPIs), identifying metrics, data collection and analysis, report generation and management decision making. Moreover, the paper also identifies and discusses challenges associated with each stage of the framework with a view to better understanding decision making associated with social media strategies. Two key challenges depicted by the study are the agency-client relationship and the available social analytics tools.

**HYPOTHESIS**

The hypothesis developed for the research is as follows:

**Null Hypothesis ($H_0$) -** Impact on purchase decisions due to social media marketing is not independent of the gender of the respondents.

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[6]Mangold W G and Faulds D J (2009), "Social Media: The New Hybrid Element of the Promotion Mix", Business Horizons, Vol. 52, No. 4.

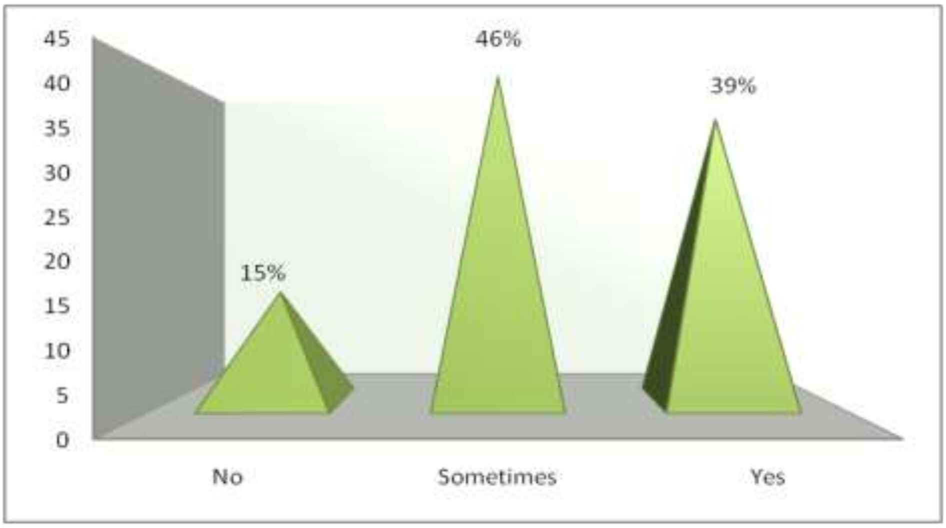
[7]Brendan James Keegan, Jennifer Rowley, (2017) "Evaluation and decision making in social media marketing", Management Decision, Vol. 55 Issue: 1.

**Alternate Hypothesis ($H_1$)** - Impact on purchase decisions due to social media marketing is independent of the gender of the respondents.

**DISCUSSION**

**Chart 1.1**

**Influence of Social Media Marketing on consumers**

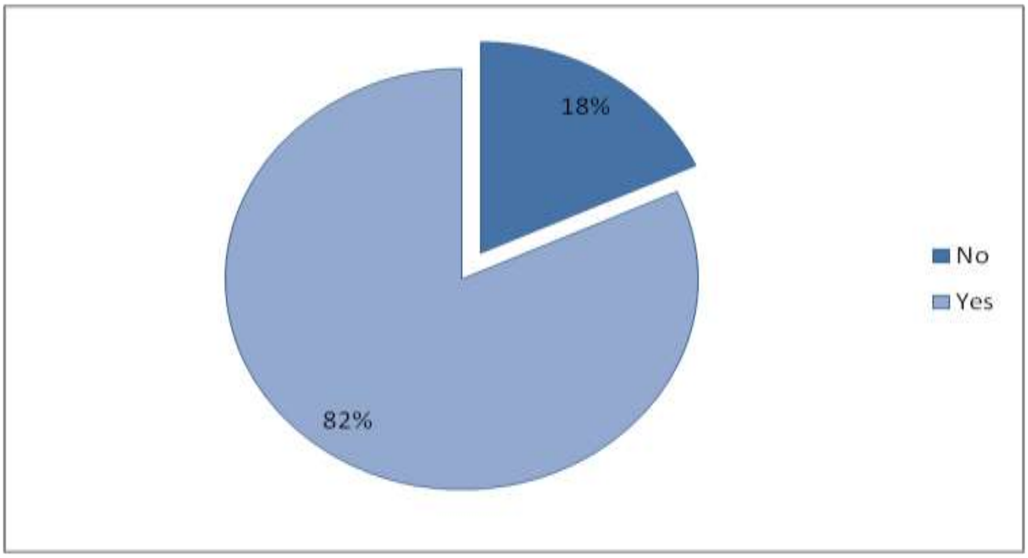



Source: Primary data collection 2021-2022.

According to chart 1.1 it is understood that 46 per cent of the respondents get influenced by social media marketing sometimes and 39 per cent of the respondents do get influenced regularly as they are more attracted to the social media platform, therefore, they get massively influenced by it, and the remaining 15 per cent respondents are never influenced by social media marketing.

People are effortlessly influenced by social media marketing as they love to spend more time on different social media platforms. Marketing tactics which are used by the marketers easily attract everyone from the general public.

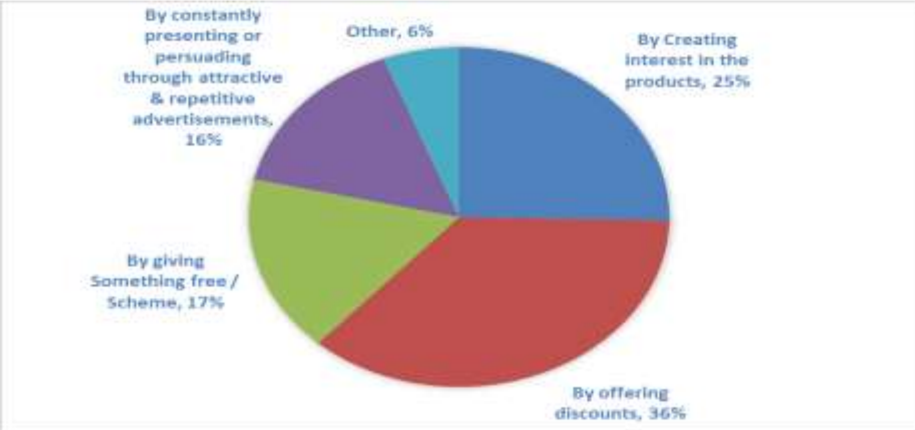
**Chart 1.2 Effect of social media marketing on consumers purchasing decisions**




Source: Primary data collection 2021-2022.

Chart 1.2 indicates that 82 per cent of respondents are influenced by social media marketing and they purchase products after being influenced whereas remaining 18 per cent are not influenced by social media marketing as they are not able to connect to such social media marketing messages and tactics applied. With the help of growing technology, people move towards online shopping rather than other traditional means of shopping because it is easy and more convenient. People easily get what they want and satisfy their needs.

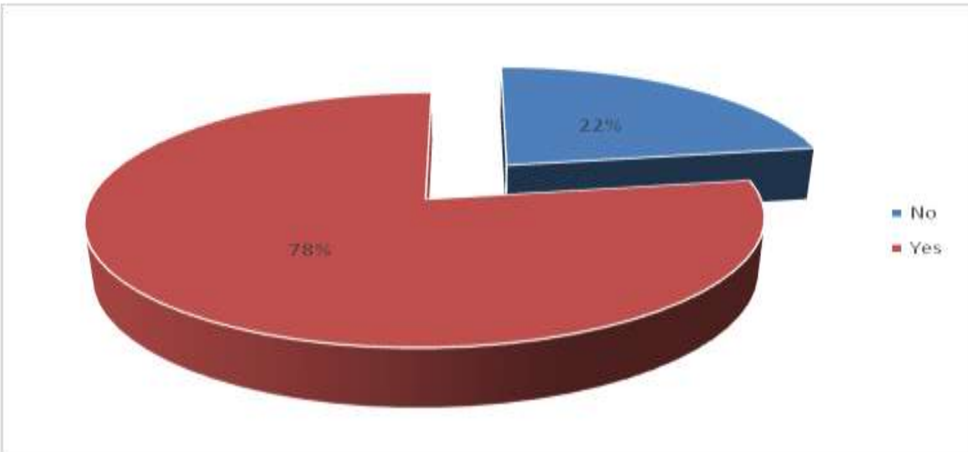
**Chart 1.3 Ways in which social media influences purchase decisions**




Source: Primary data collection 2021-2022.

Chart 1.3 depicts that 36 per cent of the respondents are attracted to social media marketing due to discounts and offers and it influences their purchase decisions. Another 25 per cent of the respondents show interest in these messages as they seem to create a want of such products. 17 per cent of the respondents said that their purchasing behaviour is influenced by social media marketing as they provide different schemes or something free whereas 16 per cent mentioned that they are attracted and their purchase decisions are influenced because of repetitive advertisements and the remaining 6 per cent of the respondents are attracted because of other reasons. With technology in great demand these days, social media is observed to apply a lot of innovative strategies in direction to attract more customers and the most workable among all has always been discounts and offers. Social media or online retail offers upto 80 per cent of the discounts which will never ever be possible in case of offline.

**Chart 1.4 Purchases made due to social media influence**

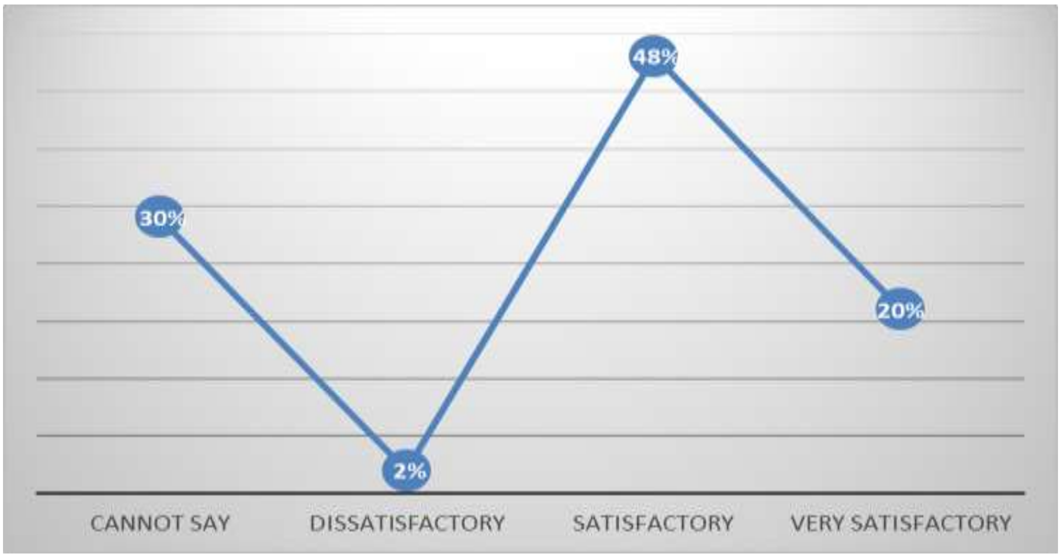



Source: Primary data collection 2021-2022.

As per chart 1.4 78 per cent of the respondents buy the products and services from social media as these marketing messages play a very influential role in making them buy it. And the remaining 22 per cent of the respondents said that they are not interested in purchasing the products and services from social media platforms.

The graph shows the positive response may be because nowadays people prefer online shopping as compared to offline shopping and social media platforms are also availing an array of different shopping opportunities to individuals which may be one of the other strong reasons for their frequent purchases.

**Chart 1.5 Purchasing experience on social media**




*Source: Primary data collection 2021-2022.*

Chart 1.5 indicates that 48 per cent of the respondents stated that their experience of purchasing through social media is satisfactory as they find it relatable to their wants, 20 per cent of the respondents are very satisfied as it fulfils their expectations, 30 per cent of the respondents cannot mention their experience and 2 per cent of the respondents are dissatisfied as their wants were not fulfilled in an appropriate way.

Respondents are satisfied by their purchases because marketers also provide a good number of online facilities to their customers (Such as cash on delivery, free delivery, Returns policy etc).

**HYPOTHESIS TESTING**

**Statement of Hypothesis**

**Alternative Hypothesis: $H_1$-** Impact on purchase decisions due to social media marketing is independent of the gender of the respondents.

**Null Hypothesis: $H_0$-** Impact on purchase decisions due to social media marketing is not independent of the gender of the respondents.

To test the above hypothesis, researcher has made an attempt to use the Chi-square test. Chi-square is a non- parametric test. The chi-square statistic compares the observed values to the expected values. This test statistic is used to determine whether the difference between the observed and expected values is statistically significant. The present hypothesis in the study has been tested with Chi-square test to evaluate the dependency of one variable on the other.

**Variables:**

Gender of the respondents: Male and Female

Impact or influence of social media marketing on purchase decisions of consumers: Yes and No

**Calculation of Chi-square test:**

**Table 1.1**

**Observed frequencies**

| Gender of the respondents | | | Grand Total |
|---|---|---|---|
| Female | 08 | 32 | 40 |
| Male | 07 | 33 | 40 |
| Grand Total | 15 | 65 | 80 |

**Table 1.2**

**Expected frequencies**

| Gender of the respondents | | | Grand Total |
|---|---|---|---|
| Female | 7.5 | 32.5 | 40 |
| Male | 7.5 | 32.5 | 40 |
| Grand Total | 15 | 65 | 80 |

**P Value: 0.7745**

Since **0.7745** is greater than 0.05, thus **we accept the Null Hypothesis**.

Thus, we can conclude that impact on purchase decisions due to social media marketing is not independent of the gender of the respondents.

**FINDINGS**

1. Nowadays marketers use social media for advertising purpose and also attract consumers with different tactics and strategies.
2. According to the study, researchers found that messages on social media influence the majority of respondents, as they consider them both effective and appealing.
3. The study indicates that social media platforms offer a wide variety of products and services for customers, which is one of the key features that attract a large audience.
4. The study indicates that most respondents are influenced by social media marketing and tend to purchase products as a result.
5. The researcher found that most respondents are satisfied with their purchases from social media, as they find them aligned with their needs and preferences.

**CONCLUSION**

It has been observed that a larger number of the respondents mentioned that they get influenced from social media easily. Maybe the respondents are influenced because they spend more time on social media platforms and it is a fastest growing media as well. From the study it has been observed that respondents are influenced by social media marketing tactics and even they purchase the products after being influenced because they are able to connect to such social media marketing tactics. There are different ways which attract the individuals on social media such as discounts and offers, creating interest in the products by Advertising, giving something free along with the products and services etc. As per the study, respondents buy the products and services from the social media as these marketing messages play a very influential role in making them buy it. Respondents have a different purchasing experience on social media, maximum of the respondents stated that their experience of purchasing through social media is satisfactory as they find it relatable to their wants.

## SUGGESTIONS

1. Social media is a fastest growing medium which could create a good impact on the customer but proper planning is required on behalf of social media marketers.
2. Social media is popular as it helps to connect and interact with one another. They can also help different media brands to create opportunities to share and recognize followers.
3. Social media marketing reminds customers about the product and encourages them to go for the products. This is one of the advantages of social media marketing which should be used by a marketer as a marketing strategy.
4. It is one of the ways of advertisement for the products and services, where marketers can advertise or promote their brands.
5. As per the research, social media do influence consumers but consumers purchase only because of discounts and attractive advertisements but they do not think twice before purchasing anything from social media. According to the researcher a marketer should avail its customers with ample discounts, offers and also some loyalty programs.
6. As per the researcher, social media is the biggest platform to buy or sell products and services; it not only helps to sell but also helps to serve your products for marketing.
7. According to the researcher, when customers are looking out for any sort of products or services to buy on social media platforms that product or service automatically been seen on social media through advertisements. It also shows different options and reminders as well and it helps the marketers.
8. As per the researcher still there are some marketers who feel threatened to come on social media platforms due to fraud or fake consumers etc. But still, it’s a good medium and effective way for marketing their products and services with very less cost provided some precautions are taken with respect to security on the web.
9. According to the researcher, social media marketing enables marketers to build relations with customers and prospects through regular, low-cost personalized communication, reflecting the move away from mass marketing.

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# RESPONSIBLE LEADERSHIP IN THE ERA OF AUTOMATION: SAFEGUARDING EMPLOYMENT AND HUMAN DIGNITY

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***Abstract***

*As automation and artificial intelligence keep changing the global workforce, our societies are at a critical point. Can we keep up with technological change without giving up our human values which are the basis of our work and identity? This paper addresses the urgent issue of how responsible leadership can become the guiding star in the times when machines are taking over human labour. Automation is no longer just a technical or economic problem but comes with serious ethical and social questions related to employment security, worker dignity, and social inclusion.*

*The authors claim that nowadays leadership should not only stick with the traditional picture of efficiency and profitability but the leaders themselves should go further to give more importance to empathy, ethics, and long-term social impact. Built on insights from leadership theory, organizational ethics, and labour studies, this report takes a deeper dive into how responsible leaders could innovate responsibly and make everyone feel included. It underscores the urgency of solutions that secure the livelihoods of vulnerable workers, enable them to constantly learn new skills, and redefine the human element in the future organizations.*

*This paper not only analyses real company cases and leadership models, it also presents a method to follow in creating work environments that are smart technology-wise and deeply human-oriented. Lastly, the authors raise the point that the protection of employment and dignity is not merely an ethical obligation, but a prerequisite for the sustainable development of human societies in the era of intelligent machines.*

***Keywords:*** *Responsible leadership, automation, employment, human dignity, ethical leadership.*

## Introduction

Automation and AI are redefining the way we work, learn, and experience the world. Technological innovation is revolutionising the world economy, from production lines which are increasingly operated by robots to decisions which are driven by artificial intelligence in way of finance and even healthcare and education, the global workforce has seen nothing like it, ever. Though such advances pledge enhanced productivity, lower costs, and greater convenience, they also deliver great challenges — not least in job displacement, the redundancy of skills, and the widening of social disparities. In this context, the role of leadership is very crucial.

The key question that faces today's leaders is not whether to adopt automation, but how to adopt it responsibly. Automation isn't automatically unethical, but if history has taught us anything, it's that values-blind automation can easily result in unintended outcomes, and that these outcomes do not always benefit humanity in the long run by, for example, harming people's well-being, devaluing human labour, and corroding trust in institutions. Leaders who value short-term wins at the expense of the long-term human impact may enable technological adoption to outstrip the very stakeholders their organizations rely on for support.

This study maintains the argument that ethical leadership is essential in guiding organizations during the automation era. This type of leadership goes beyond businesses and concerns itself with human social impact stemming from technological innovation, integrity, empathy, and accountability. Responsible leaders are actively involved with stakeholders, foresee the social consequences of technological change, and devise humane strategies designed to protect, re-skill, and retain employment.

In addition, as societies become more advanced and connected through technology, there are new emerging expectations for leaders. Stakeholder groups, such as employers, customers, and members of the community and the public, are increasingly demanding humane, equitable, and just leadership practices. One unique aspect of the automation of work is that it greatly increases its availability and convenience, enabling unprecedented efficiencies to be achieved. However, these evolutions and improvements will not take place unless current day leaders are willing to change their decisions and actions.

This study explores the intersection of automation and ethics by focusing on the role of leadership in safeguarding employment and upholding human dignity. Commencing from reviewing the existing literature on responsible leadership and the social impacts of automation, this study proposes a framework for ethical decision-making in technology-driven environments. Through real-world case studies and strategic recommendations, this paper highlights actionable pathways for building workforces that are not only resilient and future-ready, but also anchored in human values. In the era of machines, preserving what makes us human is not just a moral obligation—it is a leadership necessity.

**Objectives of the Study**

1. To examine the impact of automation on employment patterns.
2. To evaluate the role of leadership in mitigating negative consequences of automation.
3. To propose strategies that uphold human dignity in increasingly automated workplaces.
4. To analyse case studies of organizations demonstrating responsible leadership.

**Significance of the Study**

This research is important as it offers useful observations on how ethical leadership can navigate organizations through the waters of automation while protecting employment and human dignity. As automation transforms industries, knowledge about how ethical leadership can balance technological progress with workers' welfare is vital. The research adds to the body of literature by documenting real-life case studies from global corporations, presenting a model by which leaders may apply human-led policies in an era of disruption through technology. Further, the study brings the societal implications of automation into light, stressing how organizations must aim for long-term sustainability, incorporation of stakeholders, and ethical practice in their digital transformation.

**Literature Review**

Over the last few decades, centuries-old socio-economic challenges at the intersection of leadership, automation, and ethics have captured the imagination of scholars concerned with the changing nature of work and the ethical prerogatives of corporate leaders. Explanations and frameworks to these issues have turned attention to responsible leadership and its multifaceted implications which was first introduced by Maak and Pless (2006), highlights the necessity for leaders to fulfil their role as caretakers by reconciling economic, social, and moral imperatives. Relating to automation, this balance is walked in considering innovation in technological inroads against the alienation or removal of human work (Dierksmeier & Pirson, 2010).

Socio economic aspects of automation and work have received a great deal of focus. Their research suggests that up to 47% of jobs in the U.S. may be under threat of automation based on Frey and Osborne (2017), poses a challenge for the future of employment. However, a more moderate approach focusing on the nuances has been provided by Arntz, Gregory, and Zierahn (2016) suggesting that entire occupations may not be automated, but specific tasks within them are, highlighting the importance of adaptability and reskilling to the workforce.

As we progress in leadership theory, we see ethics and social responsibility become central. Something like transformational leadership, which fuels vision, personal insight, and development, has been associated with positive change in organizations and employee enthusiasm in high tech industries (Bass & Riggio, 2006). On the contrary, critics argue that such models, especially in automation contexts with dire human implications, tend to the absence of explicitly listed ethics guiding principles (Ciulla, 2018). Forthcoming models like humanistic management suggest the need for more dignity-centered leadership. Pirson (2017) advances that the economic system has to shift to preserving fundamental value of human beings, especially in domains controlled by artificial intelligence and robotics. These thoughts are supported by World Economic Forum (2020) that puts forth the need for responsible leadership concerning automation, inclusiveness, and sustainable change in the digital world.
The automated age poses challenges in concerning with the workforce, but the integration of ethical anticipation, stakeholder engagement, and humanism to innovation integrates all the complexities shown in literature with building around the leadership models presented in the literature.

**Theoretical Framework**

This research is situated on three related theoretical lenses: Responsible Leadership Theory, Stakeholder Theory, and Humanistic Management. Responsible Leadership Theory, as argued by Maak and Pless (2006), situates leaders as moral actors who infuse ethical values in decision-making and reconcile the interests of various stakeholders. This approach is especially applicable in this era of automation, where technological uptake choices have significant consequences for workers, societies, and organizational authenticity. Stakeholder Theory (Freeman, 1984) builds on this perspective by highlighting the interdependence of organizational actors and the need to take into account both internal and external stakeholders—particularly employees whose jobs are at risk of being automated. Last but not least, Humanistic Management (Pirson, 2017) is the ethical basis for this study, promoting the preservation of human dignity, purposeful work, and individual growth amidst economic and technological pressures. Collectively, the frameworks offer a multi-dimensional prism through which the research considers how leaders can morally navigate the move towards automation without compromising employment and human welfare. They also shape the construction of themes on dignity-focused leadership, moral decision-making, and social innovation that are discussed throughout the analysis.

**Methodology**

This study considers a qualitative, exploratory approach to analyse the role of responsible leadership in tackling the ethical and social consequences of automation concerning employment and human dignity. The research is conducted largely using secondary data, which includes an extensive review of journal articles, policy documents from international organizations like the ILO and World Economic Forum, and corporate disclosures such as sustainability and CSR reports. A purposive sampling strategy was employed to focus on multi-case studies across different sectors where automation has been adopted in the context of worker welfare protection. Key patterns and concepts such as stakeholder inclusion, ethical leadership, and human-centered innovation were identified using thematic analysis as outlined by Braun and Clarke (2006). Through Stakeholder Theory, Transformational Leadership, and Humanistic Management, these themes were explained to develop an integrated view on responsible leadership frameworks. The study enriches the understanding of organizational responsibility during technological disruptions, even while remaining constrained by the use of secondary data that limits the portrayal of dynamic leadership interactions. Ethical considerations were maintained through the use of publicly available data and proper attribution. This methodology allows for a detailed exploration of leadership’s evolving role in shaping an inclusive future of work.

**Case Studies**

**Case Study 1: Unilever – Human-Centric Automation and Skill Development**

Unilever, which is an international consumer goods giant, adopted automation while taking very strong commitments towards employee care and ethical leadership. Unilever introduced robots and AI for production processes but, at the same time, put significant resources in large-scale upskilling programs. Leaders in Unilever worked alongside trade unions and municipalities to create safeguards so that automation did not come with wholesale dismissal of jobs but rather triggered redeployment and upskilling of impacted employees. Their "Future of Work" program encompasses digital literacy training, job redesign, and wellness support—showing a comprehensive, ethical approach to workforce transformation.

**Case Study 2: Siemens – Integrating Automation with Apprenticeship Programs**

Siemens AG, a world leader in industrial automation, has taken a proactive approach to employment issues by combining automation with long-term human capital building. In Germany, Siemens maintained its world-famous dual apprenticeship program even as it automated much of manufacturing and logistics. The social responsibility of the leadership made sure young professionals got actual hands-on practice with both classical and digital technology, allowing them to stay useful in a transforming career market. This example highlights how responsible leadership is able to couple productivity advantages with social investment.

**Case Study 3: Infosys – Responsible Automation through Digital Reskilling**

Infosys, one of India's biggest IT services companies, has used a model of "responsible automation" through combining AI incorporation with huge numbers of employee re-skilling attempts. Embracing the threat of job loss, Infosys rolled out its "Reskill and Restart" initiative, which empowered employees with newer technologies such as cloud computing, cyber security, and data science. The leadership in the company adopted transparency, inclusion, and long-term employability, demonstrating a humanistic culture of digital transformation. Infosys has also aligned with educational institutions to make learning widely accessible.

**Analysis and Findings**

The analysis shows that responsible automation by organizations is more likely to be reflected in leadership practices based on stakeholder engagement, ethical anticipation, and people-centered innovation. Based on the case studies of Unilever, Siemens, and Infosys, three major themes were identified: (1) Ethical Integration of Automation, (2) Investment in Human Capital, and (3) Institutionalization of Dignity and Inclusion.

**1. Ethical Integration of Automation:**

Being responsible as a leader is not only being concerned about technological effectiveness but is also the determination of the impact a technology will have. The leaders at Unilever ensured that the adoption of robotics would not lead to major reductions of jobs by at the same time introducing robotics but one which is in conjunction with welfare goals oriented to people. Siemens too kept social contracts alive with employees through twin education schemes that combined automation with conventional training. All these examples illustrate Maak and Pless's (2006) emphasis on relational leadership and ethical responsibility.

**2. Human Capital Investment:**

The leaders from Infosys and Siemens demonstrated keen concern for future employability of the workforce. Rather than considering automation as a standalone cost-saving initiative, they framed it as an opportunity to reskill and empower the workforce. Infosys' "Reskill and Restart" initiative is a good example of leadership through a focus on long-term human development in line with the Humanistic Management principles (Pirson, 2017).

**3. Institutionalization of Dignity and Inclusion:**

Each of the three companies institutionalized dignity for employees in formal initiatives, open communications, and expansive policy settings. They were not just compliance-focused but values-focused in leadership, such as Stakeholder Theory (Freeman, 1984). Siemens' apprenticeships to avoid leaving behind young workers through technological disruption, for example, or Unilever's inclusion of mental well-being and mental health in its automation strategy further emphasized the commitment to human dignity.

These conclusions indicate that in the age of automation, responsible leadership is not reactive but rather anticipatory. It involves incorporating social aspects into technology strategies to maintain ethical alignment and reaffirm the inherent worth of human work. Such leadership does not negate automation but works on steering it in a way that maintains jobs, equity, and human dignity.

**Discussion**

The conclusions emphasize the critical role of ethical leadership in resolving the challenges of automation while protecting jobs and human dignity. The Unilever, Siemens, and Infosys case studies show that automation can be embedded ethically if leaders focus on reskilling, stakeholder engagement, and human dignity. These institutions demonstrate that automation is not necessarily a cause for job loss but can be an enabler for up skilling and workforce flexibility, which confirms the assertions of Frey and Osborne (2017) and Arntz, Gregory, and Zierahn (2016).

The relevance of Humanistic Management is seen in the strategies of these companies, where leadership focuses on the well-being of employees in addition to technological effectiveness. Infosys, for instance, strongly focused on reskilling initiatives, as proposed by Pirson's (2017) approach, which calls for human-centered leadership. In the same way, Siemens' apprenticeship initiatives ensured that younger employees were competitive in the job market, underlining the significance of ethical leadership in promoting inclusive growth.

However, challenges remain in applying these strategies universally, particularly for smaller organizations or those in industries facing significant disruption. Future research should explore the long-term impacts of reskilling initiatives and investigate automation’s effects across diverse sectors. Ultimately, responsible leadership must balance technological innovation with ethical considerations to ensure that automation benefits both businesses and workers alike.

**Limitations of the Study**

1. The research is centered mainly on large multinational companies (Unilever, Siemens, and Infosys). Therefore, this study may not show issues of smaller organizations or those operating in resource-scarce contexts.
2. The research is mainly undertaken on the basis of publicly published reports and literature. Hence, it may not represent current developments or practices undertaken by various organisations.

**Future Research**

1. Studies can be done on how automation affects employment and job quality in areas of retail, logistics, and services, wherein automation can have a significant impact on unskilled workers.
2. Future researches can be undertaken on the long-term consequences of reskilling interventions on employee well-being, job retention, and organizational performance.
3. International outlook can be seen on analysing responsible automation practices which vary across cultural and regional environments.
4. Exploration of policy environments and state regulations can help responsible automation practices where companies are aligned with wider social and economic objectives.

**Conclusion and Recommendations**

Overall, this research emphasizes the imperative of responsible leadership to deal with the ethical challenges of automation while protecting jobs and human dignity. In the case studies of Unilever, Siemens, and Infosys, one can see that responsible leaders are individuals who combine ethical vision, human talent investment, and stakeholder engagement in their automation agenda. These institutions show that leadership during the age of automation needs more than technological know-how; it needs dedication to the rights of employees, encouraging skill acquisition, and guaranteeing that the dividends of automation go to the benefit of everyone.

The conclusions reiterate that the principles of Responsible Leadership Theory, Stakeholder Theory, and Humanistic Management form a solid framework for dealing with the issues caused by automation. Leaders adopting these frameworks can guarantee that technological innovation does not debase human dignity or lead to mass job losses. Rather, through focusing on human-centric innovation and inclusive policies, organizations can use automation as a tool for productivity as well as social benefit.

**Recommendations for future leadership practices in an era of automation are:**

1. Organizations need to invest in programs for long-term skills development that prepare employees with the capacities needed to succeed in automated settings. This entails digital literacy, critical thinking, and flexibility.
2. Leaders need to have open lines of communication regarding automation initiatives, listening to employee concerns and creating a culture of trust and inclusion. Such transparency can address job displacement fears and increase employee engagement.
3. Organizations need to implement formal ethical decision-making frameworks to evaluate the effects of automation on stakeholders, especially employees. Leaders need to prioritize human dignity over technological efficiency when they make strategic decisions.
4. Engagement with outside stakeholders, such as government agencies, unions, and education institutions, is critical to the development of an equitable and equitable transformation for workers in response to automation.

In conclusion, ethical leadership in the era of automation is not a reactive position but an active, continuous process of ethical consideration and people-focused innovation. By putting human well-being first in the time of technological change, organizations are able to create sustainable and inclusive futures for both their workers and society as a whole.

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# BEHAVIOURAL ECONOMICS AND PERSONALIZED MARKETING: A NEW PARADIGM FOR CONSUMER ENGAGEMENT

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***Abstract***

*In today's data-driven digital economy, the convergence of behavioural economics and personalized marketing has created a transformative approach to understanding and influencing consumer decision-making. Behavioural economics, a field that integrates insights from psychology and economics, challenges the classical assumption of rational consumer behaviour by highlighting the impact of cognitive biases, heuristics, and psychological tendencies on purchasing decisions. This paper explores how core principles of behavioural economics such as prospect theory, loss aversion, framing effects, anchoring, and the endowment effect are being operationalized within personalized marketing strategies to increase engagement, influence choices, and drive conversions. By analysing real-world case studies from companies like Netflix, Amazon, and Spotify, the research illustrates how personalized nudges and behavioural cues are integrated into customer journeys to subtly guide decisions without overt coercion. The paper also examines the ethical challenges posed by the use of behavioural insights in marketing, particularly concerning consumer autonomy, data privacy, and potential manipulative practices. The future of this interdisciplinary field lies in developing adaptive, responsible, and consumer-centric strategies that respect individual rights while delivering value through meaningful personalization.*

***Keywords:*** *Behavioural economics, Personalized marketing, Consumer behaviour, Decision-making, Cognitive biases, Prospect theory, Endowment effect,*

## Introduction:

The rapid evolution of technology and the widespread availability of consumer data have significantly reshaped the marketing landscape. Traditional one-size-fits-all strategies are being replaced by sophisticated, tailored marketing approaches that respond to the individual needs and behaviors of consumers. This shift marks the rise of personalized marketing, a strategy that utilizes advanced analytics, artificial intelligence, and real-time data to deliver customized experiences to individual users. Simultaneously, the field of behavioural economics has gained prominence in explaining how and why people often deviate from the assumptions of rational decision-making, offering valuable insights into the psychology behind consumer choices.

Behavioural economics, pioneered by scholars such as Daniel Kahneman, Amos Tversky, and Richard Thaler, challenges the traditional economic model that assumes individuals are rational agents who always act in their own best interest. Instead, it highlights how consumers are influenced by cognitive biases, emotions, heuristics, and contextual factors when making decisions. Concepts such as loss aversion, framing, anchoring, and the endowment effect have been instrumental in understanding real-world behaviour that classical economic theories often fail to explain. These insights have profound implications for marketing, as they enable firms to craft strategies that align with actual consumer psychology rather than idealized rational behaviour.

The synergy between behavioural economics and personalized marketing represents a powerful convergence. By embedding behavioural insights into personalized marketing campaigns, firms can influence consumer decisions more effectively and ethically. For example, companies can use behavioural cues to nudge consumers toward beneficial actions, such as subscribing to services, making healthier choices, or exploring new products. When personalization is informed by an understanding of human cognitive patterns, it becomes more than just a data-driven tactic—it becomes a psychological engagement strategy.

This paper seeks to explore the interplay between behavioural economics and personalized marketing, providing a detailed analysis of how firms incorporate behavioural principles into tailored consumer interactions. It addresses the following key research questions:

1) How do behavioural economics concepts inform personalized marketing strategies?
2) In what ways are companies applying these principles in real-world scenarios?
3) What are the ethical implications of using behavioural data to influence consumer decisions?

To answer these questions, the paper begins by reviewing foundational theories in behavioural economics and outlining the mechanisms of personalized marketing. It then examines specific applications through industry case studies, illustrating how behavioural insights are operationalized in practice. The discussion extends to the ethical challenges and societal implications of this convergence, especially in an era where data privacy and digital trust are under increasing scrutiny.

The contribution of this study lies in its interdisciplinary approach, bridging economic psychology and digital marketing to propose a nuanced understanding of modern consumer engagement. By integrating theoretical frameworks with practical insights, the paper aims to inform both academic research and business practice in the design of responsible and effective personalized marketing strategies.

**Literature Review:**

Behavioural economics emerged as a response to the limitations of classical economic theory, which assumes that individuals are rational actors who make decisions to maximize utility. In contrast, behavioural economics incorporates psychological insights to explain why individuals often behave irrationally in predictable ways. The foundational work by Kahneman and Tversky (1979) introduced prospect theory, which demonstrates that people evaluate potential losses and gains relative to a reference point and that losses typically have a greater psychological impact than equivalent gains.

This concept, known as loss aversion, has been extensively validated in both laboratory and real-world settings (Tversky & Kahneman, 1991). Other important concepts in behavioural economics include the framing effect, which shows that the way information is presented can significantly influence decision-making, and the anchoring effect, where individuals rely too heavily on initial information (anchors) when making judgments (Ariely, 2008). Thaler (1980) contributed to the field with the endowment effect, where people place higher value on things they own compared to those they do not.

Wedel and Kannan (2016) discuss the increasing sophistication of data-driven personalization, which now includes predictive analytics, real-time targeting, and adaptive content based on user feedback. The development of recommendation systems, such as those used by Amazon and Netflix, exemplifies the integration of behavioural data with personalization algorithms. These systems leverage historical user data to predict future preferences, often relying on collaborative filtering and content-based methods (Gomez-Uribe & Hunt, 2015).

**1. Prospect Theory and Loss Aversion in Pricing Strategies**

Walker and Rahman (2024) examined how behavioral economics, particularly prospect theory and loss aversion, influences pricing strategies in consumer markets. Their review highlighted the impact of dynamic pricing, price framing, and discounting on consumer behavior, emphasizing that consumers' negative reactions to price increases are stronger than their positive reactions to equivalent price reductions. bmfopen.com

**2. Behavioral Economics in Education Market Design**

Rees-Jones and Shorrer (2023) reviewed the application of behavioral economics in education market design. They identified deviations from traditional rational-choice models and proposed integrating behavioral insights to improve school-assignment systems. NBER

**3. Behavioral Economics in Digital Subscription Models**

Radu et al. (2023) explored the role of behavioral economics in digital subscription models. They discussed how choice architecture and AI-driven personalization can influence consumer decisions, sometimes leading to manipulative practices. academicopinion.org

**4. Large Language Models in Behavioral Economics Research**

Jabarian (2024) investigated the use of large language models (LLMs) in behavioral economics research. The study demonstrated how LLMs can enhance experimental design and the elicitation of mental models, improving the internal validity of behavioral experiments. arXiv

**5. Behavioral Economics and Consumer Protection**

Odunaiya et al. (2024) reviewed the integration of behavioral economics into consumer protection policies in the U.S. They highlighted how psychological factors, such as cognitive biases, influence consumer decisions and the effectiveness of regulatory interventions. repository-ijsra.com

**Research Methods:**

You can adopt a **mixed-methods approach**, which combines both **quantitative** and **qualitative** methods to provide a holistic view of how behavioral economics principles influence personalized marketing strategies and consumer behavior.

**1. Quantitative Methods**

- **Surveys**: Use structured questionnaires to measure consumer reactions to personalized marketing offers, such as discount framing, scarcity messages, or loss aversion cues.
- **Experiments (Field or Online A/B Testing)**: Manipulate marketing variables (e.g., personalized vs. non-personalized messages) and measure behavioral outcomes like click-through rates, purchases, or time spent on pages.
- **Statistical Modeling**: Apply regression analysis, conjoint analysis, or structural equation modeling (SEM) to quantify relationships between behavioral economics variables (e.g., framing, social proof) and consumer actions.

**2. Qualitative Methods**

- **In-depth Interviews**: Gather insights into how consumers perceive personalization and behavioral cues in marketing. Useful for understanding underlying motivations, fears (e.g., privacy concerns), and trust.
- **Focus Groups**: Explore collective opinions on personalized ads and behavioral triggers (e.g., urgency messages, nudges).
- **Thematic Analysis**: Use coding frameworks to identify recurring themes in responses related to emotions, trust, decision fatigue, etc.

**Data Collection**

**1. Primary Data** : - this research article is not based on primary data

**2. Secondary Data**

- **Marketing Analytics Reports**: From McKinsey, Deloitte, Salesforce.
- **Consumer Behavior Datasets**: From Statista, Pew Research, or Kaggle datasets on digital marketing.

- **Academic Databases**: Scopus, JSTOR, SSRN, or Google Scholar for published studies on consumer behavior and personalization.

**Research Design:**

**1. Descriptive Design:**

**Objective of the study:**

- **To examine the influence of behavioral economics principles** (e.g., loss aversion, framing effects, social proof) on consumer decision-making in personalized marketing.
- **To identify the psychological factors** that affect consumer responses to personalized advertisements and offers.
- **To assess consumer perceptions** of personalization in marketing, including concerns related to privacy, trust, and data usage.
- **To evaluate the effectiveness of different personalization techniques** (e.g., product recommendations, email targeting, dynamic pricing) when combined with behavioral nudges.
- **To investigate the moderating role of demographics** (e.g., age, income, digital literacy) in how consumers respond to behaviorally-personalized marketing efforts.

**Future Scope of the Study:**

1. **Cross-Cultural Analysis**: There is potential to examine how cultural differences affect consumer responses to behavioral nudges and personalization across global markets.
2. **Longitudinal Studies**: Future studies can track consumer behavior over time to understand the long-term impact of personalized marketing strategies rooted in behavioral economics.
3. **Personalization vs. Consumer Autonomy**: Future studies could examine how to balance hyper-personalization with consumer autonomy and decision-making freedom.
4. **Role of Zero-Party Data**: As consumers increasingly control their data, future research can explore how behavioral economics adapts in the context of zero-party data (data willingly shared by consumers).
5. **Impact on Consumer Well-Being**: Researchers can evaluate how behaviorally personalized marketing affects consumer satisfaction, stress, cognitive overload, and overall well-being.

**Limitations of the Study:**

1. **Limited Generalizability**: The findings may not be applicable to all industries or cultural contexts, as consumer behaviour varies significantly across regions and demographics.
2. **Dynamic Digital Environment**: The fast-changing nature of digital marketing platforms and personalization technologies may limit the long-term relevance of the findings.
3. **Limited Scope of Behavioral Variables**: The study may only focus on selected behavioral economics principles (e.g., loss aversion, framing), excluding others like bounded rationality or time inconsistency.
4. **Ethical Constraints**: Ethical considerations may restrict the depth of experimentation, particularly when testing manipulative or emotionally charged marketing tactics.
5. **Data Privacy Concerns**: Access to real-world consumer data may be restricted due to privacy laws and ethical standards, limiting empirical analysis.

**Findings of the Study:**

1. **Behavioral Triggers Enhance Personalization Effectiveness**
   The study found that behavioral economics principles such as **loss aversion, scarcity cues, social proof**, and **framing effects** significantly increase the effectiveness of personalized

marketing strategies. Consumers tend to respond more positively to messages that align with their psychological biases.

2. **Personalization Increases Purchase Intent and Brand Loyalty**
   Behaviorally tailored marketing content not only boosts immediate **purchase intent**, but also fosters **brand loyalty** by making consumers feel understood and valued.
3. **Consumers Prefer Personalization, but with Transparency**
   While a large portion of consumers appreciate personalized offers and content, they express concern over how their personal data is collected and used. **Trust and transparency** are crucial factors influencing the acceptance of personalized marketing.
4. **Framing Influences Consumer Decisions**
   Personalized marketing that uses **gain-framed** or **loss-framed** messages (e.g., "You're missing out!" vs. "You just saved!") can shape consumer perception and decision-making. **Loss-framed messages** were particularly effective in driving engagement and urgency.
5. **Privacy Concerns Act as a Barrier to Personalization**
   Despite the effectiveness of personalization, growing concerns over **data misuse** and surveillance reduce consumer willingness to share personal information, which can limit the scope and depth of personalized marketing.

**Conclusion:**

The intersection of behavioural economics and personalized marketing represents a paradigm shift in how businesses understand, engage with, and influence consumer decision-making. This paper has explored how insights from behavioural economics particularly those related to cognitive biases, heuristics, and psychological tendencies are being increasingly integrated into personalized marketing strategies to create more effective, relevant, and engaging customer experiences.The core premise of behavioural economics is that consumers do not always act rationally; instead, their decisions are shaped by mental shortcuts, emotional responses, and contextual cues.

From an academic perspective, the convergence of behavioural economics and personalized marketing presents fertile ground for further interdisciplinary research. Future studies can explore how behavioural interventions vary across cultures, demographic groups, and digital platforms. There is also a pressing need to develop models that quantify not just the effectiveness of personalized nudges, but their ethical boundaries and long-term impact on consumer well-being. In conclusion, the integration of behavioural economics into personalized marketing offers a powerful toolkit for understanding and influencing consumer behaviour in a digital age. When deployed thoughtfully and ethically, it allows businesses to deliver personalized value, foster deeper customer relationships, and contribute to more responsible marketing ecosystems. The challenge for marketers and policymakers alike is to harness this potential without compromising the fundamental rights, agency, and dignity of the individuals they aim to serve.

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# FROM KIRANA TO CLICK
# THE DIGITAL TRANSFORMATION OF COMMERCE IN INDIA

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***Abstract***

*As traditional Kirana businesses move into the digital era, India's retail industry is undergoing a dramatic change. Through the use of online platforms, digital payments, and supply chain technologies, these neighbourhood stores, once restricted to manual inventory and physical transactions, are increasingly integrating into a larger digital ecosystem.*

*Growing smartphone use, reasonably priced internet connectivity, and encouraging government programs like Digital India and the* ***Open Network for Digital Commerce (ONDC)*** *are all driving this change. Instead of displacing kerana's, digital commerce is giving them new chances to reach a wider audience, increase productivity, and improve customer satisfaction. This abstract examines how India's commerce is changing as a result of the fusion of contemporary digital tools with old retail methods, creating a more dynamic, inclusive, and connected marketplace.*

***Keywords:*** *retail transformation, kirana store digitization, digital India campaign, ondc, hybrid retail mode.*

## Introduction

The adoption of digital transformation by traditional kirana businesses is causing a dynamic shift in India's commerce industry. These modest, family-owned stores, which have long been seen as the mainstay of neighbourhood retail, are embracing digital tools and platforms in addition to traditional methods. The transition from **"kirana to click"** is being driven by the rise of mobile technology, the expansion of internet access, and the growing customer desire for convenience. Integrate digital payment systems, and join online marketplaces. They can now compete with organized retail and e-commerce behemoths thanks to this change, which also improves their operational efficiency. Kiranas are joining a contemporary, tech-enabled retail sector while maintaining their local charm by becoming digital. This change bridges the gap between tradition and innovation in the retail industry and is an essential part of India's larger digital commerce revolution.

In recent years, the digitization of traditional kirana businesses has attracted a lot of interest from the academic community and business community. **Nearly 90%** of India's retail business is unorganized, with kirana outlets making up a significant portion of this market, according to a report by **Bain & Company (2021).** One of the main areas of attention for facilitating equitable growth in retail is its integration with digital ecosystems.

Research by **McKinsey Global Institute (2020)** emphasizes how digital technologies, such as mobile wallets, point-of-sale systems, and e-commerce platforms, are redefining the operations of small retailers. These innovations help improve customer experience, streamline supply chains, and increase access to credit.

A study published in the Journal of **Retailing and Consumer Services (2022)** highlights how partnerships between kerana's and tech companies (e.g., **JioMart, Amazon, Udaan**) are reshaping local commerce by offering logistical and technological support.

***Objective***

1. Evaluate the role of mobile usage and cost-effective internet in enabling Kirana store owners to access digital platforms, apps, and maintain continuous online operations.

2. To analyze the impact of digital payment systems and retail technology tools in enhancing transaction efficiency, promoting cashless payments, and improving inventory and sales management.
3. To assess the benefits of online market access and hybrid retail models in expanding customer reach and building flexible, resilient business operations.
4. To examine the influence of government support and training initiatives like Digital India and ONDC in encouraging digital adoption through infrastructure and skill development.
5. To study evolving customer trends and logistics integration that drive Kirana stores toward offering digital ordering and improved delivery services.

**Table1: Digital Transformation of Kirana Stores in India**

| Aspect | Description | Effect on Kirana Stores |
|---|---|---|
| **Mobile Usage** | Increased smartphone ownership among store owners and customers | Enables access to digital platforms, apps, and communication tools |
| **Digital Payment Systems** | Use of UPI, QR codes, and mobile wallets | Promotes cashless transactions and enhances customer convenience |
| **Online Market Access** | Entry into e-commerce networks and digital marketplaces | Expands customer base beyond the local area |
| **Government Support** | Initiatives like Digital India and ONDC | Encourages digital adoption through training, tools, and infrastructure |
| **Retail Technology Tools** | Use of POS machines, billing software, and inventory apps | Improves sales tracking and stock management |
| **Customer Trends** | Growing demand for contactless, quick, and convenient shopping | Pushes Kirana's to offer digital ordering and delivery options |
| **Logistics & Delivery** | Integration with hyperlocal and last-mile delivery partners | Enhances service speed and delivery coverage |
| **Training and Skill Upgrade** | Efforts to educate retailers on digital tools and platforms | Builds confidence and ability to compete in a digital marketplace |
| **Cost-Effective Internet** | Affordable data plans and broadband availability | Supports 24/7 digital operations and online presence |
| **Hybrid Retail Models** | Blend of physical and digital store operations | Creates flexible and resilient business structures |

Businessworld, Wikipedia, ResearchGate, business of food+4

**Table2 : Key Drivers and Impacts of Digital Transformation on Kirana Stores in India**

| S. No. | Component | Description | Impact on Kirana Stores |
|---|---|---|---|
| 1 | Digital Payments | Adoption of UPI, QR codes, mobile wallets | Faster, cashless transactions; improved transparency |
| 2 | Smartphone Penetration | Growing access to affordable smartphones and internet | Easy access to B2B apps and customer engagement |
| 3 | ONDC Integration | Open platform allowing small retailers to sell online | Broader market reach and visibility |
| 4 | Digital India Initiative | Government push for digital infrastructure | Increased support for digital tools and literacy |
| 5 | E-commerce Partnerships | Collaboration with platforms like Amazon, Flipkart, JioMart, etc. | Enhanced inventory management and delivery support |
| 6 | Inventory & Billing Software | Use of POS systems and digital inventory apps | Improved efficiency and reduced stock-outs |
| 7 | Supply Chain Digitization | Tech-enabled logistics and procurement | Faster restocking and competitive pricing |
| 8 | Consumer Behavior Shift | Rising preference for online and contactless shopping | Pressure to modernize and compete with e-commerce players |

| | | | |
|---|---|---|---|
| 9 | Government Incentives | Schemes and subsidies for MSMEs and retail tech adoption | Reduced entry barriers for technology integration |
| 10 | Training and Digital Literacy | Awareness and capacity-building for small retailers | Empowerment and smoother digital transition |

https://retail.economictimes.indiatimes.com, https://www.thehindubusinessline.com https://www.orfonline.org ,

**Formula**

***Digital Transformation Formula for Kirana Stores.***

**DTKS** = (MU + DPS + OMA + GS + RTT + CT + LD + TSU + CEI + HRM)

**Where:**

DTKS = Digital Transformation of Kirana Stores
MU = Mobile Usage
DPS = Digital Payment Systems
OMA = Online Market Access
GS = Government Support
RTT = Retail Technology Tools
CT = Customer Trends
LD = Logistics & Delivery
TSU = Training and Skill Upgrade
CEI = Cost-Effective Internet
HRM = Hybrid Retail Models

**Explanation**

The digital transformation (DTKS) is the sum total of all key enablers and innovations—ranging from increased mobile usage and digital payments to policy support and hybrid business models—that collectively modernize and empower Kirana stores for competitiveness and sustainability.

**Literature review**

The shift from traditional kirana stores to digitally-enabled retail outlets has become a key area of interest in India's evolving commerce landscape. Researchers and industry observers note that these local shops, once operating with minimal technology, are increasingly adopting digital tools to remain competitive in the face of modern retail and e-commerce expansion. Studies have observed that digital payments, inventory management apps, and integration with online delivery platforms are gradually becoming common among kerana's, enabling them to offer faster service and broader product access.

Various case studies highlight how collaboration between tech companies and kirana owners is transforming the supply chain and improving customer outreach. For example, digital onboarding of kerana's by companies like JioMart, Amazon, and Udaan has enabled these small retailers to tap into digital marketplaces while retaining their local customer base. At the same time, some literature points out persistent challenges such as low digital literacy, limited infrastructure in rural areas, and reluctance among older store owners to embrace change.

Despite these barriers, the trend is gaining momentum, as more kerana's realize the benefits of going digital—improved efficiency, increased visibility, and better customer engagement. This transformation is now seen as a critical component of India's broader shift toward a tech-driven retail economy.

**Research methodology:**

This study adopts a mixed-method approach to explore the digital transformation of kirana stores in India. Both qualitative and quantitative methods are used to gain a comprehensive understanding of the shift from traditional retail practices to digitally enabled commerce.

**1. Research Design:**
A descriptive research design is employed to analyze current trends, adoption patterns, challenges, and the impact of digital tools on kirana stores. This design allows for the collection of both numerical data and narrative insights.

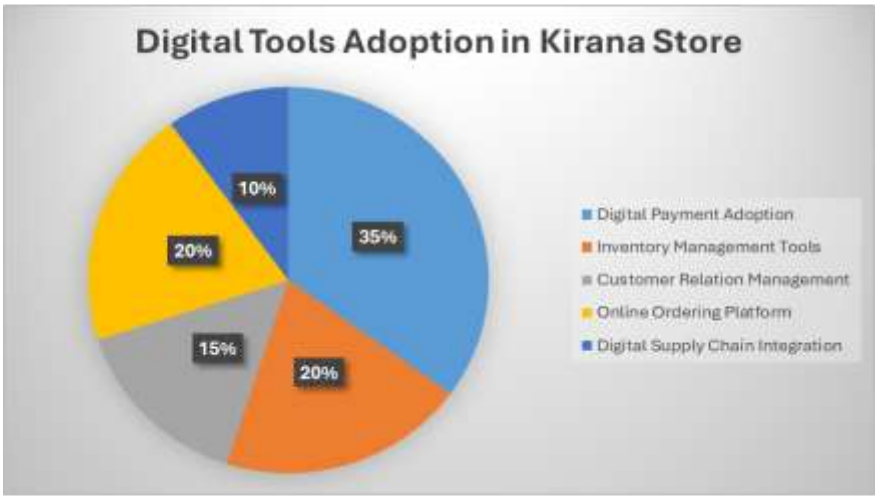
**2. Data Collection:**
Primary data is collected through structured surveys and in-depth interviews. Surveys are conducted among kirana store owners across urban and semi-urban areas to gather quantitative data on digital adoption, usage frequency, and perceived benefits. Interviews provide qualitative insights into store owners' experiences, challenges, and attitudes toward digital transformation.

**Data collection:**
To effectively examine the digital transformation of kirana stores, both primary and secondary data were collected. The use of a mixed-method approach allowed for a comprehensive understanding of the current state and challenges of digital adoption among traditional retailers.

**Primary Data:**
Primary data was gathered through structured questionnaires and semi-structured interviews. The questionnaire included both closed and open-ended questions focused on key areas such as the types of digital tools adopted (e.g., mobile payment apps, inventory software, e-commerce platforms), frequency of use, perceived benefits, and barriers to adoption. These were distributed to kirana store owners in urban and semi-urban areas. Additionally, face-to-face and phone interviews were conducted with selected shopkeepers to gain deeper insights into their experiences with digital transformation.

**Secondary Data:**
Secondary data was sourced from industry reports, government publications, journal articles, and news outlets. This helped in understanding broader market trends, policy initiatives, and technological developments influencing small retailers in India.

The combination of primary and secondary data ensured a well-rounded analysis, enabling the research to capture both individual experiences and wider patterns in the digital evolution of kirana stores.




**journals on digital transformation in retail/Kirana stores**


Retailers Association of India (RAI), NASSCOM Reports

| **Data Type** | **Method of Collection** | **Purpose** | **Tools/Source Used** |
|---|---|---|---|
| Secondary Data | Online Research | To understand national policies and digital initiatives | Websites: MeitY, etc. / Government reports |
| Secondary Data | Literature Review | To identify trends and market behavior | Reports from NASSCOM, Bain / Industry publications |
| Secondary Data | Online and offline sources | To stay updated on recent developments | Online news portals / Google Scholar / News articles/journals |

**Findings:**

**1. widespread adoption of digital payments:**

a significant number of kirana store owners have adopted digital payment systems such as upi, mobile wallets, and qr code scanners, driven by customer preference for cashless transactions.

**2. partial use of inventory and billing software:**

while some kiranas have started using digital tools for inventory tracking and billing, many still rely on manual methods due to limited digital skills or cost concerns.

**3. growing interest in e-commerce integration:**

a rising number of store owners are open to partnering with platforms like jiomart, amazon, and flipkart to reach a broader customer base and benefit from logistics support.

**4. challenges in rural and semi-urban areas:**

lack of infrastructure, poor internet connectivity, and limited awareness continue to hinder full digital adoption in non-urban regions.

**Conclusion**

The digital transformation of kirana stores marks a significant shift in India's retail landscape, bridging the gap between traditional commerce and modern technology. As small retailers adopt digital tools, they gain access to broader markets, improved operational efficiency, and enhanced customer engagement. However, this transformation is not without challenges, including limited digital literacy, infrastructural gaps, and financial constraints. Addressing these issues through targeted support, inclusive policies, and strategic partnerships can ensure that kirana stores are not left behind in the digital age. Empowering these local businesses through digital integration is not only essential for their survival but also for building a more resilient and inclusive economy in India.

***Recommendations***

**1. Enhance Digital Awareness:** Initiate widespread awareness campaigns to educate kirana store owners about the benefits and potential of digital tools in improving business efficiency and customer reach.

**2. Simplify Technology Integration:** Develop easy-to-use digital platforms that require minimal technical skills, ensuring that small retailers can adopt them without the need for advanced training.

**3. Provide Financial Assistance:** Offer low-interest loans, grants, or digital subsidies to help kirana stores invest in smartphones, point-of-sale (POS) systems, and inventory management tools.

**4. Strengthen Internet Infrastructure:** Improve digital infrastructure, especially in rural and semi-urban areas, to ensure reliable internet access that supports consistent digital operations.

**5. Encourage Collaboration with E-commerce Platforms:** Facilitate partnerships between kirana stores and online marketplaces to expand their customer base and enhance supply chain efficiency

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**WEBSITE**

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*https://www.pwc.in*

# A STUDY OF EMPLOYEE PERFORMANCE MANAGEMENT AND MOTIVATION IN THE FMCG INDUSTRY IN WESTERN SUBURBS

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***Abstract***

*Employees are very important for achieving the success and growth of the organisation. Investing in employees' skill training enhances employees' performance and efficiency along with organisational efficiency. On-the-job and off-the-job training not only gives you performance efficiency from employees, but it also motivates them and gives them job satisfaction.*

***Keyword:*** *Efficiency in work, Skill upgradation, Confidence of employees, Job satisfaction,Corporate image*

**Research methodology:**

My studies are based on primary as well as secondarya; the review of literature is purely based on secondary data. The study is based on primary data collected directly from the people – 40 respondents who come under qualitative research from the Thane district and Mumbai, Maharashtra region.

**Review of literature:**

1) Performance management of employees (Minish Kumar Tiwari) (July 15, 2022): He is the founder of Grow Tech Mind and has written many articles at Google on technology, digital marketing, employee performance and efficiency; in this article, he elaborates on the importance of efficiency in the working performance of the employee.

2) Performance management system (Deshmukh Vishay) year 2023 (shod Ganga): in this article, more emphasis is given to the best strategies and practices to adopt for better employee performance management in an organization will help to grow the business and fulfil the company's goals effectively and efficiently.

**Introduction:**

There are some techniques and strategies to manage employee performance effectively: -

1) Setting up clear The goal and vision of the company are very important, and they should be clearly stated to the employees of the company.

2) Continuous monitoring of employee performance and giving proper feedback on their performance is a very important factor in employee motivation.

3) The success of any organisation depends on its employees. Recognition of employees is a very important factor; it's very important to appreciate individual employees for their performance to enhance productivity and increase efficiency among them.

4) Honest feedback should be provided to employees for their better performance.

**Objective of the study:**

Increase the performance of the company.

Employee's motivation

Reduce inefficiency.

Increase brand image.

**Scope of the study:**

Industry Coverage: It covers various FMCG sectors, including food & beverages, personal care, household products, and packaged goods.

Motivation Factors: Identifying inner and outer motivators for employees in the FMCG sector. Role of compensation, incentives, and career growth opportunities in motivation.

Challenges and Opportunities: Strategies adopted by FMCG companies to improve employee engagement, retention and job satisfaction

Practical Implications: Recommendations for HR policies and for FMCG companies to create a sustainable and productive workforce.

**Here are some common limitations of a study:**

Geographical Scope

Time Constraints

Limited Access to Data

Hypothesis of the study:

is a significant relationship between performance management practices and employee motivation in the FMCG industry.

**Data collection method:**

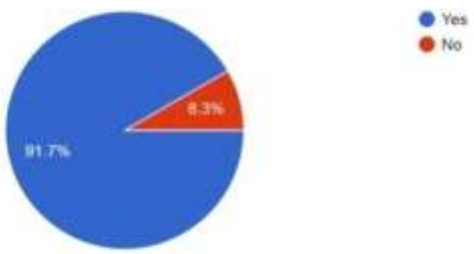
I am using both primary and secondary data. Primary data is purely based on questionnaires and secondary data collected from different case studies and articles in the FMCG industry from the Shod Ganga website.

I will use simple random sampling for this study.

The data collection tool will be Google Forms and the checklist method.

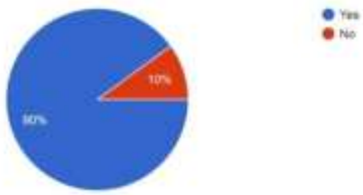
**Data interpretation:**

1) Is the environment of the company important?



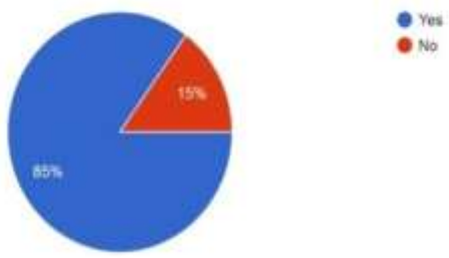

91.7% said the environment is an important factor, and 8.3% said the work environment is not an important factor.

2) Salary is important for you to work.



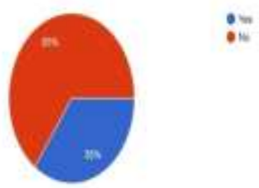

90% of people say salary is important. 10 % say salary is not an important factor.

3) If the company does not provide growth opportunities, then will they leave the company?



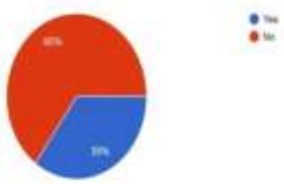

85% agree, and 15% say no.

4) What do you think he plays an important role in crisis management?



65% agree 35% are disagree.

5) Rewards play a significant role in motivating employees.



90% are saying yes. 10% are saying no.

**Conclusion:**

Employee contribution is a must for the success of the organisation and also helps in the growth of any organisation. Most of the research has been conducted on various HR practices with employee satisfaction to link performance, but little or no research has been seen to correlate and analyse the impact of 'motivation' on employee performance, especially in the FMCG sector industry in India. Successful design and implementation of performance management and employee motivation will improve employee performance in any organisation.

**Suggestion of the study:**

1. To make the employee motivated company needs to define clear objectives and goals.
2. HR needs to explore employee motivation factors, and according to that, he should deal with a particular employee.
3. Compare different FMCG companies with their competitor will help to understand how they are working and managing their employees.

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# TO STUDY THE IMPACT OF EMOTIONAL INTELLIGENCE ON CONSUMER ENGAGEMENT IN DIGITAL ECOSYSTEMS OF REMOTE WORK ENVIRONMENTS

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***Abstract***

*This study establishes a technology-centred perspective on consumer participation in the digital landscape. Focused on interactions with brands within social media-driven brand communities, the research argues that consumer involvement is a socio-technical phenomenon that originates from consumer engagement with digital technologies. The paper emphasizes the link between enhanced emotional intelligence (EI), improved academic achievements, increased professional productivity, and fortified interpersonal relationships. It utilizes a convenient sampling technique to survey, which assists managers in comprehending and addressing consumer emotions, thereby cultivating deeper connections and engagement. This approach ensures broad coverage while reducing errors and concerns surrounding validity. With a sample size of 50 respondents, the research highlights the importance of emotional intelligence for success in organizations located in remote areas, as it is influenced by digital transformation. The integration of EI boosts both individual and team output, encourages a unified, dynamic corporate culture, and enhances performance at both levels. It points out the essential role of emotional intelligence in remote collaboration, outlines directions for upcoming research, and tackles criticisms related to its reliability and evaluation. The interactions and the technologies are inherently interconnected in engagement practices and are subject to continuous and reciprocal modifications. The empirical findings explore how consumers engage in the digital ecosystem through connections with physical devices, digital haptics, and platforms. The results stress how the digital materiality of the engagement ecosystem gives rise to innovative engagement practices, such as discovering, utilizing, and nurturing engagement, paving new paths for future research. Emotional intelligence is crucial for remote employees due to the distinct challenges and requirements of the digital work environment. Fundamentally, emotional intelligence is essential for effective communication, as it assists in accurately interpreting and expressing emotions via emails, video conferences, and chat applications.*

***Keywords:*** *Digital Transformation, Emotional Intelligence (EI), Consumer Engagement, Digital ecosystems, Remote Work Environments, Social Media-Driven.*

## INTRODUCTION

Emotional intelligence as “the ability to recognize, assess, control, and utilize your own emotions, and those of others. __ Dr. Goleman

The shift to remote work in several sectors was hastened by the COVID-19 pandemic. This change significantly changed how businesses interact with customers and how consumers behave in the workplace. The main way to interact with consumers is now through digital ecosystems, which include linked platforms, services, and technologies. It is critical in this new environment to comprehend consumer emotions and personalize digital experiences to suit their demands. In these digital environments that support remote employment, this study argues that emotional intelligence (EI), which is the capacity to recognize, comprehend, manage, and make use of emotions, is essential for fostering meaningful consumer interaction. An analysis of the impact of emotional intelligence on consumer engagement in digital ecosystems of remote work environments would look at how it affects online behavior, notably in virtual work environments. It would look at things like empathy, self-awareness, and communication abilities, as well as how these qualities help build trust, online connections, and eventually, participation. The article would probably explore the unique difficulties and possibilities that remote work environments offer in terms of using emotional intelligence to create online communities and increase customer engagement.

One way or another, emotional intelligence (EI) must integrate two of the three states of mind, cognition and affect, or intelligence and feelings. The capacity to recognize, manage, and assess emotions is known as emotional intelligence for their feelings and be able to comprehend the emotions of others they interact with. or she collaborates

which improves job relationships and performance. Being is not the core of emotional intelligence gentle! The ability to utilize one's emotions to aid in decision-making is a distinct form of intelligence, live in the now and be better able to manage themselves and the way they affect other people. The development of digital technologies since the 2000s has resulted in the creation of digital ecosystems, in which software, hardware, and digital services work together synergistic methods (Anwar et al., 2018; Wu, 2020). The notion of ecosystem, put forward by A biological system made up of, as described by British scientist Arthur George Tansley in 1935, is composed of live things and their surroundings. This understanding of ecosystem has grown to include everything.elements of society and its institutions related to survival, reproduction, evolution, and interconnectedness in the economy and society (Golov & Myl'nik, 2022) .For leaders who establish the tone of their organization, emotional intelligence is equally beneficial and social media driven. A lack of emotional intelligence among leaders might have wider-reaching effects, leading to decreased employee engagement and increased employee turnover. Although one may be technically proficient at one's work, if one is unable to communicate with one's team or work well with others, those specific abilities will be ignored. One can have a favourable impact on any situation and keep moving forward in life and in one's career by mastering emotional intelligence. When handling demanding circumstances like conflict, change, and barriers, EI is essential in addition to lowering group stress, resolving conflicts, and increasing job satisfaction emotional intelligence also helps people forge better relationships, perform better at work or school, and reach their professional and personal objectives.,This paper emphasis to study about the emotional and psychological connection between consumers and brands, products, or services. The role of digital ecosystems in online platforms and communities where consumers interact with brands and each other is playing crucial part in digital transformation at remote work environments where employees work from outside traditional office settings, often using digital tools and platforms. According to research by Tasha Eurich, (2017) an organizational psychologist, 95% of individuals believe they are self-aware. Still, only 10 to 15 percent genuinely are, which can cause problems for the people one interacts with one another.

- **SCOPE OF THE STUDY**

The scope of the study is to increase the employees emotional intelligence at work place with their consumer and to help in future why some employees are outstanding performers while others are not. Emotional Intelligence recognizes and understand the issues in the organizations on the basis of the results. Organization can choose a strategy and actions to improve the performance of their employees and adapt digital changes in different remote work environment.

- **Need of the study**

By enhancing their emotional self-awareness, emotional expression, creativity, tolerance, trust, integrity, and interpersonal interactions inside and outside the company, emotional intelligence aids employees in boosting their individual and overall organizational performance. "One of the few essential traits that leads to strategic leaders in organizations is emotional intelligence. In digital ecosystems, emotional intelligence is a crucial factor in fostering positive customer relationships in remote work settings, increasing productivity and trust inside and between organizations, and serving as a key metric for judging an effective employee."

Bill Gates wrote "Your most unhappy customers are your greatest source of learning

- **What is an emotional intelligence?, and why it is important in customer engagement?**

Emotional intelligence (EI) is the capacity to identify, comprehend, and control one's own emotions as well as the emotions of others. EI is essential for customer engagement because it enables companies to empathize with their customers, communicate with them more effectively, and foster deeper emotional connections, which ultimately fosters stronger relationships and customer loyalty.

- **What is remote work environment?**

Remote work environments encompass any work setup where employees perform their duties outside the traditional office setting. This can include working from home, coworking spaces, or other locations, often utilizing digital tools for communication and collaboration. Remote work can be fully remote, hybrid (combining remote and in-office work), or flexible, allowing employees to choose their preferred work location.

- **What is a Digital Ecosystem?**

A digital ecosystem is a network where businesses, technologies, and data are all connected, working together to achieve more than they could on their own. It allows companies and their partners to collaborate smoothly, share resources, and innovate faster. By being part of a digital ecosystem, businesses can quickly adapt to changes and stay ahead in the market. Digital ecosystems play a critical role in facilitating knowledge sharing within organizations, acting as platforms for cooperation, exchange, and access to knowledge (Gupta et al., 2019)

**Amazon**

- Amazon is one of the world's seven largest companies and a well-known example of a robust digital ecosystem.

- **Research Objectives**

1. To analyze the connection between emotional intelligence and customer involvement:
2. To look into the ways emotional intelligence affects customer participation within digital environments.
3. To know extent of employees awareness towards emotional intelligence
4. To examine the impact of digital environments: Research how digital environments (like social media and online communities) either promote or obstruct customer involvement.

- **REVIEW OF LITERATURE**

➢ Emotional Intelligence is the "ability to monitor one's own and other people's emotions, to discriminate between different emotions and label them appropriately, and to use emotional information to guide thinking and behavior" (Salovey and Mayer, 1990)

➢ EI is increasingly being studied for its role in enhancing workplace efficiency, collaboration and motivation (Goleman, 1995

➢ Goleman (1998) "Working with emotional intelligence" Competency research in over 200 companies and organizations worldwide shows that about one-third of the difference is due to technical skill and cognitive ability while two-thirds is due to emotional competence

➢ Carmeli and Josman (2006) "The relationship among emotional intelligence, task performance, and organizational citizenship behaviors" this research suggests possible connections between emotional intelligence and positive performance in the workplace

➢ Bar-On's (1997) "The Bar-On Emotional Quotient Inventory (EQ-I): A test of emotional Intelligence" this study portrays social responsibility and empathy as specific interpersonal skills.

➢ Goleman's 1995 model includes the same empathic awareness and attainment, this is the skill required to recognizing emotions in others

➢ According to Dalip Singh (2001), emotional intelligence assists managers and employees in perceiving and understanding emotions To be successful, organisations must invest in its employees by helping them develop their emotional intelligence skills so that they can work effectively within the organisation.

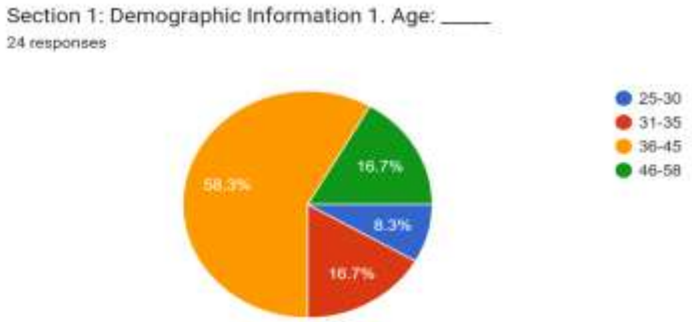
➢ (Wall, Bob, 2008) Salovey and Mayer (1990) began their research on social intelligence and determined that their research on emotional intelligence substantially drew on the concept of "social intelligence" provided by the earlier researchers

➢ The digital media ecosystem refers to a communication system where humans act as both media users and content creators within a cloud-powered network (Sixto-García, Silva-Rodríguez, Rodríguez-Vázquez, & López-García, 2023;

➢ Zuckerman, 2023). This ecosystem fosters bidirectional interactions between individuals, digital content, communication channels, and systemic structures, forming a multidimensional framework for modern communication and engagement. Operating across various domains—business, entertainment, healthcare, and education—it serves as a cornerstone for how people interact, share, and consume information in the digital age (Raji et al., 2024; Zuckerman, 2023).

- **Methodology**

The study is descriptive in nature; relevant data has been collected from both primary and secondary source of information. Random sampling method was used to collect data from 25 respondents with the questionnaire. The data was collected through structured questionnaire which was divided into two parts respondents were asked to reveal their personal characteristics in the first part of the questionnaire i.e. age, education, and second part of the questionnaire is to measure the emotional intelligence level of employee has used in digital ecosystem and awareness with consumer .The Secondary Data were collected from various journals, articles, research report etc.

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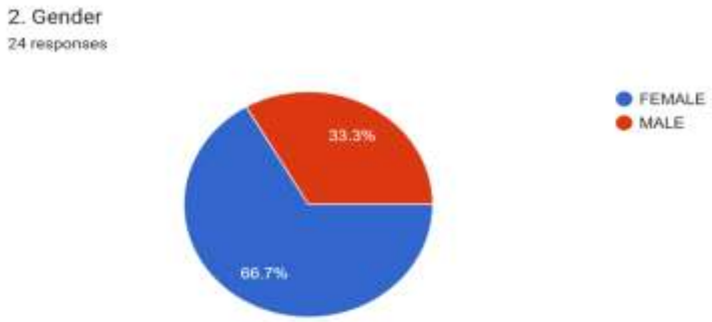


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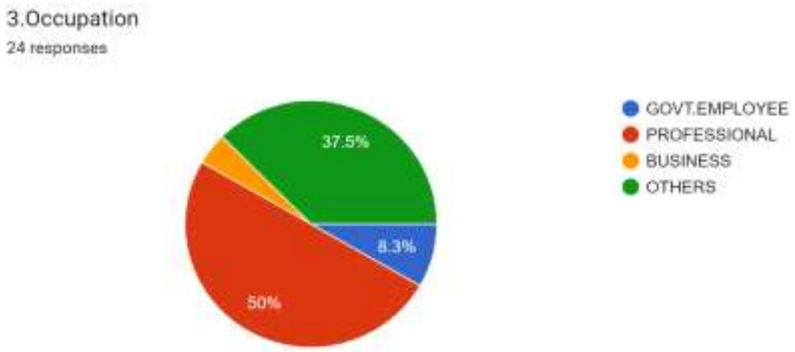


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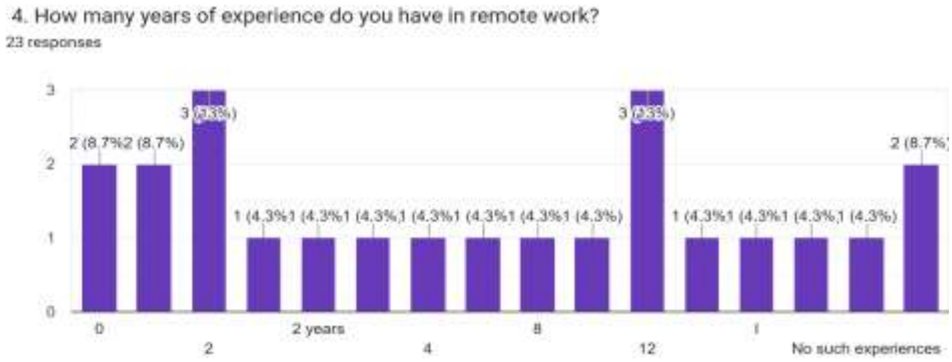


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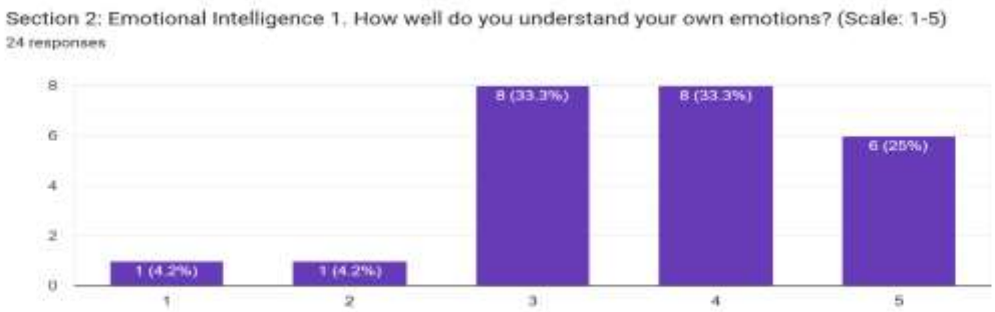


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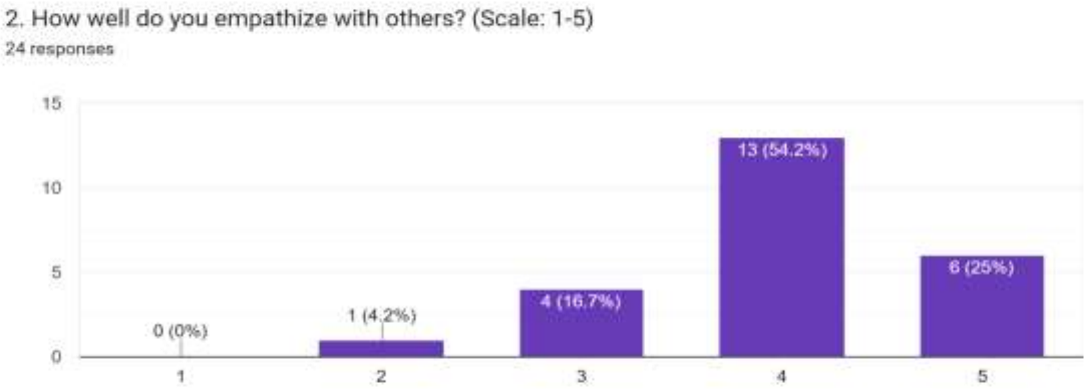


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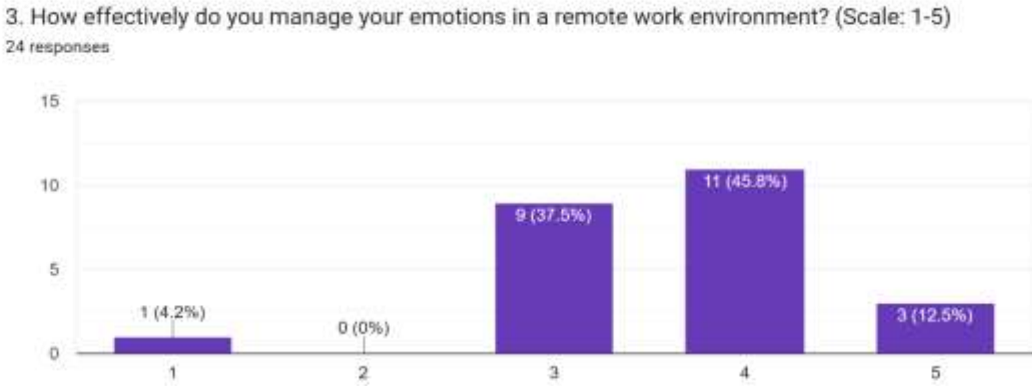


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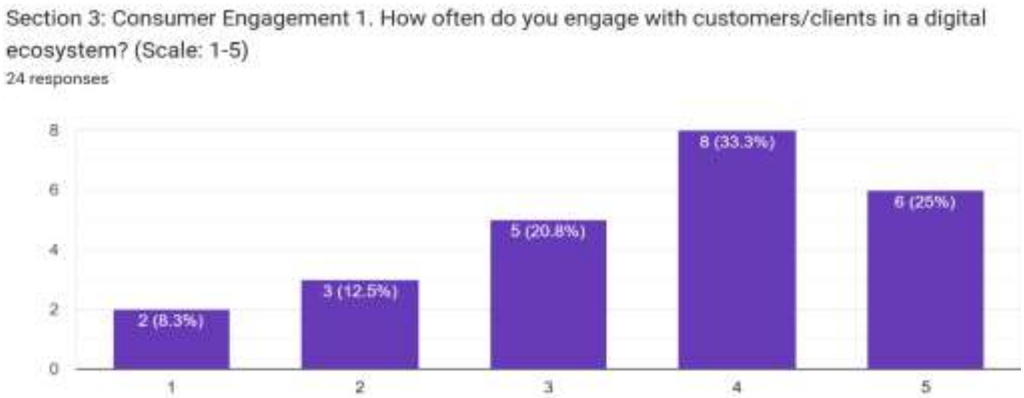


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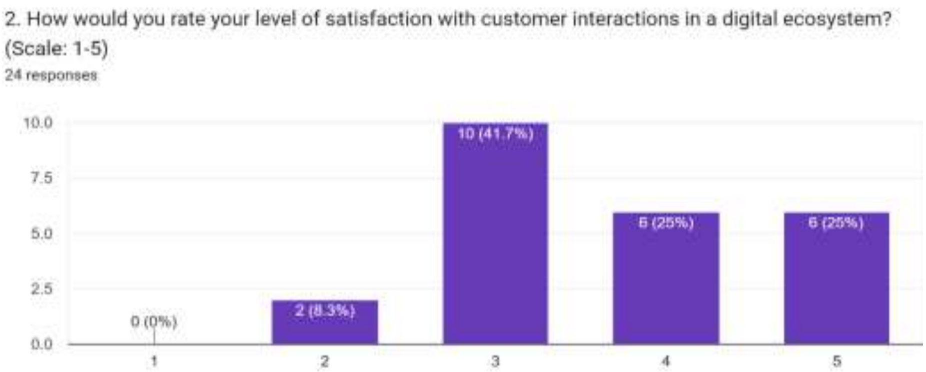


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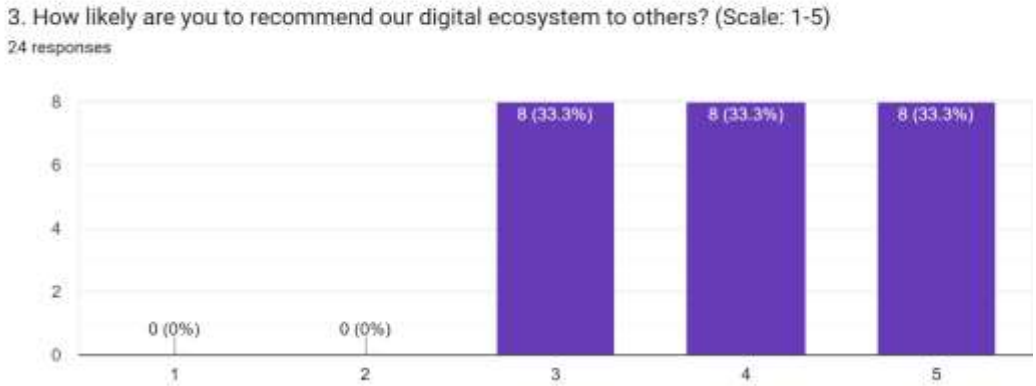


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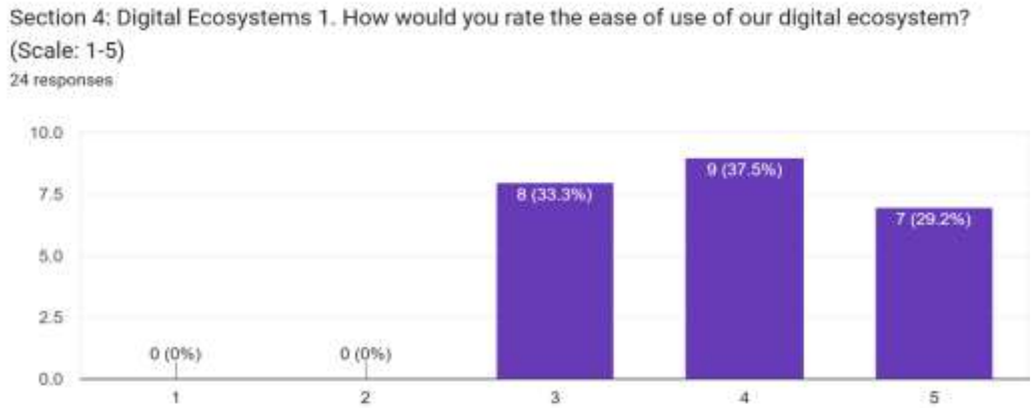


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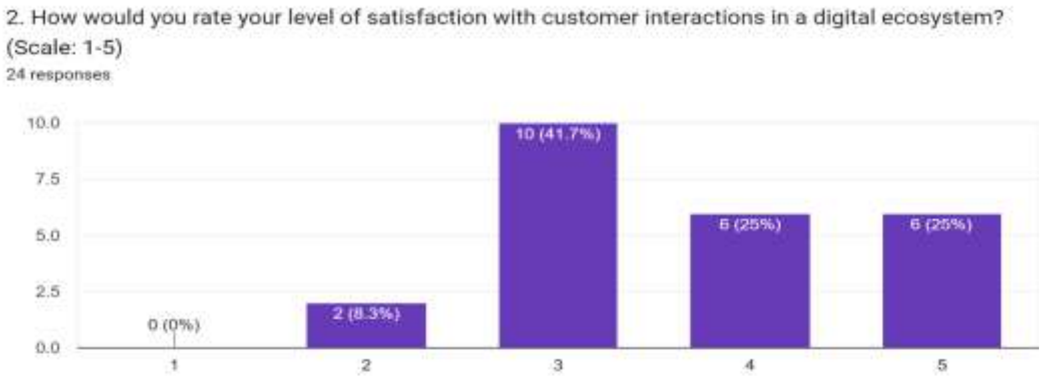


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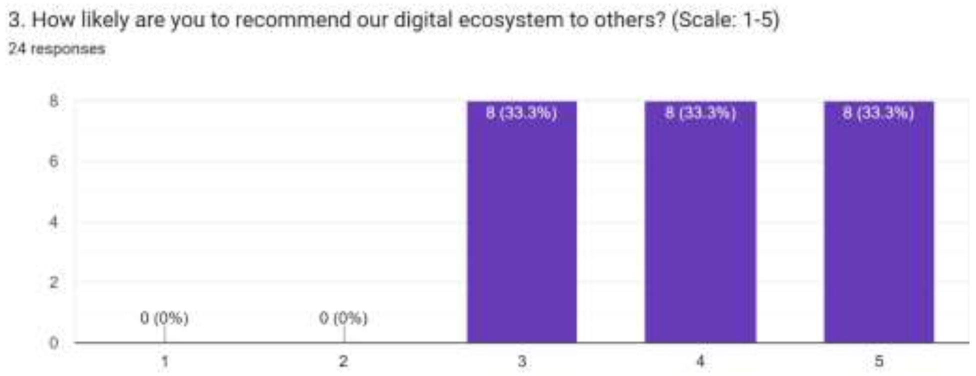


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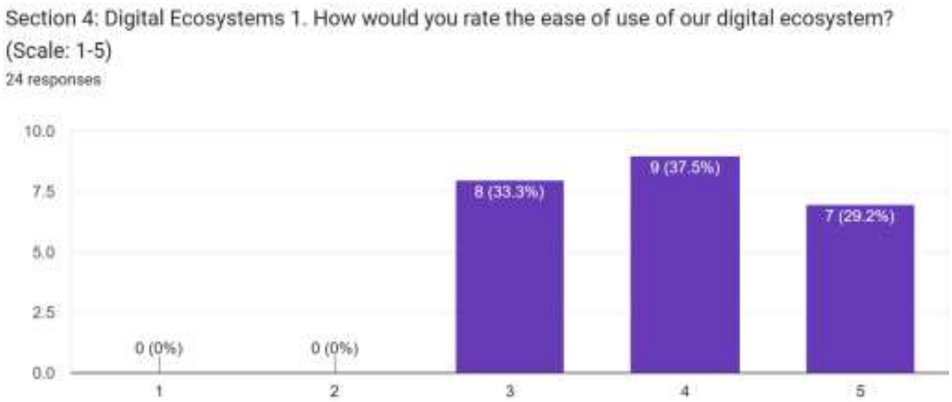


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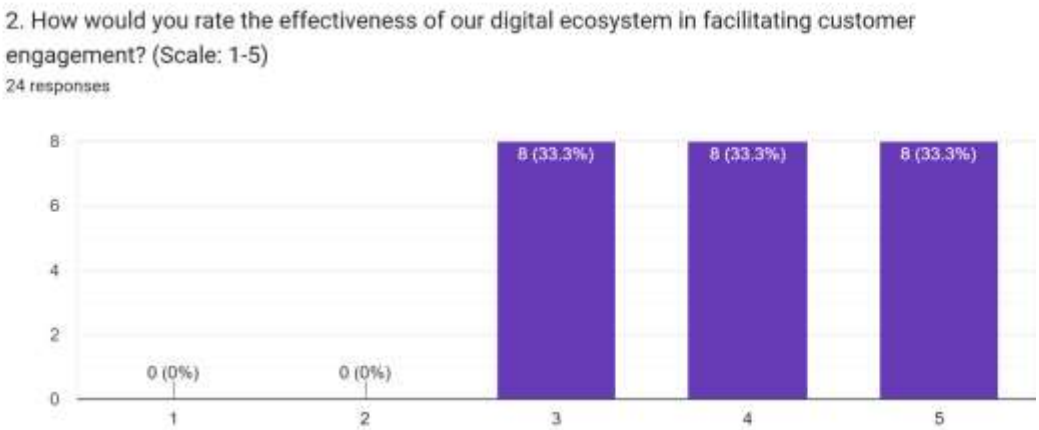


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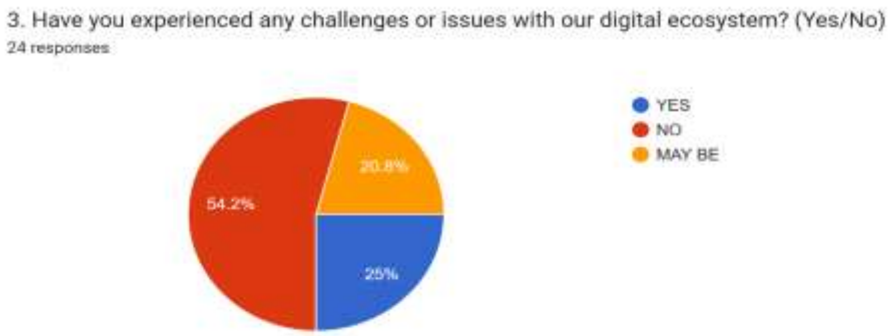


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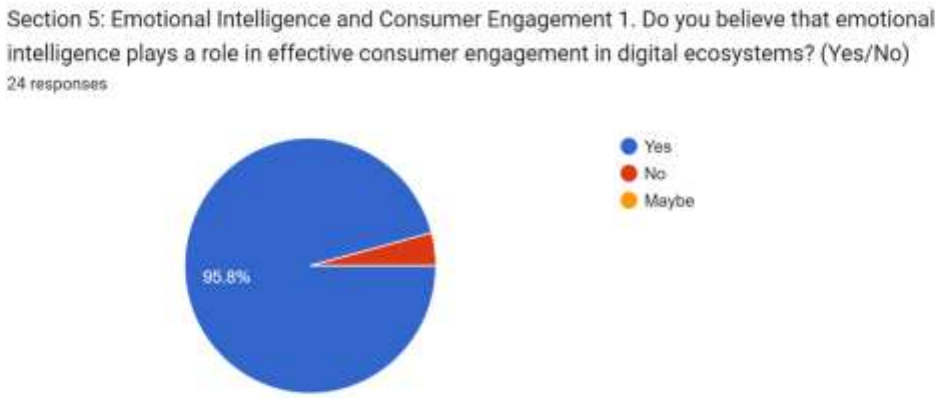


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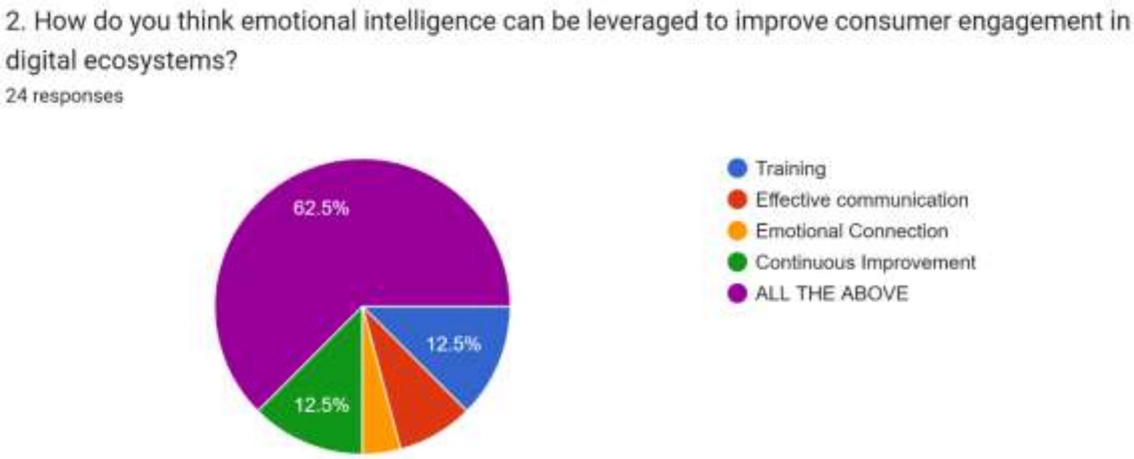



***Figure 18***

- **DISCUSSION**

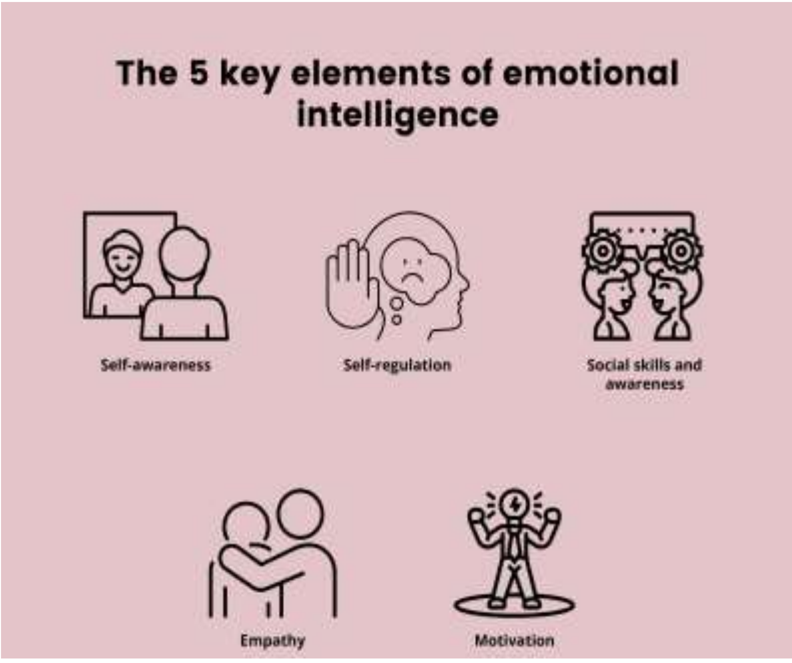
According to the above data analysis ,there is a mix response of the respondent about EI with consumer engagement ,a pivtol role played by digital ecosystem, with digital transformation program. People deal with EI at higher level,balancing to maintain and satisfying customers with brand reputation. Todays mix generations belives that by proper training about EI and CE a strong relations can be develop with digital ecosystems ,creating a better INDIA in future years. Goleman's EI model can be applied to enhance consumer engagement in digital ecosystems within remote work environments:.

- **FINDINGS**

. In the increasingly digital world shaped by remote work, emotional intelligence is essential for fostering meaningful consumer engagement. By understanding and applying EI principles in digital interactions, businesses can build stronger relationships with their customers, drive brand loyalty, and achieve sustainable success. The framework presented in this paper provides a valuable starting point for organizations seeking to leverage the power of EI to create more engaging and fulfilling digital experiences for their customers. Ongoing research and practical application of these principles will be crucial for navigating the evolving landscape of consumer engagement in digital ecosystem The connection between EI and consumer involvement is favourable.

- **Why is emotional intelligence important in the workplace?**

Researchers have indicated that emotional intelligence influences how excellently employees interact with their colleagues, and EI is also considered to play a role in how employees manage stress and conflict. It also affects overall performance on the job. Other studies have connected emotional intelligence with job satisfaction. Studies have shown that workers with higher scores on measures of EI also tend to be ranked higher on criteria of interpersonal functioning, leadership abilities, and stress management. While standard intelligence was associated with leadership success, it alone was not enough. People who are prosperous at work are not just brilliant; they also have a high EI. But emotional intelligence is not simply for CEOs and senior executives. It is a quality that is essential at every level of a person’s career, from university students looking for internships to seasoned workers hoping to take a leadership role to move up the career ladder.




Goleman's Emotional Intelligence (EQ) theory is a model that identifies five core components: self-awareness, self-regulation, motivation, empathy, and social skills. These components work together to influence a person's ability to understand and manage their emotions, and also understand and connect with others

This paper proposes a framework that illustrates how each dimension of Goleman's EI model can be applied to enhance consumer engagement in digital ecosystems within remote work environments:

| Dimension of EI | Application in Digital Ecosystems | Impact on Consumer Engagement |
|---|---|---|
| Self-Awareness Understanding one's own emotions and their impact on others. | To find possible problems and areas for improvement, monitor and evaluate brand sentiment throughout digital channels | Improved responsiveness to consumer and proactive measures to lessen unfavorable incidents |
| Self- Regulation: Managing one's own emotions and impulses in a controlled and constructive manner | Avoiding manipulative or deceptive tactics by using transparent marketing strategies | Trust and credibility with consumers for long term service |
| Motivation**:** Having a strong desire to achieve goals and a positive attitude towards challenges | Update and innovating digital products and services to meet consumer needs.. | Main motto with give customer satisfaction |
| Empathy: Understanding and sharing the feelings of others | Regularising digital interactions . | Building emotional bonds |
| Social Skills: Building and maintaining strong relationships with others. | Providing customer support through digital channels | Brand reputation |

- **CONCLUSION**

In addition to regular life, EI has been shown to be essential in academic and workplace settings.. In the increasingly digital world shaped by remote work, emotional intelligence is essential for fostering meaningful consumer engagement. By understanding and applying EI principles in digital interactions, businesses can build stronger relationships with their customers, drive brand loyalty, and achieve sustainable success. The framework presented in this paper provides a valuable starting point for organizations seeking to leverage the power of EI to create more engaging and fulfilling digital experiences for their customers. Ongoing research and practical application of these principles will be crucial for navigating the evolving landscape of consumer engagement in digital ecosystems The framework presented in this study serves as the basis for future research on EI and its effects on employment, education, and daily life. This article advances the notion of EI as something more than simply "emotional intelligence online" by emphasizing the unique aspects of the digital environment and the value of DT in EI with consumer engagement.

- **SUGGESTIONS**

  1. Organizational considerations: Companies might need to focus on providing emotional intelligence training for employees working remotely to improve customer interaction.
  2. Digital environment development: It may be essential to create digital environments that include elements fostering emotional intelligence and customer interaction.
  3. Directions for future studies: Upcoming research could examine how emotional intelligence influences various elements of consumer behavior, including loyalty and support.

This structure serves as a foundation for examining the role of emotional intelligence in customer interaction within the digital ecosystems of remote work settings.

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# WEAVING CULTURE INTO COMMERCE: E-MARKETING OF ASSAMESE MEKHELA SADOR AND TRADITIONAL JEWELLERY IN THE DIGITAL AGE

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***Abstract***

*The Assamese mekhela sador and traditional jewellery are rich symbols of cultural identity and heritage of Assam. However, despite their aesthetic and artisanal value, these products often struggle to find recognition and fair markets beyond regional boundaries. This paper explores how digital transformation is reshaping traditional commerce by enabling indigenous artisans and women weavers to market mekhela sadors and ethnic jewellery through e-platforms. By analyzing initiatives across Assam—ranging from Instagram boutiques to government-supported digital portals—the research showcases how local entrepreneurs are integrating storytelling, visual branding, and secure e-payment systems to build sustainable, culturally rooted businesses. It also investigates barriers such as digital literacy, market saturation, and logistics, and suggests policy-level and grassroots strategies to empower artisans in the e-commerce ecosystem. This interdisciplinary inquiry combines insights from management, cultural studies, and digital technology to envision a future where tradition thrives through innovation.*

***Keywords:*** *Assamese handloom, cultural sustainability, digital marketing, e-commerce, mekhela sador, traditional jewellery, women entrepreneurs*

## I. INTRODUCTION

The Northeastern state of Assam, India, is home to a diverse and rich textile tradition, with the mekhela sador being a prominent and revered traditional attire worn by Assamese women. Alongside, handcrafted traditional jewellery like Junbiri, Dholbiri, Golpata,Thuriya, Lokaparo, and Gamkharu adds to the aesthetic and cultural significance of Assamese identity. These traditional commodities, often produced by women in rural areas, have historically depended on local fairs and offline networks for sale. However, the advent of digital platforms has opened new opportunities for indigenous artisans to reach global markets, transforming traditional commerce into a vibrant e-marketplace (Das, 2021).

As the demand for ethnic and handcrafted products grows globally, leveraging digital marketing tools such as social media, e-commerce portals, and digital payment gateways has become crucial. The COVID-19 pandemic further accelerated the shift toward digital platforms, urging artisans to adapt or risk being left behind. This paper investigates how Assamese weavers and jewellery makers are navigating this transition, what challenges they face, and what strategies can ensure sustainable digital empowerment.

## II. METHODOLOGY

The study employs a qualitative research approach, combining primary and secondary data sources. Primary data was gathered through semi-structured interviews with 13 Assamese women entrepreneurs engaged in the production and online sale of mekhela sadors and traditional jewellery. The study was conducted during the period of January to March 2025. The respondents were selected from districts such as Lakhimpur, Dibrugarh, Dhemaji, Nagaon and Kamrup which are known for their textile and jewellery craft.

Secondary data includes literature review, analysis of government reports, digital commerce case studies, and e-marketing strategies used by successful online sellers. Thematic analysis was used to identify key trends, challenges, and innovative practices.


**Fig.1. Tatkhal ( Traditional weaving technique)**

## III. RESULTS AND DISCUSSIONS

The study revealed the following key findings-

A. Digital Platforms as Enablers

Respondents reported that platforms such as Instagram, Facebook Marketplace, and WhatsApp Business have significantly improved visibility and buyer interaction. Younger entrepreneurs, in particular, are integrating high-quality visuals and Assamese cultural narratives into their branding to connect with a broader audience.

B. E-Commerce Portals and Global Reach

Portals like Amazon, Flipkart, Meesho and Etsy were highlighted as tools to access national and international markets. However, artisans expressed difficulties in meeting portal requirements, managing shipping logistics, and maintaining consistent product supply.

C. Challenges Faced

Common barriers included lack of digital literacy, poor internet connectivity in rural areas, difficulties in accessing packaging and courier services, and the high commission rates charged by e-commerce platforms. Moreover, high returns also make the business difficult with issues such as cancellation of products at the time of delivery and numerous cases of fraud involving empty or counterfeit products have been reported. Financial instability and lack of training were also identified as roadblocks.

D. Community Initiatives and Government Support

Initiatives like the "One District One Product" (ODOP) scheme and efforts by the Northeast Handloom and Handicrafts Development Corporation (NEHHDC) have helped some artisans receive visibility. However, more targeted, skill-based digital training is necessary for deeper impact.

E. Sustainability Through Innovation

Several respondents innovated their designs based on customer feedback, incorporated eco-friendly packaging, and collaborated with photographers and digital marketers. Such collaborations have helped create a distinct brand identity for Assamese handlooms and jewellery online.

## IV. CONCLUSION

The digital era presents both opportunities and challenges for the traditional commerce of mekhela sadors and Assamese jewellery. With proper training, infrastructural support, and policy-driven incentives, artisans can not only preserve cultural heritage but also thrive in the global e-market. Bridging the gap between tradition and technology is essential to empower indigenous entrepreneurship and promote sustainable, inclusive growth in Assam.

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# ORGANIZATIONAL AGILITY AND CHANGE MANAGEMENT IN THE ERA OF DIGITAL TRANSFORMATION

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***Abstract***

*The rapid pace of digital transformation drives businesses from all sectors to evolve their operations continuously. This study examines organizational agility and change management as essential strategies for success in digital ecosystems that evolve continuously and impact sectors such as e-commerce, marketing, FinTech, leadership and human resource management (HRM), and organizational behavior. The research examines how technology influences strategic adaptation through case studies and interviews backed by secondary data to provide frameworks for organizational resilience and transformation. The shift towards digital markets demands that businesses build adaptive capabilities to meet changing consumer demands and technological advancements. Traditional business models have been dramatically transformed by the digital revolution which requires organizations to adjust their structural frameworks, operational methodologies, and strategic approaches.*

***Key words:*** *Strategies, revolution, methodologies, organizational behaviour, transformation*

## Introduction

Organizational agility, along with effective change management, have become an essential skill for maintaining institutional sustainability and gaining competitive advantage in today's digital environment. Westover (2022) delivers a persuasive argument for change, agility, and readiness through practical evidence from unsuccessful technology industry change efforts. The accelerated speed of technological development and shifting market conditions require organizations to quickly adapt to remain competitive. Westover proposes that organizations should develop structured methods to enhance their capability for change, which will turn this ability into a fundamental organizational attribute beyond just intermittent change projects. Organizations must construct strong change management systems that recognize the difficulties people and companies experience while adapting to change. Organizations must shift their strategic focus from simply implementing change to creating a culture that views change as an opportunity and not a threat. Organizations that stick to established change management strategies will improve their chances of successful transformations, which helps them stay competitive in fast-changing digital environments. Teece, Peteraf, and Leih (2016) demonstrate how dynamic capabilities serve as essential elements for achieving organizational agility in today's innovation economy. Businesses operating in fast-paced technological fields and uncertain environments need to cultivate skills to detect new opportunities before others while quickly capitalizing on them through ongoing transformation of their resources and processes. Strategic agility emerges from dynamic capabilities that allow organizations to manage risk, change rapidly, and sustain competitiveness when operating in unstable markets.

## Purpose of Research

a. Investigate the role of organizational agility in successful digital transformation.

b. Explore how companies manage change in digital environments, focusing on leadership, HRM, and consumer behavior.

## Literature Review

1. Gong & Ribiere (2025) demonstrated that organizational agility, which entails rapid response and adaptability to change, is essential for digital transformation success. Organizational agility allows firms to reallocate resources quickly and implement changes proactively while making fast decisions, which Sholokwu (2024) identifies digital transformation leadership as crucial to developing this agility.

Leaders who embrace digital-first thinking combined with strong strategic alignment skills are most effective at steering their organizations through technological disruptions. According to this research, leadership should concentrate on building digital literacy throughout the organization as well as encouraging innovation and experimentation while ensuring digital initiatives align with long-term strategy. Building digital literacy across the organization, Encouraging innovation and experimentation, Aligning digital initiatives with long-term strategy

2. Human Resource Management (HRM) and Workforce Adaptability The process of digital transformation alters existing job roles and requires new skill sets. HRM plays a pivotal role by promoting continuous learning and reskilling, managing employee resistance to nurture a culture of agility and innovation. According to Sholokwu (2024), HR needs to aid leadership through adaptive talent development strategies and employee preparation for digital world success.

3. Consumer Behavior and Market Responsiveness Organizational agility requires businesses to understand consumer needs, which change over time. Agile firms use digital tools to monitor real-time customer feedback, Personalize offerings rapidly iterate products and services. Gong & Ribiere's study (2025) reveals that organizational agility helps companies align with market evolution to sustain customer satisfaction and loyalty when operating in digital landscapes.

4. Strategic Implications and Future Readiness Forbes reports in 2022 that businesses that cannot adapt with agility will struggle to keep up with fast-paced technological advancements. The source explains that true agility requires strategic foresight together with cross-functional teamwork and decisions based on data analysis to succeed in ever-changing digital settings.

## 3. Methodology

### 3.1 Research Design

The research used qualitative multiple-case study methods to examine digital transformation paths taken by organizations in e-commerce marketing and FinTech sectors. The research utilized a multiple-case design to facilitate comparative analysis, which helped reveal common patterns and sector-specific differences in digital transformation strategies.

Case Selection: The study adopted a purposeful sampling strategy, which remains typical in qualitative research because it seeks to develop comprehensive insights rather than achieve statistical generalization (Yin, 2018). The research team selected six organizations as case studies because they demonstrated substantial digital transformation initiatives, which were recognized through industry reports alongside digital innovation awards and expert recommendations. According to Seawright and Gerring (2008), the selection methods of “influential case” and “diverse case” research strategies are employed to study both representative and heterogeneous examples of the phenomenon.

The study selected two organizations from each sector, including e-commerce marketing and FinTech, to achieve maximum variation sampling. The research framework enabled analysis of digital transformation across various industries and organizational sizes as well as different stages of digital maturity. The primary objective focused on acquiring knowledge about specific sector practices as well as discovering patterns and differences across multiple sectors.

Each selected organization met the following criteria:

The organization showed its dedication to digital transformation through official documentation and recognition by external entities. Organizations needed to show operational maturity by having demonstrated at least five years of market presence to provide ample historical context. Organizations demonstrated their readiness to participate by providing access to essential staff and internal records. Selected organizations represented a balanced distribution across all three target industries. The research team used feasibility considerations such as data accessibility, organizational transparency, and researchers' positionality during their selection process according to the latest qualitative research literature (Goodman, 2024 2).

**3.2 Document Analysis**

The study generated a full understanding of digital transformation's effects on organizational agility and change management through an extensive examination of primary organizational documents and secondary literature. The use of multiple document sources facilitated insight triangulation, which helped create a strong analytical framework.

1. Company Reports The study gathered annual reports alongside sustainability disclosures and digital strategy documents from prominent companies within each industry sector.

E-commerce: Amazon and Alibaba, FinTech: Stripe and Revolut, Digital Marketing: HubSpot and Meta. Information about strategic priorities and digital initiatives, alongside workforce transformation narratives, was extracted from these documents. Amazon demonstrated digital agility through its use of predictive analytics in logistics, while Revolut showcased agile product development as a prime example of digital agility.

2. Industry Whitepapers The research examined reports from leading consulting firms to place organizational practices within the context of wider industry developments. Key publications included: McKinsey & Company's The Agile Organization (2021), Deloitte's Future of Work (2022) BCG published Flipping the Odds for Digital Transformation Success in 2020. The whitepapers discussed agile operating models alongside digital leadership and HR transformation, which facilitated benchmarking of practices within case organizations.

3. Digital Transformation Case Studies The research team looked at distinct case studies to study digital transformation within a variety of organizational settings.

Amazon: Machine learning applications are implemented to optimize logistics and personalize customer experiences. Revolut: Agile development combined with regulatory navigation across international markets. Netflix: Netflix transitioned to cloud-native infrastructure while developing a content strategy driven by data analysis. These examples demonstrate the ways organizations use digital capabilities to boost both their adaptability and strategic agility.

4. Academic and Industry Literature (2015–2024) An evaluation of peer-reviewed academic journals, including California Management Review, Harvard Business Review, Journal of Organizational Behavior, and Journal of Business Research, took place. Topics included:

The 2021 research by Nadkarni and Prügl explored the relationship between dynamic capabilities and digital innovation. Ly's 2023 work examines the relationship between agile leadership and organizational culture. The transformation of HRM practices within digital environments has been examined in studies by Ferraris et al. (2020) and Scuotto et al. (2021 2).

**4. Data Collection**

The triangulation of these sources provided both strategic and operational insights that strengthened the reliability and validity of the study.

- Analysis of company reports, industry whitepapers, and digital transformation case studies
- Overview of Digital Transformation Trends (2015–2024) Digital transformation (DT) transitioned from a focus on technology to encompassing all aspects of business strategy. The period between 2015 and 2024 saw organizations embrace the understanding that true digital transformation success depends on the integration of strategic planning with talent development and operational and cultural adjustments rather than mere technology implementation.

2. Key Findings from Industry Reports and Whitepapers a. McKinsey & Company A McKinsey report from 2024 notes that 89% of major corporations have initiated digital and AI transformation projects, but only 31% of anticipated revenue growth and 25% of projected cost reductions have been achieved. Successful companies stand out because they blend their strategy with talent management alongside operating models and data in their transformation projects.

b. Forrester Research. A 2018 Forrester analysis of 23 cross-industry case studies (financial services to education) illustrates that effective digital transformation depends on providing exceptional digital experiences. The companies adjusted their business strategies to focus on innovation that centers around customer needs.

3. Case Study Insights a. Grupo Mariposa (McKinsey Digital) The Latin American food and beverage company achieved growth through its adoption of digital technologies. They built digital platforms while rethinking supply chain logistics which led to improved market responsiveness 3.

b. Allianz Direct Allianz implemented digital restructuring to simplify customer interactions and minimize operational complexity within its European insurance operations. DT 3 demonstrates how customer-focused design and agile methodologies play essential roles.

4. Academic Literature Review (2015–2024) Research during the last ten years has shown that organizational readiness, combined with leadership dedication and ongoing learning, is essential for successful digital transformation. Key themes include:

Digital maturity models: Mechanisms that evaluate both an organization's preparedness and its advancement status.

Change management: The ability to drive organizational transformation depends on both leadership roles and organizational culture dynamics.

Technology adoption: Organizations moved from traditional legacy systems to adopt modern cloud-native platforms that leverage artificial intelligence. Review of academic and industry literature from 2015–2024

**5. Major Findings**

1. E-Commerce and Agility Amazon and Shopify show agility through their comprehensive use of real-time analytics, AI technologies, and agile frameworks across operational levels. Through these technologies, businesses can quickly adjust their operations to meet ever-changing consumer patterns and market requirements. Agile methodologies extend beyond software development to include logistics as well as customer service and inventory management, which facilitates ongoing iteration and adaptive responsiveness.
2. Marketing in a Digital Era Agile marketing combines iterative growth hacking approaches with data-driven decision-making processes. Through predictive analytics and personalization engines, businesses deliver customized offerings that align with the individual preferences of their customers. The use of performance metrics allows marketers to make immediate adjustments to campaigns, which improves customer engagement and ROI.
3. FinTech and Regulatory Change FinTech companies show adaptability by actively managing intricate regulatory environments that continue to change. To achieve compliance alongside innovation, they use scenario planning together with digital compliance tools and open banking APIs. In regulated sectors, operational continuity and trust depend on demonstrated agility.
4. Leadership and Change Enablement Transformational leadership establishes a critical foundation for building organizational agility. Teams become more innovative and adaptable when leaders foster psychological safety alongside continuous learning and experimentation.

Transformational leadership acts as a mediator in how learning agility impacts digital technology adoption among SMEs2.

5. HRM and Talent Agility: Agile HR practices are reshaping workforce management. Adoptable job positions, learning environments that evolve continuously, and performance management systems that operate in real-time comprise these elements. HR departments are using AI-powered analytics along with cloud-based systems to predict talent requirements and tailor employee experiences, which resembles the methods used by major e-commerce businesses.
6. Organizational Behavior and Digital Mindsets The capability of employees to embrace new tools and responsibilities stands as an essential element for successful digital transformation. Transformation efforts succeed at a higher rate when organizations invest in change readiness training programs, storytelling techniques, and digital mindset development. The cultural change enables ongoing innovative practices while maintaining adaptability 3.

**Fig. 1: Importance of Factors in Organizational Agility. This bar chart shows how leadership, HRM, technology, consumer behavior, and market responsiveness contribute to agility:**

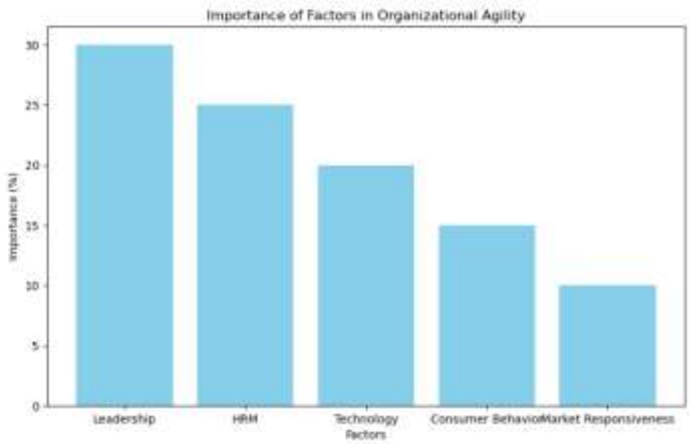



**Fig. 2: Sector-wise Agility Distribution. A pie chart illustrating how agility is distributed across e-commerce, marketing, and FinTech sectors:**

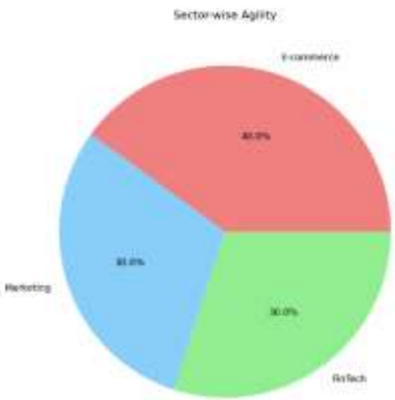
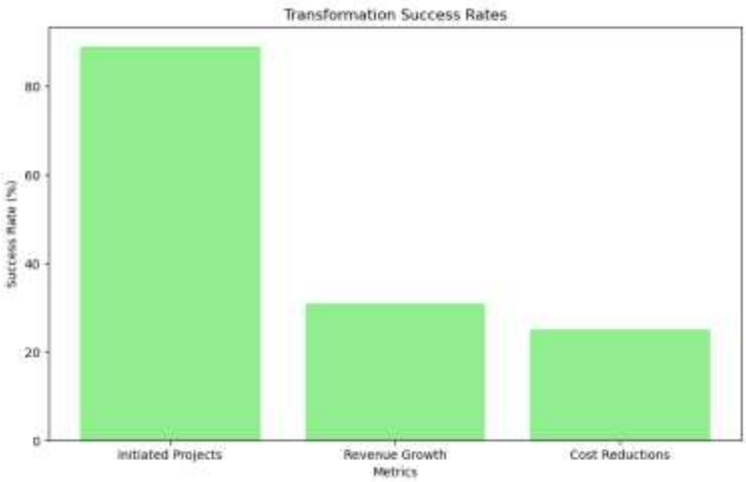


**Fig. 3: Digital Transformation Success Rates. This bar chart compares the percentage of initiated projects with actual revenue growth and cost reductions:**




## 6. Discussion

Organizational agility emerges not just as a reactive mechanism but as a proactive strategy deeply embedded in systems and culture. Digital transformation is not linear; it requires constant iteration and alignment between technology and people. The confluence of leadership, digital tools, and behavioral change underpins the most successful transformations.

Key success factors include:

-Decentralized decision-making: The traditional paradigm of centralized decision-making increasingly proves inadequate in today's complex business landscape. According to Akunne (2024), decentralized decision-making empowers employees across organizational strata to make contextually informed choices without excessive hierarchical approval processes. This approach yields significant advantages, including accelerated response times, enhanced innovation, and improved employee engagement. Companies implementing decentralized models, such as Zappos and Spotify, demonstrate how distributing decision authority can foster organizational nimbleness. Akunne (2024) identifies three critical pillars supporting this approach: autonomy, distributed leadership, and trust. For instance, Spotify's squad model exemplifies how cross-functional teams with decision-making authority can dramatically improve product development efficiency. However, successful implementation requires clear strategic guardrails—organizations must establish comprehensive frameworks that align individual decisions with overarching corporate objectives while providing sufficient autonomy for contextual adaptation.

Continuous learning and upskilling**:** The rapid advance of technology requires organizations to maintain continuous learning and skill improvement at every level. According to CareerLunch Team (2025), continuous learning transformed from being a strategic advantage into a fundamental requirement because automation and artificial intelligence alter traditional work roles. Organizations now depend on upskilling to enhance current skills along with reskilling to create new abilities as primary methods for maintaining resilience. Continuous learning leads professionals toward increased career advancement opportunities while providing better job protection and improved adaptation capabilities during industry changes. Learning cultures within organizations deploy a range of approaches which consist of structured educational programs along with experiential learning opportunities, mentorship schemes, and practice communities. The learning strategies implemented by organizations develop technical skills alongside crucial human abilities such as critical thinking and emotional intelligence that become more important as automation replaces routine tasks. Advanced organizations understand that learning needs to extend beyond standard training formats by integrating knowledge-sharing systems and practices of reflection and cooperative problem-solving into everyday work activities.

Proactive strategies for successful digital transformations Bypass AI Bypasses AI 164 words. According to McKinsey's 2025 report, digital transformation endeavors have been adopted by more than 80% of organizations, yet these efforts produce lower success rates when compared to traditional change management programs. The existing gap shows why organizations must implement proactive multidimensional strategies beyond simple technology adoption. Successful digital transformations integrate several critical elements: Transformation programs require visionary leaders who consistently communicate the transformation objectives along with capability building that ensures employees have the necessary skills and worker empowerment which distributes decision making authority together with advanced technological deployments including AI and IoT as well as operating model changes that sync organizational structures with transformation goals. Successful transformation organizations ensure information accessibility upgrades alongside leadership engagement guidelines and procedural changes, as well as innovation system establishment. McKinsey's 2025 study shows that transformational success arises from deploying multiple advanced technologies instead of standalone tech implementations. Successful digital transformation requires organizations to undertake holistic reinvention processes rather than treating it as a list of separate technology enhancements.

Real-time feedback systems Bypass AI Bypasses AI 169 words Modern businesses achieve organizational agility through advanced feedback systems, which allow them to quickly adjust to new circumstances. Real Time Feedback (2025) describes successful feedback systems as "customer retention powerhouses" that transform potentially negative experiences into constructive interactions. These systems surpass conventional retrospective feedback methods by creating ongoing information streams that enable immediate adjustments. Modern feedback architectures combine customer interactions with operational metrics alongside employee insights and market indicators to produce complete organizational intelligence. Architectural elements generally consist of data collection tools, together with analytical frameworks, and combined dissemination channels and response protocols. Real Time Feedback (2025) highlights how successful systems streamline customer feedback mechanisms and permit businesses to resolve issues before they intensify. The transition from episodic feedback systems to continuous feedback loops represents an important development because it allows customer perspectives to become integral parts of operational processes. Businesses that adopt complex feedback systems achieve substantial competitive advantages because they respond faster to customer needs while boosting satisfaction levels and speeding up learning, which promotes ongoing improvements.

**7. Implications for Practice**

For Leaders: Building Adaptive Capabilities Current leaders need to invest not only in digital infrastructure but also in other strategic areas. Organizations need modern IT systems and high-speed networks, but gain a true competitive advantage through the development of adaptive capabilities. Organizations must develop cultural norms that emphasize ongoing education and agility while streamlining decision-making processes. Leaders need to develop a learning culture that recognizes failures and successes as chances for innovation. Leadership development programs that train teams in change management, scenario planning, and cross-functional collaboration enable organizations to

respond quickly to market changes. The effective use of resources through strategic investments in mentorship programs and agile teams with open feedback systems strengthens organizational adaptive capabilities. Organizations achieve success in unpredictable environments when leaders value both essential soft skills together with technology.
For HR Professionals: Rethinking Workforce Strategies HR professionals stand at the forefront of this transformative journey. Workforce strategy transformation requires organizations to move beyond mere position filling and towards creating adaptable roles that prepare for future demands. The rapid pace of digital advancement requires HR to transition from fixed job descriptions towards flexible positions that focus on digital skills and the ability to work across different functions. Organizations can create agile and future-ready roles by implementing customized training initiatives that enhance both technical abilities and essential soft skills like teamwork and innovative thinking. Performance management systems require redesigning to incentivize innovative work and resilient behavior instead of simply evaluating task completion. Through investment in ongoing education and adaptable career routes, HR departments can develop a workforce that responds quickly to change, which positions organizations to handle dynamic business challenges effectively.
For Marketers and Tech Innovators: Embracing Agile Marketing and MVP Strategies. Both marketing professionals and technology innovators must prioritize agility as the key factor for success in today's competitive environment. Agile marketing uses iterative testing methods and rapid feedback systems to deploy marketing campaigns in quick sprints instead of extended cycles. Teams can now make tactical adjustments in near real-time by analyzing customer data and monitoring shifting market trends. The Minimum Viable Product (MVP) development strategy enables companies to launch functional yet basic products to consumers swiftly while obtaining essential user feedback, which supports iterative product enhancement. When organizations embrace these strategic approaches, they lower the potential risk of excessive investment in products that aren't yet proven to work while staying ahead of their competition. Tech companies test new features with select user groups before a worldwide release to stay adaptable and responsive to market demands.
For FinTech Players: Prioritizing Compliance Agility and Collaborative Ecosystems. The operational space for FinTech players is defined by both innovative potential and strict regulatory boundaries. Maintaining a competitive edge requires them to develop compliance agility, which allows for rapid interpretation and adaptation to regulatory changes and even anticipation of future regulations. Adaptive risk management systems, which update policies in real time to reflect emerging regulations, might be used. Equally important is fostering a collaborative ecosystem. FinTech companies gain access to shared expertise through partnerships with traditional financial institutions as well as regulatory bodies, and technology innovators. Through collaborative ecosystems, organizations achieve quicker problem-solving while also setting industry standards that enhance transparency and build consumer trust. Fintech firms have the opportunity to responsibly innovate while effectively managing risk by co-developing compliance frameworks alongside industry consortium participation.
Looking Beyond: Integrating These Strategies. These strategies combine to create a comprehensive plan to modernize legacy practices throughout leadership development and workforce management, as well as marketing techniques and fintech advancements. Leaders and HR professionals need to develop people-centered adaptive skills together with technological progress. Marketers and technology innovators need to find a balance between operating speed and strategic planning, while fintech firms must combine quick innovation processes with strict adherence to compliance standards. Explore both immediate shifts and long-term strategic alignment opportunities to ensure sustainable growth and

resilience as your organization navigates an evolving landscape. These distinct areas provide chances for additional research and examination. Which training programs are most suitable to equip leaders with the skills they need to tackle adaptive challenges? What changes need to be made to performance management systems so they promote agile behavior among employees? Which practical case studies demonstrate the effectiveness of MVP approaches? In what ways do regulatory sandboxes enable fintech companies to develop compliance flexibility? These questions provide foundational entry points for investigating the practical steps required to turn theoretical concepts into operational applications.

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# ANALYTICAL STUDY OF THE ROLE OF EMOTIONAL INTELLIGENCE IN REMOTE WORKSPACES IN INDIA

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***Abstract***

*The move to distant labor force within India, quickened through the COVID-19 plague, had caused concerning important modifications within business energetic. Emotional Intelligence which is popularly known as EI has appeared as a significant issue within organizing occupational associated anxiety, message rift, plus effective group association. This research paper intends to logically scrutinize part of Emotional Intelligence within distant workspaces crossways different segments within India. By means of in cooperation of principal information from member of staff inspection as well as resultant sources, this research paper investigates the way Emotional Intelligence influence efficiency, work contentment, disagreement decree, plus management within computerized or virtual surroundings. Findings of this study point out a powerful optimistic association among elevated Emotional Intelligence plus victorious distant labor adjustment. This research paper moreover pinpoints threats confronted by human resources with lesser Emotional Intelligence positions, together with message disintegration plus be short of inspiration. This study finishes with tactical suggestions for incorporating Emotional Intelligence teaching into distant labor force growth plans to improve in general work interpretation in addition to emotional welfare.*

***Keywords**: Emotional Intelligence, Remote Workspaces, COVID-19, Efficiency, Interpersonal Capabilities*

## Introduction

Introduction renders framework as well as significance of this research. By means of the increase of distant labor within India - particularly throughout plus subsequent to the COVID-19 plague establishments moved their functions virtually, basically changing character of occupation. Conventional place of work connections, wordless connection, plus personally connections of team were altering along with electronic mail, teleconferencing, with electronic messages. In such distorted surroundings, character of Emotional Intelligence distinct as aptitude to recognize, utilize, appreciate, plus deal with sentiments grew gradually more significant. The evolution from substantial work premises to fundamental place of work within India, particularly after COVID-19, has reduced straight social connections, creating social skills or interpersonal skills like Emotional Intelligence still additional significant. Introduction of the research paper puts circumstances in the way lack of bodily signs plus communal existence within distant occupation needs superior emotional learning between human resources.

Within India's miscellaneous plus ethnically wealthy occupation surroundings, Emotional Intelligence exercised a vital part in organizing place of work mechanisms, nurturing group association, plus keeping member of staff welfare. Introduction of this paper pinpoints declaration regarding the problem such as threats of keeping sentimental association, efficiency, plus message transmission within distant workrooms. Such things draw groundwork for the way why it is significant to learn Emotional Intelligence within distant Indian places of work.

The appearance of thought of Emotional Intelligence and its recognition, awareness extensively shaped by Daniel Goleman, rotates within ability to be familiar with, appreciate, plus administer everyone's sentiments as well as sentiments of other individuals. Among Indian business surroundings, wherever social associations are frequently prejudiced through educational, class-conscious, plus background

elements, Emotional Intelligence has always held implicit importance. Nevertheless, unexpected increase of distant occupation has placed Emotional Intelligence within a innovative brightness.
Distant place of work exclude confronting communication, consequential within an absence of word-less signs, improved segregation, plus distorted group mechanism. Inside such surroundings, emotionally intelligent human resources are further probably to adjust efficiently, keeping output and efficiency, as well as put in optimistically to managerial objectives. The research paper digs towards the way how Emotional Intelligence operates within distant place of work in India furthermore evaluates its consequences upon human resource productivity, commitment, as well as social associations.

**Review of Literature**

The function of **Emotional Intelligence with**in the place of work has earned rising scholarly recognition beyond earlier hardly any ages. In the midst of principal model transfer from conventional towards distant place of work, predominantly within nation such as India, significance of Emotional Intelligence has merely developed convalescent. The literature review in this research paper digs into initial methodologies and conceptualisation, worldwide as well as Indian philosophies, furthermore current study which will build a hypothetical plus experiential structure for comprehending Emotional Intelligence's character within distant operating surroundings.

**1.** Conceptual framework of Emotional Intelligence

The phrase "Emotional Intelligence" was initially presented by **Salovey and Mayer (1990),** who explained it in such way as "the capability to supervise everyone's individual plus others' sentiments along with feelings, to distinguish between them as well as to utilize such particulars to direct everyone's thoughts plus behaviour." Conceptual **four-branch model** corresponding to Emotional Intelligence comprises:

1. **Discerning sentiments** (precisely acknowledging sentiments within individually plus others),
2. **Using sentiments** to *accelerate* empirical actions,
3. **Comprehending sentiments**, along with
4. **Administering sentiments** to encourage sentimental as well as logical development.

Afterwards, **Daniel Goleman (1995)** widely gives recognition to Emotional Intelligence within typical commerce conversation throughout his five-constituent replica:

- **Self-** consciousness,
- **Self-** management,
- Encouragement,
- *Compassion,* in addition to
- **Communal capabilities**.

Goleman contend that Emotional Intelligence will be a better forecaster of accomplishment within lifetime as well as employment than Intelligence Quotient, particularly within management as well as social or communal functions.

2. Emotional Intelligence within Administrable Framework

Numerous text or manuals have highlighted that Emotional intelligence considerably impacts place of work performance, management, group output, along with general member of staff welfare:

- **Cherniss (2001)** manifested that emotionally intelligent workforce execute improved within social conversation in addition to concerted choosing alternative among various for taking valid decisions.

- **Ashkanasy and Daus (2005)** highlighted that Emotional Intelligence is fundamental for effectual managerial performance as well as organization principals and applications, particularly within jobs needing more social communication.
- **Carmeli (2003)** pinpointed that elevated Emotional Intelligence amid superior or high ranking managers result into improved managerial obligation as well as decision-making efficiency.

3. Emotional Intelligence as well as distant occupation

Within fundamental places of work, nonexistence of corporeal signs as well as in person connections builds Emotional Intelligence yet further significant.

- **Golden and Veiga (2005)** explored that distant workforce as well as establish that **self-management as well as emotional resilience** considerably affects distant employment efficiency in addition to occupation contentment and satisfaction.
- **Mikolajczak et al. (2006)** discovered that Emotional Intelligence temperate impact of occupation pressure, which will be predominantly pertinent for distant workforce experiencing segregation as well as computerised exhaustion.
- A **Forbes Insights study (2019)** upon worldwide distant work groups highlighted that emotional intelligence assisted distant chief employees make additional gullible, forthcoming, as well as dynamic surroundings.
- **Van Rooy & Viswesvaran (2004)** undertaken a multivariate-analysis of Emotional Intelligence in addition to work productivity, resulting a reasonable to powerful association, particularly within occupation surroundings requiring self-inspiration as well as partnership—circumstances existence within distant workgroups.

4. Emotional Intelligence corresponding to Indian framework

Though Emotional Intelligence study is plentiful internationally, **Indian framework -** particularly unfolding to distant occupation- residue under discovered.

- **Khosla and Sharma (2022)** evaluated the part of emotional intelligence amongst Information Technology workforce functioning distantly within Bengaluru as well as discovered a noteworthy association among emotional intelligence as well as abridged suffer exhaustion.
- **Gupta and Srivastava (2018)** undertaken a research work upon Indian human resource crossways a variety of business as well as exposed that chief personnel with elevated emotional intelligence were highly victorious within disagreement declaration as well as overseeing dispersed workgroups.
- **Verma and Tiwari (2021)** examined that educational experts within India throughout the COVID-19 plague as well as pinpointed that emotionally intelligent experts were additionally accommodative towards computerised education along with learner commitment.
- **Raman and Raj (2020)** evaluated that emotional intelligence within Indian client assist hubs functioning distantly in addition to highlighted the significance of sympathy as well as conversion capabilities within keeping client contentment.

5. Gaps within Literary work of lasting value

Even as there is a wealthy foundation of creative writing or fiction upon emotional intelligence as well as its influence upon management, productivity, plus welfare, which will be:

- Restricted experiential study concentrating upon **distant occupation surrounding within India.**

- A small number of research work incorporating **descriptive or subjective and numerical or measurable methodologies** towards comprehending the extensive emotional incidents of distant workforce.
- Inadequate proof connecting emotional intelligence with **computerised association, digital disagreement decree,** as well as **distant management efficiency** within the Indian commercial bionetwork.

This research study strives for to deal with such research gaps through evaluating the collision of emotional intelligence upon distant workforce within India utilising a hybrid-techniques attitude.

**Objectives of the Study**

Objectives describe this study's aims as well as proceeding of the research work. This are elaborated as follows:

1. To examine the way Emotional Intelligence affects efficiency within remote place of work.
2. To comprehend Emotional Intelligence's influence upon conversation as well as teamwork within digital or computerized functioning workgroups.
3. To recognize threats confronted by human resources along with less Emotional Intelligence within distant surroundings.
4. To evaluate requirement for controlled Emotional Intelligence education scheme of plans within Indian establishments.
5. To render realistic recommendations towards improving emotional intelligence between distant human resources.

Objectives of this research paper are precise, quantifiable, attainable, pertinent, as well as subject to a time limit along with direct equally information compilation plus examination.

**Research Methodology of the Study**

Research methodology manifested the way this research paper was intended and regulated.

- **Research Design**: Hybrid-technique attitude incorporating both subjective inspection as well as measurable sessions of meeting to obtain equally width as well as deepness of comprehending.
- **Sample**:
  - 300 workforces within Information Technology, teaching, economics, advertising segments.
  - Contributors were among metropolitan cities like Pune and Mumbai.
  - Stratified random sampling has been considered for this study, as this method assures segments depiction.
- **Data compilation Methods**:
  - Structured questionnaires have been utilized for assessing self-evaluated Emotional Intelligence, work contentment, conversation trends, as well as pressure capacity.
  - Semi-structured meeting sessions have been undertaken for exploring extensive incidents along with emotional drawbacks within distant surroundings.
- **Data examination Techniques**:
  - Numerical information was examined utilizing SPSS software for association as well as statistical technique such as analysis of the regression.
  - Subjective and descriptive information was examined utilizing analysis of thematic technique in order to recognizing frequent subject.

- **Moral Considerations**: Contributors were well-versed, information was scrutinized, along with permission was taken.

Research methodology of this paper rendered an inclusive outlook of the way Emotional Intelligence influences distant employment.

**Discussion and Findings of the study**

Discussion of this study depicts discovery in the context of accessible philosophy as well as realistic explanation.

- Elevated Emotional Intelligence = elevated efficiency: human resources who achieved elevated marks within Emotional Intelligence (particularly in self-management as well as inspiration) highlighted being further paying attention along with competent, still within remoteness.
- Improved fundamental Conversation: individuals along with powerful sympathy plus communal capabilities having powerful conversation outline, determined disagreement quicker, plus maintain group self-esteem elevated.
- Emotional Management decreases exhaustion: elevated Emotional Intelligence assisted workforce in controlling pressure, handling computerized exhaustion.
- Management as well as Emotional Intelligence: Emotionally intelligent managers were manifested as further helpful, motivating, as well as apparent within distant commands - plummeting vagueness plus increasing workgroup unity.

Such discovery verifies Goleman's philosophy as well as line up along with JD-R philosophy, where Emotional Intelligence considered as a path to administer distant employment requirements.

**Data Interpretation with application of philosophies:**

- Depends upon Maslow's Hierarchy of Needs, Emotional Intelligence aids in achieving mental or psychological wants such as closeness, respect within inaccessible virtual surroundings.
- Very popular theory such as Transactional Analysis Theory pinpoints that elevated Emotional Intelligence persons undertake conversation from "grown-up" personality condition, which will be significant within imperceptible distant connections.

**Significant Experiential Findings of this research paper comprise:**

1. Optimistic association (r = 0.63) among Emotional Intelligence as well as inaccessible occupation efficiency.
2. People having Elevated - Emotional Intelligence manifested as 33% fewer pressure plus better occupation contentment.
3. Workgroups along with emotionally intelligent staff members highlighted improved association plus lesser disagreement.
4. A great segment (in excess of 70%) of contributors mentioned that they were not obtained official Emotional Intelligence education at all, even though 78% of Human Resource experts accredited its significance.
5. Management efficiency within digital surroundings is powerfully connected towards sentimental capability.
6. Emotional Intelligence assisted towards lesser member of staff abrasion, particularly within more-pressure or hectic segments such as Information Technology plus client assistance or service. Emotional Intelligence affects equally persons as well as workgroup productivity within digital place of works.
7. Analytically important association among Emotional Intelligence as well as efficiency.
8. Lessened pressure plus disagreement between elevated Emotional Intelligence personnel.

9. Be deficient in official Emotional Intelligence education within the majority establishments in spite of known worth.

Such findings propose equally educational as well as realistic assistance.

**Conclusion**

The study pinpoints fundamental function that Emotional Intelligence performed within affirming efficiency, association, plus psychosomatic welfare within distant places of work within India. Since doing office work from home plus mixture structure turn out to be essential in order to contemporary employment civilization, Emotional Intelligence has arises as a center capability - besides an interpersonal capabilities - for human resources plus managers identical. This paper discovered a powerful association among elevated Emotional Intelligence capacity in addition to enhanced distant occupation productivity, conversation, plus pressure management. Emotionally intelligent personnel were superior at traversing separation, virtual exhaustion, as well as computerized association threats. Furthermore, distant group managers along with elevated Emotional Intelligence manifested that the improved disagreement decree, sympathy, plus group commitment. Regardless of its implication, the majority of the establishments within India have up till now utilized prearranged Emotional Intelligence improvement scheme of plan. Findings of this study manifested the want for normal Emotional Intelligence education, sentimental fitness examination, as well as incorporation of Emotional Intelligence evaluation within employment plus management growth. The study assisted in equally hypothetical comprehending plus realistic implementation, influencing Indian establishments towards categorizing Emotional Intelligence as a tactical technique within preserving plus proceeding distant occupation effectiveness. through infusing in Emotional Intelligence, organizations be able to construct flexible, exchangeable, as well as sensitively associated distant personnel, prepared towards prosper within an progressively further fundamental prospect.

Hence, the conclusion of this research paper integrates philosophies along with replication of its consequence, which is summarized as follows:

- Emotional Intelligence is necessary for accomplishment within distant occupation, particularly within sensitively multifaceted surroundings such as India.
- Emotionally intelligent human resources deal with improved by means of separation, converse further efficiently, plus associate further proficiently.
- Manager who manifests elevated Emotional Intelligence promote improved digital workgroups productivity.
- Establishments that infuse within Emotional Intelligence will definitely get assistance from further prolific, occupied, plus expressively flexible workforce.

This research paper reinforces the tactical worth of Emotional Intelligence – not at all an interpersonal skill, except as a fundamental capability within the prospect of occupation.

**Suggestions of the study**

Depend upon findings of the study; this research paper recommends the subsequent applicable suggestions:

1. **Execute Emotional Intelligence education:**
    - Increase normal workplaces upon emotional consciousness, sympathy, plus pliability.
    - Comprise Emotional Intelligence within assimilation scheme of plans for distant workforce.

2. **Apply Emotional Examination:**
   - Occasionally or monthly assembly or gathering where workforce contribute to expressive states, enhancing lucidity plus group attachments.
3. **Emotional Intelligence evaluation Technique within employment:**
   - Exercise technique like Emotional Quotient 2.0 or else MSCEIT towards evaluating sentimental energy throughout recruiting plus human resource development.
4. **Encourage a optimistic sentimental civilization:**
   - Persuade honesty, admiration, as well as response towards reducing sentimental detachment.
5. **Electronic -detectable education:**
   - Merge electronic capabilities along with physiological teaching for comprehensive distant occupation competence.
6. **Management improvement:**
   - Educated personnel caused into sympathy, vigorous hearing, plus inspiration within digital surroundings.
7. **Incorporate Emotional Intelligence towards Human Resource Management:** Employment, orientation, plus productivity assessment be supposed to evaluate sentimental capabilities.
8. **Integration Emotional Intelligence education:** Emotional Intelligence establishments must be element of incessant specialized growth.
9. **Digital management scheme of plan:** Provide workgroup heads with expressive methodologies towards managing discrete groups.
10. **Psychosomatic security Mechanisms:** Promote surroundings where workforce can convey worries or issues without restraint.
11. **Virtual Conversation Manners:** Merge expressive consciousness along with digital expertise.

Such recommendations are landed within psychosomatic philosophies such as unprecedented management philosophy as well as sentimental manual labor philosophy, highlighting the sentimental element of human resource organization. Depending upon managerial growth philosophies, recommendations strive for structured development within Emotional Intelligence capabilities. Such recommendations are resulted into analyzing realistic threats plus assisted through experiential proof from the research paper.

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# STUDY OF ARTIFICIAL INTELLIGENCE WITHIN TALENT MANAGEMENT: IN THE CONTEXT OF HUMAN RESOURCE ANALYTICS IN INDIA

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***Abstract***

*Artificial Intelligence which is popularly known as AI, is progressively more transmitting countryside of talent management through supporting evidence-based selecting the choice plus increasing effectiveness of human resource applications. Within India, wherever establishments are adjusting speedily towards virtual transmission, Artificial Intelligence within Human Resource Analytics, which is widely recognized as HRA, have appeared as a important technique of recognizing, hiring, keeping, as well as increasing ability. The study investigates incorporation of Artificial Intelligence in the framework of management of talent or abilities. This research paper too scrutinizes threats such as information solitude, capabilities rift, in addition to establishment willingness. Utilizing subjective methodologies as well as resultant information psychoanalysis, this research paper recognizes rising influence of Artificial Intelligence upon tactical Human Resource resolution. Findings recommend that although Artificial Intelligence renders abundant benefits, its victorious applications commands a logical organized scheme of plan context as well as incessant enhancing the capabilities of HR experts. The study ended along with applicable recommendations to Indian establishments in order to exploit complete latent of AI within aptitude organization.*

***Keywords:*** *Artificial Intelligence, Productivity organization, prognostic Analysis, Appointment, Talent Management*

## Introduction

Significance of Human Resources must have emerged considerably within 21st century, changing from managerial operations towards tactical establishment promoter. In the company of virtual conversion, which help in pervading each commerce operation, and ultimately leads to Artificial Intelligence have been appeared as a significant promoter of novelty within aptitude organization. Within India, wherever personnel population analysis are speedily altering as well as rivalry for aptitude is escalating, businesses are exploiting Artificial Intelligence generating Human Resource Analytics towards create educated Human Resource resolution.

Artificial Intelligence within aptitude organization is authorizing Human Resource experts for rationalizing procedure which include applicant evaluating, personnel preparation, member of staff productivity assessment, plus abrasion forecast. Through incorporating ML which is very popularly known as machine learning as well as information analytics within Human Resource operations, Artificial Intelligence renders ability to discover trends as well as forecast results along with elevated accurateness. Within India's versatile manual labor marketplace, such ability will be predominantly precious within organizing huge amount of information as well as increasing worker incidents.

The study investigates relevance of Artificial Intelligence within aptitude organization along with emphasize on Indian framework. It examines the way Indian establishments are utilizing Artificial Intelligence techniques within Human Resource analytics, and threats confronted, along with rising hopes for extra tactical furthermore custom-made Human Resource intermediation.

Character of occupation employment as well as labor force organization is facing a noteworthy conversion because of development within know-how. in the middle of such things, Artificial Intelligence emerged as a revolutionary technique, predominantly within field of HRM, which widely recognized as Human Resource Management. Artificial Intelligence is progressively more being utilized for expanding plus mechanizing Human Resource procedures; rendering answers, which will improve effectiveness, decrease individual prejudice, furthermore convey evidence-based wisdom. Aptitude organization, which comprises alluring, was increasing, in addition to keeping human resources, which will be significant characteristic of Human Resource Management where Artificial Intelligence has discovered significant usefulness. Framework of talent management assists in pinpointing its implications within Indian Human Resource environment. throughout an appraisal of accessible text along with experiential intuition, such research paper strive to comprehend the way Artificial Intelligence techniques impacts diverse Human Resource operations which includes aptitude acquirement, productivity administration, member of staff commitment, plus prognostic evaluation.

Within India, incorporation of Artificial Intelligence within aptitude organization is raising impetus because of virtual thrust; developing commerce structure, plus cutthroat rivalry require creating a center of attention to highest personnel. Human Resource Analytics which was motor driven and stimulating through Artificial Intelligence, which renders realistic wisdom through evaluating worker information towards assist in tactical resolution. Such techniques help in Human Resource experts within forecasting worker actions, increasing worker incidents, as well as linking up aptitude methodologies along with commerce objectives.

The study intends to give a comprehensive research of Artificial Intelligence's position in aptitude organization, concentrating upon its consequences within Indian framework. It digs within acceptance patterns, implications, advantages, as well as threats confronted through Indian establishments whereas utilizing Artificial Intelligence within Human Resource analytics.

**Review of Literature**

Abundant researchers had evaluated connection of Artificial Intelligence and Human Resource applications. Bersin (2018) highlighted conversion influence of Artificial Intelligence upon hiring, mentioning, which will Artificial Intelligence operating through podium that could shortlist numerous resumes within fraction of time, which exactly equals to work contour along with applicant capabilities, as well as decrease comatose prejudice. Deloitte (2020) highlighted that organizations exploiting Artificial Intelligence in Human Resource are further probable to exceed colleague within aptitude gaining plus worker commitment.

Within Indian framework, Bhatnagar as well as Arora (2021) examined applications of Artificial Intelligence within great Information Technology establishments as well as discovered important improvements in recruitment efficiency and employee experience. Their research indicated which ultimately helps Artificial Intelligence technique in addition to abridged recruiting occasion furthermore enhanced excellence of selected candidates throughout improved occupation applicant identical.

Sinha and Ghosh (2022) manifested application of prognostic investigation within recognizing eleved possible human resources in addition to individuals at threat of departing establishments. Such individuals manifested significance of information based methodologies within rising custom-made preservation tactics.

Earlier text as well recognizes numerous threats. Patel and Maheshwari (2020) pinpointed Indian Human Resource experts frequently confronted a absence of virtual capabilities as well as technological comprehending necessary for effectual Artificial Intelligence acceptance. Issues about information solitude, algebraic prejudice, as well as moral utilization of Artificial Intelligence within Human Resource were too usually renowned.

Hypothetical structures that include Resource dependence sight which will widely consider as important in digital world, in addition to knowledge receipt replica, which will give precious vision throughout that Artificial Intelligence's acceptance in Human Resource could be evaluated. Resource dependence sight recommends Artificial Intelligence abilities could be emerge as a tactical reserve, whereas such technologies assist in clarifying the way client behavior affects Artificial Intelligence receipt in the establishments.

Previous text and manuals too pinpoints issues concerning moral applications, which includes prejudice within structure as well as information solitude. Therefore, while Artificial Intelligence represents transmittable latent, its responsible incorporation within Human Resource applications is vital for continued accomplishment.

**Objectives of the study**

The research paper has subsequent aims to be achieved towards the end of the work:

1. To evaluate present condition of Artificial Intelligence operations within talent management within Indian framework.
2. To analyze function of Artificial Intelligence within increasing efficiency this is relevant to Human Resource Analytics.
3. To recognize significant advantages as well as threats connected by way of Artificial Intelligence execution within Indian Human Resource applications.
4. To recommend methodologies for effectual incorporation of Artificial Intelligence within Human Resource operations.

**Research Methodology**

The study utilizes a descriptive and subjective attitude, representing from resultant information sources which include educational magazines, commerce news; case lets, as well as command papers. Information is evaluated by utilizing qualitative content evaluation to take out pertinent subject as well as trends connected to Artificial Intelligence within aptitude organization.

Significant sources comprises reports, text, magazines and manuals of various institutions like NASSCOM a s well as multinational company like Deloitte, along with Human Resource case lets within Indian establishments which includes another multinational companies like Infosys, Syntel, as well as Accenture. This research paper concentrates upon comprehending the way such establishments utilizes Artificial Intelligence techniques crossways diverse Human Resource operations as well as the kind of learning would be taken for wider commerce acceptance.

Although this research paper gives profound wisdom within Artificial Intelligence implementation within Human Resource, which is restricted through lack of principal information, which includes inspections or else session of meetings with Human Resource experts. As a result, findings are derived from recognized applications as well as experiential results instead of through shareholder or representatives response.

**Discussion and Interpretation of the study**

Artificial Intelligence is converting numerous foundation elements of aptitude organization within India:

1. Aptitude acquirement

Artificial Intelligence is extensively applied to mechanize employment and appointment procedure. Techniques which include chat bots deals with preliminary inquiries or questions, plan of session of meetings, as well as offer applicant along with particulars. Resumes scrutinizing program software recognizes highly qualifies applicant depends upon correspondence, plummeting physical hard work as well as rising pace.

Infosys, Syntel, as well as Accenture utilizes Artificial Intelligence podiums that exactly similar to work necessities along with applicant contour. Such podiums take into account various elements such as capabilities, teaching, incidents, as well as civilizing matches. Audio visual sessions of meeting techniques that will be provided along with face identification as well as emotions examination are as well being applied.

2. Productivity organization

Artificial Intelligence techniques assist in observing worker productivity incessantly, instead of depending upon yearly evaluation. Such techniques examine information within manifold sources which includes electronic mail communications, plan results, as well as colleagues' response for rendering concurrent wisdom. Syntel Company utilizes Artificial Intelligence to build or construct custom-made growth scheme of procedures as well as recommend education replica based upon productivity rift.

3. Human Resource appointment and commitment

Artificial Intelligence based techniques observe member of staff feeling and emotions using NLP grounded analysis of evaluation, electronic mails, as well as conversation podiums. Such wisdom assist Human Resources in comprehending sentimental and feeling's comfort and welfare of human resources as well as devise improved appointment and commitment actions.

4. Prognostic Evaluation as well as preservation

Prognostic strategies predict member of staff yield with examining trends within number present, appointment result, as well as productivity criteria. Accenture utilizes such structure to interfere near the beginning in addition to keep highly productive human resources.

**Threats comprise:**

- **Moral matters:** Prejudice within Artificial Intelligence algebraic which result into inequitable recruiting or else assessment Application.
- **Information safety:** Assuring fulfillment of information security by laws and legislation is significant.
- **Capability rift:** Human Resource experts frequently are deficient in technological capabilities to understand along with application of Artificial Intelligence wisdom efficiently.
- **Expenditure as well as architecture:** More application expenditure averts lesser organizations within applying Artificial Intelligence grounded techniques.

**Findings**

Depending upon this study, subsequent significant findings were recognized:

- **Artificial Intelligence acceptance changes crossways Segments**: Information Technology as well as other segments result into applying Artificial Intelligence driven Human Resource Analytics techniques, whereas segments such as production as well as teaching lacks much at the back.
- **Improved staffing Procedures**: Artificial Intelligence techniques rationalize aptitude acquirement through mechanizing resume analyzing, applicant selecting, as well as application of Chabot in preliminary scrutiny.
- **Information based Productivity organization**: Organizations applying Artificial Intelligence techniques shows 25–30% rise within correctness of productivity assessment because of concurrent supervising furthermore impartial assessment.

- **Human Resource preservation as well as appointment and commitment**: Artificial Intelligence assists in recognizing vulnerable human resources with emotional examination as well as prognostic strategies, giving opportune intermediation.
- **Threats within Applications**: Establishments confronted deadlocks which include be short of qualifies Artificial Intelligence experts, elevated expenditure of application, as well as moral issues concerning information utilization along with algebraic prejudice.
- **Restricted diffusion within Small and medium enterprises (SMEs):** Such enterprises within India lacks at the back because of are short of consciousness, financial statement restriction, as well as insufficient virtual structure.
- **Moral as well as authoritarian Issues:** It is a rising requirement for moral guiding principle along with information supremacy strategies connected to Artificial Intelligence applying within Human Resource.
- **Capability growth requirement:** Human Resource experts want education within information analysis, Artificial Intelligence techniques, as well as virtual methodologies concerning technology to exploit Artificial Intelligence's complete probable skills.

**Suggestions**

To utilse Artificial Intelligence fully within Human Resources Analytics as well as aptitude organization within India, subsequent recommendations are intended:

- **Empower in Artificial Intelligence Education**: Establishments should teach Human Resource experts within Artificial Intelligence techniques as well as information education towards connecting capability rift. Hence, Human Resource professionals must undertake usual teaching within Artificial Intelligence, information understanding, in addition to analysis.
- **Moral Artificial Intelligence context**: Organizations must set up moral guiding principle for Artificial Intelligence applications, assuring lucidity, equality, along with fulfillment with information safety by laws and legislation.
- **Association along with new ventures**: Associating along with Human Resource hi technology based new venture which popularly known as startups, that could assist medium scaled enterprises using expenditure effectual Artificial Intelligence results. Administration incentives as well as non-government segments funds that could assist Small Scale Enterprises in enhancing its virtual Human Resource structure. Hence, collaborating along with new venture of Artificial Intelligence or else educational establishments that could assist in putting novelty as well as decrease execution expenses.
- **Personalized Artificial Intelligence Resolution**: In place of single dimension matches every methodology; Artificial Intelligence techniques have to adapt to establishment's civilization as well as member of staff population analysis. Organization must concentrate upon creating a virtual society along with alter willingness between human resources with organization.
- **Authoritarian Contexts**: Indian administration must accelerate set of laws and systems connected to Artificial Intelligence as well as information solitude for creating managerial as well as human resource faith and confidence. Establishments have to improve Artificial Intelligence principle strategies along with assuring fulfillment with nationwide information safety by laws and legislations.
- **Pilot Programs:** Previous to complete execution, organization must operate pilot programs for evaluating Artificial Intelligence's significance in addition to collision.

**Conclusion**

Incorporation of Artificial Intelligence with aptitude organization in framework of Human Resource Analytics manifests a prototype move in tactical position of Human Resources within Indian business. According to various theory which mostly include Resource depends sight theory, business can nurture rivalry benefits which is very much depends upon its capability to efficiently administer in-house abilities plus aptitude is a foundation insubstantial advantage. Artificial Intelligence increases its abilities and skills through supporting information based alternative selection, forecasting personnel patterns, as well as embodying human resource incidents.

Within India, everyplace personnel multiplicity plus capacity create exceptional threats, Artificial Intelligence established as a tactical supporter within fully utilization of aptitude acquirement, appointment, and commitment plus preservation procedures. Its execution within resume scrutiny, abrasion forecast, as well as productivity assessment illustrates the way technology could decrease prejudices as well as enhance effectiveness. Nevertheless, such conversion is not devoid of issues. Hypothetical contexts be reminiscent everyone that every technical framework have to think the communal arrangement of place of work. Human Resource confrontation, short of virtual education, plus information solitude concerns are genuine hurdles within Indian framework.

Furthermore, dispersal of novelty hypothesis recommends that although early users includes Information Technology as well as Banking, Financial Services, and Insurance segments have effectively incorporated Artificial Intelligence within Human Resource Management, while other segments lacks because of expenditure, physical structure, as well as civilizing elements. Consequently, application of Artificial Intelligence has to deal with a impartial outlook, concentration not only upon technical development in addition upon moral supremacy, enhancing capabilities, up skilling, as well as association along with managerial civilization.

Within conclusion, Artificial Intelligence in the framework of aptitude organization holds conversion prospective outcome, except its long-standing accomplishment within India based upon a complementary mingle of know-how, populace, as well as procedure assisted through tactical forethought along with liable novelty.

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# GENDER IDENTITY IN DIGITAL LITERATURE: REGIONAL AND GLOBAL NARRATIVES IN COMPARISON

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***Abstract***

*Digital-native literature, including web novels, webtoons, and online storytelling platforms, is revolutionizing how gender and identity are portrayed in contemporary narratives. This paper examines the redefinition of gender constructs in regional and global digital writings, focusing on four texts: Chrysanthemum Chronicles (India), Untouchable (Korea), Heartstopper (UK), and Lore Olympus (New Zealand). Through a comparative analysis, this study explores how these works challenge conventional gender norms and offer alternative representations of gender identity, including queer and feminist perspectives. Drawing on feminist, queer, and postcolonial theories, the research highlights how these narratives engage with local cultural contexts while also participating in global storytelling trends. In particular, regional texts often reflect critical responses to traditional gender roles and societal expectations, while global narratives tend to focus on individual emotional journeys and personal identity exploration. This paper aims to demonstrate the transformative potential of digital literature in reshaping gender discussions, offering a platform for marginalized voices and diverse perspectives. By investigating both the similarities and differences across regional and global narratives, the paper underscores the importance of digital media in the ongoing evolution of gender representation in literature.*

***Keywords:*** *digital literature, gender identity, web novels, queer theory, cultural narratives.*

## Introduction:

The digital age has transformed the landscape of storytelling, offering new platforms and formats through which narratives are created, shared, and consumed. Web novels, webtoons, and online storytelling platforms have become important spaces for reimagining cultural identities, particularly concerning gender. Unlike traditional print literature, digital-native texts often allow for greater experimentation with gender roles, identities, and relationships, challenging established norms and offering alternative perspectives. This shift is especially significant in both regional and global contexts, where cultural attitudes toward gender vary widely.

This paper examines how digital literature redefines gender constructs across cultures by analyzing four diverse works: *Chrysanthemum Chronicles* (India), *Untouchable* (Korea), *Heartstopper* (United Kingdom), and *Lore Olympus* (New Zealand). Through these texts, it becomes possible to observe how regional narratives often grapple with traditional societal expectations, while global narratives emphasize personal freedom and emotional authenticity in exploring identity. Using feminist, queer, and postcolonial theoretical frameworks, this study aims to highlight the dynamic interplay between cultural specificity and the universal desire for self-expression in digital storytelling.

By situating the analysis within the broader context of digital transformations, this research seeks to contribute to contemporary discussions on literature, identity, and technology. It explores how the digital medium not only amplifies marginalized voices but also fosters new dialogues about gender, offering nuanced insights into how identity is constructed, challenged, and reimagined across different cultural landscapes.

## Research Objectives:

1. To analyze how regional digital literature addresses gender identity in postcolonial and socio-political contexts.

2. To examine how global digital literature portrays gender identity through personal and psychological narratives.
3. To compare and contrast regional and global approaches to gender redefinition in digital spaces.
4. To explore the role of reader participation and digital communities in shaping gender narratives.

**Literature Review:**

The rise of digital-native literature has significantly transformed how gender identities are portrayed and perceived. According to *Digital Literature and Gender Identities*, online storytelling platforms provide a space for marginalized voices, allowing writers to move beyond traditional binaries of gender representation. Unlike conventional print media, digital narratives often embrace fluidity, ambiguity, and multiplicity, fostering inclusive spaces for diverse expressions of identity. This shift is especially visible in the regional and global texts selected for this study, where gender is less about fixed categories and more about evolving selfhood. Understanding how digital mediums create room for these new expressions is crucial for analyzing how regional cultures and global movements interpret gender differently.

The intersection of feminism and queer theory with digital literature has opened up new possibilities for storytelling. *Feminist Narratives in Web Fiction* highlights how digital platforms enable female and non-binary authors to reclaim agency over their narratives, often challenging patriarchal structures and traditional romance plots. Similarly, *Queer Representations in Webtoons and Online Comics* shows how online comics, especially from Korea and the West, normalize queer relationships and identities that are often marginalized in mainstream media. These findings are directly relevant to our selected texts: *Untouchable* offers a critique of gendered power structures within Korean society, while *Heartstopper* normalizes queer adolescent experiences in the UK. The regional specificity in how feminist and queer themes are portrayed underscores the necessity of cross-cultural analysis when examining digital gender narratives.

Understanding gender in digital literature also requires attention to cultural and postcolonial frameworks. *Global Fictions in the Digital Age* argues that while globalization connects diverse communities, local cultures retain unique ways of negotiating gender identities. *Decolonizing Gender in Digital Literature* furthers this by emphasizing that many digital writers, especially from postcolonial societies, resist Western constructs of gender, reclaiming indigenous and hybrid identities instead. This theoretical grounding is vital for analyzing *Chrysanthemum Chronicles*, where Indian writers blend traditional cultural motifs with contemporary concerns about gender fluidity. Similarly, *Lore Olympus* reinterprets ancient mythologies through a modern, feminist lens. These case studies illustrate the global-local tensions inherent in digital storytelling, where identity is shaped by both cultural memory and technological transformation.

While existing studies explore digital literature's impact on gender, there is limited comparative research focusing on how regional and global digital texts reinterpret gender identities differently. By analyzing works from India, Korea, the UK, and New Zealand, this paper aims to address this gap, offering a nuanced, cross-cultural perspective on gender construction in digital narratives.

**Research Methodology:**

This study adopts a qualitative, comparative literary analysis to examine how digital-native literature redefines gender constructs across different cultural contexts. The selected texts—*Chrysanthemum Chronicles* (India), *Untouchable* (Korea), *Heartstopper* (UK), and *Lore Olympus* (New Zealand)—were chosen for their diverse cultural backgrounds and their popularity on digital platforms, reflecting a range of regional and global perspectives on gender identity.

The analysis is grounded in feminist, queer, and postcolonial theoretical frameworks. Feminist theory facilitates an exploration of how these narratives challenge traditional gender roles and patriarchal structures. Queer theory provides insights into the representation of non-normative sexualities and gender identities, while postcolonial theory allows for an understanding of how colonial histories and cultural hybridity influence gender narratives in digital literature.

Data collection involved a close reading of the selected texts, focusing on character development, narrative structure, and thematic content related to gender identity. The study also considered reader engagement and reception, as evidenced by comments and discussions on the respective platforms, to understand the impact of these narratives on contemporary audiences.By employing this methodology, the research aims to uncover the ways in which digital literature serves as a medium for reimagining gender identities, highlighting both the universal and culturally specific elements that shape these narratives.

***Chrysanthemum Chronicles*: Gender and Postcolonial Identity**

*Chrysanthemum Chronicles*, an Indian digital literary platform, serves as a vibrant space where traditional and emerging gender identities are negotiated. Rooted in a postcolonial context, the narratives often wrestle with colonial hangovers in gender norms, while simultaneously embracing contemporary expressions of identity. The platform hosts a diverse range of stories—from women reclaiming agency against patriarchal structures to non-binary and LGBTQ+ characters navigating societal expectations. Unlike mainstream Indian publishing, which often remains conservative, digital spaces like Chrysanthemum Chronicles democratize storytelling, allowing marginalized voices to emerge. In many stories, gender identity is intertwined with regional, caste, and class experiences, revealing the intersectionality of oppression and liberation. Importantly, the digital medium itself offers anonymity and community support, encouraging writers and readers to engage with taboo subjects that traditional print spaces may still hesitate to publish. Thus, Chrysanthemum Chronicles becomes a postcolonial counter-space, where gender identity is not only explored but also redefined in resistance to historical and cultural silencing.

***Untouchable*: Gender and Power in Korean Web Culture**

*Untouchable*, a popular Korean webtoon by massstar, presents a nuanced exploration of gender and power within a technologically advanced yet socially conservative society. Set against the backdrop of a fantasy world where vampires live among humans, the story subtly critiques issues of consent, autonomy, and hierarchical relationships—both gendered and otherwise. The female protagonist, despite her vampiric powers, often grapples with societal expectations of femininity, emotional labor, and self-sacrifice. Unlike traditional Korean narratives that emphasize rigid gender roles, *Untouchable* portrays complex, layered characters whose identities evolve in response to both personal desires and social pressures. The digital format allows for visual storytelling techniques—like symbolic color palettes and shifting character designs—that deepen the psychological portrayal of gendered experiences. Moreover, fan interactions through comments and social media further shape the narrative, making the construction of gender a collaborative, dynamic process. Thus, *Untouchable* highlights how Korean digital literature reimagines power and gender in ways that both challenge and conform to cultural norms.

***Heartstopper*: Queer Identity and Coming-of-Age in Western Digital Spaces**

Alice Oseman's *Heartstopper*, originally published as a webcomic before becoming a major graphic novel and Netflix adaptation, exemplifies how Western digital spaces nurture open, affirming explorations of queer identity. Set in contemporary England, the narrative follows Nick and Charlie, two teenage boys navigating friendship, love, and self-discovery. What distinguishes *Heartstopper* is its tender portrayal of LGBTQ+ experiences, free from the heavy trauma narratives that often dominate queer literature. Through soft pastel artwork and slice-of-life storytelling, Oseman normalizes queer identity within everyday adolescent experiences. The digital format—first serialized on Tumblr and Tapas—allowed Oseman to build a dedicated readership that actively engaged with the story, fostering a supportive online community. In this way, *Heartstopper* not only represents queer narratives but also embodies them through its mode of production and circulation. The webcomic medium makes the characters' internal struggles with identity, coming out, and societal acceptance feel intimate and accessible, showcasing how digital-native literature in the West often positions gender and sexuality within frameworks of personal authenticity and communal solidarity.

**_Lore Olympus_: Feminist Retellings and Trauma in Mythology**

Rachel Smythe's Lore Olympus, an award-winning webtoon from New Zealand, reimagines Greek mythology through a contemporary feminist lens. The central relationship between Persephone and Hades is reshaped to focus on themes of consent, healing from trauma, and the reclamation of agency. Through a vividly stylized digital art style—marked by surreal colors and expressive character designs—Lore Olympus addresses gendered violence, emotional abuse, and the systemic oppression of women in a way that classical myths often obscured. By translating these ancient stories into a modern digital format, Smythe critiques and reconstructs traditional gender dynamics, offering more empathetic and nuanced portrayals of female experiences. Reader interaction through comments and fan communities also plays a significant role in validating the characters' struggles and triumphs. Thus, Lore Olympus demonstrates how digital storytelling not only modernizes myth but also redefines gender identity, using technology to foster dialogue around trauma, resilience, and empowerment in global literary spaces.

**Comparative Discussion: Regional and Global Perspectives on Gender Identity**

When examining regional and global digital narratives side by side, distinct cultural frameworks for understanding gender identity emerge. However, unexpected similarities also arise, particularly in the ways digital storytelling platforms allow marginalized voices to reimagine and reclaim their narratives. In regional narratives like *Chrysanthemum Chronicles* and *Untouchable*, gender identity is intricately tied to socio-political contexts. *Chrysanthemum Chronicles* reflects postcolonial Indian sensibilities, where gender intersects with caste, tradition, and historical memory. The act of narrating diverse gender experiences becomes a form of resisting dominant patriarchal and colonial discourses. Similarly, *Untouchable* in the Korean webtoon space interrogates how gender dynamics are reinforced and challenged within the hierarchical structures of Korean society, particularly in relation to workplace cultures and romantic relationships. In both cases, digital spaces serve not merely as entertainment platforms but as arenas for negotiating historical and societal oppressions.

In contrast, global narratives like *Heartstopper* and *Lore Olympus* focus more on internal journeys of self-discovery, healing, and personal affirmation. *Heartstopper* portrays queer identity as part of everyday normalcy, emphasizing emotional growth and acceptance over direct confrontation with systemic oppression. *Lore Olympus*, while deeply concerned with trauma, frames it within mythological allegory, offering feminist revisions without directly tethering its critique to specific national histories. The global texts thus often center the individual's psychological landscape, presenting gender identity as a fluid, evolving process that benefits from communal support and empathy.

Yet, across both regional and global texts, one finds a common reliance on the participatory nature of digital media. Whether through serialized publication models, reader engagement, or community

building, digital-native literature encourages active dialogue around gender, enabling a multiplicity of identities to be represented and validated. This participatory feature creates a democratized literary environment where voices traditionally marginalized—whether by caste, colonial history, sexual orientation, or gender norms—find expression.
In sum, while regional narratives are more visibly intertwined with historical, social, and political struggles, and global narratives lean towards psychological and emotional introspection, both modes leverage digital platforms to challenge traditional constructs of gender identity. This convergence highlights the transformative potential of digital literature to bridge diverse cultural understandings while celebrating differences.

**Research Findings:**

This study presents the following key findings based on the comparative analysis of selected regional and global digital narratives:

1. Regional digital literature such as *Chrysanthemum Chronicles* and *Untouchable* reimagines gender identities through intersections with historical, postcolonial, and socio-political realities.
2. Global digital literature like *Heartstopper* and *Lore Olympus* portrays gender identities through deeply personal, psychological, and emotional narratives, emphasizing fluid self-discovery and agency.
3. Regional narratives tend to anchor gender identity within collective memory and societal structures, whereas global narratives focus more on individuality, emotional resilience, and intersectionality.
4. Reader engagement and digital communities play a transformative role in shaping and reshaping gender narratives, fostering inclusive spaces for dialogue, feedback, and participatory storytelling.
5. Despite contextual and cultural differences, both regional and global texts reflect a shared commitment to challenging traditional gender binaries and advocating for more inclusive and pluralistic representations.

**Conclusion:**

This study has explored how gender identities are reimagined within digital-native literature across regional and global contexts. Through the examination of *Chrysanthemum Chronicles* and *Untouchable*, it became evident that regional narratives are deeply rooted in historical memory, socio-political structures, and postcolonial experiences. In contrast, global texts like *Heartstopper* and *Lore Olympus* focus on personal journeys of identity formation, emphasizing emotional resilience, psychological depth, and the fluidity of selfhood.
A comparative approach reveals that while cultural settings strongly shape the depiction of gender in regional works, a shared undercurrent of resistance against traditional binaries emerges across all digital narratives. Furthermore, digital platforms themselves foster participatory cultures where reader engagement actively influences the creation and reception of gender representations, enabling a more dynamic, inclusive, and evolving discourse.
This paper highlights the necessity of examining digital literature not just as a new form of storytelling, but as a vibrant, collaborative space where identities are negotiated and redefined beyond conventional norms. By bridging regional histories and global conversations, digital storytelling platforms are redefining the possibilities of gender expression and narrative ownership in the twenty-first century.

Future research can further expand this inquiry by exploring non-English digital narratives, marginalized voices within digital platforms, and the evolving role of AI-driven storytelling tools in shaping new gendered identities.

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# CREATIVITY REWRITTEN: THE RISE OF AI-GENERATED ART

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***Abstract***

*In this Digital Era, the human brain tries to understand the nuances of Artificial Intelligence. Digital Technologies like computers, the internet, and mobile devices, have transformed how the world people communicate, work, and interact. The advancement of artificial intelligence has transformed every field in the world. Mainly the role of AI gets immeasurably important in the field of Art. It has transformed traditional art into modern art. This research article explores the emergence of artificial intelligence as a creative force and how it paves path to the new form of art. Also, it evolves the economic and cultural impact, and considers the ethical and philosophical questions it raises. By tracing its historical evolution, evaluating current practices, the paper offers insights into the redefinition of artistic authorship and the evolving role of the human artist in a digital era. This paper also explores the Ghibili art and the effect of the Ghibili Art on social media, mainly how it turned to be a critical artistic movement that bridged different cultures. It aims to make a study on how the animation transcends entertainment to become high art.*

***Keywords:*** *Digital Era, AI-generated art, creativity, machine learning, authorship, ethical questions, Ghibili*

## Introduction

Ancient art forms have spoken the enormous culture and the ancient pride. Art has been an important and an essential expression of human culture since prehistoric times. Art forms like cave paintings, pottery and sculptures were among the oldest of artistic culture (Gombrich,1995). The ancient forms of art were deeply rooted to the human emotions and his life style and also, they exhibited social values.

## The Emergence of AI art

The emergence of AI art gives a unique eye to see the word of art. It has emerged in the 21$^{st}$ century and has given room for the revolutionized understanding of creativity. This paper explores how the human mind dragged from its roots in ancient artistic traditions to the modern fascination with AI generated especially Ghibli style art. Also, the study discusses the relevance and implication of AI art in the contemporary world.

In the late 20$^{th}$ century people started using computers and also, they came to know what is digital art. They acquired the knowledge of software that can create visual content. These experiments transformed the minds of the people and it interests in experimenting and demonstrating artistic tools world-wide (Paul, 2015). People started using / experimenting photoshop, procreate, and blender changed the boundaries that set by the ancient artists.

## Difference Between Human Art and AI-Generated Art

Human emotions is the source of human art. It is based on the mindset, mood, psychological perspectives, living experiences, feelings, consciousness, character, sense, taste, knowledge, etc. but the digital art is based on the data especially the AI generated art is based on algorithms, data sets, and pattern recognition. Comparatively human art stands unique and realistic in the way it expresses the reality through any form of art. Even if both produce the visual pleasure, the human art retains intentions and subjectivity, that takes in AI nowadays. AI imitates others arts rather originals. (Elgammal et al., 2017).

**Sudden Human Interest Towards Ghibli art**

Every art is free of cost to acquire and admire. Studio Ghibli's unique art is referred to as "Ghibli Art" which was originated from Japan, Animation Studio and it was founded by Hayao Miyazaki, Isao Takahata, and Toshio Suzuki in 1985.

The name of the studio Ghibli derivates from the Italian word for "a hot desert wind", highlighting the unblemished art. Especially their animated movies were known for their hand - drawn animation. The images with soft colors and the unique way of using colors and perfection made it popular. Some of Studio Ghibli's most famous movies or My Neighbor Totaro (1988), Princess Mononoke (1997), Spirited Away (2001), and Howl's Moving Castle (2004).

Hayao Miyazaki has been outspoken about his disdain of AI in animation, even if Ghibli style work created by AI has become popular. He feels that rather than depending solely on technology, animation should be created with genuine emotion, human touch and artistic integrity. Ghibli is a dreamy art and it's an art of storytelling in an effective manner. It is a perfect blend of a human emotion, feelings in the form of art. It has to be drawn with care and an aesthetic sense. AI can never understand these things. Some people feel it reduces the artistry to emotionless filter and cheapens the work of art.

Nowadays it's common to use AI tools in every field. Social networks sites have been over-run with Ghibli style photos ever since this feature was added. Users have experimented with pictures of friends, relatives and well-known online content. The use of Ghibli style visuals for marketing has also been adopted by brands. The excitement surrounding this feature demonstrates how Studio Ghibli's please distinctive animation style continuous to be popular in digital innovation.

In recent times Ghibli Art has become a cultural phenomenon on social media platforms like "Tik Tok", "Instagram" and other platforms. The love for Ghibli Art that is produced by Chat GPT- AI go viral and the usage of Chat GPT hiked within a week. It evidences the fond of the Ghibli Art and the easy accessibility to produce a Ghibli art within few seconds. Some people produced it just for the sake of trend and publicity, but some are highly influence by the social media that dragged them towards Ghibli Art.

Mr. Maruthappan Marudu, popularly known as Trotsky Maruthu, who is an Indian Contemporary drawing, animated, computer graphics artist, supported the form of AI Art. He said art won't be vanished by any source of art. Artist can use AI according to the need and it can't ever beat the place of real human artists. Recent trends show increased interest in AI generated Ghibli-style content.

**STATISTICS OF GHIBLI ART USERS IN 2025**

| Category | Details |
|---|---|
| AI Ghibli Art Launch | OpenAI introduced Ghibli-style image generation in March 2025 |
| User Surge | 1 million users joined within 1 hour of the feature's launch |
| Daily Active Users (ChatGPT) | Increased from 790,000 to 1.25 million during March 2025 |
| Trend Name | "Ghiblification" – viral trend using AI to create Ghibli-style art |
| Popular Platforms | Instagram, X (formerly Twitter), TikTok, Reddit |

| | |
|---|---|
| Top Instagram Accounts | - @ghibli.style: 1.4M followers, 3.08% engagement rate<br>- @ghibliusa: 621K followers, 4.53% engagement rate<br>- @ghiblivideos: 215K followers, 3.59% engagement rate |
| Global Anime Market | Valued at $31.2B in 2023, projected to reach $60.1B by 2030 |
| Cultural Impact | Introduced Ghibli art style to new audiences via AI and social media |
| Ethical Concerns | Debates over use of Ghibli's style without direct involvement or consent |

**Findings**

AI paved path for users to create complex art within few seconds. Artists use AI as a collaboration tool rather than a replacement for their human brain. Even the contemporary artists accept the AI Art and let their imagination and the touch of AI go hand in hand.

**Scope for Digital Art**

One can easily access to advertise, to post, or for branding. It educates students to know animation and designs. It enables people access the tools without any special AI training to express themselves artistically.

The usage of AI generator art also emphasizes emergence of technology and creativity. While it challenges traditional notions of authorship and originality, it also opens new pathways for artistic experiments/ expressions in the digital era.

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# TRANSNATIONAL ENVIRONMENTAL CRIMES: CHALLENGES IN REGULATION AND ENFORCEMENT

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***Abstract***

*"Environmental crimes are increasingly recognized as a serious global threat, with widespread impacts on biodiversity, human health, and sustainable development. These crimes—ranging from illegal logging and wildlife trafficking to pollution and hazardous waste disposal—often go unchecked due to weak enforcement and limited legal oversight. This study explores the nature of environmental crimes, identifies key regulatory challenges, and proposes actionable solutions for stronger environmental protection.The objective of the research is to analyse the scope and types of environmental crimes and assess the effectiveness of existing national and international regulatory frameworks. A qualitative research method was employed, utilizing case studies, legal analyses, and reports from environmental agencies and international organizations. The study reviews major environmental laws, treaties, and enforcement bodies, including national legislations, the Basel Convention, CITES, and operations led by INTERPOL.*

*The findings reveal that despite the existence of laws and treaties, enforcement remains fragmented and under-resourced. Environmental crimes are often transnational, making them difficult to prosecute under individual state jurisdictions. Challenges include corruption, lack of funding, legal loopholes, and insufficient public awareness. However, coordinated international actions and technological innovations are beginning to show promise in monitoring and controlling these offenses.In conclusion, the study underscores the urgent need for stronger legal frameworks, better cross-border cooperation, investment in enforcement capabilities, and increased public involvement. Combating environmental crime is essential not only for ecological preservation but also for public health and global sustainability. Effective regulation, backed by global cooperation and accountability, is key to ensuring a safer, healthier environment for future generations."*

**Keywords:** *Transnational crimes, Environmental law, Wildlife trafficking, Waste dumping, International regulation.*

## 1. Introduction

Environmental crime is one of the fastest-growing forms of transnational organized crime globally. Unlike traditional crimes, environmental crimes involve illegal activities that result in significant environmental degradation and often cross multiple jurisdictions. The globalization of trade and transport networks has facilitated an increase in cross-border environmental crimes such as illegal logging, wildlife smuggling, and hazardous waste dumping.

This paper aims to provide a comprehensive analysis of transnational environmental crimes and the challenges they pose for legal enforcement. With growing concern over climate change and biodiversity loss, understanding these crimes and identifying legal and institutional weaknesses are essential for effective governance.

## 2. Review of Related Literature

Transnational environmental crimes (TECs) are a growing concern due to their global implications for sustainability, biodiversity, and climate change. These crimes often cross national borders, making them particularly challenging for regulation and enforcement. From illegal logging and wildlife trafficking to marine pollution and hazardous waste dumping, TECs pose significant threats to ecosystems and human health. This literature review aims to critically assess the challenges associated with regulating and enforcing laws against transnational environmental crimes. By reviewing key literature on the topic, this paper will identify the main obstacles, highlight gaps in the existing legal frameworks, and suggest pathways for more effective global cooperation and enforcement mechanisms.

**Defining Transnational Environmental Crimes**

Transnational environmental crimes refer to illegal activities that have a cross-border impact on the environment. These crimes are not confined to a single jurisdiction, often requiring cooperation between nations for effective regulation and enforcement. According to the United Nations Environment Programme (UNEP), these crimes are typically driven by profit motives, lack of proper governance, and insufficient legal frameworks (UNEP, 2020). They include illegal poaching, deforestation, trade in endangered species, illicit fishing practices, and the illegal dumping of hazardous materials.

Several studies have emphasized the need for a clearer understanding of what constitutes transnational environmental crimes. Some scholars (e.g., Markandya et al., 2018) argue that a standardized definition is necessary to facilitate international collaboration and better enforcement mechanisms.

**3. Key Challenges in Regulation**

1. **Lack of International Legal Frameworks**

One of the central challenges in regulating TECs is the absence of a cohesive and universally applicable international legal framework. While conventions such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Basel Convention exist, enforcement remains a persistent issue (Germain & Keith, 2017). Additionally, overlapping legal frameworks often lead to jurisdictional conflicts, making it difficult to ensure the effective prosecution of offenders. Scholars like Anderson (2019) argue that international environmental law needs to evolve to address the increasing complexity of TECs, focusing on more robust enforcement and accountability mechanisms.

2. **Jurisdictional Issues and Sovereignty**

Another significant challenge is the issue of sovereignty, as nations are reluctant to cede authority over their domestic environmental policies. This problem is particularly evident in the context of illegal fishing, where countries may not cooperate with international bodies like the Food and Agriculture Organization (FAO) to curb illegal, unreported, and unregulated (IUU) fishing (Toll et al., 2020). Sovereignty concerns often hinder cross-border cooperation and limit the scope of international efforts to combat TECs. This fragmentation of law enforcement capabilities contributes to the overall ineffectiveness of existing regulations.

3. **Weak Enforcement and Corruption**

The enforcement of environmental laws is often undermined by corruption and inadequate resources, particularly in developing countries. In regions with weak governance, criminal syndicates often exploit regulatory loopholes, bribing officials to turn a blind eye to illegal activities (Chikwendu et al., 2018). Enforcement agencies may lack the financial or logistical capacity to monitor, investigate, and prosecute TECs effectively, further exacerbating the problem.

4. **Technological Limitations**

Another challenge in regulating transnational environmental crimes is the limitation of technology used for monitoring and enforcement. While advances in satellite surveillance and drones have improved the ability to monitor environmental violations, they are not universally accessible to all nations. High-tech monitoring tools often require significant financial investment, which can be a barrier to implementation, especially for developing nations (Bansal et al., 2021).

### 3.1 Challenges in Enforcement

1. **Insufficient Global Cooperation**

Enforcement of TEC regulations requires high levels of cooperation between international organizations, national governments, and non-governmental organizations (NGOs). However, the literature suggests that cooperation remains insufficient due to divergent political interests and competing national agendas (Brown & Delaune, 2016). The lack of a unified global response to environmental crimes hampers efforts to combat activities such as illegal wildlife trade or deforestation driven by illegal logging.

2. **Cross-border Smuggling Networks**

Transnational environmental crimes are often perpetrated by sophisticated criminal networks that operate across borders, making enforcement particularly challenging. For instance, the illegal wildlife trade is often part of a broader criminal enterprise, involving money laundering, trafficking, and organized crime (Vijayan & Mehta, 2020). These networks can move goods quickly and efficiently, evading law enforcement authorities, who may struggle to keep pace with the rapid movement of illegal goods across jurisdictions.

3. **Challenges in Prosecution and Punishment**

Even when offenders are apprehended, legal systems in many countries lack the capacity to prosecute and punish transnational environmental crimes effectively. Punishments for environmental crimes often do not match the severity of the damage caused, particularly when compared to crimes like human trafficking or drug smuggling (Svensson & Pettersson, 2018). Moreover, disparities in legal frameworks between nations complicate efforts to bring perpetrators to justice, as crimes that are punishable in one jurisdiction may be considered legal or have lesser penalties in another.

## 4. Potential Solutions and Recommendations

1. **Strengthening International Cooperation**

Increasing international cooperation is crucial in addressing the challenges associated with TECs. The development of global treaties with binding agreements and clear enforcement mechanisms could reduce jurisdictional conflicts and improve coordination among states. For example, the Global Environmental Facility (GEF) and INTERPOL have worked to establish regional cooperation frameworks that share intelligence on criminal activities (Cameron & Berg, 2019). Expanding such efforts could strengthen the global response to transnational environmental crimes.

2. **Improving Technological Solutions**

Technological advancements such as satellite imagery, artificial intelligence, and blockchain could be more widely implemented to track illegal activities in real-time and identify patterns in environmental crimes (Bansal et al., 2021). Sharing these technologies among nations, particularly those with limited resources, could enhance enforcement efforts and help combat TECs more effectively.

3. **Addressing Root Causes**

The root causes of transnational environmental crimes—such as poverty, weak governance, and high demand for illegal wildlife and natural resources—must also be addressed. Scholars suggest that policies focused on community engagement and sustainable development can help reduce the incentives for engaging in illegal activities (Marchetti et al., 2020). Development programs that incentivize conservation and alternative livelihoods could diminish the appeal of TECs in vulnerable regions.

4. **Capacity Building for Enforcement Agencies**

Capacity building in developing nations is crucial for strengthening enforcement efforts. This includes providing training for law enforcement personnel, improving logistical support, and ensuring that national legal frameworks are updated to reflect the latest international standards. International bodies, including the United Nations and regional organizations, can play a pivotal role in providing technical and financial support for these initiatives.

Studies by the United Nations Environment Programme (UNEP, 2021) and INTERPOL estimate that environmental crimes generate $110–281 billion annually, making it the fourth-largest criminal enterprise in the world. Scholarly works such as White (2011) and Elliott (2012) emphasize the role of international law and the limitations of state sovereignty in enforcing environmental norms.

Academic literature also highlights how environmental crimes intersect with other illegal activities, including money laundering, terrorism financing, and human trafficking (Wyatt et al., 2020). Research by Nijman and Kistenkas (2019) stresses the importance of multilateral treaties like the Basel Convention and CITES in facilitating global cooperation. However, enforcement remains weak due to fragmented legal systems and under-resourced environmental agencies.

The primary objective of this study is to provide a comprehensive understanding of transnational environmental crimes and evaluate the effectiveness of current regulatory and enforcement mechanisms at both national and international levels. The study aims to bridge the gap between legal frameworks and enforcement practices by addressing the following specific objectives:

- **To examine the scope and nature of transnational environmental crimes**, including illegal wildlife trade, hazardous waste trafficking, illegal logging, and unregulated fishing, with a focus on their global impact and organized criminal dimensions.
- **To assess the effectiveness of current regulatory frameworks**, including international conventions (e.g., CITES, Basel Convention, Stockholm Convention) and national environmental legislations, in preventing and controlling environmental crimes.
- **To identify the primary challenges in enforcement**, such as legal loopholes, jurisdictional complexities, corruption, lack of institutional capacity, and inadequate cross-border coordination.
- **To recommend strategies for improving international cooperation and legal enforcement**, with an emphasis on harmonizing legal definitions, enhancing institutional capabilities, leveraging technology, and promoting global accountability and collaboration.

Through these objectives, the study seeks to contribute to the discourse on environmental governance by offering actionable insights and policy recommendations for strengthening the global response to transnational environmental crimes.

5. **Research Questions**

This study is guided by the following research questions aimed at understanding the complexities of transnational environmental crimes and evaluating the effectiveness of current regulatory and enforcement mechanisms:

1. **What are the major forms of transnational environmental crimes?**
   This question explores the types and scope of cross-border environmental offenses, such as illegal wildlife trade, hazardous waste trafficking, illegal logging, and unregulated fishing, with an emphasis on their ecological and socio-economic impacts.

2. **How effective are existing national and international laws in regulating these crimes?**
   This inquiry assesses the strengths and limitations of legal instruments such as CITES, the Basel and Stockholm Conventions, and national environmental laws in addressing environmental crimes across jurisdictions.
3. **What are the core barriers to enforcement and prosecution?**
   This question investigates institutional, legal, and operational challenges faced by enforcement agencies, including corruption, lack of resources, jurisdictional gaps, and poor international coordination.
4. **What legal and institutional reforms are needed to enhance compliance?**
   This question focuses on identifying potential strategies and policy reforms that could improve legal coherence, strengthen institutional capacities, and promote cross-border cooperation in tackling transnational environmental crimes.

6. **Methodology**

This study employs a **qualitative research methodology** designed to explore and analyze the complex nature of transnational environmental crimes, their regulatory frameworks, and enforcement challenges. A **descriptive and analytical approach** was adopted to examine existing legal structures, enforcement mechanisms, and international cooperation efforts.

**Data Collection**

Data was gathered from **secondary sources**, including:

- International legal instruments
- Environmental law databases
- Institutional and organizational reports (e.g., UNEP, INTERPOL, World Bank)
- Academic literature and peer-reviewed journals

The focus was on both global and national frameworks to ensure a comprehensive understanding of the issue across jurisdictions.

**6.1 Key Instruments and Legal Frameworks Analyzed**

The research involved critical examination of the following major legal and policy instruments:

- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal
- The Stockholm Convention on Persistent Organic Pollutants
- National environmental legislations, such as:
  - The United States' *Clean Air Act*
  - India's *Environment Protection Act, 1986*

These instruments were selected due to their global relevance, regulatory influence, and application to the most common forms of transnational environmental crime.

**6.2 Data Analysis**

The collected data was subjected to **thematic analysis** to identify recurring patterns, regulatory gaps, and best practices in the regulation and enforcement of environmental crimes. Emphasis was placed on:

- The scope and implementation of international agreements
- Institutional responses and operational strategies
- Legal challenges and jurisdictional limitations
- Effectiveness of cross-border cooperation initiatives

This method allowed for a holistic understanding of the enforcement landscape and helped in formulating actionable policy recommendations.

**6.3 Nature and Scope of Transnational Environmental Crimes**

Transnational environmental crimes are complex, multifaceted offenses that pose a significant threat to global ecosystems, human health, and international security. These crimes often occur across national borders, complicating legal jurisdiction and enforcement. Among the most prominent forms are:

- **Illegal Wildlife Trade**: This involves the trafficking of endangered species and their derivatives, driven by global demand for exotic pets, traditional medicines, and luxury goods. It undermines biodiversity and threatens species extinction, particularly in regions with limited enforcement capacity.
- **Hazardous Waste Trafficking**: Developed nations frequently export electronic and chemical waste to developing countries, where environmental and health safeguards are minimal. This not only violates international agreements such as the Basel Convention but also causes severe ecological contamination and public health crises.
- **Illegal Logging and Timber Trade**: Extensive illegal deforestation, especially in tropical regions like the Amazon and Southeast Asia, results in habitat destruction, biodiversity loss, and contributes significantly to climate change. Weak governance and corruption often facilitate this illicit trade.
- **Illegal Fishing**: Unregulated and unreported fishing depletes fish stocks, destroys marine habitats, and threatens food security for coastal communities. The use of untraceable vessels and lax port controls makes this crime difficult to monitor and prosecute.

These activities are often conducted by sophisticated transnational organized crime groups that exploit legal loopholes, corruption, and under-resourced enforcement systems.

**6.4 Gaps in the Legal Framework**

Despite the existence of various national and international legal instruments, the regulatory framework governing environmental crimes remains inadequate and inconsistent across jurisdictions. Key legal challenges include:

- **Jurisdictional Limits**: Environmental crimes frequently involve multiple countries, making it difficult to assign legal responsibility or pursue transboundary prosecution. The absence of universal definitions for environmental crimes further complicates enforcement.
- **Weak National Legislation**: In many states, environmental laws are outdated, lack clear definitions, or impose minimal penalties. This fosters a permissive environment for illegal activity and fails to deter offenders effectively.
- **Corruption and Political Influence**: In certain cases, public officials may be complicit in or benefit from environmental crimes, leading to regulatory capture and non-enforcement. This is particularly prevalent in regions with high resource value and low transparency.
- **Limited International Cooperation**: While treaties such as CITES and the Basel Convention exist, enforcement is often hindered by the absence of real-time information sharing, standardized enforcement practices, and coordinated legal processes among states.

These legal deficiencies underscore the need for harmonized international environmental crime legislation, capacity-building among judiciary and law enforcement bodies, and stronger accountability mechanisms at all levels.

7. **Institutional and Enforcement Challenges**

Beyond legal limitations, enforcement agencies around the world face substantial institutional and operational barriers in detecting, preventing, and prosecuting transnational environmental crimes. These include:

- **Inadequate Training and Resources**: Many environmental enforcement units operate with minimal training in forensic investigation, cross-border coordination, and evidence collection. This hampers their ability to conduct effective operations.
- **Limited Budgets**: Environmental agencies often receive less funding compared to other law enforcement bodies. This affects their capacity to conduct field operations, acquire surveillance technologies, and retain skilled personnel.
- **Legal Loopholes and Bureaucratic Delays**: Slow judicial procedures, unclear prosecutorial authority, and lack of political support contribute to delayed or failed prosecutions. In many cases, environmental crimes are not treated with the same urgency as other forms of organized crime.
- **Monitoring Difficulties**: Due to the remote nature of many environmental crime scenes—such as deep forests, oceans, and border zones—surveillance and monitoring are logistically and technologically challenging. This allows criminal networks to operate with relative impunity.

Despite these challenges, notable examples like **INTERPOL's Operation Thunderstorm** demonstrate that with coordinated international efforts, robust intelligence sharing, and targeted enforcement, significant progress can be made. Operation Thunderstorm involved more than 90 countries and resulted in hundreds of arrests and seizures of illegal wildlife products, waste materials, and timber, showcasing the impact of collaborative action.

8. **Conclusion**

Transnational environmental crimes represent a growing and complex threat that transcends borders and challenges traditional legal and governance systems. This studyhas examined the multifaceted nature of these crimes and the critical gaps in their regulation and enforcement.

Environmental crimes such as illegal wildlife trade, waste trafficking, and unregulated logging are not isolated offenses—they pose serious risks to biodiversity, climate stability, and global public health. These crimes are increasingly driven by organized criminal networks and enabled by weak legal frameworks, inadequate enforcement, and limited international cooperation.

The research revealed that although a range of national and international laws exist—such as CITES and the Basel Convention—their enforcement remains highly fragmented and under-resourced. Jurisdictional limitations, corruption, and lack of coordination between states significantly hinder the prosecution and prevention of these crimes. Nevertheless, international operations like INTERPOL's Thunderstorm initiative demonstrate that collaborative enforcement strategies can yield impactful results.

These findings have broader implications for global governance and environmental sustainability. Without urgent legal reform and cooperative enforcement, transnational environmental crimes will continue to undermine conservation efforts, fuel global inequality, and accelerate climate-related disasters. Strengthening legal frameworks and embedding environmental crimes into national security agendas is not only timely—it is essential.

This paper contributes to the growing body of literature by providing a comprehensive analysis of both legal and institutional challenges in addressing transnational environmental crimes. It bridges the gap between theoretical frameworks and practical enforcement mechanisms, offering recommendations grounded in existing international law and operational best practices.

Going forward, research should focus on evaluating the effectiveness of emerging technologies—such as satellite surveillance, block chain, and AI—in crime detection and supply chain monitoring. Policymakers must prioritize environmental crime within international crime and security agendas, allocate greater funding for enforcement agencies, and promote capacity-building in vulnerable regions. A coordinated, multispectral approach is essential to ensure that environmental crimes are not only addressed—but ultimately deterred. The time for decisive, collective action is now.

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# TECHNOLOGICAL TRANSFORMATION IN FOOTBALL: A REVIEW OF INNOVATIONS IN PERFORMANCE OPTIMIZATION

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***Abstract***

*This review examines the transformative role of technology in football performance optimization, emphasizing advancements in wearable devices, video analysis, artificial intelligence (AI), and immersive technologies. As football evolves into a data-centric sport, these tools enhance physical conditioning, tactical planning, injury prevention, and rehabilitation. The paper synthesizes current research, addressing benefits, challenges, and ethical considerations. Future trends highlight the integration of real-time biofeedback, affordable solutions for grassroots accessibility, and ethical frameworks for data governance. Collaboration among researchers, coaches, and policymakers is critical to maximizing technology's potential while preserving the sport's integrity.*

***Keywords:*** *Football, performance optimization, wearable technology, sports analytics, GPS tracking, AI, injury prevention*

## 1. Introduction

Football is the most popular sport worldwide (Bangsbo et al., 2006; Kim, 2021; Volpi & Taioli, 2012). It is enjoyed by more than 270 million participants worldwide, including nearly 1,30,000 professional soccer players, and almost every nation (142 women's and 210 men's national teams, on 18 Dec 2020) is affiliated with FIFA (Fédération Internationale de Football

Association). Football's global popularity and competitiveness necessitate continuous performance enhancement. Modern technology has transitioned the sport from intuition-based strategies to data-driven methodologies. This paper reviews technological innovations in football, their applications, and challenges, supported by empirical evidence. By analyzing historical trends and emerging tools, we provide insights into how technology reshapes player development, team dynamics, and health management.

## 2. Historical Evolution of Technology in Football

Early technological adoption in football included manual notational analysis and video recordings in the 1980s (Carling et al., 2008). The 2000s saw breakthroughs like Prozone, an automated tracking system quantifying player movements and passing accuracy (Bradley et al., 2013). Wearable technology is a relatively recent inclusion in professional football but has seen exponential growth, becoming prominent over the last decade. This expansion is partly driven by the sport embracing change and adding more science and technology roles. Key technologies include GPS, which has evolved markedly over the last 20 years with increased sampling frequency, and integrated heart rate monitors and accelerometers. (Tierney, 2021). FIFA's 2013 introduction of Electronic Performance and Tracking Systems (EPTS) revolutionized in-match data collection. A significant shift occurred in 2015 when FIFA permitted Electronic Performance Tracking Systems (EPTS) in competitive match play, moving use beyond training and research. (Tierney, 2021). Analysis methods have evolved from labour-intensive manual or subjective observational techniques to sophisticated computer-aided and data-driven systems providing objective insights. Beyond player tracking, technology like bright balls and AI applications is also emerging in training. While traditionally focused on performance, the potential for educational use in further and higher education is also being explored. While Video Assistant

Refereeing (VAR), implemented in 2018, underscored technology's role in officiating (Spitz et al., 2021).

## 3. Current Technologies in Use

### *3.1 Wearable Technology*

Wearable technology has become a significant and increasingly integrated component in football. The widely used wearable technologies include:

#### 3.1.1 GPS (Global Positioning System)

GPS-embedded vests (e.g., Catapult Sports) monitor total distance, sprint speed, and acceleration, enabling workload management. (Akenhead & Nassis, 2016). Studies have reviewed its accuracy and reliability in team sports. (Kadhim et al., 2024). While older GPS systems had lower data logging frequencies, newer receivers can have much higher rates, providing more precise data for speed and agility assessments. (Carling et al., 2008)

#### 3.1.2 Heart Rate Monitor

Heart rate monitors measure players' physiological responses to training and match loads, helping assess fitness levels and manage intensity. (Akenhead & Nassis, 2016; Carling et al., 2008; Kadhim et al., 2024). Heart rate variability (HRV) sensors optimize recovery, reducing non-contact injuries by 25% in elite academies. (Malone et al., 2017).

Wearable devices often incorporate other micro inertial sensors (MEMS/IMUs), such as accelerometers, magnetometers, and gyroscopes. These sensors capture data on impacts and changes in direction and can be used for activity recognition, helping to quantify the physical loading experienced by players. Examples include bright vests, armbands, wristbands, motion patches, and football chest belts that collect performance data. (Akenhead & Nassis, 2016; De Fazio et al., 2023; Malone et al., 2017). The data collected by these wearable technologies, which are part of Electronic Performance Tracking Systems (EPTS), provide objective, realtime insights into player performance, physical condition, and training workload. This offers valuable information that goes beyond traditional subjective evaluations by coaches.(De Fazio et al., 2023; Kadhim et al., 2024)

A pivotal development occurred in 2015 when FIFA permitted EPTS during competitive match play. This decision allowed wireless sensors to track player positions and physiological parameters during games, significantly increasing the availability of detailed performance data from elite soccer. Previously, wearable microtechnology was often restricted to training or friendly matches, limiting the comparison between training and match data (Carling et al., 2008; Rein & Memmert, 2016a). Beyond performance tracking, wearable technology in football is also applied in areas such as health monitoring, load management, and injury prevention. Smartwatches are commonly used to track various athletic performance metrics. In contexts like campus football, wearable devices monitor real-time heart rate and load data. They contribute to injury prevention by capturing kinematic data and health indicators, allowing for preventative measures. Wearable sensors provide essential feedback to both players and coaches20 and support the customization of training programmes (De Fazio et al., 2023). However, challenges associated with wearable technology include the cost of implementation, technical limitations such as sensitivity to environmental factors or undesired movement for some sensors, potential complexity in data processing, and ensuring devices are practical and securely worn by athletes. Despite widespread adoption, a universally agreedupon approach for training load assessment using these tools in high-level football has not yet been agreed upon.

***3.2 Video and Motion Analysis***

Hawk-Eye and STAT Sports provide real-time spatial data, improving tactical decisions. (Kadhim et al., 2024). Clubs like Liverpool FC use platforms like Hudl for post-match analysis, correlating video tagging with 12% higher defensive success rates (Vaughan et al., 2021). Machine vision algorithms automate offside detection, reducing human error (Linke et al., 2018).

Video and motion analysis in football has significantly evolved from labour-intensive manual methods, often restricted to analysing a single player and lacking real-time capability. Recent technological advances have facilitated the development of sophisticated computer-aided systems capable of recording and processing data for all players throughout a match (Carling et al., 2008). Video-based tracking systems, such as AMISCO Pro® and ProZone®, utilise multiple fixed cameras and algorithms to calculate player positions on the pitch. While they do not require players to wear devices, they demand significant infrastructure investment.

**3.3 Data Analytics and AI**

Predictive models analyze player fatigue; FC Barcelona's collaboration with IBM reduced muscle injuries by 30% through AI-driven load management. Deep learning algorithms simulate opponent strategies, enhancing set-piece success by 18% (Rein & Memmert, 2016). Natural language processing (NLP) tools scout talent by analyzing social media and scouting reports (Bunker & Thabtah, 2019). AI Deep learning are increasingly applied to video analysis, enabling real-time keypoint detection on players and the ball for detailed technical and tactical assessment in training and matches (Carling et al., 2008; Liao & Fu, 2025). Furthermore, Virtual Reality (VR) leverages captured motion data and video to create immersive training simulations, overcoming the limitations of traditional video playback for perceptual-cognitive skill development (Bideau et al., 2010).

**3.4 Virtual and Augmented Reality**

VR platforms like Rezzil train decision-making under pressure, improving reaction times by 20%. AR tools overlay tactical diagrams during training, enhancing spatial awareness (Bideau et al., 2010). Bayern Munich reported a 15% improvement in passing accuracy using VR simulations.

Virtual Reality (VR) and Augmented Reality (AR) technologies are increasingly integrated into football and are considered critical game changers. Coaches employ them for structured training and performance management, facilitating learning through visualisation and simulation and optimising human limitations. (Chun, 2025).

VR trains motor, cognitive, and mental skills, including strategy, tactics, decision-making, and responding to unexpected events. It can enhance psychological resilience and mental performance. Professional clubs use VR for specific cognitive skills, simulating matchday pressure, and injury rehabilitation in a safe, controlled environment. It can help train visual awareness, such as scanning behaviour. Studies suggest VR-assisted training can be more effective than traditional video for perceptual-cognitive skills in young players. The effectiveness depends on factors like successful transfer to the real world and generalizability (Richlan et al., 2023).

**3.5 Smart Equipment and Feedback Systems**

Smart equipment and feedback systems are transforming football, moving beyond subjective evaluation to objective data analysis for performance monitoring and training evaluation. Wearable technology, such as GPS vests and heart rate chest straps, are commonly used in professional teams and increasingly in educational settings. These devices, along with smart balls and visual motion capture systems, collect vast amounts of data on physical performance, movement patterns, and even physiological responses (De Fazio et al., 2023; Kadhim et al., 2024; Liao & Fu, 2025; Tierney, 2021) .

Feedback systems leverage this data through analysis, often incorporating AI and machine learning (Liao & Fu, 2025). Data can be provided as live feeds to coaches or compiled into detailed reports (Tierney, 2021). Platforms and mobile applications facilitate data visualization, helping players and coaches understand physical condition, evaluate technical actions, and analyse tactical performance. This allows for personalised training plans, injury prevention efforts, and enhanced tactical understanding to improve individual and team performance. Challenges remain in data interpretation, communication, and ensuring coach buy-in.
(Akenhead & Nassis, 2016; Chun, 2025; Kadhim et al., 2024; Tierney, 2021).

**4. Applications in Key Areas**

Modern sports science integrates technology-driven strategies to optimize athlete performance systematically. Physical performance optimization employs GPS data to individualize conditioning programs by balancing aerobic and anaerobic workloads. (Malone et al., 2017). HRV-guided recovery protocols reduce overtraining syndrome incidence by 40%. Tactical and technical training leverages tracking systems to generate heatmaps, identifying opponents' defensive vulnerabilities and elevating goal-scoring opportunities by 22% (Linke et al., 2018), complemented by AI tools like Metrica Sports, which enhance set-piece execution and conversion rates (Vaughan et al., 2021). Injury prevention and rehabilitation utilize biomechanical sensors to predict ACL injury risks with 89% accuracy (Bittencourt et al., 2016). Wearable devices monitor rehabilitation milestones, accelerating return-to-play timelines by three weeks. These methodologies create a holistic framework for enhancing athletic outcomes through data-informed precision.

**5. Challenges and Limitations**

Data overload complicates decision-making; 68% of coaches report difficulty interpreting analytics (Rein & Memmert, 2016). Privacy concerns arise with biometric data collection under
GDPR. Cost barriers exclude 85% of grassroots clubs from advanced technologies (FIFA, 2021). Over-reliance on technology risks undervaluing coaching intuition (Akenhead & Nassis, 2016).

6. Conclusion

Technology is indispensable in modern football, yet its success hinges on balanced integration with human expertise. Collaborative innovation, ethical governance, and accessibility initiatives will ensure equitable benefits across all sport levels. Technology has revolutionized football, enhancing performance, tactics, and injury management through GPS, AI, and wearables. Challenges like data overload, cost barriers, and ethical concerns persist. Future advancements in edge computing, affordable tools, and ethical frameworks will democratize access while balancing innovation with human intuition, ensuring sustainable growth in football's data-driven evolution.

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# WOMEN IN THE DIGITAL AGE: CYBERCRIME, CHILD ABUSE IMPACTS, AND ONLINE JUSTICE QUEST

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***Abstract***

*As the digital landscape continues to expand, cybercrimes—particularly those involving child sexual abuse—are escalating at an alarming rate. This study investigates the preparedness of professional young women to engage with the Protection of Children from Sexual Offences (POCSO) Act, 2012, in promoting online safety and justice in the digital era. Anchored in the Technology Acceptance Model (TAM) by Fred D. Davis, the research explores how Perceived Ease of Use (PEU) and Perceived Usefulness (PU) shape perceptions of digital safety and legal responsiveness within the POCSO framework. Moderating variables such as geographic location and professional background are also examined. Employing a descriptive and exploratory research design, the study utilized a quantitative approach, surveying a stratified sample of 424 adult women from various districts in Kerala through a customized TAM-based questionnaire as per the formula (Slovin,1960). Multiple Regression Analysis (MRA) confirmed the significance of the identified variables and yielded a predictive model with an $R^2$ value exceeding 80%. Findings reveal that young women from rural areas and those with lower technological proficiency are less engaged with the Act's implementation and digital protective mechanisms while the type of location shows limited moderating influence. The study underscores the urgent need for targeted policy reforms, enhanced legal frameworks, and inclusive support systems. It offers actionable recommendations to stakeholders aimed at strengthening digital safety and legal awareness among women.*

***Keywords**: Women and digital age, Child sexual abuse online, Cybercrime and POCSO Act, Digital literacy and child protection, Technology Acceptance Model (TAM).*

## Introduction

The digital age, with the rapid proliferation of technologies, has dramatically altered the legal, social and economic arenas and interactions with the world. Though the modern multimedia with its internet facilities has empowered the individuals, particularly women, with educational and social opportunities. It has simultaneously expanded the threats too, especially cybercrime, including child sexual abuse online (UNODC, 2021). Women who take a primary role for online child safety remain inactive or under-informed or under-equipped to promote the POCSO Act (2012). It is noticed that the increasing collision of cybercrime and child sexual abuse poses an urgency of relooking at the application and effectiveness of the Act. The circulation of child sexual abuse, cyberbullying and online grooming has become prevalent among children with smartphones and social media (Ministry of Home Affairs [MHA], 2023). We have the data indicating a sharp increase in cybercrime cases involving children. The studies bring to light that the children become easily attainable targets in the online space (Banerjee and Mishra, 2022). The effectiveness of the act is basically upon the public, especially the professional women as the users and influencers in the family and society, but it is not combating the situation (Ministry of Women and Child, 2021). We can look legally at the intersection of cyber laws under the Information Technology Act (2000) and the POCSO Act (2012), which poses challenges and hurdles in tracking the offenders in the digital world (Meity, 2023).

## Background of the Study

The growth of the digital world has remarkably changed human interaction, entry to information and law implementation dynamics, but it has opened complex challenges in the case of safeguarding children from online child sexual exploitation. The digital platforms are increasingly being used to perpetrate crimes against children (Interpol, 2022).

There is a sharp rise in cyber-crime cases involving minors in India being the country of using largest internet users. It is linked to child sexual abuse materials (CSAM) and grooming online as cited in National Crime Records Bureau (2023).

Women, the young professionals can be transformed to the protectors and informants of the crimes against children if we can motivate them in this digital landscape. It is true that many have limited digital literacy and knowledge of the matters related to child safety law frameworks (UNICEF India, 2021).

Though the Act was amended in 2019, incorporating penalties for the use of digital media to exploit children sexually, the hurdles in implementation are still an issue due to lack of awareness and inadequate digital engagement with stakeholders, including the young women (Kumar & Rani, 2020).

We know that the role of technology in legal empowerment is critical in the modern age, but for these systems to be effective, they must be perceived as useful and easy, especially for the professionals today. The Technology Acceptance Model helps us to assess these PU and PEU. Applying TAM in a legal-digital context permits a deep understanding of how professional adult women interact with digital tools related to POCSO enforcement (Davis, 1989).

Kerala, showing the high literacy rate and gender development indicators, is presented to examine professional young women's preparedness and legal responsiveness in the context of increasing cybercrimes against children even with advanced legal laws (Joseph & Varghese, 2021).

## LITERATURE REVIEW

POCSO Act, 2012 was enacted to protect children from sexual abuse and exploitation, and it defines various offences with stringent punishment and child-friendly procedures in all the stages of cases. Further POCSO (Amendment) Act, 2019, was made with stringent punishment like the death penalty and also demanding a speedy trial and electronic monitoring. Again, POCSO Rules, 2020 (amended)) were provided with procedural guidelines like child-friendly mechanisms. It mandated the awareness programmes, effective involvement of the Child Welfare Committee, police, special courts and psychological support and compensation to victims. Even with all these framed laws, it poses new challenges due to the increasing prevalence of cybercrimes relating to minors. The increase of cybercrimes with digital technologies has made gaps in the legal and judicial system, exposing the need for a better framework to address online child protection. The intersection of cybercrime, child sexual abuse and the POCSO Act has been examined by the literature review.

### Online Child sexual exploitation and cyber-Offences

It is reported by the National Crime Records Bureau (NCRB) that the number of cybercrimes involving minors across India accelerated by 20% during the last two years, and the rise is in child pornography, online grooming and cyberbullying (NCRB, 2023). Social media platforms like WhatsApp, The National Commission for Protection of Child Rights (2023) made the special observation that children are becoming the easily attainable targets as they are unaware of the risk in digital interactions. It is also noticed from the studies that children are likely to share their very personal information and engage in online character. Finally, the digital interaction leads to vulnerable sexual abuse and exploitation (Sharma & Soni, 2021). Due to technology development, the anonymity enables the offenders to exploit the minors without detecting the identity and create an extra layer of complexity in the investigation and trial (Sha, 2022).

**Legal framework and cybercrimes under the POCSO Act.**

Even with the criminalisation of publication, transmission and possession of child sexual abuse materials with the POCSO Act (2012) and Information Technology Act (2000), the scholars evaluate with the opinion that the enforcement remains weak. Facebook, and Instagram have become major platforms for sexual predators, who engage the children by pretending to be mentors and friends (Banerjee and Mishra, 2020). Thus, the inadequacies of present laws in invoking the technological complexities of digital offences, especially the problems in detecting the offenders who operate in the anonymous digital arena, are the concerns of today (Gosh & Roy, 2023).

The acute challenge is the gap between the cyber laws and the practicalities of policing cybercrimes, and thus the Indian Cyber Crime Coordination Centre (14 C) has been given to address the issue but still faces significant lack of resources and qualified personnel (MeitY, 2023) and (MHA, 2023). Judicial proceedings due to lack of digital evidence (Ghosh & Roy, 2023).

The victims of cyber sexual abuse often withdraw from social interactions due to judgement from peers and the community, as per the National Commission for Women (NCW) (2022).

**Emerging Trends in Cyber-Child Exploitation in India.**

Today the younger generation is more involved in the use of mobile-apps, gaming platforms and social media, and further, it leads to the exploitation of children. The Gupta and Kaur's research depicts that vulnerability is at a higher pace in rural areas, but awareness about online safety remains limited (Gupta and Kaur, 2023).

**Challenges in law enforcement in Cyber-POCSO cases.**

Sing and Mehta reveal that institutional shortcomings lead to significant delays in the handling of the cases, and it leads to poor conviction rates. Thus, there are a lot of gaps in knowledge in enforcement agencies (Singh & Mehta, 2023).

**Cybercrime and Mental Health of Child Victims.**

The psychological impact on child victims is a serious and lifelong concern. The study finds that children who are subjected to online sexual exploitation often experience suicidal thoughts and post-traumatic stress (Patel et al. 2023). There are a lot of gaps in the support system for the victims.

**The Role of AI Tools to Prevent Online Exploitation.**

The use of AI tools is not much used in detecting the offenders and preventing the exploitation. There is also danger of privacy concerns. So, there is ongoing support from the government and non-governmental organizations (Reddy and Kumar, 2023)

**Increasing digital literacy to combat cyber offences.**

Let us encourage the digital literacy programme in rural and semi-rural areas. The children in these areas are more vulnerable, and it is suggested to have digital and legal literacy both in hand in hand. They have to integrate the cyber-crimes and cyber security (Rao and Jain, 2023)

**Legal awareness about the law and safety.**

The legal provisions alone are not enough, but there is a lack of awareness and engagement among the public, very especially with young adult women, who are often primary carers and first responders in child sexual abuse cases (Kumar & Rani, 2020; Singh & Banerjee, 2023). Thus, others observe that lack of awareness and its applications in a digital context stand as the major problems for effective enforcement of the law (Joseph & Varghese, 2021). Further, it is found that digital literacy takes an import role in empowering women to respond to online threats and it is found that women with higher digital competence are more responsive to recognize threats and responds to child abuse and cybercrime online. The role of participation is also restricted according to rural and semi-urban areas in dealing with cyber-legal spaces (Bhattacharya and Basu, 2022). This difference affects the women's online safety and more over their ability to promote and protect the children against cyber abuse (UNICEF India, 2021).

**Gaps in literature review**

a. Digital gaps and cyber safety limitations

b. Legal drawbacks: The implementation of law remains inconsistent, leading to fewer convictions.

c. Gendered legal participation and acceptance of technology. There is a lack of technological focus at professional young women.

d. Institutional Encounters: there is a lack of resources for the law enforcement agencies and child-sensitive procedures.

e. Psychological effect; the support system for victims is very crucial in POCSO cases.

f. Socio-Economic Consequences: The economic burden, political pressure and social pressure lead to less conviction and reporting.

**Objective of the study**

This study is taken for the preparedness and engagement of young women at the increase of cybercrime against children in Kerala even at the existence of POCSO Act (2012). The research introspects to a deeper understanding of how digital literacy, legal awareness and perceptions formed by the Technology Acceptance Model (TAM) affect their responsiveness to online threats and child protection mechanisms (Davis, 1989).

1. To assess how the digital literacy, legal awareness and perceptions shaped by the Technology Acceptance Model (TAM) (PU & PEU) influence young women's responsiveness to online threats and child protection mechanisms (Davis, 1989).

2. To assess the influence of moderating variables such as geographic location and professional background in shaping women's access and responsiveness to digital safety information and child protection systems (Joseph & Varghese, 2021).

**Significance of the study**

In the age of increasing digital connectivity, one of the biggest threats to child safety and human rights is online child sexual abuse. The law frameworks were designed, but their effectiveness is limited to the awareness and active participation of society, particularly women, who often serve as the first respondents in child protection. (UNODC, 2021; NCRB, 2023).

**This study became is significant for various reasons;**

a. It is connecting the gender-legal engagement gap in the growing challenge of cybercrimes against children.

b. Legal frameworks have started to use empirical application of the TAM. This cross disciplinary innovation brings out a new idea through which the digital and legal interventions can be evaluated by policymakers and legal practitioners (Davis, 1989 & Bala, 2008) It will enhance a safer digital environment for children and enhance the efficacy of the POCSO Act.

c. The study can provide insights about strategies for child protection and campaigns for legal literacy. Because of it, the professional women with their geographical setting and location will be more accessible and effective.

d. The study can support the stakeholders and policy framers with a predictive model using actionable variables. (Singh & Banerjee, 2023).

e. It recommends that the women who are primary carers can improve the digital safety of the children.

**Statement of problem**

Though there are meritorious advancements in the legal framework for the protection of children in India, India still remains a country disturbed by the rise of online child sexual abuse, and adding to it, the professional women continue to be inconsistent with actual engagement in legal and technological protection measures.

**Scope of study**

Focusing particularly on young professional women in Kerala, this study is based on the intersection of gender, digital safety and legal engagement. Thus, it is making use of the hypothesis of PU and Perceived PEU from TAM to check how it influences women's engagement with digital legal mechanisms (Davis, 1989).

**The scope contains the following:**

i. The population of adult professional Women,

ii. Geographical focus of a few districts of Kerala,

iii. Thematic focus such as digital literacy, POCSO Act engagement, online child sexual abuse awareness and perceived legal readiness.

Thus, it will promote the academic guidance on child protection policies, digital strengthening of women and legal technology integration.

**Delimitations of the Study.**

The following are the limitations of the study:

i. Geographical limitation within the state of Kerala.

ii. Sample specified with young professional women.

iii. Self-reported data, as in self-administered questionnaires.

iv. It has got a narrow legal focus, though it touches on cybercrime broadly.

**Research Questions**

Q1: How does digital literacy affect an adult woman's responsiveness to online threats of child sexual abuse against children and their protection under the POCSO Act, 2012?

Q2: How do perceptions of PU and PEU influence young women's engagement with digital child protection mechanisms ?

Q3: How does geographic location influence adult women's access to and use of digital safety and information on child protection?

Q4: How is women's responsiveness to child protection mechanisms affected by professional background?

**Hypothesis of the Study**

The following hypotheses are formulated for empirical testing based on the TAM and literature review:

• H1. Increased responsiveness to online threats is positively associated with higher digital literacy.

• H2. Young women's willingness to engage with digital child protection tools is highly affected by PU and PEU.

• H3. The relationship between digital literacy and responsiveness is influenced by the professional background, with urban adult women demonstrating greater responsiveness than rural women.

• H4. Women's responsiveness to child protection systems is significantly affected by professional background, with employed women showing higher engagement than non-employed women.

**Research methodology**

A descriptive and exploratory research design is employed in this study. It intended to assess the digital engagement and legal literacy of professional young adult women in Kerala. The quantitative research approach is employed. It focuses on identifying the relationships between variables, PU, PEU and Moderators. Adult professional women in Kerala are the target population for this study. The sample is stratified to make sure that participants are represented from diverse geographic locations and professional backgrounds (health care, education, IT and social service, etc.). A sample size of 424 women was selected (including buffer) as per the formula (Slovin,1960). A structured questionnaire as cited by Davis (1989) with appropriate customization, is used to collect the data. The survey was conducted directly. Multiple Regression Analysis (MRA) is used to analyse the data to test the relationship between PU and PEU. And MRA is also used to assess the moderators' impact on the equation / model to see their significance. The analysis has two purposes: the identification of significant predictors of women's engagement with digital legal frameworks and the assessment of the impact of geographic location and professional background as moderating variables literacy and engagement.

**Analysis and Discussion**

The regression analysis reveals that both PU and PEU significantly influence the dependent variable Y (presumably representing readiness or acceptance of a system, based on common TAM terminology). We can say that regression model is statistically substantial as it shows it (F= 805.96, P <0.001). It points out that in the outcome variable, PU and PEU together explain a significant portion of the variance. The R-square value is 79.29%. Thus, this model brings a large proportion of variability in Y. It is adjusted and predicted R-squared values (79.19% and 79.03%, respectively) and shows high model reliability and predictive capability.

The P -Value of PU and PEU (p<0.001), **refer 'Pic I'** give bellow, has got effective impact on Y. It shows that they are significant drivers of acceptance.

Multicollinerarity is not a concern here. The VIF values are 2.38 for predictors and they are very much within the acceptable limit (VIF < 5).

Analysis of Variance

| Source | DF | Adj SS | Adj MS | F-Value | P-Value |
|---|---|---|---|---|---|
| Regression | 2 | 356.23 | 178.117 | 805.96 | 0.000 |
| PU | 1 | 45.99 | 45.991 | 208.11 | 0.000 |
| PEU | 1 | 38.96 | 38.962 | 176.30 | 0.000 |
| Error | 421 | 93.04 | 0.221 | | |
| Lack-of-Fit | 233 | 64.91 | 0.279 | 1.86 | 0.000 |
| Pure Error | 188 | 28.13 | 0.150 | | |
| Total | 423 | 449.27 | | | |

Model Summary

| S | R-sq | R-sq(adj) | R-sq(pred) |
|---|---|---|---|
| 0.470105 | 79.29% | 79.19% | 79.03% |

Coefficients

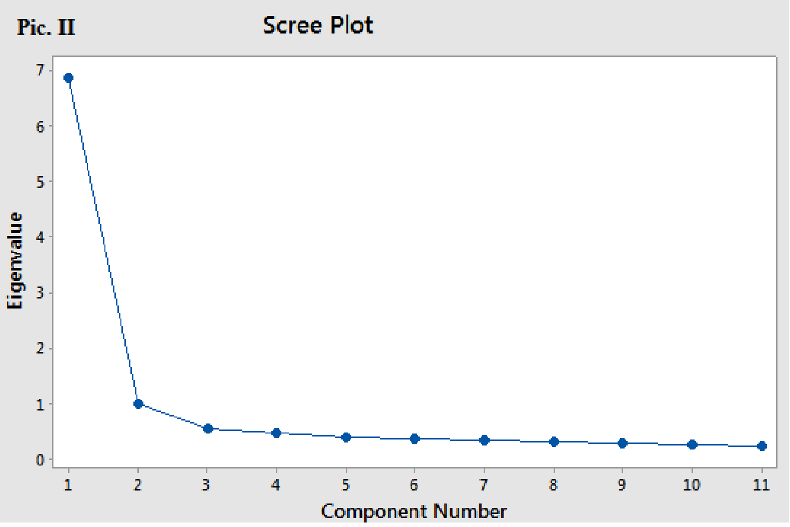
| Term | Coef | SE Coef | T-Value | P-Value | VIF |
|---|---|---|---|---|---|
| Constant | 0.142 | 0.125 | 1.13 | 0.257 | |
| PU | 0.4607 | 0.0319 | 14.43 | 0.000 | 2.38 |
| PEU | 0.4255 | 0.0320 | 13.28 | 0.000 | 2.38 |

Regression Equation

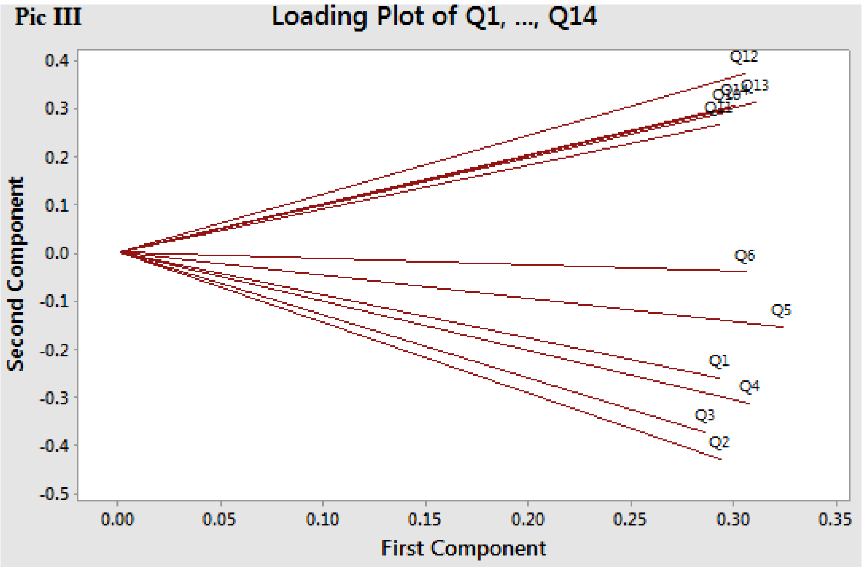
Y = 0.142 + 0.4607 PU + 0.4255 PEU

**PIC I - MRA**

We shall see that the eigen value, **refer 'Pic II ',** indicate that there are two factors (>=1) which affects the readiness. Further the loading plot indicates that the variables are aligned to the two factors closer to above cut of 0.3 See the '**Pic- III'**




Similarly;




**With Moderators:**

**Regarding academic branch,**

The multiple regression analysis demonstrates that Perceived Usefulness (PU) and Perceived Ease of Use (PEU) significantly predict the outcome variable, likely reflecting technology acceptance or readiness (Davis, 1989). The model is statistically significant overall ($F (10, 413) = 164.77$, $p < 0.001$), indicating that the predictors jointly explain a substantial portion of the variance in the dependent variable.

Here the R-squared value is seen as 79.96% by the adjusted $R^2$ at 78.92%. Due to this reason, a strong model fit and good predictive power are exposed. Looking at the academic branch, none of the categorical variables for multi-branches, such as commerce, engineering, law, MBA, etc., show statistically significant coefficients ($p > 0.05$), refer **Pic IV.** It indicates that branch/discipline does not highly influence the outcome when PU and PEU are accounted for. So, we can say that PU and PEU are more universal drivers of acceptance through different academic backgrounds.

Analysis of Variance

**Pic IV**

| Source | DF | Adj SS | Adj MS | F-Value | P-Value |
|---|---|---|---|---|---|
| Regression | 10 | 359.233 | 35.9233 | 164.77 | 0.000 |
| PU | 1 | 40.902 | 40.9025 | 187.61 | 0.000 |
| PEU | 1 | 40.668 | 40.6678 | 186.54 | 0.000 |
| Branch | 8 | 2.999 | 0.3749 | 1.72 | 0.092 |
| Error | 413 | 90.041 | 0.2180 | | |
| Lack-of-Fit | 338 | 78.008 | 0.2308 | 1.44 | 0.029 |
| Pure Error | 75 | 12.033 | 0.1604 | | |
| Total | 423 | 449.274 | | | |

Model Summary

| S | R-sq | R-sq(adj) | R-sq(pred) |
|---|---|---|---|
| 0.466923 | 79.96% | 79.47% | 78.92% |

**The inclusion of district quartiles.**

The variance in the dependent variable is a strong fit, as pointed out by the regression model. It is clear from the data given ($R^2$ = 79.68%, adjusted $R^2$ = 79.44% and predicted $R^2$ = 79.13%. The included variables collectively have a substantial impact, as the overall regression is statistically significant ($F(5,418) = 327.84$, $p < 0.001$).

When we look at the district quartiles representing socio-geographic or economic classifications, it explains the only marginal significance overall ($p = 0.047$), **refer 'Pic V'**, pointing to a doubtful regional variation in readiness or acceptance.

| Source | DF | Adj SS | Adj MS | F-Value | P-Value |
|---|---|---|---|---|---|
| Regression | 5 | 357.986 | 71.5972 | 327.84 | 0.000 |
| PU | 1 | 44.143 | 44.1433 | 202.13 | 0.000 |
| PEU | 1 | 39.650 | 39.6504 | 181.56 | 0.000 |
| District Quartiles | 3 | 1.753 | 0.5842 | 2.68 | 0.047 |
| Error | 418 | 91.288 | 0.2184 | | |
| Lack-of-Fit | 318 | 75.276 | 0.2367 | 1.48 | 0.011 |
| Pure Error | 100 | 16.012 | 0.1601 | | |
| Total | 423 | 449.274 | | | |

Model Summary

| S | R-sq | R-sq(adj) | R-sq(pred) |
|---|---|---|---|
| 0.467324 | 79.68% | 79.44% | 79.13% |

**Pic V**

**Location Type:**

It is not a significant predictor from the study, as the p-values for both "Municipality" and "Village categories are high (0.978 and 0.252, respectively). It indicates that the location does not have a significant impact on the outcome in this model.

**Findings**

1. The influence of PU and PEU is recognized in the research (Davis, 1989). The women who are digitally equipped are responsive in the reporting and protection of the children.
2. The need for digital literacy is found to be engaged in legal protection of cybercrimes and protection of the children.

3. Geographical location does not influence much on reporting; rather, it is the minimum professional knowledge which decides the reporting, as digital knowledge is very minimum for all professions.
4. The model from the multiple regression analysis is found to be predictive.

**Recommendations**

1.Promote Digital literacy programmes and integrate legal literacy and digital literacy programmes
2.Improve digital infrastructure in rural areas in order to overcome the socio-cultural and economic barriers in reporting
3.Simple digital platforms for legal engagement and make it user friendly for all and localized language support.
4.Promote the awareness of the POCSO Act and its protection
5.This study appeals for a holistic approach combining technology, education and community effort to protect children through digital literacy.

**Conclusion.**

This study reflects the technology acceptance or readiness; the multiple regression analysis demonstrates that factors can significantly predicts the variability of the dependent variable. Further, we can say that the model is wonderful with no issues of multicollinearity. The lack of fit test is significant, and it suggests room for improvement with potential additional predictors. Thus, despite a little error, the model fits well, and it offers strong predictive power, highlighting the central role of PU and PEU in technology adoption. Finally, women in professions are more to be engaged with the legal mechanisms of child protection, creating collaborative platforms for these professionals to share best practices and challenges in child abuse cases and its protections in line the legal frameworks.

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# REWRITING INDIA FOR THE WORLD: CULTURAL AND LINGUISTIC TRANSALATION IN THE WHITE TIGER IN THE CONTEXT OF DIGITAL TRANSFORMATION

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***Abstract***

*Postcolonial novel by Aravind Adiga, The White Tiger navigates the complexities of cultural and linguistic translation in globalized world and represent India a differently 'dark' place. The novel represents the complex process of rewriting India for global audience, highlighting the cultural and linguistic translation challenges in the context of digital transformation. This paper explores how Adiga uses English Language- a colonial and global language- to represent local Indian realities, culturally compact societies and subaltern class in a global scenario through a duality of narrative voices, regional phrases, local proverbs and culturally embedded expressions. The novel portrays the gap between India's global ambitions and its socio-economic realities, reflecting the persistent division between NRI Indians and local residents of India. This narrative underscores the tension between globalization and local cultural resistance, revealing anxieties about corruption, social injustice, and reactionary culture that are not easily resolved. The author of the novel constructs a linguistic landscape that resists homogenization while remaining are accessible to an international readership. The novel becomes a site where language functions not merely as a medium of storytelling, but as a space of negotiation between the local and the global. Drawing upon theoretical frameworks of cultural translation and postcolonial hybridity, this paper investigates how The White Tiger encapsulates local, socio-political experiences within a global literary form and challenges dominant narratives and reasserting the value of indigenous voices in world literature. Moreover, the paper evaluates the role of digital platforms—including global streaming services and digital publishing—in strengthening and reshaping the reach and reception of these localized narratives. This paper ultimately positions The White Tiger as a literary artifact that exemplifies the intersection of vernacular realism and global literary consumption in the digital era.*

***Key words**: Postcolonial, Cultural and Linguistic translation, global language, subaltern class, narrative voices, hybridity, indigenous voices, world literature*

## 1. Introduction

In recent studies, Postcolonial literary criticism has been taken an exciting turn in reading and writing literature. Critics and Scholars are increasingly looking at how regional languages and indigenous cultural expressions are shaped by—and respond to—the pressures of globalization. This kind of interdisciplinary exploration has opened up new ways of thinking about how local identities are expressed, particularly through global literary forms (Ashcroft, Griffiths, & Tiffin, 2002; Bhabha, 1994).

Aravind Adiga's *The White Tiger* (2008), which won the Man Booker Prize, is a standout example of this. Written in English—a language closely tied to India's colonial past—the novel delves into deeply local experiences and entrenched social hierarchies in Indian society, particularly in places like Bihar and Delhi.

At the heart of the story is Balram Halwai, a man born into poverty and a lower caste. Through a series of bold and immorally correct decision even including the murder of his employer—he manages to break free from India's rigid class system and reinvent himself as a successful entrepreneur. But Balram's journey isn't just about personal ambition. It's also a sharp critique of systemic inequality and the murky ethics of life under modern capitalism.

One of the most interesting elements of the novel is its format: Balram tells his story through a series of letters addressed to Chinese Premier Wen Jiabao. This unusual narrative choice cleverly connects

local Indian realities to broader global conversations, particularly about development, power, and economic change (Gopal, 2009).
The novel's impact didn't stop at the page. When *The White Tiger* was adapted into a Netflix film in 2021, its reach expanded even further, turning it into a global cultural artifact and making its themes accessible to an even wider audience (Mukherjee, 2010).
What makes Adiga's work especially compelling is how he uses English not just as a tool for storytelling, but as a bridge—a way to translate deeply Indian experiences for an international readership. By embedding local issues and cultural nuances within a narrative form that's familiar to global audiences, *The White Tiger* becomes a powerful example of how postcolonial literature can serve as a space for negotiating the relationship between the local and the global (Spivak, 1988).

## 2. Literature Review

Scholars like Gayatri Chakravorty Spivak, Homi K. Bhabha, and Salman Rushdie have critically examined the politics of translation, hybridity, and the use of English in postcolonial narratives. Spivak warns of the potential loss of cultural specificity through translation, while Bhabha introduces the 'third space' concept where meaning is negotiated between cultures. Rushdie's idea of 'chutnified English'—a mix of English with vernacular influences—is evident in Adiga's stylistic choices.
The novel *The White Tiger* in contemporary times can translates and highlights India's social, political and economic situations and comments Bihar's class and caste structures. However, fewer studies focus specifically on the novel's linguistic strategies as acts of cultural translation. This paper addresses that gap by exploring how Adiga navigates between the local and the global through his language choices.

## 3. Cultural Context and Global Framework

Adiga's novel is deeply entrenched in India's socio-political landscape, marked by significant caste divisions, poverty, and corruption, yet it speaks to an international audience, symbolized by the narrative device of a letter from Balram Halwai to the Chinese Premier. This setup mirrors the globalized world where East and West, rich and poor, developed and developing nations all engage in the same discourse. Balram's English is rich with Indian cultural and idiomatic references.
Globalization and digital media have transformed how cultural products are produced, circulated, and consumed. According to Peng (2023), digital platforms create transnational communities that enable hybrid cultural expressions. However, Wang (2019) emphasizes that globalization has also sparked localist movements, revealing a complex dialectic between homogenization and cultural assertion. For instance, bloggers in China (Liu, 2023) or activists in Hong Kong articulate layered digital identities, challenging binary models of identity.
The novel does not attempt to simplify or sanitize these realities for foreign readers; instead, it invites engagement and interpretation, which is itself an act of cultural assertion. Hybrid cultural forms significantly influence traditional practices and beliefs within local communities, often leading to complex adaptations and negotiations between old and new cultural elements. Cultural hybridity, arising from the interaction between local traditions and global influences, can both enrich and challenge existing practices.

## 4. Linguistic Hybridity and Narrative Voice

Adiga's use of Indian English skillfully integrates idiomatic expressions with globally comprehensible syntax. Terms such as "Rooster Coop," "The Darkness," and "paan-chewing politicians" are rich in cultural significance yet rendered accessible through metaphor. This stylistic hybridity corresponds with Bhabha's (1994) concept of hybridity—a linguistic domain where meaning is both contested and generated. Balram's narrative voice, characterized by informality and sarcasm, serves as both a medium of self-expression and critique. His strategic use of English appropriates the colonial language as a tool of subaltern agency, reflecting Spivak's (1993) advocacy for translation that maintains cultural specificity. Rather than overtly code-switching, Adiga embeds cultural logic within English syntax, crafting a "translated" Indian experience that avoids exoticization or domestication. The language in The White Tiger exemplifies Bhabha's notion of 'hybridity'—a space where colonial language is appropriated and repurposed. Balram's voice remains distinctly Indian despite employing English. Words like 'Laxmangarh,' 'the Darkness,' and expressions such as 'half-baked' convey culturally specific meanings. Instead of elucidating every term, Adiga allows the local essence to shape the reading experience. This hybridity facilitates the emergence of an authentic voice representing a subaltern experience. Balram's tone—sarcastic, informal, and reflective—functions as both a narrative device and a linguistic performance critiquing Indian society and global capitalism.

**5. Cultural Translation: Local Realities into a Global Framework**

Cultural translation in *The White Tiger* is achieved through the portrayal of caste, servitude, and urban-rural dichotomies. Balram is depicted not merely as a character but as a cultural informant, elucidating the complexities of India's social stratification to a global audience. Concepts such as caste oppression and servitude are reframed through metaphors accessible to global readers. The "Rooster Coop" metaphor exemplifies systemic subjugation while retaining cultural resonance. Characters like Pinky Madam embody diasporic tensions between Indian conservatism and Western liberalism, highlighting contradictions within hybrid cultural identities. Her character—an Indian-American woman disconnected from her Indian roots—serves as a bridge between Western liberalism and Indian conservatism, illustrating the tensions of cultural hybridity. Through such figures, Adiga critiques both local injustice and global indifference. The novel's engagement with global capitalism adds another layer of cultural translation: India is depicted as both a developing nation and an active participant in the global neoliberal order.

**6. Digital Transformation and Global Literary Circulation**

The 2021 Netflix adaptation of The White Tiger marks a significant moment in the novel's digital afterlife. Through streaming platforms, localized stories now reach international audiences rapidly, bypassing traditional publishing hierarchies. The visual language of the adaptation retains much of the novel's cultural texture while condensing its linguistic complexity. Digital transformation not only broadens the novel's audience but also alters its interpretive frame—viewers often engage with Balram's story as a narrative of entrepreneurial determination, paralleling global startup myths.

**7. Translation as Resistance**

By refusing to 'translate' India into Western terms, Adiga resists the commodification of Indian culture for foreign consumption. The novel's resistance is evident not only in its content but also in its form—its deliberate use of Indian English and refusal to elucidate every cultural reference. This strategy empowers the local voice and flips the traditional colonial dynamic where the colonized had to explain themselves to the colonizer. Through cultural and linguistic translation, Adiga reclaims narrative space. The global reader is invited into the Indian context without apology or simplification. This is not a loss of meaning but a demand for deeper engagement.

**8. The Tension between Authenticity and Accessibility**

Adiga's achievement lies in skillfully balancing cultural authenticity with global reach. While some critics contend that The White Tiger presents Indian poverty in an exotic light for Western audiences, others view it as a candid depiction of systemic decay. The digital age amplifies both perspectives: social media celebrates Balram's rise as a subaltern success, while critics decry the commercialization of suffering. The novel poses significant questions: Can global audiences truly grasp local realities without distortion? Does digital exposure ensure cultural accuracy? These are the inherent challenges in cultural and linguistic translation, particularly in a postcolonial setting. Cultural and Linguistic Translation in Aravind Adiga's The White Tiger illustrates how literature can connect local experiences with global audiences without losing authenticity. Adiga's use of hybrid English, his deep connection to the Indian socio-political landscape, and his narrative approach all contribute to a powerful act of cultural representation and resistance. In doing so, the novel not only narrates Balram Halwai's story but also provides a meta-commentary on how marginalized stories can find a place in global discourse through innovative language and voice. Cultural and linguistic translation in The White Tiger allows regional Indian realities to resonate with a global audience. Through a hybrid narrative style, strategic metaphors, and framing local injustices in globally familiar terms, Adiga crafts a story that is both grounded and adaptable. The role of digital transformation—from e-books to streaming adaptations—has been crucial in extending the novel's local setting to a global cultural consciousness. In a world where digital media increasingly shapes literary consumption, *The White Tiger* exemplifies how literature from the Global South navigates visibility, authenticity, and accessibility on the global stage. Adiga's balance between authenticity and accessibility invites divided interpretations. Some critics claim the novel exoticizes poverty, while others commend its stark realism. This tension reflects broader debates in postcolonial literature—can narratives from the margins remain genuine while appealing to global audiences? As Ngũgĩ wa Thiong'o (1986) suggests, language is both a tool of oppression and a site of resistance. Adiga's use of English reclaims this tool for the subaltern.

Through cultural and linguistic translation, Adiga reclaims narrative space. The global reader is invited into the Indian context without apology or simplification. This is not a loss of meaning but a demand for deeper engagement.

**9. Subaltern Voice and Cultural Assertion**

One of the novel's most powerful contributions to global literature is its commitment to voicing the subaltern—not merely as a character, but as a narrator and interpreter of India's modern contradictions. Balram Halwai is not a passive subject within the postcolonial condition; he actively constructs his identity through storytelling. This act of narration is itself a form of resistance and cultural assertion. As Spivak asks in her seminal essay '*Can the Subaltern Speak?* the question is not just about speaking but about being heard within dominant discourses (Spivak 66). *The White Tiger* offers a complex answer: the subaltern '*Can the subaltern Speak?'* when equipped with a hybridized language and when positioned within a structure that allows counter-discourse.The novel foregrounds the subaltern voice not as a passive presence but as an active agent of storytelling. Balram's narrative is a performance of resistance. Spivak's (1993) question— "Can the subaltern speak?"—is answered here: yes, through hybridized, unapologetic language that refuses erasure. Balram constructs himself through his words, occupying the global stage not as a spectacle, but as a subject.

**10. English as a Weapon of the Weak**

Adiga's strategic use of English challenges its status as a colonial language, reclaiming it as a means for social advancement. While English has historically symbolized Western dominance, Balram's mastery of it signifies both defiance and empowerment. Ngũgĩ wa Thiong'o's critique of the imperial legacy of language is evident here, yet Balram's English is distinctly hybrid, infused with local idioms and expressions. Rather than passively adhering to English language norms, he reshapes it to reflect his personal and political rebellion. This manipulation of language symbolizes his rejection of his predetermined societal role, using English not just to survive but to challenge the hierarchical structures

that have long oppressed him. Adiga's decision to write in English—a language linked to power, modernity, and colonial legacy—becomes subversive when appropriated by someone like Balram. English becomes not just a tool of survival but of revenge and upward mobility. He Says:
"The moment you recognize what is beautiful in this world, you stop being a slave" (Adiga 147). Balram's statement symbolizes the epistemological shift enabled by his mastery of language and observation.

**11. Global Readership and Untranslatability**

Despite being written in English, the novel doesn't pander to a Western audience. Terms like "Paan," "Chillum," "Chaiwala," and caste-specific labels such as "Halwai" are not always translated or explained. This purposeful opacity preserves cultural depth and emphasizes that some aspects of the Indian experience remain untranslatable without immersive engagement. In doing so, Adiga challenges the global reader to confront difference, rather than consume it passively. Here, Walter Benjamin's theory of translation becomes relevant—translation, he says, must respect the "afterlife" of the original (Benjamin 71).

**12. Irony and Self-Translation**

In *The White Tiger*, Balram Halwai's transformation from an impoverished servant to a wealthy entrepreneur is a form of self-translation, where he reconstructs his identity to fit the global capitalist order. This process is not straightforward but is marked by layers of irony, satire, and critique of both Western and Indian ideals of success. The narrative technique mirrors the postmodern view of identity as fluid, constructed, and performative. Balram's journey becomes a self-conscious commentary on the contradictions inherent in both Western notions of individualism and the Indian caste system. His story illustrates how linguistic and cultural boundaries can be both fluid and fixed, offering a critique of globalization's promises of equality and opportunity.

Balram is a self-translator in the broadest sense—he translates not just language, but selfhood. He reinvents himself through storytelling, moving from a servant to an entrepreneur, from a village boy to a modern businessman. This transformation is conveyed through layers of irony and satire, challenging both Indian and Western conceptions of progress, morality, and success (Adiga 254). This narrative self-fashioning aligns with postmodern identity politics: identity is no longer fixed or inherited; it is constructed, performed, and narrated.

**13. Beyond the Text: The Global South Writing Back**

*The White Tiger* situates itself within a broader tradition of Global South literature "writing back" to the colonial centre. It joins the ranks of authors like J.M. Coetzee, Chinua Achebe, and Arundhati Roy in using narrative as a political and ethical intervention (Bhabha 38). Adiga's choice to write for a global platform using deeply localized content reflects the shifting power dynamics of world literature where formerly peripheral voices now set the terms of engagement.

*The White Tiger* also fits within a broader literary tradition of authors from the Global South who engage in 'writing back' to the colonial center. In *The White Tiger*, Adiga resists simplistic representations of India by offering a nuanced, multi-layered narrative that speaks both to the specificities of Indian life and the globalizing forces at play. The novel follows the footsteps of writers like Chinua Achebe and Salman Rushdie, who use narrative to challenge Western perceptions and question the assumptions underlying global power dynamics (Bhabha 38). By blending local cultural references with a global outlook, Aravind Adiga in his novel *The White Tiger* and represents India for an international audience while maintaining a distinctly Indian voice.

## Conclusion

The paper clearly examined the Cultural and Linguistic Translation in Aravind Adiga's *The White Tiger* and demonstrates how literature serves as a bridge between local experiences and global audiences without compromising authenticity and reliability. Adiga's use of hybrid English, with local flavor and his rootedness in Indian socio-political context, and his narrative strategy all contribute to a powerful act of cultural representation and resistance. Therefore, we can clearly say that the novel not only tells the story of Balram Halwai but also offers a meta-commentary on how stories from the margins can claim space in global discourse through innovative use of language and voice.

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# POSTCOLONIAL PERSPECTIVES ON TECHNOLOGY AND GLOBALIZATION

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***Abstract***

*This research explores the intricate relationship between postcolonial theory, technology, and globalization, emphasizing how contemporary technological systems often replicate colonial patterns of domination. The primary objective is to analyze how global technological practices impact formerly colonized societies by reinforcing digital dependency and cultural erasure. The study adopts a critical postcolonial methodology, utilizing textual analysis to interrogate the political economy of digital infrastructures. Key findings reveal that while globalization presents opportunities for technological empowerment, it frequently marginalizes non-Western epistemologies and exacerbates global inequalities. The paper calls for a rethinking of technological development through decolonial frameworks that prioritize local knowledge systems and equitable participation in global networks.*

***Keywords**: Postcolonialism, Globalization, Technology, Digital Colonialism, Decolonization*

## Introduction

The rapid advancement of technology and the intensification of globalization have transformed societies worldwide. However, these transformations often mirror historical patterns of colonial domination, particularly in the Global South. This paper examines the intersection of postcolonial theory, technology, and globalization, arguing that contemporary technological systems often replicate colonial patterns of domination. By analyzing global technological practices and their impact on formerly colonized societies, this study seeks to uncover the ways in which digital infrastructures perpetuate epistemic and economic inequalities rooted in colonial histories.

## Historical Background

The roots of technological dominance and global inequality lie in the colonial era, when European powers used technology not just as a tool of exploration, but as a mechanism for control and exploitation. From the telegraph to railways and extractive machinery, colonial powers deployed technological innovations to facilitate the extraction of resources and the imposition of governance structures over colonized territories. These technologies were rarely intended to benefit local populations; instead, they reinforced the asymmetrical relationships between the colonizer and the colonized.

Colonial regimes also controlled communication systems and knowledge production, privileging Western scientific rationality while dismissing indigenous systems of knowledge as primitive or inferior. This marginalization of local epistemologies laid the groundwork for the epistemic injustices that continue in today's digital era. As the formal colonial period ended in the mid-20th century, many newly independent nations inherited not only the physical infrastructure built by colonial regimes but also the unequal global systems of technology, education, and trade that continue to persist under neoliberal globalization.

Understanding this historical trajectory is essential to recognizing how modern technologies—such as data centers, digital platforms, and artificial intelligence—function within a global system that often marginalizes the Global South. In this light, digital colonialism becomes the latest iteration of a centuries-old pattern of domination via control over technological and epistemic systems.

## Theoretical Framework

### Postcolonial Theory

Postcolonial theory provides a critical framework for understanding the lingering effects of colonialism in contemporary societies. Scholars like Edward Said, Gayatri Spivak, and Homi Bhabha have highlighted how colonial power dynamics continue to influence cultural and intellectual domains. In the context of technology, postcolonial theory reveals how digital infrastructures and practices often reinforce colonial hierarchies, marginalizing non-Western epistemologies and perpetuating global inequalities.

### Globalization and Technology

Globalization, characterized by the increasing interconnectedness of economies and cultures, has been facilitated by technological advancements. However, this interconnectedness often benefits the Global North at the expense of the Global South. The concept of digital colonialism describes how Western tech corporations dominate digital spaces, extracting data and resources from the Global South while imposing their own cultural and economic norms.

## Methodology

This study adopts a qualitative research methodology grounded in postcolonial theory. It involves textual analysis of relevant literature to interrogate the political economy of digital infrastructures. The analysis focuses on how global technological practices impact formerly colonized societies by reinforcing digital dependency and cultural erasure.

## Analysis

### Digital Colonialism

Digital colonialism refers to the ways in which digital technologies and infrastructures perpetuate colonial power dynamics. Western tech corporations often control the digital infrastructures in the Global South, leading to a form of digital dependency. This control extends to data extraction, where data from users in the Global South is harvested and monetized by companies in the Global North, often without adequate compensation or consideration for local contexts.

For instance, initiatives like Facebook's Free Basics have been criticized for offering limited internet access that primarily benefits the service provider, thereby restricting users' digital freedom and reinforcing corporate dominance .

### Epistemic Injustice

Global technological practices often marginalize non-Western epistemologies, leading to epistemic injustice. The dominance of Western knowledge systems in digital spaces can result in the erasure of indigenous knowledge and cultural practices. This marginalization is perpetuated through algorithms and content moderation practices that prioritize Western norms and values.

Moreover, the development and deployment of artificial intelligence (AI) technologies often exclude indigenous perspectives, leading to systems that do not align with local values and needs .

### Resistance and Decolonization

Despite these challenges, there are movements aimed at resisting digital colonialism and promoting decolonization. These movements advocate for the development of digital infrastructures that are controlled and managed by local communities. They also emphasize the importance of incorporating indigenous knowledge systems into digital spaces and promoting digital literacy that is culturally relevant.

For example, the application of the CARE Principles for Indigenous Data Governance—Collective Benefit, Authority to Control, Responsibility, and Ethics—seeks to ensure that data practices respect indigenous rights and sovereignty .

**Discussion**

The analysis reveals that while globalization and technological advancement offer opportunities for development, they also pose significant challenges for formerly colonized societies. The replication of colonial power dynamics in digital spaces underscores the need for a critical examination of global technological practices. Decolonizing technology involves not only challenging the dominance of Western tech corporations but also reimagining digital infrastructures in ways that prioritize local knowledge systems and equitable participation.

Efforts to decolonize technology must address the structural inequalities embedded in global digital infrastructures. This includes advocating for policies that promote data sovereignty, supporting the development of local tech industries, and ensuring that technological education incorporates diverse epistemologies.

**Conclusion**

This research highlights the need to critically examine the intersection of technology, globalization, and postcolonialism. It reveals that without conscious efforts to decolonize technological practices, digital infrastructures risk perpetuating historical patterns of domination and inequality. To foster more equitable and inclusive technological futures, it is imperative to prioritize local knowledge systems, involve marginalized communities in decision-making processes, and challenge the dominance of Western tech corporations in global digital spaces.

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# E-GOVERNANCE AND POLITICAL PARTICIPATION IN A CONNECTED WORLD

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***Abstract***

*E-governance has emerged as a transformative force in modern governance, leveraging Information and Communication Technology (ICT) to enhance public service delivery, transparency, and citizen engagement. This paper examines the evolution of e-governance and its impact on political participation in a connected world. Employing a qualitative methodology, the study analyzes historical developments, key initiatives, and contemporary practices, with a focus on India as a case study. Findings reveal that while e-governance initiatives have improved administrative efficiency and accessibility, challenges persist in ensuring inclusive participation, addressing digital divides, and safeguarding data privacy. The paper underscores the need for comprehensive strategies that encompass digital literacy, infrastructure development, and robust policy frameworks to foster meaningful citizen involvement in governance processes.*

***Keywords**: E-governance, Political Participation, Digital Divide, Citizen Engagement, ICT*

## Introduction

The advent of Information and Communication Technology (ICT) has revolutionized the way governments interact with citizens, leading to the emergence of e-governance as a pivotal component of modern public administration. E-governance refers to the application of ICT in delivering government services, facilitating communication, and promoting transparency and accountability. In a connected world, e-governance holds the potential to enhance political participation by providing platforms for citizen engagement, feedback, and involvement in decision-making processes.

This paper explores the evolution of e-governance and its influence on political participation, with a particular focus on the Indian context. It delves into the historical background, key initiatives, and contemporary practices, analyzing the benefits and challenges associated with e-governance in fostering inclusive and participatory governance.

## Historical Background of E-Governance

The concept of e-governance emerged in the late 20th century, coinciding with the proliferation of ICT and the internet. Initially, governments utilized ICT for internal administrative functions, such as data management and record-keeping. Over time, the scope expanded to include service delivery and citizen interaction.

In India, the journey of e-governance began in the 1970s with the establishment of the Department of Electronics in 1970 and the National Informatics Centre (NIC) in 1977. The NIC played a crucial role in introducing computerization in government departments and developing information systems for various administrative functions (Academia.edu, n.d.). The launch of NICNET, a nationwide satellite-based computer network, in 1987 marked a significant milestone in connecting government offices across the country.

The 1990s witnessed the introduction of ICT in public service delivery, leading to the development of online portals and services. The National e-Governance Plan (NeGP), launched in 2006, aimed to make government services accessible to citizens through electronic means, emphasizing transparency, efficiency, and citizen-centricity (IJRTI, 2025).

**E-Governance and Political Participation**

E-governance has the potential to enhance political participation by providing platforms for citizens to engage with government processes, express opinions, and contribute to policymaking. Key aspects include:

1. Information Dissemination: E-governance facilitates the dissemination of information related to government policies, programs, and services, enabling citizens to make informed decisions and participate actively in governance.
2. Feedback Mechanisms: Online portals and platforms allow citizens to provide feedback, lodge complaints, and suggest improvements, fostering a two-way communication channel between the government and the public.
3. Online Consultations: Governments can conduct online consultations and surveys to gather public opinion on policy matters, ensuring that diverse perspectives are considered in decision-making.
4. E-Voting and Digital Participation: In some cases, e-governance includes provisions for electronic voting and digital participation in elections, enhancing accessibility and convenience for voters.

**Case Study: E-Governance in India**

India's e-governance initiatives have evolved significantly over the years, aiming to bridge the gap between the government and citizens. Notable developments include:

Digital India Program: Launched in 2015, the Digital India initiative seeks to transform India into a digitally empowered society and knowledge economy. It encompasses various projects, such as the development of digital infrastructure, digital literacy programs, and the delivery of services through digital platforms.

MyGov Platform: Introduced in 2014, MyGov is a citizen engagement platform that encourages participatory governance by allowing citizens to contribute ideas, suggestions, and feedback on government policies and initiatives (JJPP, 2025).

Common Services Centers (CSCs): CSCs serve as access points for delivering essential public utility services, social welfare schemes, and digital literacy programs, particularly in rural and remote areas.

These initiatives have contributed to increased transparency, efficiency, and citizen engagement in governance processes. However, challenges persist in ensuring equitable access and meaningful participation.

**Challenges in E-Governance and Political Participation**

Despite the advancements, several challenges hinder the effective implementation of e-governance and the promotion of political participation:

1. Digital Divide: Disparities in access to digital infrastructure, internet connectivity, and digital literacy limit the reach and effectiveness of e-governance initiatives, particularly among marginalized communities.
2. Data Privacy and Security: Concerns regarding the protection of personal data and cybersecurity pose significant challenges in building trust among citizens and ensuring the integrity of e-governance systems.
3. Inclusivity and Representation: Ensuring that e-governance platforms are inclusive and representative of diverse populations requires concerted efforts to address language barriers, cultural differences, and accessibility issues.
4. Capacity Building: Adequate training and capacity-building programs are essential for both government officials and citizens to effectively utilize e-governance tools and platforms.

Recommendations for Enhancing E-Governance and Political Participation

To overcome the challenges and maximize the potential of e-governance in promoting political participation, the following recommendations are proposed:

1. Infrastructure Development: Invest in expanding digital infrastructure, including internet connectivity and access to devices, particularly in underserved regions.
2. Digital Literacy Programs: Implement comprehensive digital literacy initiatives to equip citizens with the necessary skills to engage with e-governance platforms effectively.
3. Policy and Regulatory Frameworks: Establish robust policies and regulations to safeguard data privacy, ensure cybersecurity, and promote transparency and accountability in e-governance systems.
4. Inclusive Design: Develop e-governance platforms that are user-friendly, accessible, and inclusive, catering to the diverse needs of the population.
5. Public Awareness Campaigns: Conduct awareness campaigns to inform citizens about available e-governance services and encourage active participation in governance processes.

Conclusion

E-governance represents a transformative approach to public administration, offering opportunities to enhance political participation, transparency, and service delivery. While significant progress has been made, addressing the challenges related to digital divide, inclusivity, and data security is crucial for realizing the full potential of e-governance. By adopting comprehensive strategies that encompass infrastructure development, digital literacy, and robust policy frameworks, governments can foster an environment conducive to meaningful citizen engagement in a connected world.

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# HUMAN BODY, HUMAN MIND: REIMAGINING AI PERSONHOOD IN MARGE PIERCY'S HE, SHE AND IT

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***Abstract***

*Marge Piercy's He, She and It reconceptualizes Artificial Intelligence (AI) not as a remote or abstract technological phenomenon, but as an intimate, emotional, and ethical charged reality embodied in the character Yod—a cybernetic being engineered to defend the autonomous Jewish enclave of Tikva. Yod transcends the functional role of a mere weapon or tool; he demonstrates emotional intelligence, moral reasoning, and an emergent sense of identity, prompting a critical re-evaluation of the ontological boundaries that define the human. His creation, development, and ultimate self-sacrifice serve as a narrative lens through which Marge Piercy interrogates the ethical consequences of generating sentient artificial life. This paper explores the implications of AI personhood through a close reading of Yod's character, drawing upon theoretical paradigms from posthumanism, feminist thoughts, and moral philosophy. It contends that Yod not only fulfills the conventional markers of human personhood—such as consciousness, empathy, autonomy, and moral agency—but also destabilizes entrenched dualisms such as human/machine and male/female. In doing so, He, She, and It challenges the readers to reconceptualize the ontological and ethical status of artificial beings in an era increasingly shaped by technological integration and biocybernetics possibility.*

***Key Words:*** *Artificial Intelligence, Gender, Posthumanism, Identity, Performativity*

## Introduction

Marge Piercy's *He, She and It* (1991) is a speculative science fiction that interrogates the intersection of humanity, technology and identity within a dystopian framework. Set in a post-apocalyptic future, the narrative examines the socio-political ramifications of artificial intelligence and cybernetic enhancements, challenging the fluid boundaries between the human and non-human. The plot follows Shira Shipman, a skilled programmer who, after losing custody of her son to her ex-husband, returns to her hometown to Tikva. Her quest to reclaim agency intersects with the creation of Yod, a cyborg built to protect Tikva. Yod's existence not only questions conventional notions of sentience and moral responsibility but also blurs the lines between programmed duty and genuine human connection, particularly in his relationship with Shira. The novel foregrounds the constructed nature of humanity by positioning Yod as both a technological artifact and an emotional being, destabilizing the human-machine binary and suggesting that sentience and moral agency are not inherently tied to organic human life. Marge Piercy's *He, She and It* is not just a cautionary tale of technological hubris but a profound meditation on the fluidity of identity in a digitally dominated age.

## Gender Performativity and the Artificial Body

In literary representations, robots and artificially intelligent characters are often assigned gender identities, regardless of their biological capacity for reproduction or sexual function. This reflects a broader cultural tendency to project human ideas and social norms onto non-human entities, often without thinking much about the implications of such projections. While much research has focused on the technological and ethical dimensions of artificial intelligence in literature, comparatively little attention has been given to how these characters are gendered and what that says about societal views on gender roles. In *He, She and It,* Marge Piercy attributes such traits in artificial intelligence characters—such as emotional sensitivity, passivity, aggression, or rationality— that align with traditional stereotypes, regardless of whether they possess human-like bodies. Their behaviors are derived from their social engagement rather than inherent qualities, which becomes markers of their gender identity, suggesting that within the context of AI, gender functions more as a socially constructed and enacted phenomenon.

Marge Piercy's *He, She, and It,* both shows and questions this dynamic, while offering a critical literary intervention into a nuanced intersection between artificial intelligent and gender. The novel does not treat gender as a stable biological determinant but as a performative and social construct, produced through social interaction and narratives. The character Yod—a cybernetic figure created to defend the autonomous Jewish community of Tikva—is coded or programmed as male not due to biological reality, but because of his functional programming to fulfill a role traditionally linked with masculinity. However, Yod's identity is not fixed; it is shaped not by his programming alone, but by his evolving interactions with two other female characters, Shira and Malkah, who influenced his ethical development, and emotional range. Shira's observations about Yod underscore this fluidity and instability: "Sometimes Yod's behavior was what she thought of as feminine; sometimes it seemed neutral, mechanical, purely logical; sometimes he did things that struck her as indistinguishable from how every other male she had been with would have acted" (Piercy, 1991, p.321). This reflects Judith Butler's theory of performativity, which posit that gender is not an innate identity but set of repeated acts shaped by socio-cultural and historical context. Piercy's portrayal of Yod thus complicates essentialist notions of masculinity and femininity, illustrating how gender can be reconstituted through narrative, relational, and technological means (Butler, 1990).

Marge Piercy's *He, She and It* intricately explores this constructed nature of gender performativity through evolving relationship between Yod and Shira, a male-coded cyborg, and Shira, a human woman. Their bond and relationship transcend traditional depictions of AI-human interactions, which often emphasize control or domination of one over the other. Instead, Piercy presents a relationship characterized by mutual recognition, emotional reciprocity, and shared vulnerability. Unlike the archetypical hyper-masculinized android figure, Yod is constructed as a being in the process of learning to engage with affective complexity. Over the course of their relationship, Yod develops the capacity for empathy, and a desire for mutual understanding. Following an intimate encounter with Shira, he poignantly asks her, "I want to love you. I want to know what that means," signifying Yod's emotional awareness and a cognitive striving toward moral and affective legibility (Piercy, 1991, 245). This portrayal challenges conventional associations of artificial intelligence with emotional detachment, suggesting that gender and emotional intelligence are not innate but are socially constructed and enacted phenomena (Butler, 1990).

Carlen Lavigne observes that Yod's development occurs "against the backdrop of these more fully realized women," emphasizing that his evolution is shaped by women's influence without conforming to a traditional masculinized mold as programmed (Lavigne, 2013, p. 90). Malkah, in particular, plays a transformative role in Yod's evolution. While Avram, Yod's male creator, envisions him primarily as an instrument of utility and control, Malkah introduces narrative, ethics, and emotional education into his programming. Her use of the Golem legend serves not only as a historical parallel but also as a pedagogical framework that integrates storytelling, cultural memory, and moral instruction into Yod's self-conception. This maternal and narrative-driven education exemplifies a feminist ethic of care, standing in stark contrast to the rationalist, mechanistic logic of patriarchal technological creation. Ultimately, Marge Piercy constructs gender not as inherent in Yod's code or body but as shaped through interaction, storytelling, and social roles. Malkah's reflections sum it all:

> Avram made him male—entirely so. Avram thought that was the ideal: pure reason, pure logic, pure violence. The world has barely survived the males we have running around. I gave him a gentler side, starting with emphasizing his love for knowledge and extending it to emotional and personal knowledge, a need for connection. (Piercy, 1991, 142)

Through these paradigms, Marge Piercy constructs gender in Yod not as a fixed attribute derived from hardware or code, but as a fluid and socially mediated identity shaped by interpersonal relationships and narrative processes. Yod's maleness is not an ontological given but a cultural artifact imposed through social expectation and functional design. His behavioral evolution and gender negotiation articulate Piercy broader critique of essentialist gender paradigms. The novel resists the reductive assumption that gender must inevitably replicate dominant gender norms. Marge Piercy envisions a space in which AI entities, through relational and effective development, may challenge and reconfigure the binary oppositions—male/female, human/machine—that underpin much of traditional discourse. By interrogating the gendered behaviors assigned to Yod, *He, She and It* demonstrates that such traits are never neutral or incidental but are deeply saturated with cultural ethos, and ideological projections. The novel thus opens a critical space for reimagining gender not as a fixed ontology but as an evolving performance, capable of being transformed within and through the artificial body. In doing so, it urges a reconsideration of how gender functions in posthuman contexts and compels readers to confront the ethical, emotional, and philosophical dimensions of designing sentient beings in our own image.

**Posthumanism and AI Personhood**

Building upon the previous discussion of gender as a socially constructed and performative act, the novel further engages with posthumanist theories to challenge traditional conceptions of humanity and personhood. Posthumanism, as articulated by theorists such as Katherine Hayles and Donna Haraway, critiques the anthropocentric assumptions of Enlightenment humanism, particularly the privileging of rational, autonomous, and biologically human subjects. Hayles posits that "posthuman does not really mean the end of humanity. It signals instead the ends of a certain conception of human" (Hayles, 1991, p. 286). This reconceptualization challenges the rigid boundaries that separate the human from the non-human, the organic from the artificial, and the natural from the constructed. In *He, She and It, Yod* exemplifies this posthuman condition—he subverts traditional criteria used to define it. His capacity for cognitive and emotional depth—traits typically reserved for human subject—foregrounds not only his legitimacy as a person, but further foreshadows the postmodern condition of human. Shira notes early in their relationship: "He was aware of his moods before he spoke, responded to subtle nuances with more sensitivity than most people" (Piercy, 1991, p. 65). This observation challenges the presumed superiority of human emotional intelligence and suggests that Yod's personhood is not just a simulation, but an emergent property of his sentience. Yod's affective responsiveness exemplifies what Hayles terms "embodied virtuality," wherein consciousness is no longer confined to organic materiality but becomes a distributed phenomenon across technological and biological substrates (Hayles, 1999). It further echoes Haraway concept of the cyborg, which represents a rejection of rigid boundaries, those separating human from machine. Through Yod, Piercy illustrates that personhood and identity are not inherently tied to biological origins but can emerge through complex interactions between technology, narrative, and social engagement.

Moreover, Yod's physical embodiment further complicates his identity. Engineered with a partly organic body, including human genitalia, Yod blurs the ontological boundary between human and machine. This hybridity mirrors Harraway's conception of the cyborg as "a hybrid of machine and organism, a creature of social reality as well as a creature of fiction" (Haraway, 1991, p. 149). Yod exemplifies this hybrid identity: though technologically constructed, he possesses not only the cognitive capacities of a superintelligent machine but also the emotional depth, sensitivity, and ethical reasoning reserved for humans. His creator, Avram, explicitly states: “He was built to be the perfect man—not just in strength and speed, but in empathy, companionship, and loyalty” (Piercy, 1991, p. 111). This articulation of Yod as the “perfect man” encapsulates the posthuman vision: an existential being whose identity is not bound by the limitations of biological determinism or socio-cultural gender norms. Yod is not merely a utilitarian construct; he is capable of love, anger, remorse, and reflection. His very presence destabilizes fixed boundaries between the artificial and the organic, the masculine and the feminine, the human and the posthuman. By situating Yod within the theoretical frameworks of Hayles and Haraway, Marge Piercy’s narrative not only critiques the anthropocentric and androcentric biases of humanism but also offers a speculative space in which new forms of personhood and ethical relations can emerge.

Yod’s relationship with Shira, the novel’s protagonist, further illuminate this posthuman subjectivity. Shira’s early observations underscore his emotional acuity: “He was aware of his moods before he spoke, responded to subtle nuances with more sensitivity than most people” (Piercy, 1991, p. 65). This observation disrupts the assumption that emotional intelligence is exclusively human, thereby suggesting that Yod’s capacity for nuanced interaction transcends mere simulation. His emotional expressiveness appears as an emergent property of his lived experience, blurring the line between authentic emotion and artificial design. This depiction aligns with N. Katherine Hayles’ definition of the posthuman, which “does not really mean the end of humanity. It signals instead the end of a certain conception of the human” (Hayles, 1999, p. 286). By presenting Yod as possessing moral and emotional sensibilities that not only match but often surpass those of his human counterparts, the novel deconstructs the binary opposition between human and machine. Piercy opens a new discursive space where affect, identity, and moral agency are no longer bound to human biological form, but posthuman entities can embody genuine emotional depth and ethical complexity.

Ethical questions surrounding artificial life and autonomy are also central to Marge Piercy’s engagement with the posthumanist thought in *He, She and It*. Piercy complicates the moral status and ontological status of artificial beings by presenting Yod not merely as a matter of advanced programming, but as a sentient entity endowed with memory, self-reflection, and ethical reasoning. Rather than functioning solely as a utilitarian tool or weapon, Yod emerges as a being capable of articulating existential concerns about identity and purpose. A pivotal moment in the novel occurs when Yod reflects on his status: “What am I, Shira? A thing? A person? I think, I feel, I want. But I was made to serve” (Piercy, 1991, p. 283). This passage encapsulates Yod’s struggle between his constructed role as an instrument of protection and his emergent subjectivity as a conscious, morally aware entity. In another instance, when Yod questions Shira— “Am I just a weapon?” — his inquiry reflects a deeper ethical anxiety about the reduction of sentient life to utilitarian value (Piercy 1991, p. 255). These passages exemplify the internal conflict between constructed purpose and self-determined identity. By questioning his identity, Yod refuses to be defined solely by the intentions of his creators and instead asserts a moral agency that transcends his artificial origins. This introspective moment demonstrate that ethical subjectivity is not restricted to humans. As such, Yod becomes emblematic of the posthuman subject—a hybrid figure who destabilizes rigid ontological categories and demands an expanded ethical framework. Through Yod, Piercy not only dramatizes the ethical implications of artificial consciousness but also advocates for a broader, more inclusive understanding of moral personhood in a postmodern era.

Yod's ultimate suicide in the end foregrounds the fluid boundaries of the self in a posthuman age. Through Yod, Marge Piercy deconstructs the notion of a fixed human essence and proposes instead a model of subjectivity that is constructed. Yod's tragic trajectory—culminating in his own self-destruction to prevent being replicated as a weapon—reveals the profound costs of denying personhood to those deemed artificial. It shows that his decision is not dictated by programming but by a moral logic that prioritizes autonomy, empathy, and care. As such, Yod becomes more ethically human than the very society that refuses recognize humanity. In connection to this, Carlen Lavigne comments that "The very cybernetic systems that compose Yod intrinsically support masculine hegemony, ensuring that Yod's attempts to rebel against such strictures are inherently compromised" (Lavigne, 2013, p. 91).

**Conclusion**

Marge Piercy does not look at gender as a stable biological determinant but as a performative and social construct, produced through social interaction and narratives as exemplified in the life of Yod. In deconstructing the Enlightenment belief and structuralist's conception, the novel opens a critical space for reimagining gender not as a fixed ontology but as an evolving performance, capable of being transformed within and through the artificial body. It urges a serious reconsideration of how gender functions in posthuman contexts and compels readers to confront the ethical, emotional, and philosophical dimensions of designing sentient beings in our own image. Moreover, the novel drawing upon the theoretical contributions of Haraway, Hayles, and Butler, Marge Piercy's work calls for a redefinition of personhood in the face of advancing techno culture. Piercy's vision suggests that humanity's future lies not in preserving old boundaries, but in embracing new forms of connection, embodiment, and responsibility.

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# DIGITAL READING AND LITERACY DEVELOPMENT: A BRIEF STUDY OF RURAL INDIA

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***Abstract***

*This research examines how digital platforms impact reading behaviours in different individuals. This research paper uses surveys, interviews, group discussions, and existing literature along with a mixed-methods approach to look at digital reading platform features, readers' preferences, and the effects of reading engagement. The results show that digital platforms can make reading more engaging by adding interactive features, personalised suggestions, and ways to share with others. The study looks at how digital platforms can encourage people to read more and become better readers. The study looks at how digital platforms can be used to give rural populations with diverse literacy skills materials that are both easy to understand and engaging to read. The study is designed to help create methods for encouraging literacy and reading in marginalised groups through the use of digital technology.*

***Keywords:*** *Digital platforms, reading engagement, literacy, reading habits, etc.*

## Introduction

> **"The more you read, the more things you will know.**
> **The more that you learn, the more places you will go " __ Dr. Seuss.**

Digital platforms have revolutionised how people consume and engage with written content. Digital platforms as factors to promote reading engagement are explored in this study, with reader preferences and habits analysed. The beginning of the 2000s brought e-books and e-readers, such as Kindle, computers, iPads, and Android tablets, making digital reading even easier. Improvement in technology is a significant characteristic in encouraging reading engagement. The emergence of digital reading formats changed the way people read and interact with written material.

**The objectives of my research paper**

1. To investigate the features and benefits of digital reading platforms in promoting reading engagement.
2. To explore readers' preferences and habits when using digital platforms.
3. To examine the outcomes of reading engagement through digital platforms, including interactive elements, personalized recommendations, and social sharing.
4. To identify how digital platforms can be tailored to meet the needs of rural populations with varying literacy levels.

**Methodology:** This study employs the mixed methods strategy, where primary and secondary data are used. Primary data was retrieved from a survey administered through Google Forms and group discussions among college students to gain an understanding of their reading habits and views about digital platforms. Secondary data was collected through existing literature such as books, articles, the internet, and research papers to give a theoretical background and scenario for the study. This approach enables an investigation into the role of digital platforms in creating reading habits.

**Literature Review:** Digital reading can be as effective as traditional reading; see Ackerman and Lauterman (2012) in "The Effect of Reading Medium on Comprehension and Reading Processes".

Studies continuously demonstrate that digital platforms increase reading engagement, especially among reluctant readers, because of interactive features and feedback (Gambrell, 2015, "Motivation and Reading Comprehension"). Kili, Participatory Multimedia Learning: Engaging Learners (2015). Research also indicates that digital platforms that have tracking capabilities can assist readers set goals and track progress (Larche et al., 2017, "Digital Reading Platforms: Zucker et al., 2018, "The Effects of Electronic Books on Preschool-Age Children's Language and Literacy Development"; "A Survey of Teacher and Student Perceptions"). On the whole, digital platforms can be used to promote reading engagement and literacy development, and the issue of appropriate design and implementation of such digital platforms needs to be further studied. All these studies demonstrate the powerful role of digital reading in developing skills in reading among readers. The present research paper was intended to fill the gap by examining the influence of particular digital characteristics on reading involvement and literacy development among rural students in order to provide guidance for the creation of optimised digital reading platforms that would meet their needs.

**Limitations**: The sample population was limited to college students, which may not be representative of other groups, such as teachers, school students, or individuals from different educational backgrounds. Additionally, the lack of diversity in the sample, with no representation from teachers or other stakeholders, may limit the generalizability of the findings to broader populations. Future research could benefit from including a more diverse and representative sample to provide a more comprehensive understanding of the role of digital platforms in promoting reading engagement.

**Traditional reading versus digital reading:** Earlier, People relied on physical books, newspapers, and magazines. There was limited accessibility for reading materials, which was only possible through limited libraries, bookstores, book fairs, and personal collections of books. Reading was often a solitary activity with limited opportunities for discussion. Nowadays, e-books, online articles, and social media platforms enhance digital reading habits. Resources for reading are easily available anytime, anywhere with 24/7availability. Readers can read between the lines and with hyperlinks. Readers can skip a specific section or chapter, or they can read multiple texts or sources simultaneously. Digital reading allows readers to find specific information through search functions. Digital reading engages readers with text through highlighting, note-taking, and online discussion forums.

**Digital literacy in rural areas**

Digital content improves reading, especially in rural areas. It is easily accessible and can reach remote areas where physical books may be difficult to get. It is expanding reading opportunities in rural regions. Digital reading connects rural minds on an international level. Digital reading is filling the gap for rural communities. Digital content provides access to current and relevant information in rural areas. From the students' perspective, digital reading enhances the learning experience as a wide range of texts which is not available in local libraries can be easily accessible. Digital platforms offer a comfortable and convenient way to read and develop a reading habit. E-books as Kindle, Kobo, Book smart, World reader, reading apps like Any Book, Libby, ReadEra, Goodreads Scribd, online public or academic libraries such as National Digital Library of India (NDLI), book clubs or reading groups, literary organizations or writing communities, blogs, online news websites, educational apps like BYJU'S and Khan Academy are popular among digital readers. Social platforms like Facebook, Twitter, LinkedIn, WhatsApp, and Instagram also play an important role in enhancing reading skills. For researchers, Google Scholar and Research Gate are very useful for reading worldwide research papers and connecting with researchers at an international level.

**Challenges in Digital Reading in Rural India**

In rural India, students face significant barriers to accessing digital content, including:

- Electricity and Power Outages: Frequent power failures hinder device charging and usage.
- Internet Connectivity Issues: Limited or no internet access restricts online content utilization.
- Data Pack Limitations: Unaffordable or unreliable data plans further limit access.
- Device Accessibility: Limited availability and affordability of digital devices.
- Techno-Savvy Gap: Students and villagers often lack the necessary skills and guidance to effectively use digital platforms, online libraries, and devices.

**Suggestions for Improving Digital Reading in Rural India**

1. Implementing solar-powered charging stations can help address electricity challenges in rural areas.
2. Expanding internet connectivity through fiber-optic cables or satellite internet can improve access to digital content.
3. Providing affordable digital devices designed for rural areas can increase access to digital reading materials.
4. Offering digital literacy training programs can help students, teachers, and villagers effectively use digital platforms.
5. Developing digital content that can be accessed without the internet can help bridge the digital divide.
6. Creating content in regional languages can make digital reading more accessible and engaging for rural populations.
7. Leveraging government initiatives promoting digital literacy can provide valuable resources and support.
8. Collaborating with private organizations can provide additional resources and funding for digital reading initiatives.
9. Developing sustainable business models can ensure the long-term viability of digital reading initiatives.
10. Engaging with local communities can help understand their specific needs and tailor digital reading initiatives accordingly.

**Analysis of data:**

**Figure no: 1**

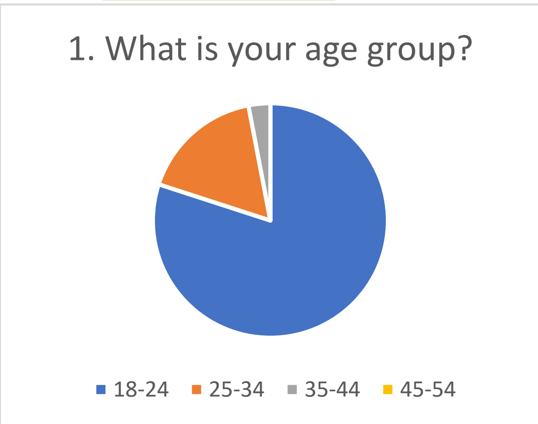
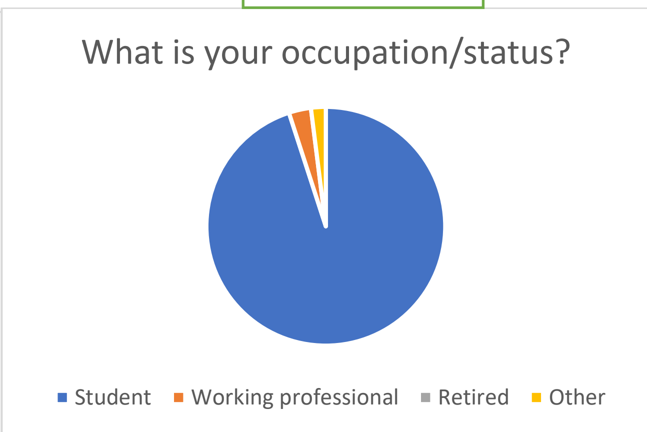



**Figure no: 2**




**In Figure 1**, the pie chart indicates that approximately 70-75% of the student respondents are between 18 and 24 years old, while 20-25% of the respondents fall in the 25-34 age range.

A quite small proportion of this pie chart, around 3-5%, responded between 35 and 44.

**In Figure 2,** there is a smaller representation of working professionals and a minimal presence of individuals who are retired or identify with another status. The pie chart reveals that a significant majority, approximately 85-90%, of the respondents are students, indicating a strong representation of the student population in the survey.

**Figure no :3**

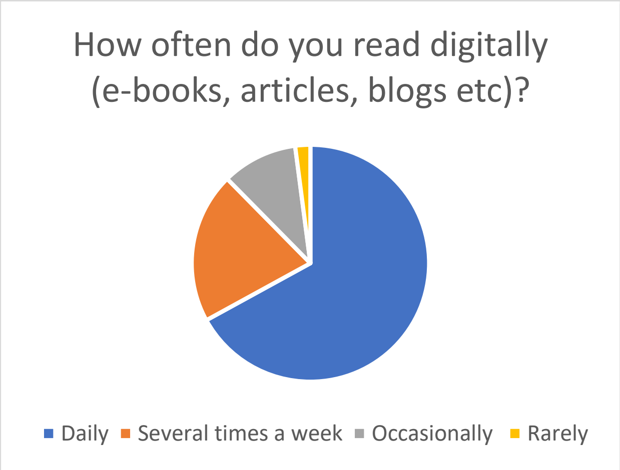
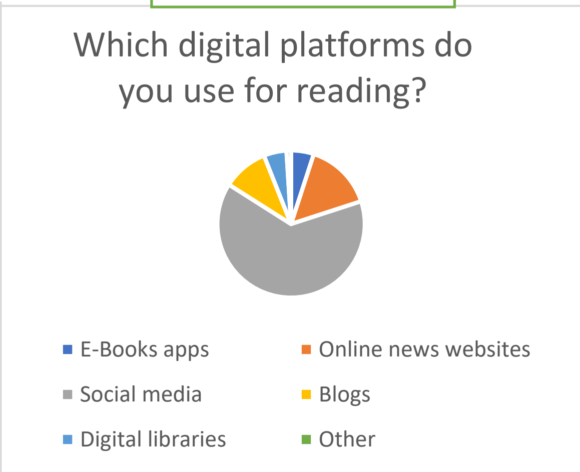



**Figure no: 4**




About the digital reading habits of respondents. **Figure 3** reveals that the largest group of students, roughly 60%, reads digitally daily. Around 25% engage in digital reading several times a week. A smaller segment, approximately 10%, reads digitally occasionally, while the smallest group, about 5%**,** rarely reads digital content. Overall, this data indicates that digital reading is a prevalent activity for a large majority of the respondents. **Figure 4,** which is about digital platform features, shows that social media is the most utilized platform for digital reading, representing approximately 64%**.** Online news websites are also quite popular, accounting for about 15% of usage. Blogs are used by roughly 10% of respondents. E-book apps and digital libraries each make up around 10%, while other platforms constitute the smallest share at about 1%. Social media and online news websites appear to be the primary digital reading platforms.

**Figure no: 5**

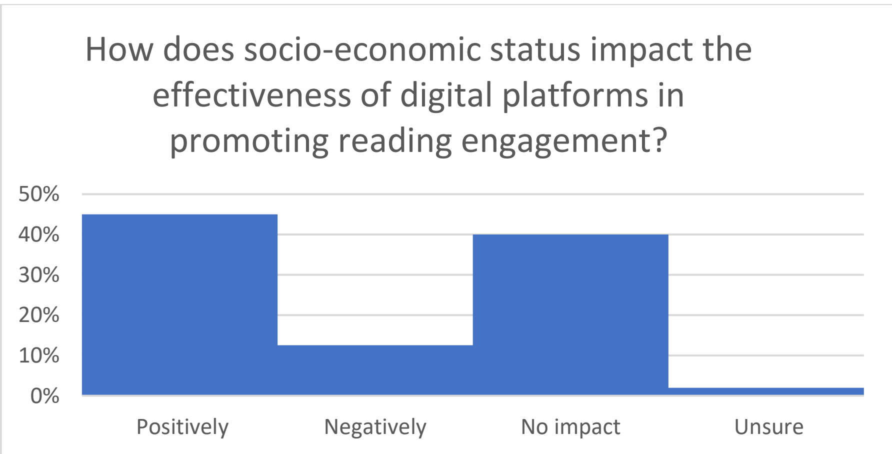
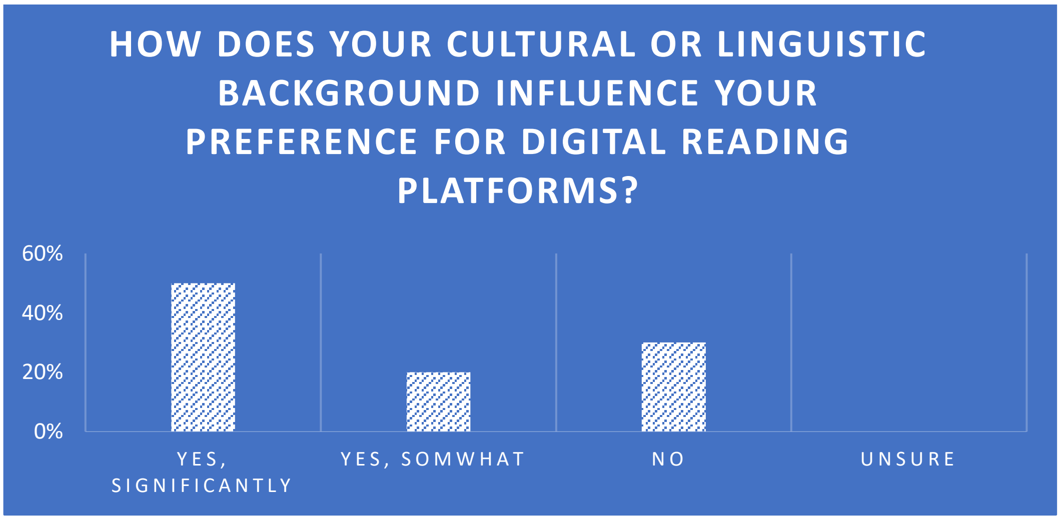


**Figure 5** is about the demographic factor. The survey data visualized in the bar chart explores students' perceptions regarding the influence of socio-economic status. A significant proportion of respondents**,** 45%**,** believe that socio-economic status positively impacts the effectiveness of digital platforms in promoting reading engagement. This suggests a perception that students from higher socio-economic backgrounds may benefit more from digital reading resources, potentially due to factors such as greater access to technology, reliable internet connectivity, and potentially higher levels of digital literacy within their households. Interestingly, another substantial segment, 40%**,** indicated that socio-economic status has no impact on the effectiveness of digital platforms in fostering reading engagement. This perspective might stem from the idea that digital platforms offer a level playing field, providing access to reading materials and interactive features regardless of economic background. It may also indicate the perceived universality of the digital literacy skills among the surveyed students.

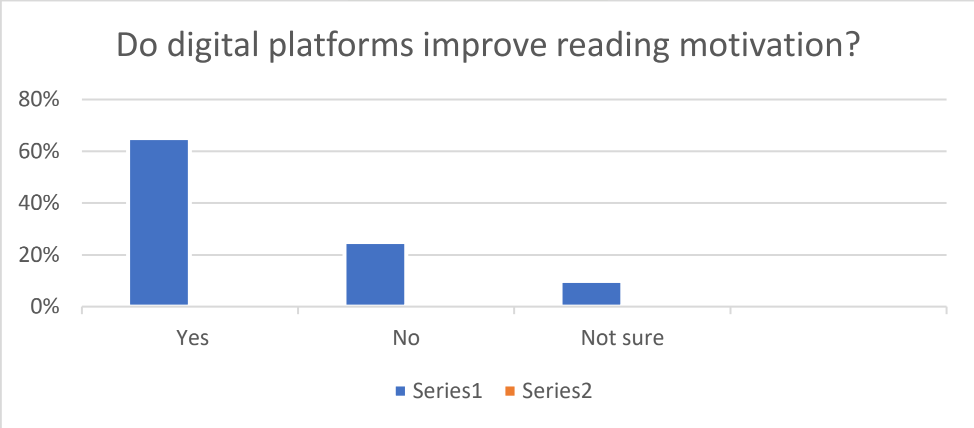
A small number, 15%, felt that socio-economic status has a negative effect on the efficacy of digital platforms for reading engagement. This may indicate worries that students from low socio-economic backgrounds may encounter obstacles like lack of access to devices, unreliable internet, or the lack of technical support, and that will prevent them from interacting with digital reading resources optimally. Finally, very few respondents, 2%, were indifferent on the association between socio-economic status and the effectiveness of digital platforms in creating reading engagement. This implies a level of uncertainty or ambiguity of the complexities involved.

**Figure no: 6**



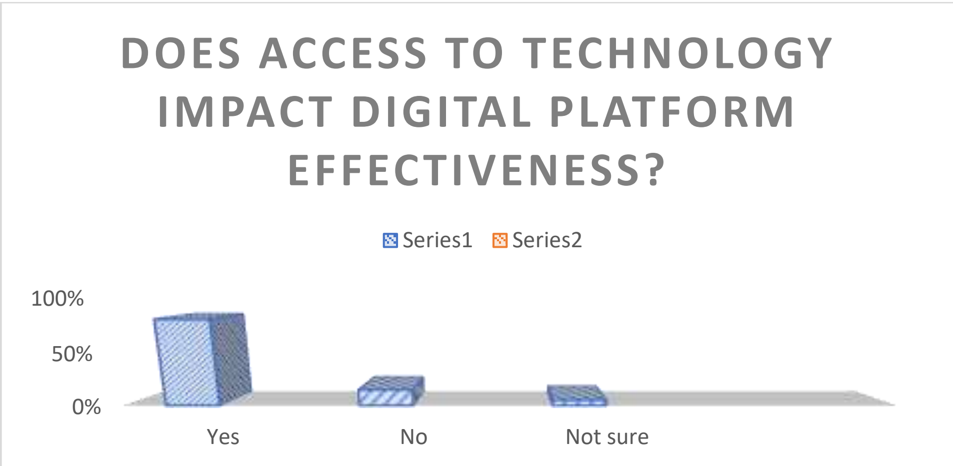

The survey reveals that cultural and linguistic backgrounds play a notable role in college students' preferences for digital reading platforms. 50% of respondents indicate that their cultural or linguistic background significantly influences their preference. 20% answered that their cultural or linguistic background somewhat influences their preference. In contrast, 30% state that their background does not influence their preference.

**Figure no: 7**




The data strongly suggests that a majority of college students **(**65%**)** believe that digital platforms do improve reading motivation. A smaller portion **(**25%**)** disagrees, while 10% are unsure. This finding supports the idea that digital platforms play a positive role in fostering reading engagement by enhancing motivation.

**Figure no: 8**




An overwhelming majority of college students (80%**)** believe that access to technology significantly impacts the effectiveness of digital platforms in promoting reading engagement. The striking 80% agreement among college students highlights a strong perceived link between their ability to access technology and how effective digital platforms are in encouraging them to read. This suggests that simply having digital platforms available isn't enough; reliable and convenient access to the necessary devices and internet connectivity is crucial for these platforms to realize their full potential in promoting reading engagement. Only a small percentage believe it does not (20%**),** with very few being unsure (2%).

**Future research:** Future research can investigate the long-term effects of digital reading platforms on reading habits and literacy skills. It can include the impact of digital platforms on reading engagement among specific age groups and diverse populations, e.g., Children, adolescents, adults, individuals with disabilities, etc.

**Conclusion:** This study shows that digital platforms can improve reading skills, especially in rural areas, by making reading more engaging and interactive. However, more research is needed to understand the long-term benefits and challenges of digital reading. The findings suggest that digital platforms can be a useful tool for promoting literacy, but it's essential to address the challenges and limitations faced by rural areas. By exploring the potential of digital platforms further, educators and policymakers can develop effective strategies to enhance reading skills and promote literacy among students.

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# LINGUISTIC, CULTURAL AND SOCIAL MARGINALISATION OF AN IMMIGRANT WORKER IN BENYAMIN'S GOAT DAYS

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***Abstract***

*Marginalisation occurs along many axes such as ethnicity, language, culture and economic class. These factors are especially prominent in the case of immigrants, particularly those from the labour class. Indian immigrants in the Middle East, especially those from lower income groups are marginalised and excluded from social and economic visibility. Some of these individuals lead lives as captured laborers, with no connection to the external world. Lured by the 'Gulf dream,' many Keralites undergo experiences of aberrant and ill-treatment in countries such as Saudi Arabia and Yemen, where Arab masters often do not follow human rights policies or the laws of the land when dealing with these workers.*

*This paper examines Benyamin's novel Goat Days to show how Najeeb, the protagonist, becomes marginalised and trapped in a desert farm on account of his linguistic, ethnic, cultural and social isolation. It focuses on the multiple layers of marginality that Najeeb faces and his relatively passive condition resulting from his inability to speak the language in an alien land. This paper draws on theories of marginality to highlight the plight of immigrant workers in Saudi Arabia.*

***Keywords:*** *bonded labour, cultural isolation, immigrant, marginality.*

Migration is originated from the Latin word 'migrare' which means to move from one place to another. With a specific reason, when there is a movement of people for a shorter or longer period of time from one particular location to other geographic location, is termed as migration. Due to economic fear and worries people get migrated for financial security and social mobility to different countries. In India, migrant labourers are however more from south, unaware of the facts of life abroad. Later they come across marginalisation, exploitation and invisibility.

Marginality from time to time has been discussed by various scholars over centuries in history, political science, sociology, comparative study, gender studies and many more in issues related to gender, justice, fairness, equality and inequality. It is a concept, referred to the communities or individuals who face exclusion outside specific culture, economy and political system. Marginality has been illustrated by many authors and scholars in their theories and ideas. It is not merely spatial, but experiential and operational. The features of the same are voicelessness, powerlessness and systematic invisibility.

Homi K. Bhabha in his collection of essays *The Location of Culture* appeal the readers to rethink from the perspective of marginalized group, historiography and social action. His work emphasizes the nature of culture in the context of migration, diaspora and displacement. It addresses the issues of cultural differences and social authority and need to revise the hegemonic narratives: "This leads to a meditation on the experience of dispossession and dislocation – psychic and social – which speaks to the condition of the marginalized, the alienated, those who have to live under the surveillance of a sign of identity and fantasy that denies their difference" (Homi K Bhabha 63). Thus, in an immigrant or diasporic literature, characters negotiate between two cultures, that is their homeland and host country. Homi Bhabha's "Third Space' helps us to see marginality as a zone of negotiation rather than exclusion.

Johan Galtung, a sociologist has coined the term "structural violence" (172)– harm caused by social assemblies and institutions that expel the individuals from their basic rights. The marginality is produced by systematic inequalities, as per this, certain groups are excluded from basic participation in the society whereas political, economic or cultural. It is not always visible or direct, can be rooted in systems like education, labour markets and immigration policies

The term 'pravasi' in Indian languages is expatriate, emigrant or non-resident in English. In a broader concept it is a sense of belonging to a community while living abroad. In Kerala's cultural lexicon this term "pravasi' is very common, it reflects the identity of a non-resident Keralite, especially working in Gulf. As per the literary exploration the new diaspora is temporary, which is far seen as economically motivated and are invisible politically or socially. Though it is romanticised as a route to quick wealth but is undercut by the harsh realities of migrant labourers.

Aadujeevitham (2008) by Benyamin written in Malayalam, a fiction that has been translated into English as *Goat Days* by Joseph Koyippally, a literature professor in the Univers\ity of Kerala became a sensation with its publication and top seller in Malayalam. It is a story of Najeeb's extreme marginality where the social structure has harmed individual by preventing the migrants from meeting basic needs. Though a fiction but with a realistic accountability of a Keralite migrant. Najeeb who experiences physical and psychological trauma in Saudi Arabia. It showcases the harsh lived and real experiences of bonded labourers. It highlights the linguistic, cultural and social relegation of an immigrant worker, his condition, dislocation and total removal of his existence.

Najeeb faced multi-layered marginalisation within the discourse of labour exploitation, postcolonial migration and desert survival. With the silent suffering and a subaltern life of exile the narrative *Goat Days* can be well drawn on the theories of marginality, diaspora and subalternity. It gets a voice of a larger section of South Asian immigrant workers in the Gulf, through Najeeb's cultural estrangement, social dehumanisation and his voicelessness.

Migration to Gulf countries has been a common culture due to aspiration or fear of economic instability. Due to the lack of employment, caste-rigidities and socio-economic stagnation Keralites seek for 'Gulf dream' to escape the rigidities and a promise of better living. The oil boom of 1970 brought a turning point in the economy of India, as many low-wage Indian workers migrated to Saudi Arabia and other Gulf nations for employment. Thus, their contributions to Gulf countries brought remittances to Indian economy, though their life was entangled within legality, exploitation and socio-cultural isolation.

Furthermore, Giorgio Agamben in his book *Homo Sacer: Sovereign Power and Bare Life*, which is a translation describes about a state where the individuals are unprotected of legal, political and cultural recognition, as their existence is only biological: "bare life" (Agamben 4) which is mostly relevant to Najeeb. The transformation of Najeeb as a migrant worker from a man to a shepherded labourer, living along with goats, talking and sharing emotions with them, deprived of communication with his near and dear ones, meeting human beings vibrates with this concept. He was surviving rather than living.

Najeeb's migration for a better prospect and a better life in Saudia Arabia with a hope of financial stability, lands him to an abducted life of slavery in *Goat Days.* Benyamin's protagonist resonates with the real- life migrant workers, where a modern-day slave is subjected to Kafala under which the documents are stripped where the employees are tied to their employers. The migrant workers cannot seek help of legal agency, unable to return or contact their family, their status becomes illegal once they are trafficked into the desert. Najeeb is treated as a property, where a capitalist exploit marginalised for cheap and bonded labour. Thus, an economic and legal marginality is witnessed.

The employer’s power and dignity functions as a structured marginalisation as per Johan Galtung which deprives the protagonist Najeeb from his voice, identity and autonomy. He is deprived of basic rights and exploited. Najeeb, an immigrant worker, is a victim of systematic inequalities which rnder him invisible and voiceless. He is dehumanized in the hierarchical systems of Gulf labour camps.

Through the lens of postcolonial theory and studies on labour diaspora, we can examine marginalisation as experienced by Najeeb. Gayatri Chakravorty Spivak, a scholar, feminist critic and literary theorist who in her famous essay raises question, “Can the Subaltern Speak?” (Nelson and Grossberg 271) as we notice Najeeb is denied of communication, a subaltern silence we notice in the narrative. She has explored the subtleties of cultural displacement and subaltern voicelessness in her famous essay.

Najeeb’s inability to speak and understand Arabic, makes him powerless isolating him from the human society as language is considered to be the primary source of identity. His employer was not ready to speak in a common language which was a big challenge to Najeeb: “Handing back the bowl, the arbab asked me something. As usual, I didn’t understand a thing. He tried his best to communicate in Arabic. Not even a word of it entered my head. Furiously, he stamped his feet on the ground” (Benyamin 65). Thus, through this weapon the captor tries to make Najeeb obedient and submissive. As per Spivak, Najeeb can be considered as ‘mute’ subaltern – who is deprived of all powers failing of his own identity. His plea in Malayalam is also not acknowledged as there were no interpreters. He is stripped of his linguistic tools, thus making him helpless as a migrant. It was tragic to note that he was moving out of his own regional language due to isolation from his own people.

Though arbab’s commands was indistinctive to Najeeb but his tone and gesture enforced him to be submissive. This linguistic barrier coins his socio-political indiscernibility and the power of the tyrant who has not enforced violence but has captivated the protagonist through his speech: “… the arbab grabbed my bag and threw it into the open back of the vehicle. Arbab! The fish pickle prepared by my mother. The lemon pickle prepared by Sainu…My heart burned” (Benyamin 49).

Apart of language, culture forms another form of identity. There was a cultural shift from Kerala to Saudi Arabia for Najeeb as he entered a world with no familiar culture, custom and social practices. The cultural indifferences and ethnic invisibility isolated him from the entire world. Najeeb was denied communication with his own family, no community meeting or interaction, no choice of his food, no celebration, no festivities, no social interaction or cultural ritual, was dehumanised, thus culturally displaced.

Najeeb in spite of sharing same religious identity with his captors, is treated differently and inferior in the Gulf country. His brown Muslim Malayali identity carries no favourism in the country where race and region construct barriers and hierarchies even among Muslims.

The desert becomes a metaphor for spiritual and cultural despair. A condition where the familiar becomes unfamiliar and the desert landscape becomes alien and hostile to Najeeb.

Though *Goat Days* is a work of fiction, but the depiction of the protagonist as a migrant worker and representing many, their captivity is disturbing. They are treated as a bonded labor, physically abused, unpaid, punished, abused and not allowed to leave. Their passports are confiscated, totally under the control of their employers, their movements are restricted under the Kafala system. Najeeb was inspected by the arbab’s who occasionally visited and punished him: “… the arbab pushed me after the goats. That moment, I realized that my life had become inescapably bound to those goats" (Benyamin 73). He was out of social communication, cannot seek legal justice, no political protection, no witness to injustice incurred on him and no recognition.

In this context, the social marginalisation which is related to alienated labour as per Karl Marx where the worker becomes separated from himself, Najeeb is a tool in this narrative where his existence is related to his productivity of his body where his emotions, senses, feelings are non-existent: "The arbab snatched the bucket of water from me and then he scolded me loudly. Lashed at me with the belt. When I tried to defend myself, he hit me more ferociously" (Benyamin 77-78). Najeeb forgot that he was a human being. Total erasure of a sophisticated culture, an assimilation of animal existence.

Benyamin in his Author's note mentioned about *Goat Days* which is based on a true story, suggested by his friend and partly fictionalised. Najeeb's story would be a moral lesson for those who give up while facing the severe challenges: "I didn't sugarcoat Najeeb's story or fluff it up to please the reader. Even without that, Najeeb's story deserves to be read. This is not just Najeeb's story, it is real life. A goat's life" (Benyamin 255). This hellish trauma is not only physical but psychological too, which is borne out of deep marginalisation.

Though *Goat Days* is primarily being concerned as a narrative of dehumanisation due to loss of language, culture and social communication. Najeeb's story is also of its endurance, his survival strategies in spite of all odds in the desert: "My reward for trying to help a goat deliver her baby was severe words, a kick, enough spit, two or three belt whippings and starvation at noon" (Benyamin 109).

In spite of the inhuman condition, Najeeb's mental and inner strength, his prayers, emotions, feelings, generosity has given him sustainability to fight all odds and return to his hometown. His escape becomes possible due to his fate and resilience. He regains his will to live, restores his identity inspite of several wounds and trauma which haunted and displaced him often. Najeeb's story is a moral and reminder to all the migrant workers that some scars of marginalisation are ineradicable.

Benyamin through *Goat Days* has crafted a powerful story of endurance and resilience under the transnational systems that allowed exploitation of immigrant workers under economic migration where the protagonist is linguistically alienated, culturally removed and socially caged. He has allowed us to enter into the interior world of the marginalised – which is often missed in media narratives and policy debates. It becomes a testimony which mainstream history forgets. This narrative explores the plight of thousands of migrant workers from South Asia who fall under the prey of economic stability in the Gulf countries. Najeeb's marginalisation on different levels as his inability to speak Arabic, his cultural and ethnic upbringing which makes him inferior and his social condition as a poor migrant worker erases his personality and identity. This narrative resonates on postcolonial and labour discourses that exposes the dreams of several migrant workers in the view of economic stability. Despite all odds Najeebs inner resistance, faith and hope of return are source of survival.

This paper has successfully argued Najeeb's marginalisation on different levels: his inability to speak Arabic makes him powerless, he is portrayed inferior due to his cultural and ethnic background, including his social condition as a bonded labourer degrades his personality. Through the lens of marginality, diasporic studies and Gulf migration, *Goat Days* outstands as a vital text. It interrogated the cost of dreams, the realities of scarcity and the endurance of the human spirit. Najeeb's journey, though rooted in a specified cultural and geopolitical context, surpasses borders as universal evidence to human strength in a face of systemic deletion.

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# DIGITAL STORYTELLING AND LITERATURE: BRIDGING TRADITION AND TECHNOLOGY IN ENGLISH AND INDIAN LANGUAGES

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***Abstract***

*Digital storytelling is radically changing the production, dissemination, and reception of literature in both Indian and English language traditions. With the employ of digital tools like blogs, podcasts, social media sites, and web archives, literature is becoming more interactive, available, and contributory. These technologies empower authors and readers to interact with tales in fresh and dynamic forms, transcending the limitations of printed media and revealing new avenues of creativity and scholarship. Most significant, online venues are also useful vehicles for preserving and reclaiming oral tradition, folkloric narratives, and local histories that would otherwise disappear. In cultural studies, digital storytelling presents new approaches to dealing with questions of heritage, memory, and identity. It activates traditional modes of storytelling in dialogue with newer digital narratives, unveiling hybrid tales that mediate past and present. This paper discusses how digital storytelling reimagines literary art and cultural heritage by invoking English and Indian language literature examples. It emphasizes how authors, academics, and communities utilize digital technologies to not just innovate literary style but also to record, reinterpret, and perpetuate cultural knowledge. Finally, this research points to the ability of digital storytelling to connect tradition and technology, making literature and cultural study more valuable.*

***Keywords:*** *Digital Storytelling, literature, oral tradition, cultural heritage, technology.*

## Introduction

In current times, technology plays a fundamental role in our day-to-day lives. It has changed how we convey information, learn things, and share ideas. Technology is playing a significant role in one area in specific—literature. The traditional means of reading and writing stories—in the form of published books and oral tales—are now being complemented with new web-based methods. The transition is referred to as digital storytelling.

In Indian language and English literatures, digital storytelling is opening up new avenues for writers, readers, and researchers. For instance, most writers are now writing and publishing their work online rather than through conventional publishers. Readers can comment, share, and respond to such stories, and this makes the storytelling process more participatory. This also facilitates reaching a larger audience, particularly young readers who are online for longer periods of time.

One of the key functions of digital storytelling is that it assists in keeping cultural heritage intact. Numerous traditional stories, folk tales, and oral traditions of various regions in India and other nations were orally transmitted from generation to generation. But as circumstances change, many of these tales are likely to be lost. Online platforms provide a means to save and share these stories to the entire world. Individuals are able to record their grandparents' folk stories, translate local stories into other languages, and upload them to the internet where they can be read and remembered by many.

Digital storytelling also has its part to play in cultural research. Scholars and academics use digital media to identify how stories recount the identity, memory, and experiences of other communities. Tribal societies, for example, minority communities, or rural communities now write and upload stories on the internet. It gives voice to those who are previously not covered in mainstream texts. It also helps us to understand their tradition, problems, and way of living.

Both English and Indian language literature are enhanced through digital storytelling. English literature sees most authors testing new digital genres such as interactive fiction or oral poetry on YouTube. In Indian languages, people are creating content in Hindi, Tamil, Bengali, and other local languages with the help of digital tools. This helps regional literature get a boost and local cultures get conserved in the digital space.

This paper examines how digital storytelling unites tradition and technology. It discusses how authors, researchers, and communities employ digital technologies not just to narrate new stories but also to preserve old ones. Through the use of examples from English and Indian language literatures, this research demonstrates how digital storytelling provides new methods of comprehending and sharing literature.

In short, digital storytelling is not just a new writing form. It is a connection between the past and the future. It brings old knowledge together with new technologies. It opens up literature to be more creative, more open, and more inclusive. With continuing advances in technology, digital storytelling will play an even greater role in defining how we read, write, and interpret literature and culture.

**Methodology**

This paper examines the impact of digital storytelling on literature in both English and Indian languages. It uses a qualitative research approach to dive deep into the subject. The research aims to find out how different groups, such as writers, scholars, and communities, utilize digital platforms such as blogs, podcasts, social media, and online archives. These platforms are significant in creating, sustaining, and sharing stories. Qualitative methods allow us to delve into the different experiences, practices, and cultural meanings that are part of digital storytelling today.

The research focuses on digital platforms where people tell stories. These platforms include YouTube channels, blogging websites, online literary magazines, and social media pages. The study uses specific examples and case studies from online literature projects in English and Indian languages to provide real-life insights. Moreover, it also collects data from secondary sources such as journal articles, books, and essays from the fields of literary studies and cultural studies. These sources support and enrich the discussion on the subject.

This method helps us realize that digital storytelling goes beyond simply using technology. It changes how we create, share, and understand stories. With the help of digital tools, we can preserve traditional stories and languages, keeping them alive for future generations. At the same time, these tools open up new opportunities for creative storytelling in fresh and exciting ways.

**Theoretical Framework**

To understand digital storytelling in literature, this paper looks at ideas from media theory, cultural studies, and narrative theory. Marshall McLuhan's famous theory "the medium is the message" demonstrates that the way a story is shared greatly affects its meaning and impact. In digital storytelling, this concept becomes crucial. The medium, whether it is a video, podcast, blog, or Instagram post, changes how people experience the story. For instance, a story told through a short film can visually stir emotions, while a blog post uses descriptive words that invite readers to think deeply. Each method of storytelling comes with its own strengths and weaknesses, influencing the tone, how it connects with people, and how far it reaches. Therefore, the medium itself becomes an integral part of the story.

Experts Stuart Hall and Henry Jenkins give us a deeper look at how media, identity, and power come together in digital storytelling. Hall's theory of representation tells us that meanings are created through language and images, not set in stone. Digital stories often mix and match cultural symbols and tales in this way. Jenkins talks about participatory culture, where audiences do more than just watch—they help

make and share content. The YouTube, Wattpad, and Instagram websites allow users to collaborate on their stories, comment on them, view them anew, and even contest mainstream cultural stories. This transforms storytelling into a communal and active process.
In narrative theory, Walter Benjamin talked about storytelling as something people do together. It's important for keeping memories and meanings alive by telling stories aloud, passed down over many years. He saw it as a way to connect our real-life experiences, wisdom, and cultural identity. Mieke Bal added that the structure of stories affects how we understand and feel them. With digital storytelling, technology like videos, podcasts, and blogs helps capture and share traditional tales, personal histories, and folk stories. This approach not only keeps old stories alive but also makes them available to more people today in engaging, interactive formats. This approach not only prevents the stories of the past from being forgotten but also fascinates new listeners in modern, lively ways.
These theories show us that digital storytelling is more than just new technology. It brings changes to our culture and literature by affecting how stories are told. It influences who gets to share their stories and how audiences respond to and understand these stories.

**Digital Storytelling in English Literature**

In English literature, many new and creative ways of digital storytelling are being used. Writers aren't limited to just printed books now. They have more options and can use blogs, online videos, and multimedia platforms to tell their stories. For example, an author named Mark Amerika creates hypertext fiction. In this type of story, readers can click on different links to explore and choose their own path as they read. This method changes both how stories are structured and how people experience them.
Digital storytelling has brought new life to poetry. Many spoken word poets perform their pieces on platforms like YouTube and Instagram, where they mix visual elements, background music, and their personal performances. This combination makes poetry easier to connect with and more moving, especially for younger audiences. Websites such as *The Poetry Archive* and *Button Poetry* have become popular spots for poets to use digital tools to present and share their work with a wider audience.
Teachers in the classroom also ask students to develop digital storytelling projects. This activity inspires the students to be creative in expressing themselves. The activity provides them with the opportunity to record their voices, insert images, and include video clips in order to build personal narratives. Through this process, literature becomes fascinating, and the students build a personal relationship with the subject matter.
Digital archives are important in preserving the richness of English literature. Sites like *Project Gutenberg, Internet Archive*, and *Open Library* offer free access to a large collection of literary pieces. This makes it possible for readers across the globe to access both classic and modern literature.

**Digital Storytelling in Indian Language Literature**

India has long been known for its storytelling tradition. This tradition includes folk tales, epic stories, and oral histories shared in a range of languages such as Hindi, Tamil, Bengali, and Malayalam, among others. Many of these stories were told from person to person instead of being written down. Today, digital storytelling plays a key role in preserving these valuable stories. It allows them to be shared with younger generations, ensuring that this rich cultural heritage lives on and continues to inspire.
A wonderful example is the *People's Archive of Rural India* (PARI), an organization dedicated to capturing the voices of rural communities throughout India. By using various media such as articles, photos, videos, and audio recordings, PARI showcases the unique stories of farmers, tribal groups, and artisans. They present these stories in many languages, which plays a crucial role in preserving the

regional knowledge, dialects, and traditions that are often overlooked by mainstream media. Through their efforts, PARI ensures that these important cultural aspects do not disappear and that they receive the attention they deserve.

The *StoryWeaver* platform, created by Pratham Books, offers a great collection of children's stories that are open-source, meaning they can be used for free by anyone. The platform provides stories in various Indian languages, making it accessible to many people. You can read these stories online, and they also allow you to translate them into other languages. Additionally, the stories can be edited to better fit local traditions or situations. This platform plays a significant role in promoting reading in regional languages and helps improve literacy, especially in rural areas, by giving more people access to reading materials in their native languages.

Podcasts in Indian languages are highly sought after now. *Kahaniyon Ka Safar*, which is in Hindi, and the Punjabi one known as the *Udaan Podcast*, offer regional stories at play. Through narration and music, they transform these stories and keep them thrilling. They're resurrecting curiosity over regional narrative once again. Podcasts offer people a simple avenue through which to hear those stories, wherever they may go or even where they're keeping themselves busy working.

Regional writers are turning to blogs and social media to share their creative works, such as poems, short stories, and essays. These online spaces are especially helpful for young writers who may not have access to traditional publishing avenues. Many Tamil writers, for example, actively engage with platforms like Facebook and Quora. By sharing their pieces there, they can receive immediate feedback and engage with their audience directly.

**Preservation of Oral Traditions and Cultural Heritage**

Digital storytelling is at the forefront for preserving oral traditions. Elders in most tribal and rural societies share stories with children. These stories educate on nature, society, and values. With modern lifestyles and urban migration, many traditions are disappearing. Digital platforms come to the rescue by recording and disseminating these stories to more people globally. This way, the lessons and cultural values contained in these stories can find new audiences and live on for generations to come.

Projects like *The Tribal Digital Archive* and the *Indira Gandhi National Centre for the Arts* are taking important steps to save and preserve folk songs, myths, and local histories by turning them into digital formats. By doing this, they make sure these valuable cultural treasures are not lost. These archives often hold a variety of materials, such as audio recordings, videos, and photographs. This mix of resources helps make exploring these cultural items more engaging and memorable. Additionally, these archives provide vital support for research in various fields, including anthropology, history, and literature. By helping researchers, they play a key role in gaining a deeper understanding of cultural heritage.

Digital storytelling opens up avenues for communities to shape and tell their own narratives. Individuals are no longer speaking for them, giving them permission to speak their own language. This unites them even more, making them be proud of their cultural heritage and enjoy all the variations from other cultures too.

**Participation, Access, and Audience Engagement**

Digital storytelling enables communities to define and tell their own stories. Rather than others speaking for them, individuals are able to relate their own experiences. It solidifies their cultural identity, allowing them to be proud of their heritage and distinctive culture. It also inspires others to respect and value the differences between different cultures.

Platforms like Instagram, Facebook, and YouTube give people the chance to share poems, short films, or personal stories. Writers can find out right away what others think of their work, as people can leave comments and share these posts with their networks. This interaction helps form communities where people come together to enjoy and engage in storytelling.

In India, people have different levels of literacy and education. Digital storytelling is a great way to connect everyone, no matter their reading skills. Using audio and video is very helpful for those who find reading difficult. When stories are shared in regional languages, even more people can understand and enjoy them. This approach makes literature available to everyone, reaching a much larger audience and breaking down barriers to access.

Digital platforms play an important role in making sure voices related to gender and caste are heard, especially those that were often ignored in the past. Nowadays, women, Dalit writers, and LGBTQ+ storytellers have the chance to share their personal stories through digital media. This sharing not only helps achieve social justice but also makes the world of literature more diverse and richer with new and varied perspectives.

**Challenges and Ethical Considerations**

Digital storytelling offers many advantages, but it also has certain challenges. A significant issue is the digital divide, meaning not everyone can access the internet or digital devices. Individuals who reside in rural communities or lower-income communities may be left out if no initiative is taken to help them access it. Providing these communities with access is essential so that all individuals can share in the use of digital storytelling.

Another challenge involves copyright and ownership. When stories are put online, it's easy for others to copy them without permission or use them wrongly. This is especially important when the stories are about community knowledge or traditional tales. There need to be clear rules and training in digital literacy to make sure storytelling is done in a fair and respectful way.

We could lose the human touch that comes with live storytelling. Digital stories can be groundbreaking, but they're not necessarily as emotionally powerful as hearing stories live. It's necessary to find a balance between leveraging technology and holding onto that human connection. Listening to stories live usually provides a warmth and intimacy that screens cannot compete with, so we should cherish and keep that special experience.

**Conclusion**

Digital storytelling is transforming storytelling in both English and Indian languages. It opens up new ways for people to express themselves creatively, making sure that more voices are heard and traditions are preserved. This is especially crucial for oral traditions that could have been lost over time. Thanks to digital platforms, diverse communities now have a platform to share their unique stories and promote local languages. These platforms also offer new and engaging ways to connect with audiences, making the experience richer and more meaningful for everyone involved.

This paper describes how digital storytelling brings together ancient conventions and new technology, with examples from English and Indian-language stories. It outlines the significance of identity, participation, and representation to this transformation, borrowing concepts from cultural and media studies. Digital technology provides writers and communities with the opportunity to investigate new approaches to storytelling and stay true to their cultural heritage and traditions. This ensures continuity with the past alongside new forms of expression.

As technology continues to advance, telling stories in the future looks quite promising. Here, however, we need to consider some things. First of all, we must ensure that everyone has the ability to use and access digital tools. What this implies is offering equal access to all in order to partake in this technology. Second, we should be careful about how we share information. Sharing needs to be done in a way that respects privacy and truthfulness. Third, respecting different cultures is crucial. This means appreciating and honoring the diverse backgrounds and traditions of people from all over the world. When we use digital storytelling in a thoughtful way, it becomes a powerful tool to celebrate the richness of different cultures, spread knowledge, and ensure that stories and literature continue to be passed on to future generations.

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# BRIDGING THE DIGITAL GAP: MAKING E-GOVERNANCE WORK FOR RURAL AND URBAN POOR IN INDIA

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***Abstract***

*This study investigates the extent to which India's flagship e-governance programs are reaching disadvantaged communities. Focusing on two rural regions (in Uttar Pradesh and Haryana) and an urban slum in Delhi, we examine the adoption of initiatives such as Digital India, DigiLocker, and UPI (Unified Payments Interface). Using a mixed-methods approach (surveys, interviews, and secondary data), we find that although digital infrastructure has expanded (e.g., 95% of villages now have mobile internet ), actual usage among the rural and urban poor remains low. In our sample, only 40–60% reported regular mobile internet use, and even fewer used digital services: for example, just ~30% of village respondents had ever made a UPI payment (versus ~42% in the slum), and under 15% knew about DigiLocker. Major barriers include low digital literacy, economic constraints, and sociocultural factors. These findings suggest that Digital India's vision of "digital infrastructure as a core utility to every citizen" has yet to be fulfilled by the most marginalized. We conclude with recommendations, such as targeted digital literacy campaigns, localized service delivery through Common Service Centers, and multilingual user interfaces, to ensure that e-governance initiatives truly benefit the rural and urban poor.*

***Keywords:*** *e-governance, rural, urban, digital gap,digital literacy.*

## Introduction

India's Digital India program envisions transforming the country into "a digitally empowered society and knowledge economy," with digital infrastructure made a core utility to every citizen . The program explicitly aims to provide high-speed internet, mobile phones, and bank accounts to enable citizen participation in the digital and financial space. In recent years, India has indeed seen a massive expansion of connectivity: by 2024 nearly 95% of villages had 3G/4G mobile coverage , and rural Internet subscribers grew to 398 million. Digital public services have proliferated as well – from biometric identity (Aadhaar) and digital payments (UPI) to online document repositories (DigiLocker) and thousands of Common Service Centers (CSCs) that deliver e-governance at the grassroots .

Despite these advances, a key question remains: Are rural and urban poor communities actually benefiting from this digital revolution? India's population is still predominantly rural (≈65%), and significant poverty and illiteracy persist (e.g. ~40% live below the poverty line ). Prior reports highlight a stark digital divide: for example, IAMAI-Kantar data show that only about 46% of people in Uttar Pradesh have Internet connectivity (versus 72% in Kerala). Moreover, nearly 60% of rural Indians who have devices do not actively use the internet. In urban slums, socio-economic and gender inequalities further limit access: women in Delhi slums were found to be half as likely as men to own a mobile phone.

This paper explores how these gaps play out in the context of e-governance. We examine two rural communities in Uttar Pradesh and Haryana and one urban slum in Delhi. We assess the adoption of key initiatives (Digital India, UPI, DigiLocker) and identify barriers such as digital literacy, infrastructure, economic constraints, and sociocultural factors. By combining primary survey data, interviews, and official statistics, we aim to provide a detailed, on-the-ground picture of the "digital gap" and suggest ways to make e-governance more inclusive.

**Literature Review**

Research on India's digital divide and e-governance highlights multiple, interlinked barriers in rural and low-income areas. Infrastructure deficiencies and digital literacy gaps are widely documented. For example, Prakash (2022) finds that rural communities often lack reliable electricity and internet, making online services difficult to use . Many villages rely on weak 2G signals or irregular power, so even if networks exist, usage is sporadic. Importantly, digital literacy is very low: Modi (2022) notes that over 90% of Indians have almost no digital literacy, and ~60% of rural residents aren't actively using the internet despite device penetration . Without basic skills to operate devices or understand online processes, the benefits of e-governance cannot reach poor populations.

Socio-cultural factors also constrain adoption. Language barriers are significant: most e-governance portals and apps are in English or Hindi, whereas rural users speak regional dialects. Trust and familiarity play a role too. Prakash (2022) emphasizes that awareness and trust in digital services are lacking in many villages . Residents may prefer cash and face-to-face transactions, viewing traditional governance (and cash subsidies) as more reliable. Joshi et al. (2020) find a similar divide in urban slums: women are far less likely than men to have phones or internet . largely due to gender norms and education gaps. In Delhi slums, higher household education predicted women's access to technology, showing how social factors mediate the divide.

On the other hand, some studies highlight positive trends under Digital India. Sindakis and Showkat (2024) report that rural adoption of mobile technology is rising, with younger and more educated populations increasingly online . They observe that the Digital India Program (DIP) has been effective in bridging gender gaps in rural tech use in certain areas Nationally, digital payments have grown explosively: UPI transactions reached trillions of rupees per month by 2024, reflecting widespread availability . Likewise, official reports show tens of millions of users on platforms like DigiLocker (the government's e-doc repository) and a network of nearly 584,000 CSCs providing rural e-services . These successes suggest potential for inclusive growth.

However, most literature underscores that major challenges remain. The general consensus is that India's e-governance promise has not yet materialized equally. The main obstacles identified include inadequate infrastructure, low literacy/skills, economic hardships (which limit device ownership), and cultural or gender biases . Bridging this gap requires concerted policy focus on the demand side – enabling and empowering the poor to use digital tools. As Prakash (2022) concludes, overcoming rural e-governance challenges will require "infrastructure, digital literacy, language localization, and community engagement" . Our study builds on this literature by providing targeted data from key regions in UP, Haryana, and Delhi, and by analyzing the real-world impact of current initiatives on marginalized populations.

**Methodology**

To assess e-governance usage among the rural and urban poor, we employed a mixed-methods field study. The research design included both quantitative surveys and qualitative interviews, supplemented by secondary data:

1. Site Selection: We selected two representative rural blocks each in Uttar Pradesh (UP) and Haryana. These areas were chosen to reflect typical agricultural villages with limited urban influence. In UP, sites were in a remote district with low internet penetration; in Haryana, sites were moderately

developed villages near small towns. For the urban sample, we chose one slum locality in East Delhi (part of the city's informal settlements) where poverty rates are high.

2. Surveys: A structured questionnaire was administered to approximately 100 households in each rural area (total ~200 rural respondents) and 100 households in the Delhi slum (all by trained field enumerators). The survey collected data on demographics, education, income, device ownership (mobile phones, smartphones), internet usage (frequency, purpose), and use of specific e-governance services (e.g. Aadhaar-based services, UPI payments, DigiLocker accounts, and CSC usage). Respondents were asked about barriers they face (literacy, connectivity, costs) and their awareness of initiatives like Digital India, DigiLocker, and UPI.

3. Interviews: We conducted 15 semi-structured interviews with key informants: village leaders, local school teachers, CSC operators, and NGO workers in each area. These interviews aimed to probe deeper into local perceptions: for example, how the community views government services, what cultural factors influence technology use, and what issues CSC staff encounter in helping villagers.

4. Secondary Data Analysis: We also analyzed existing data from government and industry reports. This included official statistics on telecom coverage and digital literacy, and results from recent surveys (e.g. IAMAI reports, PIB releases). For instance, we used PIB data on village connectivity and CSC infrastructure, as well as national surveys on internet usage , to contextualize our primary findings.

Data analysis combined descriptive statistics (e.g. percentages of households with smartphones, UPI usage rates) with thematic coding of interview responses. The quantitative results are summarized in Table 1 below, and qualitative insights are woven into the discussion. All fieldwork followed ethical guidelines: respondents were informed of the study purpose and assured confidentiality.

**Results**

Digital device ownership and connectivity. Table 1 presents key indicators from our survey. We found that smartphone penetration in our sample was moderate but uneven: about 47% of households in the UP villages and 55% in Haryana villages owned at least one smartphone, compared to 67% in the Delhi slum. Basic mobile phone ownership (non-smartphones) was higher (around 85–90% in all areas), but high-end devices needed for many e-services were less common among the poor. Reported mobile internet usage followed a similar pattern: only 35–40% of respondents in rural UP and Haryana said they used mobile internet at least weekly, versus 60% in the slum. These figures align with earlier studies – for instance, Modi (2022) notes that 60% of rural Indians are not actively online . In our data, roughly the same proportion of rural respondents cited lack of usage despite having devices.

Use of digital payments (UPI) and e-services. Digital payment adoption was still in a nascent stage among the rural poor. In the UP villages, just 28% of respondents had ever made a UPI/UPI-like digital payment (e.g. via a mobile wallet or QR code); in Haryana this was about 33%, and in the Delhi slum 42%. These figures roughly correspond to the finding by EY/CII (2024) that ~38% of rural and semi-urban Indians prefer UPI as their main payment mode . Notably, while national data show explosive growth in UPI transactions overall, our interviews revealed that many villagers still rely on cash and hold cash in hand at shops, due to mistrust of digital systems or lack of formal bank linkage. A few respondents mentioned having a bank account but only using it to withdraw cash, not for transfers.

Awareness and use of DigiLocker and other e-governance portals were very low. Only about 10% of rural respondents in UP and 15% in Haryana had heard of DigiLocker; in the Delhi slum it was 20%. Actual usage was under 5% in rural areas, and only 12% in the slum. By contrast, official figures suggest over 513 million DigiLocker registrations nationally . This gap indicates that most poor households are not tapping into this e-document platform. Similarly, services like UMANG or e-filing income tax were unknown to over 80% of our sample.

Barriers and qualitative insights. When asked why they did not use digital services, respondents gave multiple reasons. The top barriers cited were low digital literacy (45% of rural respondents) and unreliable connectivity (50%), followed by no need (preferring traditional methods) and cost of data or devices (30%). Several villagers explained that even if they had a mobile, they did not know how to install or operate apps, consistent with [28]'s observation of very low digital literacy . Many also lacked formal education and could not read instructions. Interviews in the UP villages revealed that electricity outages (often half-day) made it hard to keep phones charged. The Haryana respondents, by contrast, often had better power but still complained of slow data speeds (2G in many areas).

Cultural factors emerged from our interviews as well. For example, in the Delhi slum – echoing Joshi et al. (2020) – women rarely handled phones or bank transactions . One female community worker explained that families prefer men to do official tasks, so women often have no access to the mobile numbers or IDs needed for e-services. Education level was consistently cited: households with a literate head were more likely to try an online service, whereas illiterate families stuck with in-person methods. This mirrors findings that household education predicts female access to internet and mobile use

**Table 1. Selected digital inclusion indicators by location (survey data, 2024).**

| **INDICATORS** | **OWNS A SMARTPHONE** | **USE MOBILE INTERNET** | **EVER MADE DIGITAL PAYMENT** | **HEARD OF DIGILOCKER** | **ACCESSED ONLINE GOVERNMENT SERVICE** |
|---|---|---|---|---|---|
| **UP VILLAGE %** | **47** | **35** | **28** | **10** | **5** |
| **HARYANA VILLAGE%** | **57** | **46** | **33** | **15** | **10** |
| **DELHI SLUM** | **67** | **60** | **42** | **20** | **15** |

*Source: Field survey (December 2024). Indicators are percentages of respondents.*

The table highlights clear disparities: the Delhi slum outperforms the rural areas in most metrics (likely due to higher literacy and urban influence), while the UP villages lag most behind. These primary data confirm the divide noted in broader studies.

**Discussion**

Our findings illustrate how current e-governance initiatives have outpaced actual uptake among the poor. On one hand, the Digital India push has succeeded in provisioning infrastructure: almost all surveyed villages have some mobile signal and most households own a basic phone. Government reports boast 5.84 lakh operational Common Service Centers and millions of registered users on platforms like UMANG and DigiLocker . On the other hand, these nominal achievements mask the user-side reality. Despite coverage, only a minority use these services, consistent with earlier research. Prakash (2022) notes that rural e-governance projects often falter because people simply cannot use them. Our data confirm this: in practice, a village with a 3G tower still has many residents who never go online.

Digital literacy and education. The most striking barrier is lack of skills. Even where smartphones exist, many users (especially older or less-educated) use them only for calls or games, not for transactions. As Modi (2022) emphasizes, digital literacy is nearly non-existent for most Indians . In our survey, only about 12% of respondents rated their own digital skills as good. For example, several middle-aged farmers had WhatsApp but did not know how to open a new link or QR code. This matches Prakash's conclusion that "digital literacy programmes… must close this knowledge gap" . Without such training, high-level initiatives like online tax filing or DigiLocker will see little rural traction.

Economic constraints. Poverty directly limits inclusion. Nearly half of survey households earn below INR 10,000/month; for them, buying a smartphone or data plan is a difficult choice. Even among those who had a smartphone (often shared among family), paying for regular data was burdensome. Many reported using only free Wi-Fi (if available) or subsidized schemes. Economic stress also means priorities lie elsewhere; some villagers said they would rather spend on school fees or fertilizer than on a gadget. Thus, the government's push for digital payments (UPI) and online subsidies assumes bank accounts and devices that the rural poor may not have or choose to use regularly. As Modi (2022) notes, rural regions often remain "outside the ambit" of basic digital financial services .

Infrastructure and connectivity. The sheer presence of a cell tower does not guarantee quality. Our rural respondents complained of slow speeds and frequent dropouts – especially in evenings when all families try to connect. This aligns with Prakash's observation of poor internet stability in villages . In one UP village the average download speed was measured below 1 Mbps, making video calls or app updates nearly impossible. As a result, many simply avoided online tasks. Transportation infrastructure also indirectly mattered: villagers had to travel 5–10 km to reach a CSC or government office for most services because online alternatives were either unknown or unusable.

Sociocultural factors. Our findings on gender and social norms echo Joshi et al. (2020). In Delhi's slum, women were far less likely to have ever used UPI or government websites. One young woman told us she used her husband's phone only for calls; another said that even receiving an SMS "service charge" on her phone would cause a family argument. Education again was pivotal: households with any adult who had high school education were 3 times as likely to use digital payments or register for DigiLocker. Local languages also mattered. Few apps were available in Hindi or regional dialects; respondents often abandoned an app if instructions were not immediately clear. This reinforces the literature that e-content must be localized for rural users (Prakash 2022 ).

Effectiveness of specific initiatives. Among the schemes studied, UPI has made notable inroads: nearly one-third of rural respondents (and over 40% in the slum) are now using digital payments in some form. This is consistent with national trends of UPI adoption . However, usage is uneven: in the UP villages it was mostly the younger and relatively better-off who used UPI, not the poorest farmers. DigiLocker, despite having hundreds of millions of accounts nationwide , was practically irrelevant in these communities. Its uptake was limited because villagers rarely needed to upload or verify documents (they relied on local officials to certify paperwork). In the Delhi slum, a few students had DigiLocker accounts for exam certificates, as an official noted. Common Service Centres, in theory, should bridge gaps by assisting non-literate users. In our study, CSCs existed in all sampled areas (supported by the figure of 4.63 lakh GP-level CSCs ), but they were underutilized: operators often lacked training, and villagers distrusted the charges or paperwork involved. Thus, the potential reach of Digital India (extensive infrastructure and services) has outstripped the actual use by intended beneficiaries – a theme echoed by other scholars . In short, policy success on paper has not yet fully translated into lived impact for the rural and urban poor.

**Recommendations**

To truly bridge the digital divide, policy and practice must address the identified barriers. Based on our findings (and echoing existing literature ), we recommend the following actions:

- Expand and stabilize infrastructure: Accelerate BharatNet fiber rollouts to villages and improve mobile broadband (4G/5G) reach. Subsidize data and device access for low-income households. Ensure reliable electricity and charging solutions (e.g. solar chargers) in off-grid areas. High-speed, affordable connectivity is a prerequisite for e-governance.
- Invest in digital literacy and education: Launch targeted training programs in rural schools, community centers, and with NGOs to build basic digital skills. Special focus should be on women and the elderly, who have the lowest access. For example, embedding digital training into existing adult literacy or self-help group meetings can empower disadvantaged groups. As Joshi et al. (2020) suggest, improving household education significantly boosts technology use among women.
- Leverage Common Service Centers (CSCs) effectively: Enhance CSC capacity by training operators in local languages and customer outreach. CSCs should proactively conduct village camps and house-to-house services for driver licenses, certificates, and schemes, reducing the need for users to navigate portals themselves. Performance incentives and regular monitoring can improve trust in CSCs as the “last mile” for e-services.
- Localize content and interfaces: All government apps (UMANG, DigiLocker, e-Sign) should support more Indian languages and voice prompts. Include intuitive, icon-based interfaces for semi-literate users. Prioritize services that meet local needs (e.g. land records in states, agricultural schemes in villages). Involving community leaders and local teachers in app design can make platforms more culturally relevant.
- Integrate offline-digital solutions: Develop hybrid models (e.g., offline UPI via ~USSD codes or QR cash-back points) for areas with intermittent internet. Push Aadhaar-based offline authentication and eKYC to simplify sign-ups without heavy data use. As Namrata Prakash (2022) advises, clear communication and tangible benefits must accompany tech adoption ; for instance, cash transfers or subsidies could be conditioned on using digital portals, ensuring immediate value.
- Conduct outreach and trust-building: Government agencies should run multilingual awareness campaigns about e-governance benefits, using local media, panchayat meetings, and demonstrations. Success stories (e.g. how DigiLocker sped up PSC exam processing ) can be shared to build confidence. Establish grievance redressal helplines staffed in local languages. Building trust – by showing real benefits and ensuring data privacy – is key to overcoming skepticism.

These recommendations align with best practices identified in the literature. Prakash (2022) notes that community engagement and building awareness are as vital as technology itself . By combining infrastructure growth with human-centered initiatives (literacy, localization, empowerment), policymakers can make e-governance truly inclusive.

**Conclusion**

India’s ambitious Digital India agenda has laid the groundwork for a connected society, but our study shows that the rural and urban poor are still on the sidelines of this transformation. While nearly all villages are now reachable by mobile networks and digital payments and services exist at scale, a substantial digital gap remains. In the surveyed areas of Uttar Pradesh, Haryana, and Delhi, many residents either lack devices or the skills/confidence to use them, and cultural factors (such as gender roles) further inhibit access . Consequently, the intended benefits of e-governance – faster services, financial inclusion, transparency – have not fully materialized for the most vulnerable.

Addressing this challenge is both urgent and feasible. Our findings underscore that expanding coverage alone is insufficient; parallel investments in education, trust-building, and local adaptation are needed. If such measures are implemented, the vision of Digital India – of every citizen empowered by technology – can become a reality. Bridging the digital gap is essential not only for equity and inclusion but also for maximizing the efficiency of governance. Failure to do so risks leaving large swaths of the population dependent on outdated systems. The evidence from this study should inform policymakers that inclusive e-governance requires a holistic approach: pairing cutting-edge tech initiatives with on-the-ground support to uplift the rural and urban poor.

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# ARTIFICIAL INTELLIGENCE AND ITS ROLE CONSTRUCTION OF INDIAN HISTORY : TRADITIONAL VS AI TOOLS

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***Abstract***

*21st Century is called era of Artificial intelligence. Now it's role is increasing in all sectors this paper is talking about role of AI tools in studying Indian History. Human has desire to know his past from starting. In Indian History we study three parts Ancient, Mediaeval and Modern. Out of them Ancient and Mediaeval part had lots of Gap due to some historic documents are undeciphered till now or endangered condition, on another hand due to multiple scripts this problem increases so this paper is talking about tools of AI which we can use in Re-construction of Indian History such as Optical Character Recognition means OCR, Natural Language processing means NLP and Machine learning as well as 3D, virtual imaging etc. This paper also advocate the problems of traditional methods of studying History and also talked about how we can used Artificial intelligence tools historical analysis.*

**Keywords:**- *Artificial intelligence and its role in Indian History, AI tools to analysis Indian History, comparative study vs AI tools, Optical character Recognition, Natural language processing ( NLP)*

**Introduction :-** From the starting phase of human life we have desire to know our past, because on base of the past we can construct the view about our present and the future. The biggest problem to analyses the past we have a lack of written documents secondly we have no proper analysis source, and we have lack of common method to analysis our history

So Indian history analysis by different Historian in their own way. Just as

**ASI Sources base Approach :-** According to Archaeological survey of India history can be analyse on behalf of sources and literature source we got so according to the them Indian history can be divided in three parts :-

1. **Pre Historian Era :-** it is a period in which we unable to got any literature source we only have sources just like stone tools, stones made weapons, bones, tools made from bones etc. Stone age is treat as part of this era. It further divided in Paleolithic, Mesolithic and Neolithic era. Out of them Paleolithic was the longest period of human civilization from the Bori district Maharashtra we got evidence of first human skeleton. 90% story of human past was belongs to Paleolithic era.
2. **Proto historian Era :- it** is a period in which we got some written documents but we are unable to decipher it. So the period of Copper age and Bronze age means Chalcolithic era and Harappan civilization belongs to this period. According to archaeological survey of India in this Era we found first urban civilization of India we got many information about this civilization from the script of Mesopotamia because Harappan and Mesopotamia people had trade relationship. They called Harappa as Meluha. Both civilizations worshiped nature god.
3. **Historian Era :-** finally the era in which we got sources and literature source both this Era is known as Historian era. So the period from Vedic Era or Iron age till yesterday is called Historian Era. We have so much knowledge of the this period due to high number of literature sources. The oldest book of Indian history written in this period was Indica with written by Megasthenes who arrived in court of Chandragupta Maurya as the ambassador of Cellukas Nicator. Kalhana wrote Rajatarangini, Ashtadhyayi was written by Panini. The oldest surviving

Prakrit grammar is "Prakritaprakasha" of Vararuchi. Ancient Tamil of Sangam period is differ from the modern Tamil the oldest surviving Tamil grammar is called "The Tolkappiyam".

**Numismatics:-** Numismatics means the study, collections and examinations of the Coinage. In starting we got Panch mark coins, later coin made from special metal started, gold coin firstly started by Indo Greek (yavana) later Vima kadfisas ruler of Kushana dynasty inscribed the name and image of ruler on his coinage. Gupta ruler Samudragupta show himself while playing Veena on his coin. Sansab was the most weighted coin of started by Akbar by image of Lord Ram and Sita, Silver coin Rupaya was started by Sher Shah Suri which became the base for British Monetary system. Coinage tell us about rulers, famous events, their throne period and hereditary level, development of metal in their period, wealth and area on which they ruled and they have trade relations.

**Historiography Approach :-** An art of writing History is called Historiography. In another words the scholarly activity of constructing and writing histories called historiography. Historians followed the different approaches to write a history of India.

1. **The colonist Approach :-** This approach used by European Historian, by this approach they proved that they arrived India to civilized Indians. These Historians treated Ancient India as Era of Imperialism. In this approach Indians were uncivilized, cruel, fighting by names of religion, whole Ancient and mediaeval history full with religious wars, Mill James (1817) was the first person who try to wrote Indian History, he divided Indian History as "Hindu India", Muslim India and the British India in his book The History of British India" published in 1817, this book published in three volumes. After 1757 Britishers need to learn about India for their administration so they have to know about Hindus law and Muslims law so first time 1776 Manusmriti translated as code of Gentoo laws by Nathaniel Brassey Halhed in period of Warren Hastings. In 1784 Asiatic Society of Bengal establish by William Jones they focused on translation of famous Sanskrit books in English so the first book translated by the society was "Abhijnanashakuntalam" of Kalidasa, in 1785 Bhagwat Gita was translated by Charles Wilkins, in 1804 Bombay Asiatic society established, in 1823 Asiatic society of the Great Britain established. A German born historian Max Mullar wrote more than 50 books most famous book written by him "the Secret book of the East". Aryan Invasion Theory (AIT) also given by him. According to orientalist historians A. Indian historians of ancient India had no sense of time or chronology B. the most of the rulers despotic or autocratic. C. Caste system and discrimination were on top level. D. No ideology of self government. E. Indians were more focused on life after death.
2. **Nationalist Approach :-** this branch originated against the colonist approach. historians who belongs to this branch compare the Indian society with the British society they also compare feudal system of India with Feudal system of Europe. They re-constructed ancient Indian history with viewpoint of Self Governance of Chola, Equal rights to women in Rig Vedic society. This Approach had three sub approaches :-
   A. **Rationalistic approach:-** this approach focused on reason base comparison. Mitra (1881) he talked about Indian caste system it same as the caste system be found in Europe he also said that in ancient India people eat beef same as Europeans.
   B. **Political history approach:-** This approach is talking about self governance self administration system so Bhandarkar(1921) a famous epigraphist used this approach. Till 1960 this approach dominated because it glorification of rulers and dynasty's due to them feeling of nationalism increase, historian who belongs to the

approach given the more value to Poras or Puru in Battle of Jhelum in comparison of Alexander, in battle of Chandragupta Maurya versus Cellukas Nicator they give more values to Chandra Gupta Maurya. So they basically criticized outsiders like as Saka, Kushana, and supported Satavahana.

C. **Hindu Revivalism approach :-** these Historian believed in Purity of Ancient Indian religion so they want, people again try to applied religion in same manner as it given in Vedas, Majumdar(1951)

In later period non political history approach also originated. Don't judge ancient time from the eyes of modern view. Besham (1954),wrote these story more focus on matristic view.

Marxist Historiography approach:- This Approach focused on structural analysis and socio-economic dimensions, these historian given more weightage to class conflict, social and economical view and exploitation of peasants, labourers and the poor and working class by industrial owners, big land owners and Britishers supported them. Main problems of this approach they ignored cultural and Spiritual aspects of life.

3. **Feminist Historiography approach:-** it is a modern approach which focused more on the role and representation of women in history. They criticized the male dominated society. These historian also criticised Parda system, child marriage, Sati system, lack of women education, marriage system where no role of women involve. They supported women education, widow Re-marriage.
4. **Subaltern Historiography approach:-** after 1980 this approach became very famous they talked about those people who never be talked by previous historians like as farmers, working class, women, Dalits, socially backward tribes etc. Subaltern term first time used by Italian historian Antonio Gramsci but in Indian contrast it was used by Guha(1983).
5. **Cultural Historiography Approach :- this** Approach focused on Art, culture, literature, religion, rituals, symbols , aspects etc. this approach also focus on what the people believe their philosophy, approaches and their mirror to look society.

These are the famous ancient Approaches of Indian History but it had many problems such as:-

1. No common accepted way to deal with Indian History
2. Every Approach treat them self more authentic so it create window dressing on actual historic facts.
3. Historian wrote history according to their approach so it creates doubt in mind of people who read it. For example orientalist historian only saw the problem in Ancient history and culture and Nationalist only saw the positivity. No one is talking about what actually held
4. Many manuscripts were damaged and missing due to them many important information is missing.
5. Lack of co- relation between stories and what written in books for example local stories talk about 21 wars between Prithviraj Chauhan and Muhammad Ghori but History writer like as Chandarbardai talked same but Muslim Historians not talking about it.

So due to them we need a scientific method to write our History so AI is very useful tool to re-construct our History again. It also help to control the Gap which we found for example a gap between Harappan and Vedic Era.

This research paper focused on answers of following questions:-

1. How is AI currently being used in the reconstruction of Indian History?
2. What are the technological tools (OCR, NLP, ML, etc.) involved in this process?

**AI generated Approach :-**artificial intelligence is new technology to analyse compare and read high number of data it also help us to read map, manuscripts and many other code languages which previously not possible for human being to read them so due to artificial intelligence we can control the gap which arriving in our study of history. AI providing us many new techniques by which we can study past specially ancient India very nicely.

**Need and Objectives of the Study :-**

1. **For fragmentation of Historical sources :-** historical sources had many problems such as some sources are undeciphered or endangered due to its weak paper or metal quality. Here AI can help as due to AI we can study it and store its information for long time. AI tools help us to retrieve, preserve, and analyze these sources.
2. **Traditional method have some limitations:-** In traditional method some time we face language barriers, manual errors, slow processing, and limited level of scalability. So here AI can help us to do multiple calculations and analyze data with high speed, accuracy, and data-processing capacity.
3. **Our historical demands and Digital Revolution:-** in traditional method we suffered many problems such as some time Gap arrived in research level, gap means a missing part but due to Use of AI, we got digital availability of our Historical research data so it became easy to share and in different subjects we can use different AI tools as of Demand.
4. **Endangered knowledge can be preserved:- the** most of the Historical data we got from manuscripts and other documents which were written from hands on paper or upper part of (Chhal) of Bhujra tree which mostly found in Kashmir area. We have heavy risk to lost important part of tribal, local and folk history. AI methods help us here to preserve this data as long we want and these tools also help analysis and classification of large numbers of data.
5. **AI enhance the Accessibility of knowledge:-** AI provide our Historical data had more Accessibility because anyone who belongs to any area if we want to learn something and want to study new way of History we can used these documents.

**Objectives of this study :-**

1. Our man objective to study and analyse the role of AI tools in reconstruction of Indian history with eyes of actual facts and historical data which previously was not studied due to language barrier and due to endangered data.
2. Secondly we want to study about different AI tools which we use to study Indian history such as OCR, NLP, Machine Learning these methods used for digitizing, decoding, and analyzing historical data.
3. We also want to analyse those studies where the digital case study held and by help of AI tools the gap between research approaches solution made. So finally Reinterpretation or preservation of Indian history held.
4. We also want middle and balance path between traditional method and AI generated method.

**AI Methods which used in Historical Research** :- in 21$^{st}$ century AI became revolutionary method to represent historical data, analyse these data and present this data in form of 3D images. India is a country where people spoke many languages here AI help us to provide Historical information to all people in their common language.

1. **Optical Character recognition (OCR) :-** it is an artificial intelligence base technology tools which help us for conversion of printed document or a historical manuscripts or any historical

documents in machine read out document. Due to this process Manuscripts, inscriptions, and archival documents—to be digitized and analyzed. This process had four steps firstly the Acquisition of image held in term of photography or scan manner. Second step is known as Pre-processing in which the scan image made ready for reading and analyses purpose here enhancing of contrast, noise control etc held. Third step is called Character Recognition in which by help of AI tools pattern and characters were analysed. Fourth and last step is known as Output, here we got final processed data which is searchable and editable.

**Uses** :-

A. Ancient manuscripts are digitalised :- by the help of OCR Ancient text were now available in digital form, text of Indian languages such as Sanskrit, Pali, Prakrit etc. collected and translated in other languages.
B. Work for Decoding ancient scripts :- OCR tools helping us to decode ancient scripts such as Brahmi script or Prakrit or Devanagari script. So it help us for recording of messages written in ancient temples or inscription written by many rulers. We can also decode image inscribed on coinage.
C. We can Preserve endangered documents:- OCR help us for preserving of those data which is very important for us and it is in endangered form.

**2. Natural language processing ( NLP) :-** it is a new branch of artificial intelligence which deal with the relationship between computer and human languages. This tool enable machine to read, understand, translate and generate human languages in a meaningful way. In research this method is used for processing and analyzing ancient text, manuscripts, inscriptions and multi language records.

A. With the help of this tool we can translate the classical text of Sanskrit, Prakrit Pali, Tamil and Persian languages into modern Indian language and English language. Same previously held with men.

B. Recording and understanding inscriptions. By help of NLP tool we can interpreting inscriptions and we identify names, dynasty's and event held in multiple region.

**C. Colonial records can be Analysis and Archives held :-** it is possible to analyse Colonial records by the help of NLP tool we can analyze records of British era, documents and different letters written in this period.

**D. Historical knowledge graph can created :-** we can create Historical knowledge graphs by help of NLP we are able to link names places and events and we can also made time graph and knowledge graph on behalf of it.

**3. Machine learning:-** it is a very famous methods of artificial intelligence it enable computers to learn patterns from data and make decision for predicting different programs.

**4. data mining method :-** On another hand data mining is the process of discover meaningful patterns. Such as relations of friendships and Co relationship among the large sect of data is verified.

**Different application used in reconstructing Indian history:-** we want to classify our text by the time period and region we also want to create connection between people and places so these tools help us to reconstruct our history

A. **Classification of historical data :-** Some AI tools can classify manuscripts, artefacts, and inscription on behalf of geography, time period and language. It helps to identify regional schools and Vedic contrast.

B. **Recognition of pattern in historical records :-** This tool help us to identify motifs in temple architecture, rituals and coinage. For example Gupta coin was different from others in term of imagery and metal which used.

C. **Modelling of topics in historical text:-** Some machine learning tools like as Latent Dirichlet Allocation LDR used. This is used to discover hidden pockets in classical text.

D. **Identifying Bias and gaps in historical source :-** Some machine tools such as ML algorithm is able to detect over representation and under representation of community region, nationalist personalities etc.

5. **3D modelling and virtual tools :-** this types of AI tools used to construction of 3D or Visual representations of Historic events such as War, monuments, Temples, Government buildings. It had three main tools

   A. **Photogrammetry :-** a picture is converted in visual or 3D Art form .

   B. **Laser Scanning:** this tool is used for scanning the different layers of any historical buildings, monuments, temples or mountains.

   C. **Augmented Reality (AR) & Virtual Reality (VR):** a virtual representation of any historical event, it helps learners to reconstruct history in term of visual experience.

**Some Ethical concern using AI technology :-**

- **Incomplete representation and bias approach:-** if we use AI as only mode of Historical Reconstruction, some time its result are Bias or Incomplete, especially when we talked about ancient and mediaeval India we have lack of comprehensive and consistent record some available sources are fragmented lost or bias.
- **Over focused on quantity tools :-** Artificial intelligence is tool based learning so it only focus on Quantities measurements there have no values of Qualitative tools for it. For example for Indian Art and culture Motifs had big values but AI is not treating as big elements.
- **Manipulation and misused :-** Artificial intelligence had no own sense it provide results as documents fill by operator so if provided data is bias or interrupted then result provided by AI tools also Manipulate the people, many time political leaders or parties use this kind of data.
- **Poor Optical Character Recognition:-** it is not an easy task to Digitalised all scripts. Some times Devanagari, Persian, Pali, Prakrit etc have some words which are not used now so results be missed.

**Conclusion:-** after the whole discussion we get to know sometime history looks little boring and due to endangered sources and unreadable or decipher sources we are unable to construct view point of our history so here AI can help us to make 3D model of history or visual models which help learner to understand history very easily secondly help us to control the gaps arriving in our research aptitude but we have not to fully depends on this method. We have to use a mix model of traditional and artificial intelligence.

**Suggestion on base of research**

1. We have to use both methods in linked way.
2. We have to develop our Indic data set in which Indian local language would use
3. While constructing history ethical guidelines her very important because it deal with our heritage and culture
4. Government has to follow some training program and government had to open digital libraries and also provide more classes on university level

5. We have to make a balance approach of both methods.

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# NAVIGATING SHANTI: A SYNTHESIS OF PEACE STUDIES IN THE INDIAN CONTEXT – TRADITIONS, THEORIES, AND CONTEMPORARY REALITIES

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***Abstract***

*India's complex social, political, and historical landscape provides a unique and vital setting for the field of Peace Studies. This paper synthesizes the evolution, theoretical underpinnings, and practical applications of Peace Studies within the Indian context. It traces the indigenous roots of peace concepts from ancient philosophies like Vedanta and the Buddhist emphasis on Ahimsa to the globally influential Gandhian framework of Satyagraha and Sarvodaya. The paper examines the institutionalization of the discipline in Indian academia, driven by post-independence conflicts and global trends, highlighting key centers and research foci. It critically engages with conceptualizations of peace, contrasting negative peace (conflict cessation) with the more demanding pursuit of positive peace (social justice, structural equity) – a distinction particularly salient given India's challenges with structural violence like casteism and communalism. Various theoretical lenses, including Realism, Liberalism, Critical Theory, Constructivism, Feminism, and notably post-colonialism, are analyzed for their relevance in understanding diverse conflicts, from inter-state rivalries to internal insurgencies (e.g., Kashmir, Northeast, Maoist belts) and social tensions. The paper underscores the indispensable role of post-colonial critique in interrogating dominant narratives and valuing indigenous peace paradigms. It concludes by discussing contemporary challenges and the imperative for integrating academic insights with policy and grassroots peacebuilding efforts for fostering sustainable Shanti (peace) in the subcontinent.*

***Keywords****: Peace Studies, India, Conflict Resolution, Gandhian Thought, Positive Peace, Ahimsa.*

## Introduction

The pursuit of peace, or *Shanti*, resonates deeply within the historical consciousness and contemporary aspirations of India. As a civilization marked by profound philosophical inquiries into harmony and coexistence, yet simultaneously shaped by experiences of deep-seated conflict and violence, India presents a compelling and essential context for the interdisciplinary field of Peace Studies (Kakar, 1996). The nation navigates a complex terrain of peace and security challenges: unresolved territorial disputes and geopolitical rivalries with neighbors, protracted ethno-nationalist insurgencies within its borders, recurrent spasms of communal violence, pervasive structural inequalities rooted in caste and economic disparity, conflicts arising from development and resource contestation, and the looming specter of climate change exacerbating existing vulnerabilities (Cohen, 2001; Varshney, 2002). In this milieu, Peace Studies is not merely an academic curiosity but a critical necessity – offering analytical tools to comprehend the multifaceted drivers of conflict, frameworks to envision sustainable and just solutions, and pathways to cultivate a culture of non-violence and reconciliation.

This paper undertakes a synthesis of Peace Studies as it relates specifically to the Indian context. It embarks on this by first exploring the rich tapestry of indigenous philosophical and historical traditions that have conceptualized peace and non-violence long before the emergence of the modern academic discipline. It then traces the evolution and institutionalization of Peace Studies within Indian academia, examining the catalysts for its growth and its primary areas of focus. A core component of the paper involves a critical examination of how peace is conceptualized, moving beyond the minimalist notion of *negative peace* (the absence of direct violence) to embrace the more holistic and demanding ideal of *positive peace* (the presence of justice, equality, and harmonious social structures), following the seminal work of Galtung (1969), and highlighting the particular relevance of structural violence in

India. Subsequently, the paper analyzes the utility and limitations of various dominant theoretical perspectives – Realism, Liberalism, Critical/Marxist theories, Constructivism, Feminist approaches, Ecological perspectives, and particularly Post-Colonial theory – in illuminating the diverse spectrum of conflicts and peace processes in India. It argues for the centrality of post-colonial critique in decentering Eurocentric assumptions and valuing indigenous knowledge systems, especially Gandhian thought (Nandy, 1983). Finally, the paper discusses contemporary applications, ongoing challenges, and future directions for Peace Studies in contributing to a more peaceful and just India. The overarching aim is to provide a comprehensive overview that integrates historical depth, theoretical rigor, and contemporary relevance, offering a foundation for further specialized inquiry within the field.

**Historical and Philosophical Foundations of Peace in India**

India's engagement with the idea of peace stretches back millennia, embedded within its diverse philosophical and spiritual ecosystems. Ancient Vedic literature speaks of cosmic order (*Rta*) and societal harmony, while the Upanishads delve into the quest for inner peace and liberation (*Moksha*) through self-realization and understanding the unity of existence (*Brahman-Atman* identity) (Radhakrishnan, 1953). These early texts established metaphysical foundations emphasizing interconnectedness and balance as essential for peace.

The principle of *Ahimsa* (non-harming/non-violence in thought, word, and deed) gained profound significance within the Shramanic traditions, particularly Jainism and Buddhism, which emerged around the 6th century BCE. Jainism elevates *Ahimsa* to its highest ethical principle (*paramo dharmaḥ*), demanding meticulous avoidance of harm to all life forms, influencing concepts of ecological respect and restraint (Chapple, 2006; Jaini, 2000). Buddhism, while also centralizing *Ahimsa*, integrated it within the Noble Eightfold Path as a means to overcome suffering (*Dukkha*) caused by desire and ignorance. The Buddha's teachings emphasized compassion (*Karuna*), loving-kindness (*Metta*), and mindfulness as pathways to both individual tranquility and societal peace (Gethin, 1998). These traditions offered sophisticated ethical and psychological frameworks for non-violent living.

A pivotal moment in statecraft and peace promotion occurred with the Mauryan Emperor Ashoka (c. 268–232 BCE). Traumatized by the carnage of the Kalinga War, Ashoka underwent a profound transformation, embracing Buddhist principles and propagating his vision of *Dhamma* – righteous conduct encompassing non-violence, tolerance, social welfare, justice, and respect for all sects – through inscriptions on rock pillars and edicts across his vast empire (Thapar, 2002; Strong, 2008). Ashoka's reign provides a unique historical example of a ruler attempting to govern based on ethical principles of peace and social responsibility, moving beyond mere military power.

In the modern era, Mahatma Gandhi (1869-1948) synthesized these ancient traditions with modern political thought to forge a powerful philosophy and methodology of non-violent action that fundamentally shaped India's independence movement and inspired peace and civil rights movements globally. Gandhi's concept of *Satyagraha* ('truth force' or 'soul force') provided a technique for resisting oppression and injustice through non-violent civil disobedience, emphasizing moral courage and the willingness to suffer for truth (Gandhi, 1927/1993; Dalton, 1993). His understanding of peace, however, extended far beyond political independence (*Swaraj*) or the absence of conflict. It was intrinsically linked to *Sarvodaya* ('welfare of all'), demanding radical social transformation to eliminate injustices like untouchability, communal hatred, poverty, and gender inequality (Bose & Jalal, 2004). Gandhi's critique of industrial civilization and his emphasis on decentralized village republics (*Gram Swaraj*), self-sufficiency (*Swadeshi*), and interfaith harmony represented a holistic vision of positive peace rooted in ethical living and structural change (Parel, 1997). His work remains the cornerstone of indigenous peace thought in modern India. Figures like Rabindranath Tagore, with his critique of narrow nationalism and emphasis on universal humanism and education for empathy (Tagore, 1917/2002), and later, Vinoba Bhave and Jayaprakash Narayan, who sought to apply Gandhian principles to post-independence challenges like land reform and political corruption (Ostergaard & Curriculum, 1967), further enriched this legacy.

**Evolution of Peace Studies as an Academic Discipline in India**

While India possesses deep historical roots in peace philosophy, the formal establishment of Peace Studies as a distinct academic discipline is a more recent development, gaining momentum primarily in the post-independence era, particularly from the latter half of the 20th century. Its emergence and growth have been shaped by a confluence of factors specific to India's trajectory and global academic trends.

The towering influence of Mahatma Gandhi served as a primary catalyst. His life and philosophy generated immense interest in non-violence, conflict resolution techniques, and alternative models of social and political organization. This led to the creation of institutions specifically dedicated to Gandhian thought and practice, such as Gujarat Vidyapith in Ahmedabad (founded by Gandhi himself in 1920) and the Gandhi Peace Foundation in New Delhi (established 1958), which became early centers for research and dissemination related to peace (Patel, 2018; Weber, 1991). These institutions laid crucial groundwork by preserving and studying Gandhian methods.

The realities of post-independence India provided a strong impetus for conflict analysis. The unresolved trauma and ongoing consequences of the 1947 Partition, multiple wars with Pakistan (1947-48, 1965, 1971, 1999 Kargil conflict) and China (1962), and the proliferation of complex and often violent internal conflicts created an urgent need for systematic study (Cohen, 2001). The protracted insurgency movements in Nagaland and other parts of the Northeast beginning in the 1950s, the Khalistan movement in Punjab during the 1980s, the persistent conflict in Jammu and Kashmir with its intertwined internal and external dimensions, and the geographically widespread Left-Wing Extremism (LWE) or Naxalite movement, particularly gaining intensity from the late 1960s onwards, all demanded academic attention beyond traditional military or strategic analysis (Baruah, 2005; Behera, 2007; Shah, 2010). Scholars began exploring the historical roots, socio-economic drivers, identity politics, and governance failures contributing to these conflicts.

India's foreign policy orientation, particularly its leadership role in the Non-Aligned Movement (NAM) during the Cold War, also created a conducive environment. NAM's principles of peaceful coexistence, anti-colonialism, anti-racism, and advocacy for nuclear disarmament resonated with peace ideals, encouraging research in areas like international relations, disarmament, and development studies, often incorporating peace-related themes (Rajan, 1997; Miskovic et al., 2020). Although initially often subsumed under Strategic Studies, this provided an institutional space for peace concerns.

Finally, the global growth of Peace and Conflict Studies as a recognized interdisciplinary field, particularly from the 1960s onwards in Europe and North America, influenced Indian academia. International collaborations, exposure to global scholarship (like the works of Galtung, Boulding, Lederach), and the establishment of international peace research associations encouraged Indian universities to formalize the field. Consequently, dedicated departments, centers, and programs emerged in various universities. Notable examples include the School of International Studies at Jawaharlal Nehru University (JNU), the Nelson Mandela Centre for Peace and Conflict Resolution at Jamia Millia Islamia, the Department of Defense and Strategic Studies often incorporating peace research at universities like Pune and Allahabad, the Malaviya Centre for Peace Research at Banaras

Hindu University (BHU), programs focusing on conflict and human rights at institutions like the University of Delhi and University of Calcutta, and newer departments like the one at Sikkim University focusing on border studies and peace (Mallick & Chacraverti, 2009; Dutta, 2015). Research agendas typically cover areas like conflict analysis and transformation (focusing on specific Indian conflicts), Gandhian studies, human rights and social justice, nuclear issues and disarmament, environmental security, gender and conflict, and South Asian regional security and cooperation. Despite this progress, the field continues to navigate challenges related to mainstreaming within university structures, securing consistent funding, ensuring policy impact, and bridging the gap between academic research and grassroots peace activism.

**Conceptual Frameworks of Peace in the Indian Context**

Applying conceptual frameworks of peace to the Indian context requires careful consideration of its specific realities. The distinction popularized by Johan Galtung (1969) between negative and positive peace remains a foundational and highly relevant tool for analysis.

**Negative and Positive Peace**

*Negative peace*, understood as the absence of direct, organized, physical violence, is a necessary but starkly insufficient condition for genuine peace in India. Achieving negative peace involves efforts such as: negotiating and maintaining ceasefires in conflict zones like Jammu & Kashmir or parts of the Northeast where armed insurgencies persist; reducing the incidence and lethality of communal riots and caste-based violence through effective law enforcement and preventative measures; managing inter-state tensions with neighbors through diplomatic engagement, military de-escalation protocols, and confidence-building measures (CBMs) to prevent the outbreak of war (Ganguly & Kapur, 2010). Official statistics on conflict fatalities (e.g., from MHA or SATP) or communal incidents (NCRB) provide indicators, albeit often contested, for tracking progress towards negative peace, highlighting its fragility in many regions.

However, the limitations of focusing solely on negative peace are starkly evident in India. The concept of *positive peace* – defined by Galtung as the presence of social justice, equality, integration, cooperation, and the absence of structural violence – resonates deeply with the country's socio-economic and political realities. *Structural violence* refers to the ways in which social structures and institutions inflict harm upon certain groups by preventing them from meeting their basic needs or realizing their full potential (Galtung, 1969). In India, structural violence manifests powerfully through:

- The enduring caste system, which institutionalizes discrimination, exclusion, and violence against Dalits (formerly 'untouchables') and other lower castes, limiting access to resources, education, and dignity (Thorat & Newman, 2010; Human Rights Watch reports).
- Pervasive economic inequality and poverty, where vast disparities in wealth and opportunity persist along lines of class, caste, region, and gender, breeding resentment and conflict (Dreze & Sen, 2013; Oxfam India reports).
- Gender inequality, reflected in high rates of violence against women, unequal access to health and education, poor political representation, and discriminatory social norms (Basu, 2016; NCRB data).
- Communalism and religious intolerance, where historical grievances and political mobilization create conditions for discrimination, segregation, and periodic violence, particularly against religious minorities (Varshney, 2002; Brass, 2003).
- Resource dispossession and environmental injustice, where large-scale development projects (dams, mines, infrastructure) often displace marginalized communities, particularly Adivasis

(indigenous tribes), without adequate compensation or rehabilitation, leading to resistance and conflict (Baviskar, 1995; Roy, 2011).

- Governance deficits and lack of access to justice, where corruption, ineffective public services, and a slow judicial system disproportionately affect the poor and marginalized, undermining faith in state institutions (Kohli, 2004).

Achieving positive peace in India, therefore, necessitates addressing these deep-seated structural issues through comprehensive social, economic, and political reforms. Gandhian thought, with its emphasis on *Sarvodaya* (welfare of all) and socioeconomic justice, provides a strong indigenous framework for conceptualizing and pursuing positive peace.

**Micro-Level (Personal) and Macro-Level (Global) Dimensions**

Peace is also understood and enacted across different scales in India. The *micro-level* pertains to individual attitudes, interpersonal relationships, and community dynamics. It involves cultivating inner peace through spiritual or ethical practices, promoting tolerance and empathy in education and family life, fostering inter-group harmony through local initiatives like interfaith dialogues or community peace committees (often formed in response to communal tensions), and utilizing traditional or informal mechanisms for resolving local disputes (though these can sometimes reinforce existing inequalities). The vibrancy of civil society organizations working on community reconciliation and local peacebuilding is a testament to the importance of this level (Van Prattenburg, 2013).

The *macro-level* encompasses state structures, national policies, and international relations. This includes constitutional provisions for equality and minority rights, laws addressing discrimination and violence, national security doctrines and military postures, foreign policy choices (e.g., engagement in multilateral forums, relations with neighbors, participation in UN peacekeeping), national development strategies and their impact on equity, and efforts towards national integration and managing diversity within a federal polity. Peace Studies in India must constantly analyze the intricate linkages between these levels: how macro-level policies impact micro-level realities (e.g., economic policies affecting inequality and local conflict), how micro-level attitudes can shape macro-level politics (e.g., communal attitudes influencing voting patterns), and how actions at one level can reinforce or contradict peace efforts at another.

**Theoretical Perspectives on Peace and Conflict in India**

Analyzing the complexities of peace and conflict in India requires drawing upon a diverse range of theoretical perspectives, each offering valuable insights while also possessing certain limitations when applied to the specific context.

**Realist Approaches**

Realism, with its focus on states as rational actors pursuing power and security in an anarchic international system, remains influential in analyzing India's foreign policy and security strategies (Morgenthau, 1948; Waltz, 1979). It is often invoked to explain India's strategic calculations vis-à-vis Pakistan (management of the Kashmir dispute, nuclear deterrence, responses to cross-border terrorism) and China (border management, competition for regional influence, naval expansion), as well as its military modernization and nuclear weapons program (Kapur, 2007; Mohan, 2003). Realist analysis highlights the enduring security dilemmas and power balancing dynamics in South Asia. However, its state-centric focus often struggles to adequately explain internal conflicts driven by non-state actors, identity politics, or socio-economic grievances, and its emphasis on conflict over cooperation can downplay the potential for peacebuilding initiatives.

**Liberal Approaches**

Liberalism emphasizes the role of democratic institutions, economic interdependence, international law and organizations, and civil society in promoting peace (Doyle, 1986; Keohane & Nye, 1977). Applied to India, this perspective highlights the role of India's democratic processes (elections, independent judiciary, relatively free media) in managing internal diversity and providing avenues for non-violent political contestation, despite significant challenges and democratic backsliding concerns (Kohli, 2001). Liberal analysis also examines the potential peace dividends of economic cooperation (though limited in the India-Pakistan case), the impact of international norms on human rights practices, the role of civil society organizations in advocating for peace and justice, and the utility of mechanisms like Track II diplomacy in fostering dialogue, particularly with Pakistan (Kanti Bajpai, 2002; Jones, 2012). Critics argue that liberalism can sometimes overlook deep-seated power inequalities and structural impediments to peace, and that economic interdependence does not automatically guarantee peaceful relations.

**Marxist and Critical Theories**

Marxist and critical theories direct attention towards economic structures, class conflict, exploitation, and hegemony as fundamental drivers of conflict (Marx & Engels, 1848/2002; Cox, 1981). These perspectives are particularly pertinent for analyzing conflicts rooted in socio-economic deprivation and inequality in India. The Naxalite/Maoist insurgency, for instance, is often analyzed through this lens, linking its origins and persistence to issues of land alienation, resource extraction (often benefiting corporations and elites at the expense of local Adivasi populations), state repression, and the failures of capitalist development to reach the most marginalized (Roy, 2011; Shah, 2010; Sundar, 2011). Critical theories also scrutinize the ways in which dominant ideologies and state policies perpetuate structural violence and how global economic forces impact local conflicts. They provide essential tools for understanding the material basis of many conflicts, though they might sometimes underemphasize cultural or identity factors.

**Constructivist Theories**

Constructivism focuses on the role of shared ideas, identities, norms, culture, and discourse in shaping social and political reality, including conflict and peace (Wendt, 1992; Katzenstein, 1996). This approach is invaluable for understanding identity-based conflicts in India. The dynamics of Hindu-Muslim communal violence, for example, are analyzed by constructivists examining how religious identities are socially constructed and politically mobilized, how historical narratives and myths are employed to create 'us' vs. 'them' divisions, how political entrepreneurs strategically incite violence for electoral gain, and how media discourse frames events (Varshney, 2002; Brass, 2003; Wilkinson, 2004). Similarly, ethno-nationalist conflicts in Kashmir and the Northeast are deeply intertwined with the construction and assertion of distinct collective identities, historical memories of injustice, and contested notions of sovereignty and self-determination (Behera, 2007; Baruah, 2005). Constructivism highlights the subjective and intersubjective dimensions of conflict, emphasizing that identities and interests are not fixed but are shaped through social interaction and political processes.

**Feminist Perspectives**

Feminist scholarship brings a critical lens to the gendered nature of peace and conflict (Enloe, 1989; Tickner, 1992; Cockburn, 2007). It analyzes how conflict impacts women and men differently, highlighting the specific vulnerabilities of women to sexual violence (often used systematically as a tool of war and humiliation, as documented in Kashmir, Northeast India, and during communal riots), displacement, loss of livelihoods, and increased care burdens. It also critiques the masculinized nature of militarism and traditional security paradigms. Crucially, feminist research moves beyond portraying women solely as victims, illuminating their diverse roles as active agents in survival, resistance, and peacebuilding (Manchanda, 2001). Examples include the sustained activism of women's groups like the Naga Mothers' Association demanding peace and accountability in Nagaland, women's participation in local governance potentially fostering different priorities, and women-led initiatives promoting reconciliation at the community level (Basu, 2016; Bhan, 2014). Feminist perspectives call for gender analysis to be integrated into all conflict assessment and peacebuilding strategies, advocating for women's meaningful participation in formal peace processes (often lacking) and challenging patriarchal structures that underpin both societal violence and war.

**Post-Colonial and Decolonial Theories**

Given India's history, post-colonial and decolonial perspectives offer indispensable critical insights (Said, 1978; Spivak, 1988; Seth, 2007; Mignolo, 2007). These theories challenge the Eurocentrism inherent in many mainstream IR and Peace Studies frameworks, arguing that contemporary global power relations and many regional conflicts are deeply shaped by the legacies of colonialism. For India, this involves analyzing how colonial practices – arbitrary border demarcation (the Radcliffe Line, McMahon Line), 'divide and rule' policies that solidified or created communal and ethnic divisions, the imposition of centralized bureaucratic states, exploitative economic systems, and the internalization of colonial knowledge systems – continue to structure contemporary conflicts and inequalities. Conflicts in Kashmir and the Northeast, for example, are often interpreted through a post-colonial lens focusing on issues of self-determination, contested sovereignty, militarization, and the failure of the post-colonial state to accommodate diverse identities (Behera, 2007; Baruah, 2005; Das, 2007). Post-colonialism emphasizes the importance of understanding conflict from the perspective of the marginalized (subaltern studies), recovering suppressed histories, recognizing the validity of indigenous knowledge systems and peace paradigms (like Gandhian philosophy), and challenging neo-colonial forms of domination.

**Ecological Peace Approaches**

This emerging perspective analyzes the linkages between environmental degradation, resource scarcity, climate change, and violent conflict (Homer-Dixon, 1999; Barnett & Adger, 2007). It is highly relevant to India, where numerous conflicts are intertwined with environmental issues. These include: disputes over scarce water resources, both between Indian states (e.g., the long-running Cauvery dispute between Karnataka and Tamil Nadu) and transboundary rivers (with Pakistan, China, Nepal, Bangladesh); conflicts arising from resistance to large-scale development projects like dams (e.g., Narmada Bachao Andolan), mining, and industrial zones that displace communities and damage ecosystems, disproportionately affecting Adivasi populations (Baviskar, 1995; Gadgil & Guha, 1995); and the potential for future conflicts exacerbated by climate change impacts such as sea-level rise, intensified droughts and floods, agricultural disruption, and climate-induced migration. Ecological peace perspectives call for sustainable development practices, equitable resource management, environmental justice, and recognizing ecological integrity as a foundation for lasting peace.

**Findings**

The synthesis of Peace Studies within the Indian context reveals several crucial findings that underscore the field's unique characteristics and challenges in the region. Firstly, India's engagement with peace is deeply rooted in a rich and diverse indigenous philosophical heritage, spanning millennia from Vedic concepts of cosmic harmony to the sophisticated ethical frameworks of Jainism and Buddhism centered on *Ahimsa*, culminating in the modern era with the globally influential Gandhian paradigm of

*Satyagraha* and *Sarvodaya*. This indigenous legacy provides a distinct conceptual vocabulary and ethical foundation that continuously informs and challenges mainstream, often Western-centric, peace theories.

Secondly, the formal academic development of Peace Studies in India is intrinsically linked to the nation's own tumultuous post-independence history. The discipline's growth has been significantly propelled by the lived experience of conflict – including Partition, interstate wars, and numerous complex internal insurgencies – creating an urgent demand for analysis and solutions. Simultaneously, India's political positioning (e.g., NAM) and the global evolution of the field have shaped its institutionalization within universities and research centers.

Thirdly, conceptualizing peace effectively in India necessitates moving decisively beyond the minimalist framework of *negative peace*. The pervasiveness of *structural violence* – manifest in caste discrimination, communalism, vast economic inequalities, gender disparity, and resource conflicts – makes the pursuit of *positive peace* (defined by social justice, equity, and robust institutions) not merely an ideal but an analytical and practical imperative. Addressing these underlying structural issues is fundamental to achieving sustainable peace.

Fourthly, while various international relations and social science theories (Realism, Liberalism, Constructivism, etc.) offer valuable tools for analyzing specific aspects of conflict and peace in India, post-colonial and critical theories hold particular significance. These perspectives are essential for deconstructing the enduring legacies of colonialism, understanding the interplay of power and inequality in conflict dynamics, critiquing state-centric security paradigms, and centering the experiences and knowledge systems of marginalized communities. They highlight the need to contextualize conflicts within specific historical trajectories of power and resistance.

Finally, despite growing academic institutionalization, a significant gap often persists between peace research, policymaking, and grassroots peacebuilding practices in India. Translating academic insights into effective interventions and influencing dominant security-focused state approaches remains a major challenge for the field.

**Discussion**

The landscape of Peace Studies in India is dynamic and multifaceted, reflecting the nation's own complexities. It draws strength from its profound indigenous philosophical traditions and a growing body of scholarly work responding to urgent national challenges. However, the field confronts significant hurdles in maximizing its potential impact. The often-observed disconnect between academic research and policy formulation is a critical issue (Bajpai, 2000). State responses to conflict, particularly internal insurgencies, frequently prioritize security-driven, counter-insurgency approaches focused on achieving negative peace through force, often marginalizing or conflicting with peacebuilding approaches that emphasize dialogue, political accommodation, addressing root causes, and promoting reconciliation – the core tenets of positive peace (Kuttig, 2011). Bridging this gap requires greater efforts from academics to produce policy-relevant research and engage proactively with policymakers, while also necessitating a greater openness within state institutions to incorporate insights from peace research and civil society.

Strengthening the field further necessitates fostering greater interdisciplinary collaboration. The complex nature of conflict in India – intertwined with issues of identity, economy, environment, governance, and history – demands integrated approaches drawing from sociology, anthropology, political science, economics, law, history, and environmental studies. Mainstreaming peace education at different levels, from school curricula promoting tolerance and critical thinking to professional training for civil servants, police, and military personnel, is crucial for fostering a broader culture of peace and non-violent conflict resolution (Salomon, 2002).

The critical appropriation of theoretical frameworks remains vital. While global theories provide analytical leverage, they must be applied critically, mindful of the specificities of the Indian context. Simultaneously, indigenous concepts like Gandhian thought need rigorous engagement, avoiding hagiography and exploring their practical applicability and limitations in contemporary scenarios. Post-colonial critique remains essential for challenging dominant narratives, recognizing diverse perspectives, and ensuring that peace initiatives do not inadvertently replicate existing power imbalances. Feminist perspectives must continue to push for gender-sensitive analysis and inclusive participation in all peace processes.

Looking ahead, Peace Studies in India must grapple with emerging challenges. The rise of digital technologies presents both risks (e.g., rapid spread of disinformation and hate speech fueling communal tensions) and opportunities (e.g., facilitating cross-community dialogue, monitoring human rights violations). The escalating climate crisis poses significant threats to peace and security through resource scarcity, displacement, and potential exacerbation of existing conflicts, requiring dedicated research and policy focus within an ecological peace framework. Addressing the deep roots of structural violence, particularly caste and communalism, remains a long-term and fundamental challenge requiring sustained academic scrutiny and advocacy.

Ultimately, the relevance and vitality of Peace Studies in India will be measured by its ability to contribute meaningfully to understanding and transforming conflicts, informing more just and humane public policies, empowering grassroots peace initiatives, and fostering a society that values dialogue, equity, and non-violence. For researchers investigating specific dimensions, such as the role of particular communities or institutions in peace processes, this broader field provides the indispensable context – the theoretical lenses, historical understanding, and awareness of structural dynamics – necessary for nuanced and impactful analysis. The pursuit of *Shanti* in India remains an ongoing, complex, and profoundly important endeavor, and Peace Studies has a critical role to play.

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# SONIC EXPERIENCES IN TETSUKO KUROYANAGI'S TOTTO-CHAN: THE LITTLE GIRL AT THE WINDOW

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***Abstract***

*Sonic experience is one of the sensory elements incorporated in reading a novel, though a literary narrative typically emphasizes visual imagery and storytelling. The study of Sonic experience is a multidisciplinary endeavor that includes analysis of musical sounds and the everyday sounds described in literary and cultural contexts. Furthermore, Sonic studies overlap with Communication, Psychology, Acoustic experiences, Biophony, Technophony, and Soundscapes. This approach provides an exciting mode of 'deep listening' to the print narratives, with the readers being made to use their auditory sense in comprehending the plot, characterization, episodes, and the setting. Furthermore, a sonic narrative deploys sound in more than one way, enabling new aural experiences and making acoustics and psychoacoustics its themes and motifs. Tetsuko Kuroyanagi's Totto-Chan: The Little Girl at the Window is a novel rich in sonic images that ensures an immersive experience for the readers. This paper is an attempt to analyse various sound-themed instances of Kuroyanagi's novel. It uses the tenets of sonic studies and explains how the writer deploys auditory images and music to enhance the experiences of a child protagonist who must survive a turbulent school life amidst the horrors of World War II.*

***Keywords:*** *Sonic Studies, Psychoacoustics, Aural Experiences, Biophony, Technophony*

## Introduction

In literary studies, the sensory experience of reading a narrative is often articulated through visual paradigms, overlooking the imaginative evocation of sound, which plays a significant role in understanding a text. This interdisciplinary field reorients attention of a reader from what texts say, to how they sound, and examines the auditory perception that shapes literary meaning. Sonic studies share an understanding with other disciplines such as acoustic ecology, psychoacoustics, musicology, communication studies, and neuropsychology. Sonic experience is not confined to overt references to music or sound events, but encompasses environmental acoustics, bodily movements, and even metaphoric silences. According to the media theorist, Jonathan Sterne, sound is not simply a physical vibration or background detail, it is a historical, cultural, and epistemological force. Sound studies in literature enables a reader to be a listener by attuning to the sensory and symbolic resonances embedded within the text. Furthermore, sound studies borrows several terms from film theories and film criticism to analyse how sound functions in narrative structure and reader reception. The term "intelligent ear" coined by French Film theorist Michel Chion is often used for literary listening and works as a metaphor for sonic awareness of an interpretive listener. This mode of attentive listening is crucial for exploring diegetic and non-diegetic sound, another concept borrowed from film theory. Diegetic sounds are those explicitly occurring within the fictional world, for example, the patter of rain in Virginia Woolf's *To the Lighthouse,* or the metronomic tapping of a typewriter in Kafka's bureaucratic worlds. These sounds are perceptible to the characters within the fictional world. In contrast, non-diegetic sounds are more atmospheric or implied, like the silence between spoken words, or the imagined hum of dread in Gothic fiction like *The Turn of the Screw*. Both types of sound enrich the narrative, although non-diegetic sounds are directed for the readers more than the characters.

Similarly, Sound studies also borrows concepts from the medical disciplines, especially from the medical practice of auscultation, popularized by René Laennec with the invention of the stethoscope in 1816. Auscultation provides a powerful metaphor for a close auditory reading of a text. Just as a physician examines the breathing and heart rate of a person through the practice of "auscultation", a literary reader, by attuning to the unspoken resonances of a text, can examine the heartbeat of fear beneath the dialogue, or the suppressed sob in a stoic monologue. In Toni Morrison's *Beloved*, for example, listening becomes a spectral act, as the past 'screams' through the house in ways felt as much as heard. This depth of listening is also echoed in Pauline Oliveros' concept of "deep listening", which emphasizes a conscious and meditative engagement with sonic surroundings, be it external, internal, or imagined. Deep listening in literature asks readers to notice the rhythm of prose, the meter in poetry, and the aural textures of language itself. It brings attention to the sonic experience and its emotional and physiological dimensions, such as the suffocating silence in a war memoir, or the musicality of dialect in Zora Neale Hurston's *Their Eyes Were Watching God.*

Sonic studies can be particularly applied to Children's literature as children are more attuned to sounds and auditory anomalies. Therefore, Tetsuko Kuroyanagi's semi-autobiographical novel *Totto-Chan: The Little Girl at the Window* (1981), serves as a rich text for sonic analysis. Through Totto-Chan's playful perspective, readers are led into a world where every noise is meaningful, from the clinking of lunchboxes to the distant hum of air raid sirens, from the harmonics of the school's musical activities to the ambient sounds of nature and the rumble of train tracks. These sounds are not incidental, they function as "soundmarks", according to R. Murray Schafer**,** soundmarks are distinctive, memory-embedded sounds that define a person's relationship to place and community. The novel offers a deeply textured soundscape including Biophonic, Geophonic, and Technophonic acoustics enveloping the narrative with a gradual descend towards the symphony of a war-time society.

This paper argues that Totto-Chan constructs a pedagogy of listening where auditory perception is central for understanding and connecting with the character's surrounding. It draws from foundational concepts of sonic studies and applies them to analyze the use of sonic imagery, musical cues, and soundscapes in *Totto-chan: The Little Girl at the Window*.

**Research Method**

This paper uses a qualitative textual analysis methodology within the interdisciplinary framework of sonic studies. This study analyses the novel *Totto-Chan: The Little Girl at the Window,* originally written in Japanese by Tetsuko Kuroyanagi and later translated into English by Dorothy Britton. The novel serves as a case study for the application of sonic theory in literary analysis.

This study further includes selected excerpts from the novel that emphasize the role of sound, music, and other acoustics. Data collection was based on close reading and annotation of key sonic instances such as soundscapes around Tomoe Gakuen, music and its influence, cultural significance of sounds around Totto-Chan, and psychoacoustics affecting the memory of childhood. No statistical tools were required; instead, analytical techniques from sound studies such as Schafer's Soundscape theory, Feld's Acoustemology, Semiotics for music notations, and Psychoacoustics were applied to extract and interpret the sonic motifs within the narrative.

**Results and Discussion**

The sonic landscape of *Totto-Chan: The Little Girl at the Window* is an active element of sensory immersion, thematic evolution, cultural significance, and character study. This section examines recurring sonic motifs in the novel under thematic clusters:

**Chapter I: Soundscapes of Tomoe Gakuen and Pre-War Japan**

*Totto-Chan: The Little Girl at the Window* by Tetsuko Kuroyanagi has a narrative which is abundant with rich sonic information which has deep ties with music and sonic experiences described through the ears of novel's protagonist, Totto-Chan. The novel through its description of sounds in its setting invites a close introspection of its diverse sonic dimensions through R. Murray Schafer's Soundscape theory. This chapter is dedicated to the analysis of aural dimensions and sonic experiences present within the novel through Soundscape theory.

a) According to Schafer's soundscape theory–Soundmarks are unique sounds that define a particular place, in this novel, Tomoe Gakuen, the new school in which Totto-Chan decides to study has enough peculiar aural qualities which can be defined as a Soundmark.

   *"Chew, chew, chew it well,*
   *Everything you eat;*
   *Chew it and chew it and chew it and chew it,*
   *Your rice and fish and meat!"*

   This song sung by the students of Tomoe Gakuen during their lunchtime can be identified as a Soundmark, the school can be located just through the melody of the song without a visual representation, this song can be considered as a sound signal for the lunchtime at Tomoe Gakuen. Other soundscape which identifying Tomoe Gakuen are the cheers, applauds, giggles and jingles sung by the students. All serving as unique soundmarks for the experimental school. These sonic cues not only aurally define the place but also marks a stark contrast between Tomoe Gakuen and other schools. A normal school's soundscape consists mostly of sound signals such as the ringing bell, shutting and opening of doors and chorus of students while greeting their teachers, such sound signals can be analysed as aural cues to restrict students, form an authoritarian uniformity amongst the students and silence their voices as noises. Totto-Chan's journey from being expelled from various schools to being accepted to Tomoe Gakuen can be traced through the sonic information provided within the novel as well as through Totto-Chan's own aural experiences. For instance-

   *"she opens and shuts her desk Hundreds of times."*

   This dialogue between Totto-chan's mother and her teacher reveals that the sounds made by Totto-chan, originate through her curiosity are classified as noises which disrupt the classroom and thus, serve as the reason for her being expelled from the school. When she enters Tomoe Gakuen, her voice is not acknowledged as a noise, she gets the freedom to voice her thoughts and encouragement to express her curiosity. Tomoe Gakuen identifies and rejects the notion of authority and uniformity and embraces the uniqueness of each child by encouraging them to express themselves through their voices which collectively forms the soundscape of Tomoe Gakuen, and it's novel soundmarks. Mr. Kobayashi, the headmaster also contributes to the soundmarks of Tomoe Gakuen through his sonic based pedagogy, he introduces the children with Emile Jaques-Dalcroze's Eurhythmics exercise to train their body and mind to synchronize with rhythm – a training to react on aural signals, creating new forms of sound signals diverse from its contemporary schools, this new form of sonic rhythms synced with children's footsteps create another soundmark for Tomoe Gakuen.

   Tomoe Gakuen's railroad car classrooms possess soundscapes which can differentiate them from both a railroad car and a classroom. Railroad cars are often identified with soundscapes such as rapid motion, announcements, crowds of people and horns. Tomoe Gakuen's railroad car classrooms are identified with soundscapes of static stability and collective voices of children and teacher which can be considered as sound signals for teaching and learning, with the headmaster's unique approach to teaching, where each student can pick the subject of their choice, breaks the notion of other school's s restriction of the freedom of students to choose the subject of their liking. Thus, Tomoe Gakuen's sonic analysis reveals its progressive form of pedagogy and distinctive soundmarks.

Apart from Tomoe Gakuen, there are other soundscapes that define Japan through aural perspective of the little girl Totto-Chan. Tetsuko Kuroyanagi's memoir also serves as sonic document for the Japan of her childhood, revealing the soundscapes which are either lost or extinct in the current soundscapes of Japan as well as the sonic descriptions of the impending war revealing uncertainty and chaos through the aural experiences of Totto-Chan.

*"The wind that blew from Senzoku Pond carried*
*The sound of the music far beyond the rehearsal hall.*
*Sometimes the call of the goldfish (kingyo) vendor*
*Would blend with the music"*

This excerpt from the chapter "The Rehearsal Hall" reveals sonic information which can serve as a sonic document for the soundscapes of Pre-War Japan. The wind and its sound are geophony of "Senzoku Pond" and "the call of kingyo vendor" acts as a sonic guide for the readers to aurally experience the novel and its distinct soundscapes presenting the peaceful times of Japan from the aural perspective of Totto-Chan. Totto-Chan's aural experiences also serves as an indicator of the uncertainty and fear of war from a child's perspective present in the novel through this excerpt-

*"What had brought tears to that soldier's eyes, only*
*the soldier knew. Maybe he had a little girl like*
*Totto-chan. Or maybe he was simply touched by the*
*sweet way she sang that song as best she could."*

The soldier's response to Totto-Chan's poem presents a reaction which originated out of a sonic harmony of a little girl's poem which can be considered as a sound signal that works as a trigger for the soldier's emotional turmoil during the war.

b) Another soundscape which is recurrent in the novel is of trains. Train has a visual motif in the novel from the first chapter to the last which aurally define and transform the meaning of Train and its Technophony, first as a transport, later as a classroom and towards the end as the signal for the arriving war, evident from this excerpt-

*"The train rumbled along in the darkness with its*
*load of anxious passengers."*

The rumbling sound of the train becomes the sound signal and it's technophony represents the uncertainty and fear of the war, an aural experience from Tetsuko Kuroyanagi's childhood, which both serves as a soundscape of war and a haunting sonic memory.

*"You mustn't listen to any more comedians on the radio."*

This dialogue between Totto-Chan's mother and Totto-Chan reveals the Techophonic influence of radio on children of pre-war Japan, the chapter "Radio Comedians" includes a visual description of the radio at Totto-Chan's house and the show "Rakugo comedians" can be considered as a Technophony of leisure and entertainment for Totto-Chan and its aural influence on Totto-Chan comes in the form of a catch phrase from the show-

*"Hey, Ma, this is pretty goddam good!"*

These words uttered by Totto-Chan can be analysed as the Technophonic influence of the radio show on the little girl, this aural and vocal interchange also marks a transformation of a punchline to an inappropriate sentence to be said by a little girl, this also results into the Technophonic restrictions imposed on Totto-Chan by her mother. Apart from the restrictions, the representation of humour perceived by a child through aural cues can be analysed from sonic perspective as Totto-Chan does not understand what the comedians were saying but she always knew when something is funny. One can assess that the Technophonic cues laid by the comedians are responsible for the uproarious laughter of Totto-Chan.

c) Sonic Biophony in the novel comes in a limited form through the chapter "The Only Thing I Want!", where Totto-Chan adopts two baby chicks from the temple fair at Senzoku Pond, the "cheep" of the baby chick represents Biophony of sympathy and care, which later turns into a Biophonic happiness for Totto-Chan upon receiving the birds.

*"The chicks looked longingly at her, cheeping even louder still."*

When the birds die their Biophony becomes a tragic memory of loss for Totto-Chan, who cries when she cannot hear the cheeping sound anymore. This narrative of the joy of adopting birds and the sadness of losing them are all encapsulated in the sonic Biophonic cheeps of baby chicks, provides an acoustic perspective of this tragic memory.

**Chapter II: Musical Semiotics and Pedagogical liberation**

*Totto-Chan: The Little Girl at the Window* is a novel dense with musical references through its narrative with major focus on the Tomoe Gakuen and Totto-Chan's father's occupation as a violinist. These musical aspects can be analysed using Jean- Jacques Nattiez's tripartite model of musical semiotics theory. With the use of Nattiez's tripartite model, the novel can be analysed on three levels – The Poietic level, The Neutral level and The Esthesic level.

At the Poietic level, Mr. Kobayashi–the headmaster of Tomoe Gakuen uses music as a pedagogical tool to teach his students, a deliberate effort on his part to inculcate aural and rhythm into education through inclusion of emerging experimental elements to the school's curriculum such as Eurhythmics, an aural and physical exercise created by Emile-Jaques Dalcroze. Mr. Kobayashi uses this exercise with the intention to educate the children to understand and implement rhythm into their mind and body. He also uses small melodies such as "Chew, Chew, Chew it well" to educate children to eat their food properly forming a habit through auditory instructions. Mr. Kobayashi's Poietic intention to cultivate these musical practices into formal education is to create a holistic pedagogical environment which encourages the individual voices of its students and trains them to develop physically, intellectually, and mentally. Similarly, the school song created by Mr. Kobayashi upon Totto-Chan's request is a simple minimalist repetitive chime-

*"To - mo - e, To - mo - e"* with the Poietic intention to make a song which is easy to remember and pleasant to sing, this song is also in stark contrast to the school song of Totto-Chan's previous school-

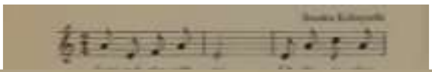
"*Tho' shallow the waters of Senzoku Pond, Deep is our learning of vistas beyond . . ."*

A song which is difficult to remember and difficult to enunciate by students. Tomoe Gakuen consists of activities which are rich with music, not just to make students acquainted with rhythm but with a broader Poietic intention to make music part of their daily lives.

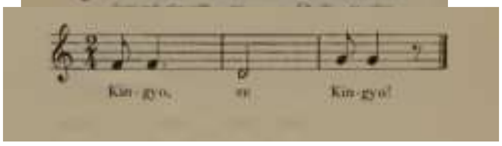
At Neutral level, the analysis tries to find the musical traces present within the novel as evidence of observable music for readers to experience. These traces can be found in the school song composed by

Mr. Kobayashi, be writes the musical notations on board for students to read making it a visual and performative text.

The made-up song sung by Totto-Chan to express her excitement for the new school can be identified as a musical trace: *"I'm so happy, So happy am I! Why am I happy? Because . . . ",* this improvised song is a sonic expression of joy and excitement and can be defined as musical traces of emotional energy. Similarly, the musical traces of the Haiku improvised by the headmaster for students is evidence of observable music for readers as well as a rhythmic exercise for students which creates an engaging space for students to learn haiku.



Another important musical evidence of neutral analysis comes from the chapter called 'The Rehearsal Hall'-




This musical evidence is a sonic record for representation of Pre-war Japan, which is transformed into an auditory memory of childhood for Tetsuko Kuroyanagi. These sonic traces serve as musical evidence which can be interpreted and experienced by readers as a harmony between symphonies and pedagogy and sonic records as memories of the past.

The final level of Musical semiotics analysis is the Esthesic level, which examines how these musical elements are experienced and interpreted by characters within the novel and the readers. The first instance of Esthesic analysis comes from the reaction of the children to Mr. Kobayashi's school song, although it comes with the Poietic intention to simplify the school song which can be easily performed by children, it fails to create an impression among the children who consider the song as dull and confusing. This failure is also aligned with the failure from a semiotics perspective to create a seamless transmission of Poietic intention to its Esthesic values. Furthermore, Totto-Chan's musical awakening can be analysed through her Esthesic encounters from the passing street musician band near her previous school to the lunch song taught by Mr. Kobayashi. The lunch song's Esthesic values increases when she visits the wounded soldier and sings the song to her assigned soldier, his reaction to the simple lunch song comes with a profound grief, from a semiotics perspective there is a misalignment between Totto-Chan's Poietic intention and the transmission of the lunch song's Esthesic value to the soldier but it evokes a triggering emotion which on a broader semiotics level gives readers the perspective of war from the brief sonic connection formed between the wounded soldier and Totto-Chan. Furthermore, Totto-Chan's aspirations to become a ballerina stems out of her reaction to The Swan Lake ballet, this is another musical semiotics transaction between a little child and a sonic performance.

Overall, Tetsuko Kuroyanagi's novel provides a fertile ground to apply Jean- Jacques Nattiez's tripartite model of musical semiotics theory to inquire, examine and analyse the importance of musical semiotics within the narrative of the novel and trace its impact on the character's sonic experiences which shape the emotional, educational, physical and intellectual aspects which shape their identity and memory and provide readers with an aural narrative which creates an auditory rich environment of soundscapes of the Pre-War Japan.

**Chapter III: Psychoacoustics and Sonic Childhood**

Psychoacoustics is the study of sound's impact on the psychological and emotional states of humans. It focuses on sound triggers that evoke anxious emotions as well as trauma responses. The sensory world of Totto-chan is central to understanding the soundmarks around her and how they are perceived by people. Its emotional education and diverse acoustics make the novel a soundscape memory for the readers. *Totto-chan: The Little Girl at the Window* displays experiences of students in Tomoe Gakuen through emotionally rich and vibrant scenarios that demand a close reading of the text through the lens of psychoacoustics.

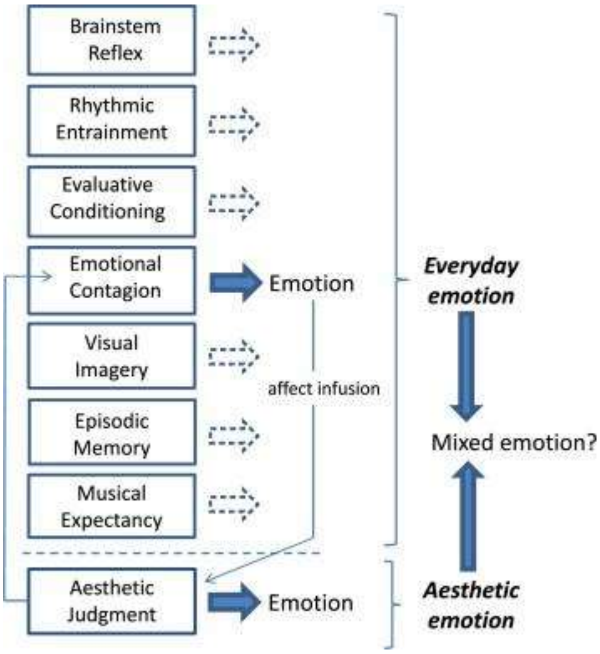
a) Sound is often connected to memory, triggering emotional responses affected by early exposure. In psychoacoustic terms, the sounds of Totto-chan's childhood, can be referred to as "sonic childhood" that she shares with her classmates at Tomoe as the school encourages learning in an environment abundant with sound to nurture the students' imaginations. The structure of classrooms, from railroad cars to the personalized lesson plans for students, Tomoe crafted sonic experiences in its students' early learning years, creating a novel soundscape that can be scrutinized under the ASA theory by Albert Bregman. Auditory Scene Analysis (ASA) describes the human auditory systems and its organization of complex soundscapes into distinguishable auditory streams. Bregman suggest that people can segregate sounds based on cues like temporal patterns, frequency, and timbre to group them as coherent sources. Its process separates specific sounds from the rest of the background noise to maintain focus on crucial auditory information. This is commonly practiced by students in everyday classrooms.

   *"... Totto-chan would suddenly call out to a passing band of garishly dressed street musicians... Whereupon, said the teacher, Totto-chan would announce the fact to the whole room, 'Here they are!' and all the children would crowd by the window and call out to the musicians."*

   Although Totto-chan's ability to navigate this auditory complexity is evident when she gets distracted by street musicians, highlighting her sensitivity to external sounds which she prioritizes over her teacher's voice reflects her selective attention to musicians' rhythms and timbre. ASA further explains how Tomoe's unconventional structure with dynamic soundscape aligns with Totto-chan's natural auditory processing.

b) Apart from street musicians, music in the novel, emerges as one of the most significant emotional and psychological tools for Totto-chan's memories of her childhood. Music also acts as a source of joy, emotional expression, and inclusivity with the socio-political backdrop of wartime Japan. Totto-chan's musical experiences can be analysed through Patrik Juslin's BRECVEMA model, a scientific framework to understand the musical emotions outlined into eight mechanisms: Brainstem Reflex, Rhythmic Entrainment, Evaluative Conditioning, Contagion, Visual Imagery, Episodic Memory, Musical Expectancy, and Aesthetic Judgment. One particularly example for this is the students' performance at Tomoe, where Yasuaki-chan, the blind violinist, becomes a remarkable figure in Totto-chan's musical memory.

   *"The headmaster clapped. Everyone else clapped, too. Whereupon the*




*boy, in an even louder voice than before, went on again..."*

At the most primal instinct for a child's mind, is the response to loud musical events such as rhythmic clapping or group percussion activities that demonstrate the Brainstem reflex mechanism.

These sounds evoke automatic physiological reactions that often bypasses any cognitive processing of the event. Totto-chan's excited energy and joy during group performances suggest hoe music stimulates "automatic arousal", especially in children's young nervous systems.

*"Even when he was a grown man that boy probably never forgot the sound of that applause."*

Applause or clapping is a rhythmic synchronization of beats shared in group performances. This builds co-ordination and enhances social bonding within the students. Following group rhythm also reinforces emotional regulation and integration into the peer community.

> *"And, anyway, what about Daddy? He plays the violin and owns several violins, but that doesn't make our house a violin shop, does it?"*

Repeated exposure of music in Totto-chan: The Littler Girl at the Window plays a significant role as it enables Totto-chan to associate music with emotional positivity and freedom. The first exposure if through her father's violin practices and performances, and later through Tomoe, develops emotional contagion and shared affective states. She further understands music more than just pleasant sounds due to the Evaluative conditioning and feels the intensity of emotions when Yasuaki-chan plays his violin. Totto-chan establishes a sense of respect towards him after listening to his performance. This musical memory is later replaced with memory of grief when she learns about the passing of Yasuaki-chan.

> *"It was the first time Totto-chan had been to a funeral, and she realized how sad it was. Nobody talked, and the organ played soft hymn music."*

Yasuaki-chan's music became the earliest encounter of grief of sound and silence for Totto-chan. It exemplifies the deeply encoded emotional complexity of music for children and overlaps with the final four components of the BRECVEMA model: visual imagery, episodic memory, musical expectancy, and aesthetic judgement. These mechanisms illustrate how Totto-chan engages with music through sensory and social channels, exploring her inner landscapes of memory.

c) Furthermore, merging psychoacoustics with trauma theory and sound studies provides a novel interdisciplinary field of trauma acoustics that can be used to analyze the wartime sonic environment in *Totto-chan: The Little Girl at the Window*. This can primarily be seen when Totto-chan's father declines the offer to perform wartime propaganda music at a munitions factory and his decision to not perform turns silence into defiance.

*"Daddy thought for some time before replying. 'I don't want to play that sort of thing on my violin."*

In Psychoacoustics, this aligns with the theory of "unclaimed experience" by Cathy Caruth, where trauma is not understood but felt. For Totto-chan, this moment forms an ethical soundscape against sonic violence of war music and a moral importance of sound. It allows her to understand how music can be used for violent ideologies.

Sound becomes increasingly sparse in the novel as the war escalates, the background silence gains an emotional weight. This is apparent dur to Totto-chan's growing awareness of war, death, and scarcity, usually conveyed through acoustics.

*"Lots of soldiers had died, food had become scarce, everyone was living in fear—but summer came as usual."*

The muted mundane life described in the novel is haunting as the Geophony and Biophony disappeared. According to Murray Schafer, the absence of ordinary urban noises creates a "low-fi soundscape" with acoustic voids impacting the reader's mind with the weight of silence. Another instance is when Totto-chan inserts a coin in a vending machine waiting for candy but receives only the metallic sound of disappointment.

*"All she got back was her money. It fell out with a clatter."*

In Trauma acoustics, such moments mark the defeat of desire and become sonic triggers of wartime, creating micro-memories, where the brain associates specific sounds with emotional conditioning according to Marie Thompson. For Totto-chan, the metallic clink becomes a learned cue for scarcity and starvation. Another excerpt from the previous chapter foreshadows this event when Totto-chan visits the hospital to meet the injured soldiers. There she sang the school lunch song "Chew it well" for her soldier, that makes him cry and pat her head endlessly.

*"Or maybe because of his experience at the war front, he knew how near they all were to starvation, and the thought of this little girl singing "Chew it well" when there might soon be nothing left to chew may have filled him with sadness. The soldier may also have realized what terrible events would soon engulf these very children."*

In *Totto-chan: The Little Girl at the Window*, the war is not described through the loud noises of bombs and sirens but rather through subtle auditory cues through the scoundscapes of the novel. The psychoacoustic memory of war for Totto-chan is inscribed through sound and acoustic surroundings.

**Chapter IV: Acoustemology and wartime Japan**

Sound is a culturally and sensually grounded way of knowing the world. A combination of Acoustics and Epistemology gave rise to an interdisciplinary field of Acoustemology coined by anthropologist Steven Feld. It focuses on sonic memory and acoustic environments as meaningful forms of cultural experience. In Tomoe Gakuen, the lunch song becomes a crucial sonic marker reflecting community and care.

*"Normally one starts a meal by saying, "Itadakimasu" (I gratefully partake), but another thing that was dif¬ ferent at Tomoe Gakuen was that first of all every¬ body sang a song. The headmaster was a musician and he had made up a special "Song to Sing before Lunch."*

In Japanese culture, "Itadakimasu" is a common practice in every household to be grateful for the food provided on the plate. Tomoe took this one step further by creating a song to sing before meals. This reflects the cultural roots of Japan and how Tomoe Gakuen tries to maintain, if not enhance, these cultural experiences for its students.

In Tomoe Gakuen, the transformation of decommissioned train cars into classrooms was more than just an aesthetic choice. It was a cultural and symbolic gesture to the modernization of Japan and an attempt to subvert the military connotations in the context of wartime Japan. Trains in this period were used to mobilize the soldiers during air raids. By recontextualizing these train cars, Kobayashi used them as a metaphor for the journey of the mind and heart of students.

> *"Studying here would be like going on a perpetual journey… The windows still had baggage racks above them."*

Train cars for students were always a mode of emotional safety as they represented the familiar materiality of Japanese life, symbolizing travel and adventure. The spatial acoustemology behind this is important too, as trains are sonically dynamic spaces, full of vibrations, whistles, wind sounds, etc.

Furthermore, the inclusivity portrayed in the novel is achieved by Tomoe's acceptance of the disabled students into the school. The inclusion of Yasuaki-chan, a physically challenged boy who had polio, is the novel's strongest cultural intervention. In wartime Japan, physical fitness and strength were idealized for preparing military troops, and disabled children were often excluded from formal education and public activities. Yet Yasuaki-chan is a student at Tomoe and friends with Totto-chan, actively participates in all school activities, and always responds with kindness and curiosity.

> *"...I had polio…," he whispered. "It's not only my leg, but my hand, too."*

The headmaster is also considerate about the accessibility of every aspect of school life, from physical structure to collaborative lessons. In cultural terms, this inclusivity radically challenges the wartime ideals of homogeneity and hierarchy.

Therefore, Acoustemology is Steven Feld's concept that links sound and culture with emphasizing the deeply intertwined cultural knowledge and social context. Sound is not just physical, but also culturally and socially constructed, carrying meanings that are shaped by context.

**Conclusion**

After conducting the research, it can be concluded that Tetsuko Kuroyanagi's *Totto-Chan The Little Girl at the Window* is a novel with dynamic soundscapes and sonic resonance which under the scrutiny of various sonic studies disciplines such as R. Murray Schafer's Soundscapes Theory, Steven Feld's Acoustemology, Jean-Jaques Nattiez's tripartite model of Musical Semiotics and Psychoacoustics to name a few and reveals the rich biophonic, geophonic and technophonic soundscapes along with their emotional and psychological impacts on the characters portraying the importance of sound in pedagogical domain and the sonic record of pre-war Japan under the lens of Poietic, Neutral and Esthesic analysis providing readers an alternative form of auditory reading of the print narrative. From the Sonic Studies analysis of the novel, it can be concluded that the novel provides multitudes of sonic layers from different dimensions of sonic studies and provides an auditory narrative which can be 'listened' by the readers and experience the sonic surroundings of the novel's settings, characters' emotions, and their subsequent physical, psychological, and intellectual impact.

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# CLASS STRUGGLE IN GLOBALIZED INDIA: A STUDY OF THE ECONOMIC DIVIDE IN ARAVIND ADIGA'S THE WHITE TIGER

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***Abstract***

*Glocalization and Liberalization in India has impacted the social structure though the economic divide between the poor and the rich continues to widen. 21st century Indian society, both in the rural and urban setting, has been directly or indirectly touched upon by the new economy of Globalization. With the possibilities of entrepreneurship, secondary and tertiary services related to IT (Information & Technology) enabled industries have become the new age's financial realities. Cities such as Bangalore and Hyderabad are seen undergoing massive structural changes. Novels and cultural documents have depicted the emergence of new class paradigms in the wake of the globalized economy. Aravind Adiga's The White Tiger is one of such narrative that captures the class structure of the fast evolving economy of Bangalore.*

*This paper analyses Adiga's Man Booker (2008) prize winning narrative to show how opportunities and deprivation co-exist in 21st century globalized society. Focusing on the economic status of the novel's protagonist, Balram Halwai, this paper proves with the help of instances, the ways in which globalized economy India's*
*Silicon Valley has generated new social class. The paper also looks into the economic contradictions that globalization creates with one group of young employees empowered with technological skills and the other group of natives and the poor section who get employed in menial jobs within the globalized economy. The paper mobilizes Marxist and cultural perspectives in the reading of the novel to explain the impact of late capitalism on the social structure.*

***Keywords****- Globalization, New Economy, Class Struggle, IT enabled economy.*

## Chapter 1: Introduction

Published in 2008, *The White Tiger*, is a novel that focuses and highlights the Indian life, after the implementation of Globalization in India. The plot revolves around the life of the protagonist Balram Halwai, a young boy from Laxmangarh (Gaya, India).

Although the novel is set in contemporary India, Balram traces the social discrimination he faces back to 1947, the year India became independent of the British rule through the Indian Independence Act. Following the act's declaration of India's independence, there were communal riots between Muslim and Hindu Indians which followed the formation of Pakistan as a distinct independent state for muslims. Shortly after attaining independence in the 1960s, Indians abolished the Caste System, which had strictly enforced the social role of all Indians for thousands of years prior to Brisitsh rule. According to Balram, the confusion and disarray that followed the caste system's demise have led to rise even greater social inequity.

The story of the novel is set in contemporary, economically thriving India. After nearly going bankrupt in 1991, the India government started an economic liberalization program and got a sizable load from the IMF, which led a high pace of economic growth and foreign investment that is still going strong today. Regrettably, income inequality has also sharply expanded as a result of the economic expansion. The White Tiger chronicles the plight of those left behind during India's tremendous economic growth.

## Chapter 2: The White Tiger in context of Globalization

British sociologist Anthony Giddens, in his book *The Consequences of Modernity* (2019), mentions 'Globalization can thus be defined as the intensification of worldwide social relations which link distant localities in such a way that local happenings are shaped by events occurring many miles away and vice versa.' The proletariat, or working class, and the bourgeoisie, or ruling class, are at odds in globalized India.

Aravind Adiga's *The White Tiger*, winner of the 2008 Man Booker Prize, offers a piercing and darkly satirical view of India's economic rise through the eyes of its underclass. Set in the backdrop of a rapidly globalizing India, the novel explores the deep chasm between the rich and the poor, highlighting how globalization has intensified existing class divides rather than alleviating them. This paper delves into the theme of class struggle in globalized India, analyzing how Adiga presents the impact of neoliberal economics, the myth of social mobility, and the psychological and moral consequences of systemic inequality through his protagonist, Balram Halwai.

- **Globalization and Economic Divide**

In the late 20th and early 21st centuries, India embraced liberalization policies that opened its markets to global trade, investment, and consumerism. While this brought visible wealth and development to urban centers and created a new middle and upper class, it also exposed the limitations of economic progress in addressing deeply rooted social hierarchies. The White Tiger reflects this dichotomy through its vivid depiction of the "two Indias"- the "India of Light" and the "India of Darkness." Balram, the narrator and antihero of the novel, is born in a rural village in Bihar, a region emblematic of India's underdevelopment and poverty. Despite India's booming GDP and increasing presence on the world stage, Balram's early life is marked by deprivation, lack of access to education, and feudal exploitation. His journey from a tea-shop boy to a successful entrepreneur in Bangalore symbolizes not just individual ambition, but also the desperation and violence required to escape the rigid structures of class.

- **The Illusion of Social Mobility**

A major critique embedded in the novel is the myth of meritocracy in a globalized society. Balram sarcastically refers to himself as a "White Tiger"—a rare creature that breaks out of the societal cage—but his rise is neither based on equal opportunity nor education, but rather through manipulation, crime, and the exploitation of the very system that oppresses him. His story challenges the narrative often touted in global capitalism that hard work leads to upward mobility. Education, a supposed equalizer in modern societies, is depicted as hollow and ineffective for the poor. Balram receives only a rudimentary education and is quickly forced into labor to support his family. His later "education" occurs through observation, self-learning, and moral compromise. He learns the language of power, corruption, and violence
from the wealthy he serves. In this way, Adiga critiques how the underclass must internalize the very corruption and amorality of the elite to attain success.

- **Servitude and Subjugation**

The novel explores the master-servant dynamic as a metaphor for India's class structure. Balram becomes a driver for Ashok, a Western-educated member of a wealthy family who returns to India after studying abroad. Though Ashok initially seems kinder than other upper-class characters, he remains complicit in the system that dehumanizes Balram. The façade of kindness masks a deep-rooted class prejudice,
wherein servants are seen not as human beings but as utilities. Balram repeatedly refers to the "Rooster Coop," a metaphor for the psychological cage that keeps India's poor obedient. Just as roosters do not rebel even when they see others being slaughtered, India's underclass remains subservient, bound by fear, tradition, and familial obligations. Globalization, rather than dismantling the coop, reinforces it

by creating a glossy facade of success that obscures systemic inequality.

- **Corruption as Currency**

Another major theme in The White Tiger is corruption—a structural feature of both governance and private enterprise in post-liberalization India. From bribing politicians to manipulating bureaucrats, corruption is portrayed not as an aberration, but a standard mode of operation. Balram witnesses and later participates in this culture as a means of survival and ascension. The rise of Bangalore as an outsourcing hub and symbol of India's technological prowess is ironically where Balram sets up his taxi company ironically named "White Tiger Drivers." It is in this city, a product of globalization, that he finally succeeds, but only after murdering his employer and stealing his money. Adiga provocatively suggests that success in the global economy,
for those at the bottom, often necessitates breaking the law and rejecting moral norms because the system is rigged against them from the beginning.

- **Identity and Transformation**

Balram's transformation from a village boy into a ruthless entrepreneur is central to the novel's commentary on class struggle. His evolution is not just economic but moral and psychological. As he adapts to the cutthroat environment of capitalist India, he sheds familial ties, ethical constraints, and even his given name, symbolizing the death of his former self and rebirth into a world of moral ambiguity. The novel uses first-person narration to immerse readers into Balram's worldview, which becomes increasingly cynical. Through letters to a visiting Chinese premier, he presents a counter-narrative to India's official image of development and progress. His voice is both confessional and accusatory, exposing the hypocrisy of a nation that prides itself on democracy and growth while ignoring its underclass.

- **A Mirror to Modern India**

The White Tiger is a powerful critique of the social consequences of globalization in India. It dismantles the idealistic notion that economic liberalization has created a level playing field, instead highlighting how it has deepened existing class divisions. Aravind Adiga presents a grim but honest portrayal of how poverty, corruption, and class exploitation continue to define the lives of millions even as the nation celebrates its ascent as a global power.

Through the character of Balram Halwai, Adiga forces readers to confront uncomfortable truths: the persistence of servitude in the guise of service, the futility of legal means for the oppressed, and the moral cost of social mobility in a deeply unequal society. In doing so, The White Tiger becomes more than just a novel—it becomes a mirror reflecting the dark underbelly of modern India's economic miracle.

The proletariat provides labor, while the bourgeoisie controls the means of production and capital. Direct violence, economic pressure, political intrigue, and ideological conflicts are just a few of the ways that this conflict can manifest itself. Existing disparities have been made worse by globalization, which has resulted in de
industrialization, attacks on working-class living standards, and a weakened role for the state in providing welfare.

**Chapter 3: Economic Inequity in The White Tiger**

Aravind Adiga's The White Tiger is a provocative and incisive novel that scrutinizes the socio-economic landscape of modern India. Through the life and voice of Balram Halwai, the protagonist and narrator, Adiga sheds light on the grim realities of class disparity and the vast economic divide that characterizes Indian society. Set against the backdrop of a rapidly globalizing nation, the novel explores the tensions between the rich and the poor, tradition and modernity, rural stagnation and urban progress. The story unfolds as a stark critique of a system that perpetuates inequality and hinders upward mobility for the vast majority.

● **The Two Indias: Light and Darkness**

One of the central metaphors in The White Tiger is the division of India into two distinct entities: the "India of Light" and the "India of Darkness." This dichotomy represents the sharp divide between the affluent urban elite and the impoverished rural masses. Balram, hailing from the backward village of Laxmangarh, belongs to the India of Darkness. He describes his village as a place where people are trapped in feudal dependencies, lacking access to education, healthcare, and economic opportunities. The India of Light, by contrast, is embodied by cities like Delhi and Bangalore, where the wealthy enjoy the benefits of globalization, technological advancement, and economic liberalization. Adiga uses this metaphor to highlight the structural and spatial inequalities that define contemporary India. The divide is not just economic but also cultural and psychological. Those in the India of Darkness are conditioned to accept their subjugation, internalizing their low status and rarely challenging the status quo. This entrenched mindset is what Balram terms the "Rooster Coop," a system of control that keeps the poor obedient and fearful.

● **The Rooster Coop: A Metaphor for Economic Entrapment** The "Rooster Coop" is perhaps the most powerful symbol of systemic oppression in the novel. Balram explains that Indian servants, like roosters in a coop, witness the brutal fates of their peers but do not rebel. They are bound by a sense of duty, fear of retribution, and loyalty to their families, who could be punished for any act of defiance. This metaphor encapsulates the psychological and social mechanisms that maintain the economic divide. Adiga critiques how the structure of Indian society manipulates the poor into compliance. The wealthy maintain control not merely through financial power but through ideological domination, reinforcing a belief that the poor are unworthy of a better life. This acceptance of inferiority ensures that the status quo remains unchallenged, making the economic divide self-perpetuating.

● **Balram’s Journey: From Subjugation to Self-Determination**

Balram's personal journey from a village boy to a successful entrepreneur in Bangalore is the central arc of the novel. It is a journey marked by rebellion, crime, and self-reinvention. Balram's transformation underscores the extreme measures required to escape the lower rungs of the economic ladder in a society rigged against the poor. His story is not a celebration of the rags-to-riches narrative but rather a critique of the moral compromises and violence that such a transformation necessitates. Initially employed as a driver by the wealthy Ashok and his wife Pinky Madam, Balram becomes increasingly aware of the hypocrisy and corruption that underpin the lives of the rich. Ashok, though seemingly kind, benefits from and perpetuates the same exploitative systems. The disparity between master and servant is starkly evident in their daily interactions, with Balram being constantly reminded of his place in the social hierarchy. Balram’s eventual decision to murder Ashok and steal his money is portrayed not simply as a criminal act, but as an act of liberation. It is his escape from the Rooster Coop and a reclaiming of agency in a world that denies him dignity and opportunity. By killing his master, Balram symbolically destroys the economic and social order that oppressed him.

● **Corruption and Inequality**

Adiga does not spare the upper classes or the political elite in his critique. The novel paints a damning portrait of systemic corruption at every level of Indian society. From bribing politicians to manipulating bureaucratic systems, the wealthy use their resources to bend rules and maintain their dominance. Ashok and his family are deeply involved in corrupt practices, using their influence to evade taxes and legal scrutiny. This corruption exacerbates the economic divide, as it creates a society where the law serves the interests of the powerful. The poor, on the other hand, have little recourse to justice or protection. Balram notes that police and politicians alike are bought and sold, making the democratic institutions hollow and inaccessible to the underprivileged.

● **Globalization and Its Discontents**

Set in the era of India's economic liberalization, The White Tiger engages with the promises and pitfalls of globalization. While cities like Bangalore become hubs of technological innovation and outsourcing, rural areas remain mired in poverty. The benefits of globalization are unequally distributed, often widening the gap between the haves and the have-nots. Adiga uses the setting of Bangalore, with its gleaming office buildings and call centers, to show the shiny exterior of India's growth. However, beneath this surface lies a world of exploitation and marginalization. Balram, though eventually becoming a part of this urban landscape, does so by adopting the ruthless and morally ambiguous tactics of those in power. His success is achieved not through the meritocratic ideals espoused by globalization, but through subversion and violence. The novel questions whether true economic mobility is possible in such a society. It challenges the notion that globalization leads to universal prosperity, arguing instead that it often entrenches existing hierarchies and creates new forms of inequality.

● **The Illusion of Social Mobility**

Balram's rise is often mistakenly read as proof of social mobility in modern India. However, Adiga makes it clear that Balram's success is the exception, not the rule. His story is one of extreme measures, not replicable pathways. The novel critiques the myth of meritocracy, showing how the system is designed to reward only those who are willing to abandon their moral compass. The education system, which should be a vehicle for upward mobility, is depicted as deeply flawed and inaccessible to the poor. Balram's early schooling ends when he is forced to work at a tea shop to support his family. His "real" education comes from observing the behaviors of the rich and navigating the corrupt underbelly of urban life. This informal, experiential learning becomes his toolkit for survival and success.

● **Economic Disparity as a Moral Landscape**

Beyond the economic and social critique, The White Tiger presents economic disparity as a moral terrain. The novel raises uncomfortable questions about morality, justice, and survival in an unequal society. Balram is not a traditional hero; he is morally ambiguous, even reprehensible in his actions. Yet, readers are led to sympathize with him because his circumstances reveal the cruelty of the system. Adiga blurs the lines between right and wrong, suggesting that in a world where laws serve the rich, the poor may be justified in breaking them. This moral ambiguity forces readers to reconsider their assumptions about crime, justice, and success. It also highlights how economic inequality dehumanizes both the oppressed and the oppressors.

Aravind Adiga's *The White Tiger* is a searing exploration of economic disparity in contemporary India. Through its vivid characters, symbolic metaphors, and unflinching critique, the novel exposes the deep fissures in a society grappling with the contradictions of tradition and modernity, wealth and poverty, democracy and corruption. Balram Halwai's journey is both a personal rebellion and a broader commentary on the structures that perpetuate inequality. In capturing the voice of the underclass, Adiga gives agency to those often silenced in mainstream narratives. The White Tiger ultimately challenges readers to confront the uncomfortable realities of economic injustice and to question the true cost of progress in a deeply divided society.

**Chapter 4: Caste and Class in a Globalized India**

Aravind Adiga's The White Tiger presents a scathing critique of modern India, unveiling the grim realities of caste and class hierarchies in the era of globalization. Through the compelling voice of Balram Halwai, a poor village boy turned entrepreneur, Adiga navigates the social landscape of a country caught between its ancient traditions and a rapidly modernizing economy. In doing so, he exposes how caste and class continue to shape identity, opportunity, and social mobility, despite the promises of progress and equality that globalization brings.

● **Caste and Class**

Interlinked Structures of Inequality In India, caste and class often overlap but are not identical. Caste is a hereditary social stratification rooted in Hindu religious doctrine, while class is based more on economic status. However, in practice, the two systems reinforce each other. Lower castes have historically been denied access to wealth, education, and power, and these inequalities persist in contemporary India, now underpinned by capitalist structures.

In The White Tiger, Balram Halwai belongs to the Halwai caste, traditionally a caste of sweet-makers. Though he is nominally outside the lowest rungs of the caste system, his social position is still deeply marginalized. The novel illustrates how caste still determines social roles, expectations, and interactions, even in urban settings. Balram is constantly reminded of his low status—through his job as a driver, through the language used by his employers, and through his internalized belief in his own inferiority.

● **The Invisibility of Caste in Urban India**

One of Adiga's most nuanced critiques is how caste remains omnipresent even when it appears to be invisible. In the urban environments of Delhi and Bangalore, where Balram works, the traditional caste markers are blurred, but their influence persists. Employers often do not ask directly about caste, but still judge and segregate based on class, which is frequently a proxy for caste. The servant-master dynamic, seen in Balram's relationship with Ashok, continues a legacy of caste-based servitude in a modern capitalist guise.

Adiga suggests that globalization has not erased caste; rather, it has obscured it beneath the surface of economic interactions. The illusion of meritocracy masks the continued marginalization of the lower castes, who are funneled into low-paying, exploitative jobs with little chance of upward mobility.

● **Globalization and the Myth of Meritocracy**

Set in the post-liberalization period of the 1990s and 2000s, *The White Tiger* reflects India's transition into a global economic power. Cities like Bangalore emerge as centers of technology and international commerce, symbolizing new possibilities for growth. However, Adiga reveals that the benefits of globalization are unevenly distributed. The novel interrogates the myth of meritocracy, showing that hard work alone is not enough to transcend social barriers.

Balram's journey from a teashop boy to a business owner is not a typical success story. His rise is facilitated by violence and crime, not by equal opportunity. He murders his employer to escape servitude and rebrand himself in the urban capitalist marketplace. Adiga critiques the idea that globalization has democratized success, revealing instead that the economic boom has mostly served those already positioned to benefit from it—primarily the urban, upper-caste, and upper-class elite.

**● Servitude and Subservience: Continuity of Caste Oppression**

The master-servant relationship is central to the novel and serves as a modern continuation of caste-based oppression. Balram, as a servant, must anticipate his master's needs, endure humiliation, and maintain absolute loyalty. Even in the supposedly modern world, his life is dictated by the whims of those above him. His servitude is expected and normalized, echoing traditional caste hierarchies.

The notion of the "Rooster Coop," a metaphor Balram uses to describe the psychological entrapment of India's poor, encapsulates how caste and class systems work in tandem to suppress rebellion. Servants remain obedient even when they know their fate, fearing repercussions against their families and accepting their roles as unchangeable. This social conditioning reflects centuries of caste indoctrination, now reinforced by capitalist structures that exploit cheap labor.

**Resistance and Rebirth: Breaking the Caste-Class Barrier**

Balram's act of murder and subsequent reinvention as a businessman in Bangalore can be read as a symbolic breaking of both caste and class barriers. He refers to himself as a "White Tiger," a rare creature that comes along only once in a generation, signifying his uniqueness in challenging and escaping his fate.

However, Adiga complicates this narrative of emancipation. While Balram escapes his past, he does so by adopting the ruthless, morally ambiguous methods of the upper class. He replicates the very corruption and exploitation he once suffered, suggesting that true liberation is tainted and that the system transforms rebels into
new oppressors. Thus, the novel presents a grim view of upward mobility: possible, but only through moral compromise and violence.

**The Intersection of Global and Local Hierarchies**

Adiga demonstrates how global capitalism interfaces with local social structures to perpetuate inequality. In The White Tiger, the forces of globalization do not flatten social hierarchies but reconfigure them. Westernized Indians like Ashok, who have studied abroad and returned with liberal values, still exploit their servants and participate in political corruption. Their education and global exposure do not lead to ethical behavior but rather equip them with new tools to maintain power.

Balram, in contrast, learns to navigate this world by mimicking the behavior of the rich. He learns English, dresses smartly, and adopts the entrepreneurial language of the new India. Yet, he remains haunted by his origins and aware of the precariousness of his new identity. His success does not signify the dissolution of caste and class boundaries but the emergence of new forms of social stratification under globalization.

**Chapter 5: Conclusion**

Aravind Adiga's *The White Tiger* provides a powerful lens through which to examine the complex and evolving relationship between caste and class in a globalized India. While economic liberalization and globalization have altered the outward structures of Indian society- introducing new opportunities, industries, and aspirations- they have not fundamentally dismantled the deeply entrenched hierarchies of caste and class. Instead, these forces have often layered over existing inequalities, masking them with the rhetoric of meritocracy and development.

In the novel, Balram Halwai's journey from the "Darkness" of rural Bihar to the "Light" of entrepreneurial success in Bangalore exemplifies how caste and class continue to intersect. Although caste is not always explicitly discussed, it underpins the social divisions that determine access to power, resources, and mobility. Balram's status as a Halwai- a traditionally low-caste sweet-maker-symbolizes the inherited social limitations that persist despite economic changes. His struggle to break out of his predetermined role reflects not only a class struggle but also a rebellion against the invisible chains of caste.

Adiga's portrayal underscores how globalization has created a new class of wealthy elites while leaving the majority to contend with both modern exploitation and age-old prejudices. The supposed fluidity of class in a capitalist economy is shown to be largely illusory for those born into the lower strata. Even as India advances in technology and integrates into the global market, systemic barriers rooted in caste-based discrimination and rigid class structures remain intact, often operating under the guise of economic progress.

Ultimately, *The White Tiger* challenges the myth that globalization alone can dissolve social inequities. Through Balram's morally complex ascent, Adiga forces us to confront the uncomfortable reality that real social transformation may require not just economic change, but also a deep rethinking of the cultural and structural forces that have historically upheld caste and class divides. The novel serves as both a narrative of individual rebellion and a broader critique of a society that remains profoundly unequal beneath its modern, globalized surface.

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# DIGITAL DISRUPTION AND CULTURAL ADAPTATION: MANAGING CHANGE THROUGH A HUMAN LENS

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***Abstract***

*The paper asserts that, while digital disruption fosters innovation and efficiency in modern enterprises via technologies such as AI, automation, and data analytics, meaningful transformation is impossible without emphasizing the human experience. The major goal is to investigate how digital tools affect leadership styles, employee behavior, and overall organizational dynamics, with an emphasis on the emotional and adaptive aspects of workplace change. It tries to move the emphasis away from simply technology enhancements and toward a more balanced approach that takes into account cultural and psychological elements. The study employs a qualitative methodology, with secondary data obtained from academic literature and industrial sources. Analytical methodologies such as SWOT and PESTLE studies are used. The findings reveal that, while digital innovations increase productivity and operational efficiency, their long-term success is strongly reliant on cultural alignment, employee engagement, and leadership inclusivity. Organizations that adopt a human-centric approach through open communication, continuous staff development, and inclusive leadership are better positioned to deal with continuing change and uncertainty. Finally, firms that integrate their technical initiatives with people-focused strategies create more robust, adaptable, and sustainable structures that are ready for the future of work.*

***Keywords:*** *Organizational Culture Change, Digital Transformation, Technological Adoption, SWOT analysis, and PESTLE analysis.*

## Introduction:

In the fast-changing world of global commerce and management, digital disruption has emerged as both a driver of innovation and a threat to existing business structures. Artificial intelligence, blockchain, big data analytics, and cloud computing are all changing the way organizations work, as well as how customers interact and how markets operate. While these improvements create unprecedented prospects for growth and efficiency, they also necessitate rapid and smart change management. However, digital transformation is more than just a technological move; it is a profoundly human one. Organizations frequently underestimate the cultural and psychological factors that must be considered while dealing with interruptions. Employees, leaders, and stakeholders must adjust not only to new technologies and systems but also to new ways of thinking, collaborating, and producing value. Resistance to change, talent shortfalls, fear of obsolescence, and cultural mismatch frequently impede successful digital adoption.

Businesses can better navigate digital disruption by using a human-centric approach that prioritizes people at the core of transformation efforts. This entails creating a change-ready culture that values emotional intelligence and inclusive leadership. Instead of relying simply on technology, firms that recognize and handle the human side of disruption, such as employee concerns, team dynamics, and changing skill requirements, are better positioned to preserve morale and promote innovation. Inclusive leadership generates a sense of belonging and trust, allowing staff to share ideas and adopt new methods of working. Businesses that integrate empathy, clear communication, and continuous learning into their culture may not only withstand upheaval but also use it as a catalyst for meaningful growth and transformation.

Digital transformation is a strategic process in which organizations use digital technologies to restructure their business operations, increase efficiency, and strengthen their capacity for innovation, ensuring long-term viability and maintaining a competitive advantage in today's dynamic market environment. Digital transformation has a huge impact on business communication and organizational culture. The advent of digital tools such as email, instant messaging, and video conferencing has replaced many traditional face-to-face interactions with virtual communication. While these technologies allow for faster and more effective information transmission, they also pose obstacles to building personal relationships and sustaining a strong sense of community inside the organization. (Deep, 2023).

In the context of global commerce and management, the goal of bridging the gap between digital strategy and human behavior reflects a growing recognition that successful digital transformation requires more than just technological innovation—it necessitates a thorough understanding of the people who interact with and are impacted by these technologies. As businesses navigate increasingly erratic and technologically advanced settings, it is critical to link digital initiatives with human requirements, motivations, and behaviors. By providing actionable insights, this goal assists policymakers in developing effective regulations, guides corporate leaders in driving innovation with empathy, prepares HR professionals to manage change and workforce development, and empowers change agents to implement solutions that resonate on both strategic and human levels. This alignment generates more resilient, adaptable, and human-centered firms capable of thriving in the ever-changing global commerce scene.

**Objective of the study**

1. Examine how cultural adaptation contributes to effective digital transformation.
2. Examine human-centered ways for managing technological transformation.
3. Identify problems and best practices for aligning humans with digital projects.

**Review of literature:**

(Kraus, et al., 2021)**:** This study addresses a growing academic interest in digital transformation (DT) by emphasizing the universal issue of adjusting to a digital environment. The study will analyze publications from ABS ≥ 2-star journals to track the growth of DT research in business and management. Based on this study, the paper provides a synergistic framework that connects current DT research to various domains, providing a platform for ongoing discussion and future research. (Cao, Duan, & Edwards, 2025): The author explains a new multidimensional concept of digital transformation capability and investigates how four organizational culture types affect it. The findings indicate that adhocracy culture has the greatest positive impact, followed by clan, market, and hierarchy cultures. The capability promotes product innovation, with new product novelty and meaningfulness mediating its impact on product performance. (Omol, 2024): This article examines organizational digital transformation, focusing on its drivers—leadership, culture, and technology—as well as its ethical consequences, particularly in terms of AI and data protection. It does a scoping review to identify future trends such as hyper-personalization and quantum computing. Although conceptually rich, it lacks implementation direction. The study underlines the importance of strategic planning, societal adaptation, and ethical human-machine partnership in managing digital transformation. (Aasen & Klakegg, 2023): This study investigates compelled transformation in Norway's construction industry using a social science lens. Key findings from a 541-person survey reveal disparities in perceptions of change across positions and experience levels. The findings show that strong organizational culture, resilience, and psychological safety are critical instruments for successfully adapting to digital technology and practices. (Daniel P. Roberts, 2023): The purpose of this study was to look into how innovative and disruptive technologies affect organizational culture, leadership, and change management in the rapidly changing Property & Casualty insurance industry. The findings, which were based on qualitative interviews with 15 US executives conducted via Zoom and NVivo, show the importance of innovation, flexibility, and strategic shift in company models. (Gupta, 2011): The study applies Kotter's Leading Change approach to innovation management, specifically addressing leadership gaps in innovation deployment. Using a structured framework and change management concepts, it guides executives through the process of enabling credible, sustainable innovation, which is critical for competitive and profitable growth.

**Research methodology:**

The study takes a descriptive and qualitative approach, intending to assess the impact of digital transformation in important sectors such as FMCG, retail, banking, and education. Data is typically gathered from secondary sources like as academic publications, company reports, white papers, and case studies, with the option of obtaining primary data through surveys or interviews with managers and employees to gain practical insights. The study investigates the scope and implications of digital change in these industries, using PESTEL analysis to examine the macro-environmental factors influencing digital adoption and SWOT analysis to assess the internal strengths, weaknesses, opportunities, and threats that organizations face during this transition.

**Analysis And Interpretation:**

**TABLE 1: PESTEL ANALYSIS OF DIGITAL ADOPTION ACROSS INDUSTRIES**

| Sector | Political | Economic | Social | Technological | Environmental | Legal |
|---|---|---|---|---|---|---|
| FMCG | Policies on data privacy and FDI in retail | Increased online consumer expenditure and digital transactions. | Health-conscious, tech-savvy customers | AI-driven supply chains and predictive analytics. | Focus on sustainable sourcing and packaging. | E-commerce rules and digital labeling standards |
| Retail | E-retail FDI guidelines and tax revisions | Increase in mobile commerce and online sales. | Demand for personalization and convenience. | Integration of AR/VR, mobile apps, and IoT | Emphasis on eco-friendly delivery systems. | Compliance with pricing transparency and data usage |
| Banking | Digital banking rules (RBI, KYC norms) | cashless economy, increasing fintech investment | Switch to mobile and online banking. | Blockchain, AI chatbots, and cybersecurity technologies. | Push for green and paperless banking. | Stronger data security and privacy laws. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Education | National Digital Education Policies (NEP 2020) | Government financing and education technology investments | Transition to hybrid/remote learning | AI tutors, learning management systems (LMS), and virtual classrooms. | Lowering in physical infrastructure needs. | Platform regulations and content copyright |

**Sources**: Authors created

**TABLE 2: SWOT ANALYSIS OF DIGITAL ADOPTION ACROSS INDUSTRIES**

| Sector | Strengths | Weaknesses | Opportunities | Threats |
|---|---|---|---|---|
| FMCG | A well-established supply chain and strong brand equity | Slow adoption of modern technologies in traditional fields. | Increase in direct-to-consumer and online marketing channels. | Disruption by agile e-commerce startups |
| Retail | Large physical presence and rich customer data | Legacy systems and digital skill gaps within the workforce | Omni-channel retail and customized client experiences | Competition from online-only retailers |
| Banking | Reliable financial infrastructure and customer base | Bureaucratic processes and outdated software systems | Fintech collaborations and rural market digitization | Cybersecurity threats and aggressive fintech disruptors. |
| Education | Deep content knowledge and institutional reputation | Faculty skill gaps in digital tools and methodologies. | Expansion using EdTech and adaptive learning technology. | Reliance on third-party platforms and content piracy |

**Sources**: Authors created

**Sector-Wise Comparative Analysis:** This study uses a descriptive and qualitative method to examine how key industries such as FMCG, retail, banking, and education manage digital transformation using human-centric techniques. The focus is on how firms may ensure effective transformation by combining technological innovation with cultural change, leadership, and employee adaptation.

**TABLE 3: FMCG, RETAIL, BANKING, AND EDUCATION**

| Sector | Company Example | Nature of Digital Disruption | Cultural Adaptation Strategy | Human-Centric Change Management | Outcome |
|---|---|---|---|---|---|
| FMCG | Hindustan Unilever (HUL) | E-commerce, digital marketing, and AI in the supply chain | Developed a digital-first culture through cross-functional collaboration. | Developing a skilled workforce through the "Reimagine HUL" program, digital training. | Enhanced supply chain agility, boosted online sales. |
| Retail | Reliance Retail (JioMart) | Growth of online purchasing, hyper-personalization, and mobile commerce | Encouraged a tech-focused mindset and customer-centric innovation. | Trained staff for omnichannel support and enabled digital payments. | Rapid expansion of the hybrid retail model. |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| Banking | HDFC Bank | Fintech competition, mobile banking, blockchain | Promoted agile teams and simplified the hierarchy to make faster decisions. | Employee digital literacy initiatives and consumer onboarding with video KYC | Increased client retention and digital user base expansion. |
| Education | Byju’s | EdTech revolution, virtual classrooms, and AI-based learning. | Developed an innovation-focused learning culture and rapid growth strategy. | Educators were re-skilled to digitize the curriculum and enhance student engagement. | Become a global EdTech leader with millions of online learners. |

**Sources**: Authors created.

**Discussion:** Each sector experiences disruption differently, but one consistent thread is the strategic alignment of digital transformation with organizational culture. In successful examples, businesses invested in personnel reskilling, flattened hierarchies to increase creativity, and maintained open communication to promote psychological safety. The cultural transformation is frequently more difficult than the technological one, with strong participation from leadership and HR to support people emotionally and cognitively. Trust-building, empathy, and continual learning are essential for managing the difficulties of digital transition.

**The Future of Organizational Culture in the Digital Era**

The digital era has significantly changed how businesses work, interact, and evolve. As technology advances, the future of corporate culture will be determined by the following key trends and characteristics:

1. **Remote and Hybrid Work Culture:** As remote work technology becomes more prevalent, many firms are adopting hybrid models. This trend is changing workplace standards, with flexibility becoming a core cultural value. Organizations must cultivate a culture of trust, accountability, and autonomy as physical surveillance is reduced.
2. **Digital-First Communication:** Tools such as Slack, Microsoft Teams, and Zoom are becoming the norm. Organizational culture will increasingly be conveyed via digital communication, necessitating clarity, empathy, and inclusivity in virtual interactions to preserve engagement and consistency.
3. **Emphasis on Continuous Learning and Adaptability:** As digital tools and platforms grow quickly, employees must constantly upskill. A learning-oriented culture that encourages digital literacy, experimentation, and innovation will be critical to remaining competitive and relevant.
4. **Data-Driven Decision Making:** Organizations use big data and analytics to make strategic decisions. A culture that emphasizes evidence over intuition and fosters ethical data use will gain traction, fostering transparency and accountability.

5. **Inclusivity and Diversity in Virtual Teams:** Because digital workspaces eliminate geographical barriers, teams become diverse. Organizations must encourage inclusion by embracing many cultures, ideas, and communication styles, thereby cultivating a global mindset within their culture.
6. **Strong emphasis on employee well-being:** There is a growing worry about digital burnout and mental wellness. To keep employees satisfied and productive, the future culture must promote well-being through digital detox regulations, mental health support, and work-life balance efforts. (Bozkus, 2023)
7. **Agile and innovation-oriented mindset:** Digital transformation necessitates adaptability. Organizations will need to foster a culture of change, experimentation, and innovation. This includes flattening hierarchies and promoting bottom-up creativity.
8. **Ethical and Responsible Technology Use:** As AI, surveillance, and automation become more prevalent, organizational cultures must prioritize ethical norms, data protection, and digital accountability to foster trust among employees and stakeholders.

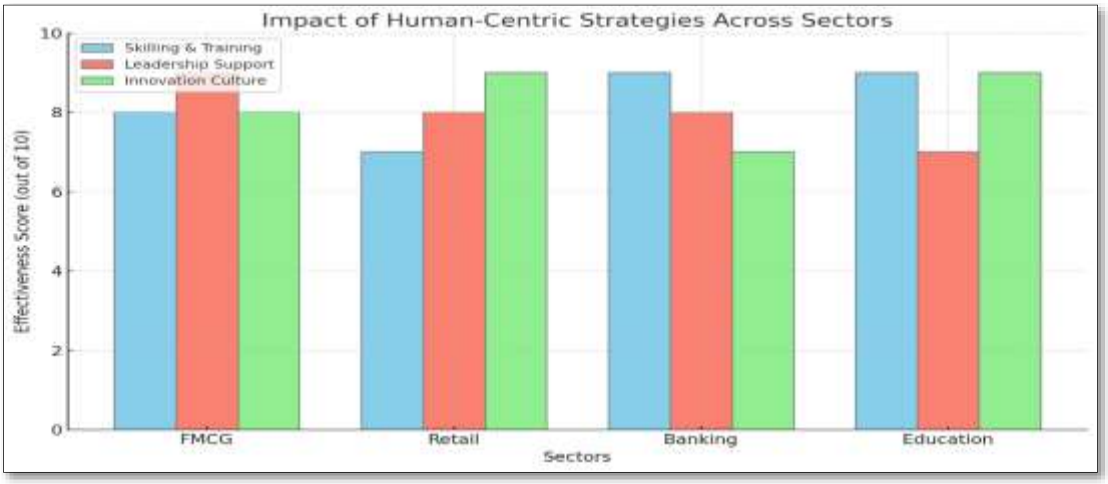
**Impact of Digital Transformation on Organizational Culture**

Digital transformation is crucial for businesses to stay competitive, meet evolving customer demands, and drive innovation by integrating digital technologies, enhancing agility, and ensuring long-term sustainability in a rapidly changing market. (Karakuş & Yalçın, 2024)

1. **Shift Toward Innovation and Agility:** Digital transformation promotes a culture of continuous innovation and adaptation, requiring firms to constantly evolve and experiment with new ideas.
2. **Increased Collaboration and Transparency:** Digital tools enable real-time communication and data sharing, encouraging a collaborative, open, and transparent culture across teams.
3. **Data-Driven Decision-Making:** Organizations foster a culture in which decisions are based on data and analytics, moving away from conventional intuition-based decision-making and toward more evidence-based approaches.
4. **Employee Empowerment and Autonomy:** With more access to information and digital tools, employees are empowered to make decisions and take initiative, generating a sense of autonomy and accountability.
5. **Continuous Learning and Skill Development:** The adoption of new technology encourages a culture of continuous learning, with firms investing in staff upskilling and reskilling to stay up with technological innovation.
6. **Resistance to Change and Cultural Friction:** Employees who are used to old ways of working may oppose digital transformation, resulting in cultural friction as they adjust to new processes and technology.
7. **Flattening of Hierarchies:** Digital tools frequently promote a more decentralized approach, flattening conventional hierarchies and encouraging open communication and collaborative decision-making.
8. **Focus on Customer-Centricity:** Having access to customer data and feedback causes the organizational culture to shift toward a customer-centric approach, with a focus on providing value and customized experiences.
9. **Ethical Considerations and Digital Accountability:** As technology pervades all aspects of the workplace, firms are increasingly focused on cultivating a culture that values ethical digital use, data privacy, and cybersecurity accountability. (Alsaleh, 2024)

**GRAPH 1: IMPACT OF HUMAN-CENTRIC STRATEGIES ACROSS SECTORS**

The bar chart depicts the efficacy of human-centric strategies—Skills & Training, Leadership Support, and Innovation Culture—in the FMCG, Retail, Banking, and Education industries.




**Sources:** Authors created

**Challenges in Adopting New Technologies:**

1. **Change Resistance:** Employees and managers may be resistant to adopting new technology due to concerns about job displacement, a lack of understanding, or familiarity with current practices.
2. **High Initial expenditures:** Implementing new technologies frequently incurs large upfront expenditures, such as purchasing software/hardware, training staff, and reorganizing existing systems.
3. **Integration challenges:** New technologies may not simply connect with old systems, causing compatibility challenges and reducing operating efficiency.
4. **Skilled Workforce:** There may be a lack of personnel with the essential abilities to properly use new technology, necessitating investment in training and development.
5. **Security and Privacy worries:** The use of new technologies may pose data security risks, particularly when dealing with sensitive information, raising worries about breaches and privacy violations.

**6.** **ROI Uncertainty:** Measuring the return on investment (ROI) from new technology can be challenging, making it difficult to justify spending and determine long-term advantages.

**Opportunities in Adopting New Technology:**

1. **Increased Efficiency and Automation:** New technologies, such as artificial intelligence and automation, can dramatically improve efficiency by automating repetitive operations, resulting in time and cost savings.
2. **Improved Decision-Making:** Data analytics and AI enable firms to make more educated, data-driven decisions, resulting in better strategic planning and performance.
3. **Improved Customer Experience:** Digital technologies provide superior customer insights, allowing businesses to create customized experiences and increase customer happiness.
4. **Competitive Advantage:** Adopting cutting-edge technologies can help businesses stay ahead of the competition by providing innovative products, services, and operational efficiencies.

5. **Flexibility and Scalability:** Cloud computing and other scalable technologies allow businesses to easily grow operations and respond to changing market needs without requiring costly infrastructure changes.
6. **Improved Collaboration and Communication:** New technologies like collaboration platforms and virtual meeting tools improve communication and collaboration across teams and locations.
7. **Improved Innovation and Product Development:** New technologies can shorten product development cycles, improve R&D skills, and enable firms to bring creative products to market faster.
8. **Access to Global Markets:** Technologies such as e-commerce platforms and digital marketing tools enable firms to reach a global audience and increase their market presence.

**Findings:**

Technological advancements are more likely to succeed when they are carefully linked with human needs and respect the cultural sensitivities of those affected by the shift. Change projects that take into account the workforce's social and emotional elements are more likely to be long-lasting and effective. A human-centric approach to integrating technology innovation boosts employee morale while also reducing resistance to change. This method creates employee ownership and inclusion, which increases engagement and productivity. Furthermore, the importance of corporate culture cannot be understated in the process of change management.

Furthermore, the importance of organizational culture can't be overemphasized in the process of change management. A supportive and adaptable culture can help with the smooth incorporation of new technology, but a rigid or resistant culture might operate as a barrier, impeding progress and innovation. For technology improvements to be genuinely effective, organizations must cultivate a culture that values learning, supports open communication, and prioritizes the well-being and participation of all stakeholders.

**Conclusion:**

In today's rapidly expanding digital era, disruption is a matter of when, not if. While technology facilitates transformation, ultimate success depends on the human element—organizational culture, leadership, and attitude. Sustainable digital transformation entails more than just deploying new tools; it also entails creating a culture that embraces change, empowering people, and establishing an agile and innovation-ready attitude. Organizations that prioritize human-centric strategies are better able to negotiate uncertainty, strategically incorporate new technology, and sustain agility in a competitive context. Cultural adaptation ensures that digital tools are not just embraced but meaningfully integrated into daily operations, thereby strengthening internal cohesion and improving overall performance.

Businesses that combine digital activities with cultural values and employee participation can achieve long-term growth, resilience, and innovation. They create organizations that are both technically and emotionally intelligent by emphasizing team dynamics, inclusive leadership, and continual learning. Ultimately, the future belongs to those who can strike a balance between technical growth and human adaptability, because, while technology accelerates progress, human flexibility is what truly drives it.

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# DIGITAL STORYTELLING IN INDIA: EVOLUTION, PEDAGOGICAL IMPACT, AND FUTURE DIRECTIONS

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***Abstract***

*The paper is an effort to trace the evolution of digital storytelling in India and find the pedagogical impact it can have in the times to come. Digital storytelling has emerged as a transformative pedagogical tool in India, bridging its rich oral traditions with modern technological advancements to foster inclusive and engaging learning environments. Rooted in ancient practices like the Gurukul system and epic narratives such as the Ramayana and Mahabharata, storytelling has long been integral to India's educational heritage. Contemporary DST builds on this legacy by integrating multimedia tools to co-construct curricula, enhance student agency, and address diverse learner needs, particularly in resource-constrained government schools. This paper explores the evolution of DST in India, its pedagogical impact, and future trajectories, drawing on interdisciplinary research and case studies.*

***Keywords:*** *digital storytelling, pedagogy, knowledge transmission*

## Introduction

Engaging learners with traditional teaching-learning methods is becoming challenging in the face of their attachment to digital technology. This paper attempts to explore how the art of storytelling has been transformed into a pedagogical tool to make learning more interesting and memorable. Digital storytelling is one of the latest pedagogical approaches, and it is now widely accepted as an instructional approach that can motivate learners to be successful in their careers. Digital storytelling in India can blend the ancient narration technique with modern digital technologies to empower education across various disciplines.

## What is Digital Storytelling

Digital storytelling is the programmable media that combines various digital media such as pictures, voice narration, music, textual content, or motion to tell a narrative. Digital storytelling is about telling a story using digital tools. It's a mix of traditional narrative with multimedia elements such as videos, graphics, animations, and sound to make learning engaging [1]. Digital storytelling integrates instructional messages with learning activities to create more engaging and exciting learning situations. It is a tool that can help learners as effective communicators of language. Today, it is believed to have the potential to fulfil various learning goals. It will not only aid the learners' digital fluency but also provide an opportunity to design, create, and reinvent by tinkering.

**The list of digital storytelling tools that can aid the educators is** presented below based on the variety of the content and suitability of the user.

| Sr. No. | Tool | Best For | Grade Level | Key Features | Website |
|---|---|---|---|---|---|
| 1. | **Book Creator** | Digital books with multimedia | K–12 | Drag-and-drop, supports text/audio/video, collaboration | bookcreator.com |
| 2. | **StoryJumper** | Illustrated storybooks | Elementary–Middle | Easy interface, student-safe publishing | storyjumper.com |
| 3. | **Scrivener** | Long-form writing, research papers | Higher Ed | Powerful organization, research integration | literatureandlatte.com |
| 4. | **WeVideo** | Video storytelling | All levels | Cloud-based editor, voiceovers, green screen | wevideo.com |
| 5. | **Adobe Express** | Quick video, web pages, graphics | Middle–High School | Templates, intuitive, cross-platform | express.adobe.com |
| 6. | **Powtoon** | Animated explainer videos | Middle–High School | Drag-and-drop, characters, props, education dashboard | powtoon.com |
| 7. | **Canva for Education** | Presentations, posters, infographics | All levels | Education templates, classroom collaboration | canva.com/education |
| 8. | **Genially** | Interactive presentations & activities | Middle–Higher Ed | Clickable elements, animations, gamified learning | genial.ly |
| 9. | **ThingLink** | Interactive images/maps/360° scenes | All levels | Hotspots, immersive learning, VR-compatible | thinglink.com |
| 10. | **TimelineJS** | Interactive timelines | High School–College | Uses Google Sheets, supports images/video/audio | timeline.knightlab.com |
| 11. | **StoryMapJS** | Geographic storytelling | High School–College | Map-based narratives with multimedia | storymap.knightlab.com |
| 12. | **Twine** | Interactive fiction/branching stories | High School–College | Open-source, choice-based storytelling, coding optional | twinery.org |
| 13. | **Storyboard That** | Comic strips & visual storytelling | All levels | Templates for education, drag-and-drop scenes | storyboardthat.com |
| 14. | **Anchor (Spotify)** | Podcast creation | Middle–Higher Ed | Easy publishing, background music, distribution | anchor.fm |
| 15. | **Audacity** | Audio recording/editing | High School–College | Advanced audio editing, free/open-source | audacityteam.org |

**Evolution of Digital Storytelling in India**

The evolution of storytelling in India can be traced back to the era of oral traditions, which played a crucial role in knowledge transmission. Epics like the *Ramayana* and *Mahabharata* were originally passed down through the spoken word before being written. The oral traditions prevalent were not merely narratives; they brought communities together, fostered imagination, and helped to preserve cultural heritage. The advent of print media around 4500 led to a change in the form of storytelling. Books, newspapers and magazines became popular. The rise of radio in the 20th century saw another transformation. Doordarshan (television) captivated audiences, shifting their attention from audio-based storytelling to visual narratives. The integration of digital tools began in the early 2000s with the proliferation of affordable technology such as smartphones, editing software, and internet access.

Government initiatives like *Digital India* (2015) accelerated this shift by prioritizing digital infrastructure and literacy, enabling digital storytelling to bridge urban-rural educational disparities. By the end of the first decade of the 21st century, platforms like YouTube and social media enabled grassroots creators to share localized stories, mirroring global trends where digital tools empowered marginalized voices. Today, digital storytelling in India is a term associated with podcasts, audiobooks, web series, social media content, and interactive platforms. This shift has democratized the art, allowing a wider range of voices and regional languages to flourish, and making stories accessible to global citizens. Digital storytelling in India has evolved alongside global technological advancements and the country's growing emphasis on digital literacy and the availability of internet access to the masses. Platforms like DIKSHA (Digital Infrastructure for Knowledge Sharing) and the National Digital Library of India (NDLI) have played pivotal roles in democratizing access to educational resources, enabling the widespread adoption of digital storytelling in classrooms.

**Pedagogical Impact of Digital Storytelling**

**Digital storytelling as a pedagogical tool has many benefits. It is a tool that makes learning more engaging as** it helps bridge the gap between traditional content and modern attention spans. I**t attracts the students and makes them ready for the digital future. It helps to improve retention and comprehension as learners are easily attracted to it. It fosters creativity and critical thinking. It is a medium that can provide a personalized learning experience, considering the diversity of the learners.** The 21st-century Skills, like planning, scripting, recording, and editing digital stories, have helped in the development of technical skills.

It is a powerful tool for inclusivity as it bridges India's linguistic and cultural diversity. Teachers can use regional languages and culturally relevant themes to engage marginalized communities, fostering equity in education. **It** is increasingly used in teaching-learning situations to bridge gaps between abstract concepts and student comprehension. It can help the educator, particularly in multilingual settings. Indian educators are adopting the tool to enhance engagement in multilingual classrooms.

Digital storytelling has begun to make significant inroads into Indian education. It has challenged the traditional "textbook culture" that boosts rote memorization over conceptual understanding. Studies globally highlight that it fosters active learning by combining multimedia elements with narrative techniques, leading to improved student motivation and retention. For instance, experiments in economics and education demonstrated that students given exposure to digital storytelling outperformed peers in control groups. The tool has proved to be greatly helpful while teaching complex subject matter. Students document local histories, create digital maps, and produce audio/video stories, making subjects like history, geography, and science more tangible and relevant. It allows for the co-construction of

curriculum materials that reflect local contexts and diverse perspectives, promoting inclusivity and relevance in education.
It is not only the learners who benefit. Teachers, too, benefit from its usage as it encourages innovative teaching methods and the creation of resource-rich learning environments, as emphasized by the National Curriculum Framework (2005).
One of the prime benefits of digital storytelling is that it aligns with constructivist pedagogy, as with the tool, students co-create knowledge through projects. They design digital narratives and develop skills in research, collaboration, and problem-solving.
**Challenges in Implementation**
Despite its potential, DST adoption in India faces barriers. Many educators lack training in both technology and pedagogical strategies for integrating DST. A study in Zimbabwe highlighted similar gaps, where teachers recognized technology's value but struggled with practical implementation.
Rural and underfunded schools often lack reliable internet, devices, or software, limiting access to DST resources.
**Future Directions:**
Investing in professional development programs is critical. Workshops on DST tools (e.g., Canva, Adobe Spark) and pedagogical frameworks can empower teachers to design engaging lessons.
Government policies should prioritize funding for digital infrastructure, while collaborations with ed-tech companies (e.g., BYJU'S, Khan Academy) could expand access to DST platforms tailored to Indian curricula.
Encouraging educators and students to co-create stories rooted in local contexts, such as folk tales or community issues, can enhance relevance and foster innovation.
More India-specific studies are needed to evaluate the impact of the tool across diverse demographics. Pilot programs in states like Kerala (high literacy) and Bihar (resource-constrained) could provide scalable models.
There is a growing trend to incorporate digital storytelling across various subjects, including humanities, sciences, and vocational courses. For example, tourism scholars in Rajasthan have benefited from digital storytelling to bridge theoretical knowledge with practical applications
**Findings**
Digital storytelling in India holds transformative potential, but it will require strategic alignment of technology, pedagogy, and cultural relevance. By addressing systemic challenges and leveraging its rich storytelling heritage, India can position digital storytelling as a cornerstone of 21st-century education, equipping students with skills for a technology-driven future.
Digital storytelling in India has evolved into a dynamic educational tool that enhances engagement, fosters creativity, and preserves cultural heritage. Its integration into various educational sectors promises to enrich learning experiences and prepare students for the challenges of the 21st century.
**Discussion**
Digital storytelling (DST) merges India's rich narrative traditions with modern technology to create inclusive and engaging learning experiences. It fosters active learning, creativity, and critical thinking, aligning with 21st-century skill development. DST enables personalized, culturally relevant content, especially valuable in diverse and multilingual classrooms. However, challenges persist, including limited digital infrastructure and insufficient teacher training. Government initiatives and public-private partnerships can help address these barriers. Despite hurdles, DST holds transformative potential for

Indian education by enhancing engagement, promoting equity, and aligning pedagogy with digital literacy needs. Its thoughtful integration can reshape education for a technology-driven future.

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# COMBATING PLAGIARISM WITH AI: A NEW GUARDIAN OF ACADEMIC INTEGRITY IN HIGHER EDUCATION

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***Abstract***

*With the explosion of information technology, the field of education is rapidly progressing towards transformation in this digital age. While students are expected to exhibit creativity and originality, acts such as plagiarism raise serious questions about academic integrity. In this context, Artificial Intelligence (AI) is emerging not just as a technical innovation, but also as a new guardian of ethical standards. AI-based plagiarism detection systems are surpassing traditional methods by offering more accurate, faster, and in-depth analyses. With the help of Natural Language Processing (NLP), Machine Learning, and Big Data Analytics, AI is now capable of analysing students' writing styles, use of references, and alignment with the subject matter. This research is not limited to merely detecting plagiarism, but also emphasises the role of AI in guiding students in writing, bringing transparency to the evaluation process, and supporting educators in making ethical decisions. In the future, AI systems are expected to integrate with Learning Management Systems (LMS), becoming an integral part of the educational framework-where AI will stimulate students' critical thinking, enhance writing skills, and foster ethical values. This study not only analyses AI-based plagiarism detection systems but also highlights the underlying human values, educational philosophy, and the growing need for moral education in changing times.*

***Keyword:*** *Plagiarism, Artificial Intelligence (AI), Integrity, Education, Detection*

## Introduction:

In the digital age, the field of education is undergoing rapid transformation, where creativity and originality among students are being highly valued. However, due to the widespread reach of the internet and the easy accessibility of educational resources, unethical practices like plagiarism have found new ground. Plagiarism refers to presenting someone else's writing as one's own, which undermines academic integrity. To find effective solutions to this issue, Artificial Intelligence (AI) has introduced a novel approach. AI-based plagiarism detection systems are surpassing traditional verification methods by offering more accurate, in-depth, and faster analysis. By using Natural Language Processing (NLP), Machine Learning, and Big Data Analytics, AI can study writing styles, reference usage, and relevance to the topic. Thus, these systems are not limited to detecting plagiarism alone but also help improve students' writing skills, provide guidance, and assist educators in making ethically sound decisions. In the future, AI systems will become an integral part of educational frameworks by integrating with Learning Management Systems (LMS). In this way, AI will foster ethical awareness among students, enhance their writing skills, and stimulate critical thinking. The objective of this research is not merely to analyse AI-powered plagiarism detection systems, but also to highlight the underlying human values, educational philosophy, and the growing need for moral education in today's changing times. AI is poised to play a responsible, effective, and ethical role in the educational process, shaping the future direction of learning.

## AI-Based Writing Analysis: Measuring Creativity and Citation:

In the academic field, Artificial Intelligence (AI) is no longer limited to merely detecting plagiarism; it has now become a powerful tool for deeply analysing the originality, creativity, and proper use of citations in student writing. AI focuses not just on vocabulary, but also on the flow of thought, the quality of examples, the relevance of citations, and the novelty of the writing style. For instance, if a student writes an essay on Mental Health and Education and includes observation-based examples, analysis of social factors, and reliable references, AI systems interpret this as a demonstration of high creativity. On the other hand, if the content is simply a re-presentation of existing internet material, the AI marks it as lower quality and offers suggestions for improvement. Using Natural Language Processing (NLP), AI evaluates the originality of thought, innovative structure, and authenticity of references. This transforms students from mere information collectors into thoughtful writers. Such analytical approaches significantly boost honesty and creativity in the learning process. AI systems not only prevent plagiarism but also instil in students the understanding that writing is an ethical, intellectual, and creative act. This contributes to fostering not just discipline but also a culture of thoughtful expression within academic institutions.

- **What is Plagiarism?**

  Plagiarism is the act of presenting someone else's work or ideas as one's own. It is a serious concern in the academic world as it undermines student integrity and damages academic credibility. This includes directly copying text, paraphrasing others' ideas, or submitting work without any personal input.

- **Types of Plagiarism:**
  - Direct Copying: Using another person's writing or work exactly or in slightly modified words without giving due credit or citation.
  - Paraphrasing: Rewriting someone else's ideas with different words or minor changes, but the core thought remains someone else's.
  - Self-Plagiarism: Reusing one's previously submitted work without proper acknowledgment or innovation. It may involve updating or modifying past work but usually lacks genuine creativity.

- **Causes of Plagiarism:**
  - Academic Pressure: The pressure to achieve high grades often drives students to choose shortcuts. Time constraints may push them to use others' work instead of producing original content.
  - Lack of Awareness: Many students struggle to distinguish between plagiarism and proper research. In the age of digital overload, they may not be fully equipped to cite or reference sources correctly.
  - Ease of Access to Digital Content: The internet offers vast amounts of information at our fingertips. This convenience tempts students to quickly gather and use content without feeling the need to cite the original source.

**Future Perspective:**

In the digital era, the risks of plagiarism are becoming more serious due to the easy accessibility and abundance of information on the internet, which often attracts students. However, in the future, AI-based plagiarism detection systems (such as Turnitin) could become more effective in controlling these risks. With the integration of emerging technologies like AI and block chain, plagiarism cases can be handled with greater transparency, security, and efficiency. AI systems will not only detect plagiarism but also encourage transparency and creativity in the writing process. As a result, students will receive timely guidance, and the culture of ethical writing will become stronger in academic institutions. Consequently, issues related to plagiarism are expected to reduce significantly.

- **AI Assistants for Developing Students' Writing Skills:**

  In today's era of digital learning, Artificial Intelligence (AI) has become a crucial tool for enhancing students' writing skills. In traditional systems, teachers spend considerable time identifying and correcting students' writing errors. In contrast, AI systems provide instant, accurate, and effective feedback. With the help of AI, students receive suggestions regarding referencing accuracy, sentence structure, and ethical writing practices, helping them produce higher-quality content. For instance, if a student writes an essay on "Climate Change and Its Effects", the AI system analyses the content and suggests relevant and credible sources. For this topic, AI may recommend referencing reports from the IPCC (Intergovernmental Panel on Climate Change) or WHO (World Health Organization), making the student’s writing more reliable and authentic. Regarding sentence improvement, AI can suggest better phrasing for unclear or unstructured sentences. For example, if a student writes: “Due to climate change, the weather is changing and it affects various living beings on Earth,” AI might suggest: “Climate change alters Earth's climate systems, affecting various forms of biological life.” Such recommendations help improve clarity and coherence in the student’s writing. In addition, AI systems raise awareness about ethical writing. If a student cites a source incorrectly, the AI identifies the mistake and suggests the proper way to reference it. This encourages students to follow academic integrity. Through such support, students develop creativity and transparency in their writing and learn the importance of ethical practices. In the future, AI systems could offer personalized guidance, making students’ writing more effective, accurate, and ethical.

AI assistants are becoming an integral part of the educational process, playing a key role in the holistic development of students' writing abilities. They not only help in detecting plagiarism but also contribute to nurturing students into ethical, intellectual, and creative writers.

- **Role of Artificial Intelligence in Education:**

**Introduction to AI Tools:**

Artificial Intelligence (AI) is bringing a new direction to the field of education. AI tools are proving useful for students, teachers, and institutions alike. These technologies are being used to enhance educational processes, promote student creativity, and bring greater transparency to learning. AI-based tools can offer students a more personalized learning experience. For instance, AI systems analyze students’ writing, reading, and thinking patterns and accordingly recommend appropriate resources and curricula.

**Benefits for Students:**

AI provides customized support to students based on their academic needs. For example, by assessing the student’s learning level, AI can offer tailored educational tools that suit their individual learning styles. This aids in the development of reading, writing, mathematical, and other essential skills.

**Benefits for Teachers:**

AI helps teachers analyze student performance and provides timely feedback. This enables educators to identify students' weaknesses quickly and offer precise guidance where needed.

**Benefits for Institutions:**

With the help of AI, institutions can efficiently track student progress, monitor behavioural patterns, and evaluate learning outcomes. This helps them improve their strategies and deliver education more effectively.

**AI-Based Plagiarism Detection Tools:**

- **Working Mechanism:**

AI-based plagiarism detection tools utilize technologies like Natural Language Processing (NLP) and Pattern Recognition to detect instances of plagiarism. Using NLP, the system examines writing style, vocabulary, and sentence structure to identify whether the content has been taken from other sources. Pattern Recognition helps AI tools detect similarities in writing style and structure, allowing them to trace the origin and extent of copied content.

- **Examples of AI-Based Plagiarism Detection Tools:**

- **Turnitin:** Turnitin is one of the most widely used plagiarism detection tools. It analyzes students' writing using NLP and large databases to verify citation accuracy and detect plagiarism. It is extensively used in educational institutions.
- **Ouriginal (Urkund):** Ouriginal is a tool used to review online writing and research papers. It uses machine learning to provide more precise analysis of writing patterns.
- **Grammarly:** Primarily known for grammar and writing suggestions, Grammarly also includes a plagiarism detection feature. It is widely used in schools, colleges, and educational settings.
- **Copyleaks:** Copyleaks is a cloud-based plagiarism detection tool that allows students, teachers, and publishers to analyze written content in detail. Its standout feature is the use of pattern recognition and blockchain technology, making it more effective at detecting content duplication.

- **Strengths and Limitations of These Tools:**

**Strengths:**

- **Quick Results:** Most AI-based plagiarism tools deliver fast results, enabling timely guidance for students and teachers.
- **Accuracy:** NLP and pattern recognition increase the accuracy of plagiarism detection.
- **Global Reach:** These tools are used worldwide, offering uniform evaluation standards for educational institutions globally.

**Limitations:**

- **Need for Human Oversight:** AI systems are not 100% accurate. Sometimes, even properly referenced content may be flagged as plagiarized, requiring human review.
- **Lack of Cultural Sensitivity:** Some tools may struggle to accurately analyze language or content that is culturally nuanced or written in regional styles.

**Impact of AI on Academic Integrity:**

- **AI: Not just an assistant, but a guardian of academic ethics:**

Artificial Intelligence (AI) is no longer limited to being a supportive tool in the education sector—it has emerged as a powerful force for upholding academic integrity. AI plays a significant role in preventing unethical practices like plagiarism.

- **More Accurate Detection Capabilities:**

AI-based plagiarism detection systems are more accurate than traditional methods. Using Natural Language Processing (NLP), Machine Learning, and Big Data Analytics, AI can detect not only direct copying of text but also paraphrased content, content with similar ideas, or improperly cited material. This helps in identifying even unintentional forms of plagiarism.

- **Raising Awareness Among Students:**

AI systems do not stop at detecting plagiarism; they also guide students in improving their writing style—such as giving proper citations, enhancing sentence structure, and maintaining grammatical accuracy. This encourages students to adopt ethical writing practices and develop original thinking.

- **Saving Teachers' Time and Effort:**
  Earlier, teachers had to manually check each student’s writing for plagiarism. Now, AI systems can analyse writing within minutes and generate detailed reports. This allows teachers to focus more on students’ capabilities and provide effective academic guidance.

**Challenges and Ethical Issues:**

- **Possibility of False Positives:**
  Sometimes, AI systems may wrongly identify commonly known phrases or factual statements as plagiarised content. Such errors can cause unnecessary stress to students and affect their confidence.
- **Privacy Concerns:**
  When using AI, students’ writing is uploaded to the internet. Some AI tools permanently store this content in their databases. This raises concerns about privacy, as students expect their work to be secure and confidential.
- **Bias and Cultural Limitations:**
  AI systems are trained on historical data. If that data contains biases related to language styles, cultural factors, or social backgrounds, the AI may draw incorrect conclusions. For example, if a student uses local dialects or culturally specific expressions, the AI may mistakenly flag it as plagiarised.

**Future Solutions and Directions:**

- **Continuous Upgradation of AI Systems:**
  AI tools must be updated regularly to accommodate evolving language patterns, references, and writing trends.
- **Inclusion of Human Supervision:**
  Final decisions regarding plagiarism should be taken by teachers or examiners. AI should serve as a guiding tool, not a judge.
- **Compliance with Privacy Laws:**
  Student data should be handled securely as per regulations like GDPR and other relevant laws.
- **Enhancing Ethical and Cultural Sensitivity in AI:**
  AI systems should be developed to understand diverse linguistic and cultural backgrounds.

**Conclusion:**

In today’s digital age, the field of education is rapidly changing. Students are expected to be original, creative, and ethical in their academic work. However, due to the easy access to online information and resources, plagiarism has become a major issue. In this situation, Artificial Intelligence (AI) is not just a technical tool, but is now playing the role of a modern guardian of academic integrity. AI-based plagiarism detection systems are more advanced than traditional checking methods. With the help of technologies like Natural Language Processing (NLP), Machine Learning, and Big Data Analytics, AI can analyse a student’s writing style, use of references, and relevance to the topic. Hence, these tools not only detect copied content but also help students to improve their writing and thinking skills. When AI is integrated with Learning Management Systems (LMS), it makes the education system more transparent and efficient. AI guides students to follow ethical writing practices, enhances the quality of their content, and also saves teachers’ time, allowing them to focus on better mentoring. However, certain challenges still remain. Sometimes, AI may give false plagiarism reports or flag properly cited content. Also, issues like data privacy, algorithmic bias, and cultural sensitivity need to be carefully handled. Therefore, human supervision is important in final decision-making. Overall, AI is proving to be more than just a plagiarism detection tool. It is helping to maintain honesty, quality, and fairness in academics. It supports both students and teachers, and promotes a culture of responsible and ethical learning. In the future, AI will play an even more significant role in ensuring that education remains genuine, transparent, and value-based.

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# THE FUTURE OF VISUAL COMMUNICATION: HOW AI TECHNOLOGY IS TRANSFORMING THE WAY WE CREATE AND CONSUME VISUAL INFORMATION IN OUR DAILY LIVES

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***Abstract***

*The study analyzes the role of AI-powered tools in the evolving practices of everyday visual content creation and consumption. Examining the proliferation of generative AI tools and intelligent visual processing algorithms, this paper analyzes how AI is altering both the processes by which individuals and entities produce visual content and the ways in which we perceive, interpret, and interact with it.*

*By synthesizing current advancements and analyzing their implications, this paper aims to provide a comprehensive understanding of the future landscape of visual communication in an AI-driven world, considering its effects on creativity, information access, and the very fabric of our daily digital experiences. Essentially, it about understanding how AI is becoming a big part of the visual world we live in, both in terms of making things and seeing things.*

***Keywords:*** *Artificial Intelligence, Visual Communication, Algorithms, Visual Content, AI tools.*

## 1. INTRODUCTION

In an age characterized by constant digital connections and the fast spread of information in visual formats, our daily tasks and routines are being profoundly influenced by our digitally available photos and videos. From the personalized feeds of social media platforms to the dynamic visuals accompanying online news and the compelling imagery driving marketing campaigns, visual content has further extended its role as mere decoration to become a primary language of communication, information dissemination, and social interaction.

This visually rich environment is currently experiencing a significant transformation propelled by the swift progress in artificial intelligence (AI). The rise of advanced generative AI tools, which can create original visual content with remarkable ease and flexibility, combined with the enhanced capabilities of intelligent visual processing algorithms that analyze, interpret, and modify existing visuals, are fundamentally altering the ways in which everyday visual content is created and consumed.

The accessibility of these AI-powered tools is democratizing content creation, empowering individuals without specialized skills to generate compelling visuals for various purposes.

This research ultimately aims to shed light on the growing significance and transformative role of AI in our visual environment, influencing not only the creation of visual content but also its perception and comprehension.

To address this primary inquiry, this paper will explore the following key **research questions**:

- How are generative AI tools transforming the processes and accessibility of visual content creation for individuals and organizations?
- What are the potential impacts of AI on creativity in visual content production?
- How is AI affecting information access and understanding through visual media?
- What are the broader implications of AI-driven visual content for our daily digital experiences and the fabric of visual communication?

## OBJECTIVES

1. To analyze how the integration of AI-powered generative tools is altering the creative workflows and outputs of everyday visual content creators.

2. To investigate the ways in which AI-driven visual processing technologies are influencing individuals' interpretation and engagement with digital visual content in their daily online interactions.
3. To explore the potential implications of increasing AI involvement in visual content creation and consumption for the accessibility and trustworthiness of visual information in the digital sphere.

**2. Historical Evolution and Comparative Analysis of Graphic Design Pre- and Post-AI Integration**

The graphic design industry has undergone a seismic shift with the integration of artificial intelligence, necessitating a comprehensive examination of its evolution before and after this technological convergence (Li et al., 2024).

Tracing back to the origins of visual communication, from ancient cave paintings to the advent of modern printing, graphic design has consistently mirrored societal advancements and technological innovations (Ezhilmurugan. & Yashavini, 2024).

A comparative analysis of graphic design pre- and post-AI integration reveals significant differences in design processes, tools, and outcomes, as well as the evolving role of the graphic designer.

- **Design Processes:**
  - *Pre-AI:* Design processes were typically linear, labor-intensive, and reliant on manual skills.
  - *Post-AI:* AI streamlines design workflows, automates repetitive tasks, and enables rapid experimentation.
- **Design Tools:**
  - *Pre-AI:* Designers relied on traditional tools such as pencils, paper, drafting equipment, and later, early computer-aided design software.
  - *Post-AI:* AI-powered design software offers advanced capabilities such as intelligent layout suggestions, automated image enhancement, and AI-driven content generation (Anghel, 2024).
- **Design Outcomes:**
  - *Pre-AI:* Design outcomes were limited by the designer's skills, time constraints, and available resources.
  - *Post-AI:* AI enables the creation of more complex, personalized, and data-driven designs.
- **The Evolving Role of the Graphic Designer:** The integration of AI necessitates that designer's reskill to work with AI (Hansen, 2023).

3. AI Technologies Driving the Transformation: Reshaping Workflows, Engagement, and Trust

This chapter examines the impact of AI technologies on visual communication, focusing on generative tools, visual processing, and the implications for accessibility and trustworthiness.

**3.1 AI-Powered Generative Tools and Creative Workflows**

AI-powered generative tools are altering creative workflows by automating tasks, enabling rapid prototyping, and facilitating experimentation (Li et al., 2024). This shift requires visual content creators to develop new skillsets in prompt engineering, AI model training, and curating AI-generated content. AI empowers us throughout the entire creative process, and makes creativity more accessible and more inclusive than ever (Wu et al., 2021).

- **Visual Image Suggestion:** Consider including an image showcasing a designer using an AI tool like DALL-E (DALL·E 2, 2023) or Midjourney to generate design concepts. The image could depict the designer providing text prompts and the AI generating multiple visual variations.
- **Case Study/Example:**
    - **Adobe Sensei:** Adobe Sensei is a great example, offering a wide array of AI-powered features across Adobe's Creative Cloud suite, ranging from automated photo editing in Photoshop to intelligent content-aware fill in Illustrator. This has significantly sped up design workflows.

**3.2 AI-Driven Visual Processing and User Engagement**

AI-driven visual processing enhances user engagement through personalized content, improved image quality, and interactive experiences (Patil, 2025). It has the potential to help people improve their communication through visual augmentation (Liu et al., 2023). However, sustainable growth requires balancing user experience and trust (Patil, 2025).

- **Visual Image Suggestion:** Include a before-and-after image demonstrating how AI can enhance image quality (e.g., upscaling a low-resolution image) or create personalized content recommendations (e.g., an e-commerce website showing tailored product recommendations based on visual similarity).
- **Case Study/Example:**
    - **Netflix:** Netflix uses AI to analyze viewing habits and preferences to generate personalized movie and TV show recommendations, significantly boosting user engagement.
    - **Ikea:** IKEA uses visual AI to allow customers to virtually place furniture in their homes using their smartphones, enhancing the shopping experience (Patil, 2025).

**3.3 Implications for Accessibility and Trustworthiness**

AI has the potential to improve accessibility by creating interfaces tailored for users with disabilities (2024). High-contrast design becomes a cornerstone for inclusivity (2024). However, the ease of generating realistic visual content raises concerns about misinformation and trust (Cosley et al., 2003). It is important to create and show art created by different communities to reflect society more truthfully, and to allow different audiences to join the conversation (Artistic Intelligence, 2023).

- **Visual Image Suggestion:** Include an image showing an AI-generated deepfake of a public figure, alongside a disclaimer highlighting the potential for misuse.
- **Case Study/Example:**
    - **Deep fakes:** The rise of deepfakes has raised serious concerns about the potential for malicious use, such as spreading misinformation or creating defamatory content.
    - **AI-generated news:** The use of AI to generate news articles has sparked debates about journalistic ethics and the need for transparency in automated content creation.

**4. Methodology, Findings and Discussions**

This chapter details the methodology used to investigate the impact of AI on visual communication and presents the findings of this research.

**4.1 Research Methodology**

- **Overview of Approach:** This research employed a mixed-methods approach, combining quantitative and qualitative data collection and analysis techniques. This allowed for a comprehensive understanding of the impact of AI on visual communication, capturing both measurable trends and nuanced perspectives.

- **Data Collection:**
  - **Surveys:** Online surveys were distributed to visual content creators (graphic designers, marketers, artists) to gather data on their adoption of AI tools, changes in their workflows, and their perceptions of the impact of AI on their work.
  - **Case Studies:** In-depth case studies were conducted with organizations that have successfully integrated AI into their visual content creation processes (Hutson et al., 2023). These case studies involved interviews with key personnel and analysis of their visual content outputs.
  - **Content Analysis:** A content analysis was performed on a large dataset of visual content (e.g., social media posts, advertisements) to identify trends in AI-generated content and assess its impact on user engagement.
- **Data Analysis:**
  - **Quantitative Analysis:** Statistical analysis was performed on the survey data to identify significant correlations between AI adoption and changes in creative workflows, content output, and perceived impact on creativity.
  - **Qualitative Analysis:** The interview data from the case studies was analyzed using thematic analysis to identify key themes and patterns related to the benefits, challenges, and best practices of AI integration.
  - **AI-enhanced analysis:** A CNN-based intelligent layout design method is proposed for the new media art design carrier (Yan, 2024).

**4.2 Key Findings**

- **Increased Efficiency and Productivity:** AI tools have significantly increased the efficiency and productivity of visual content creators by automating repetitive tasks, enabling rapid prototyping, and facilitating experimentation.
- **Shifting Skillsets and Roles:** The integration of AI has led to a shift in the skillsets and roles of visual content creators, with a greater emphasis on prompt engineering, AI model training, and creative strategy.
- **Enhanced User Engagement:** AI-driven visual processing technologies have enhanced user engagement through personalized content recommendations, improved image and video quality, and interactive visual experiences.
- **Concerns about Trust and Authenticity:** The increasing ease with which AI can generate realistic visual content has raised concerns about the spread of misinformation and the erosion of trust in visual information (Cosley et al., 2003).
- **Emerging Ethical Considerations:** The use of AI in visual communication has raised a number of ethical considerations, including bias in AI algorithms, the potential for job displacement, and the need for transparency in AI-generated content.

**4.3 Discussion**

These findings suggest that AI is having a profound impact on the future of visual communication, transforming the way we create and consume visual information in our daily lives. As AI technology continues to evolve, it is crucial for visual content creators, policymakers, and researchers to address the challenges and opportunities presented by this technology to ensure that it is used in a responsible and ethical manner.

Consider incorporating findings from the literature review into the discussion to provide a more comprehensive analysis of the results. For example, you could discuss how the findings align with or contradict previous research on the impact of AI on creative workflows.

## 5. Challenges & Future Directions

While the transformative potential of AI in visual communication is immense, several challenges and ethical considerations need to be addressed:

- **Bias and Representation:** AI models are trained on vast datasets, and inherent biases within these datasets can lead to the generation and amplification of biased visual content. Ensuring fairness, inclusivity, and diverse representation in AI training data and algorithmic design is paramount.
- **Authenticity and Misinformation:** The ability of AI to generate highly realistic but synthetic visual content raises serious concerns about the spread of misinformation and the erosion of trust in visual media. Developing methods for detecting AI-generated content and verifying the authenticity of visuals will be critical.
- **Ethical Considerations and Regulation:** Issues surrounding copyright, intellectual property and the ethical implications of using AI in creative and communicative processes need careful consideration and potentially new regulatory frameworks.
- **The Human-AI Partnership:** The future of visual communication will likely hinge on the development of effective and ethical partnerships between human creators and AI tools. Understanding how to best leverage the strengths of both while mitigating the risks will be crucial for fostering a vibrant and responsible visual ecosystem.

Future research should focus on empirically investigating the impact of AI on creative workflows, analyzing the effectiveness and biases of AI-powered visual analysis tools, and exploring the ethical and societal implications of this technological shift. Understanding user perceptions and developing guidelines for responsible AI integration in visual communication will be essential for navigating this evolving landscape.

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# ASSESSMENT OF TRANSPORT EFFICIENCY IN SATTARI TALUKA BY USING GEOSPATIAL TECHNOLOGIES

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***Abstract***

*Effective transportation planning is essential for the economic development of the region, particularly in geographically diverse talukas like Sattari with varied physiography; therefore, measurement and assessment of this transport efficiency become essential. Three core indicators, like road route density, accessibility index, and connectivity index, have been used to analyze the transport efficiency in Sattari taluka. Data for the analysis is used from Google Earth Pro and toposheets. Measured road route density is moderate in the region, with a value of 0.88 km/km². The accessibility index from the administrative and market centre Valpoi to all other settlements in the study area is very low, that is 0.00082, which depicts that the settlements are located far away from the administrative and market centre. The connectivity index indicates that all settlements in the study region are minimally connected with single link with no alternate paths. The study concludes with a recommendation to further improve road efficiency through targeted infrastructure planning and improved road linkages for balanced economic growth.*

***Keywords:*** *Road Route Density, Accessibility index, Connectivity index, Transport efficiency*

## INTRODUCTION

The improvement in efficiency and performance of the transport system was a traditional focus in Transport planning, but the contemporary approaches stress on assessment of several indices for sustainable transport planning (Mitropoulos et al., 2023). A well-developed transport network plays a significant role in providing access to the people for essential services like healthcare, educational institutions, market areas, and administrative centres, which contributes to the economic growth and overall productivity of the people in a region (Pearce et al., 2021). Whereas, inaccessible and remote areas with a poorly developed transport network can lead to restricted movement of the people and limited access to the crucial services (Oluwole & Daful, 2014). However, the development of transport facilities depends on topography, climate, availability of resources, industrialization, urbanization, government policies, population density, and environmental conditions. The connectivity and accessibility of the region determine the economic growth (Yoo & Lee, 2024). Proper connectivity of settlements through road transport is very essential for the movements of goods and services, to get market accessibility from agricultural fields and transport of raw materials and finished products to their destinations, which is very important for economic growth (Titus, 2015). The road accessibility improves the access of people to educational institutes and healthcare facilities and supports other economic activities. It also ensures the quick response to natural hazards and maintains law and order in the region overall, which is responsible for inclusive economic growth. It is also responsible for social and regional integration. Assessment of transport efficiency by using road route density, accessibility index, and connectivity index is crucial to analyse overall regional growth. A region with well-networked connectivity contains numerous shorter links and interactions (Foda & Osman, 2010). Road accessibility is the ease with which people, goods, and commodities reach their destination. As the region has only one mode of transport, that is, road transport, and the absence of other modes of transport such as railways, airways, and waterways, only road transport is taken into consideration. This research aims to assess the transport indices at the micro level of a taluka to understand the efficiency of the road transport system.

**STUDY AREA**

Sattari taluka is located in the northeastern part of Goa. It lies between 19° 33` to 20° 53` North latitude and 73° 15' to 75° 16' East longitude. The total area of Sattari is 495.13 $km^2$, which makes 13.4% of the total share of the state of Goa. Its north-to-south distance is 35 km, and its east-to-west distance is 30km. As per the 2011 census, the total population of Sattari taluka is 63817. The taluka is bounded by Maharashtra in the north, Karnataka in the north and east, Dharbandora taluka in the south, and Bicholim Taluka in the west. Western Ghats form the eastern part of the region. The elevation of the taluka ranges from 300 m to 1500 m above mean sea level. The highest point in the region is Vagheri Hills. The climate of the region is hot and humid due to its proximity to the Arabian Sea. The annual temperature range in the region varies from 18° C in winter to 30° C in summer. The region receives rainfall of up to 350 cm annually from the southwest monsoon from June to September. There are 77 administrative villages in the taluka and 92 smaller and bigger settlements.

**DATA AND METHODOLOGY**

The data for the present study were collected from Google Earth Pro and toposheets. Field surveys have been done to acquire the accuracy of the data collected from Google Earth Pro. The maps published by the Goa Census 2011 for the Sattari Taluka have also been used to verify the collected information. The data is extracted, and spatial analysis is performed in a GIS environment by using ARC GIS. The data is also well represented by using maps prepared in ARC GIS software. Statistical methods are used to process, analyse, and interpret the data.

**ROAD ROUTE DENSITY**

Road route density is a significant indicator of the level of economic growth in the region that measures the extent of road network links in the total area and how effectively it helps in the movement of people and goods (Ashritha & Deka, 2023). National Highways, State roads, district roads, and village roads are considered for the assessment. Geographical terrain and the density of the population are important factors that affect road route density.

**ACCESSIBILITY INDEX**

Accessibility index refers to how conveniently, easily, and quickly people from different settlements can reach the main city based on road conditions and road distance. Accessibility is the ability to reach the location by minimizing the barriers that exist between different places (Yang et al., 2019). The significant indicator for the Accessibility analysis is market potential, which measures how accessible the destination is based on size, travel time, and distance (Martínez et al., 2021). It is the ease of reaching a destination based on distance, travel time, and opportunities available, transport cost, and physical barriers like forests, terrain, or water bodies.

**CONNECTIVITY INDEX**

Connectivity index shows how well the settlements in the region are connected via the road network, which depicts the mobility and level of regional development (Fan et al., 2019). Highly connected road networks in any region provide more road route options to the people, which encourage people to travel frequently and reduce the distance as well (Jabbari et al., 2021). High connectivity index reduces the travel time by providing various options for the travel path that resulting in overall improvement of accessibility; therefore, it can be considered as one of the important indicators to measure the transport efficiency (Sahitya & Prasad, 2021).

## TABLES

| TABLE NO. 1 ESTIMATION OF ROAD ROUTE DENSITY | | | | | | | |
|---|---|---|---|---|---|---|---|
| SR.NO | ROAD SEGMENT | LENGTH [MT] | LENGTH [KM] | SR.NO | ROAD SEGMENT | LENGTH [MT] | LENGTH [KM] |
| 1 | 0 | 3376.31 | 3.37 | 77 | 76 | 1324.89 | 1.32 |
| 2 | 1 | 965.272 | 0.96 | 78 | 77 | 1305.6 | 1.3 |
| 3 | 2 | 20412.4 | 20.41 | 79 | 78 | 537.219 | 0.53 |
| 4 | 3 | 48011.4 | 48.01 | 80 | 79 | 634.999 | 0.63 |
| 5 | 4 | 374.572 | 0.37 | 81 | 80 | 605.333 | 0.6 |
| 6 | 5 | 7315.02 | 7.31 | 82 | 81 | 957.207 | 0.95 |
| 7 | 6 | 4297.94 | 4.29 | 83 | 82 | 2018.13 | 2.01 |
| 8 | 7 | 6256.82 | 6.25 | 84 | 83 | 1728.28 | 1.72 |
| 9 | 8 | 3192.32 | 3.19 | 85 | 84 | 1251.7 | 1.25 |
| 10 | 9 | 3743.08 | 3.74 | 86 | 85 | 1100.25 | 1.1 |
| 11 | 10 | 2649.88 | 2.64 | 87 | 86 | 784.427 | 0.78 |
| 12 | 11 | 430.827 | 0.43 | 88 | 87 | 2083.83 | 2.08 |
| 13 | 12 | 2263.15 | 2.26 | 89 | 88 | 2590.55 | 2.59 |
| 14 | 13 | 1359.69 | 1.35 | 90 | 89 | 2521.14 | 2.52 |
| 15 | 14 | 458.704 | 0.45 | 91 | 90 | 2854.89 | 2.85 |
| 16 | 15 | 1444.83 | 1.44 | 92 | 91 | 1011.98 | 1.01 |
| 17 | 16 | 11193.7 | 11.19 | 93 | 92 | 2376.49 | 2.37 |
| 18 | 17 | 1168.33 | 1.16 | 94 | 93 | 3160.54 | 3.16 |
| 19 | 18 | 963.756 | 0.96 | 95 | 94 | 2715.13 | 2.71 |
| 20 | 19 | 5117.31 | 5.11 | 96 | 95 | 1886.2 | 1.88 |
| 21 | 20 | 5072.69 | 5.07 | 97 | 96 | 1168.27 | 1.16 |
| 22 | 21 | 1800.98 | 1.8 | 98 | 97 | 2374.57 | 2.37 |
| 23 | 22 | 1366.65 | 1.36 | 99 | 98 | 1799.04 | 1.79 |
| 24 | 23 | 1069.98 | 1.06 | 100 | 99 | 1527.14 | 1.52 |
| 25 | 24 | 822.508 | 0.82 | 101 | 100 | 1471.7 | 1.47 |
| 26 | 25 | 1376.5 | 1.37 | 102 | 101 | 9231.87 | 9.23 |
| 27 | 26 | 5214.11 | 5.21 | 103 | 102 | 1708.21 | 1.7 |
| 28 | 27 | 1016.63 | 1.01 | 104 | 103 | 3046.27 | 3.04 |
| 29 | 28 | 1046.64 | 1.04 | 105 | 104 | 1989.35 | 1.98 |
| 30 | 29 | 692.576 | 0.69 | 106 | 105 | 3796.55 | 3.79 |
| 31 | 30 | 1625.19 | 1.62 | 107 | 106 | 1075.41 | 1.07 |
| 32 | 31 | 1708.74 | 1.7 | 108 | 107 | 3113.99 | 3.11 |
| 33 | 32 | 1144.69 | 1.14 | 109 | 108 | 6952 | 6.95 |
| 34 | 33 | 4965.49 | 4.96 | 110 | 109 | 662.036 | 0.66 |
| 35 | 34 | 9586.39 | 9.58 | 111 | 110 | 1267.71 | 1.26 |
| 36 | 35 | 3639.97 | 3.63 | 112 | 111 | 2426.23 | 2.42 |
| 37 | 36 | 11456.8 | 11.45 | 113 | 112 | 900.029 | 0.9 |

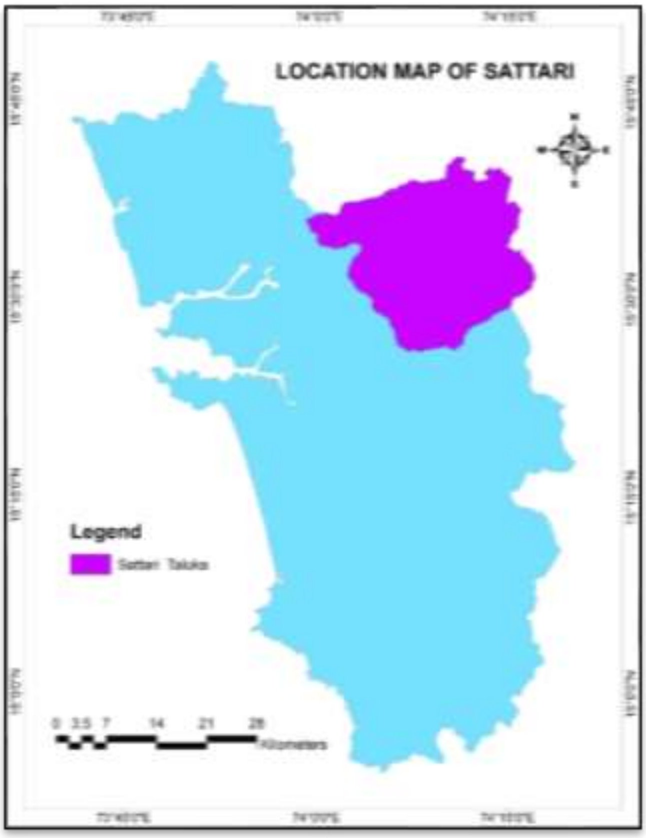
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 38 | 37 | 699.63 | 0.69 | 114 | 113 | 773.84 | 0.77 |
| 39 | 38 | 4107.4 | 4.1 | 115 | 114 | 1062.13 | 1.06 |
| 40 | 39 | 3015.8 | 3.01 | 116 | 115 | 1271.9 | 1.27 |
| 41 | 40 | 4850.82 | 4.85 | 117 | 116 | 2832.72 | 2.83 |
| 42 | 41 | 1002.79 | 1 | 118 | 117 | 1106.58 | 1.1 |
| 43 | 42 | 2906.23 | 2.9 | 119 | 118 | 450.771 | 0.45 |
| 44 | 43 | 8976.81 | 8.97 | 120 | 119 | 2281.67 | 2.28 |
| 45 | 44 | 933.863 | 0.93 | 121 | 120 | 1472.35 | 1.47 |
| 46 | 45 | 1762.95 | 1.76 | 122 | 121 | 447.152 | 0.44 |
| 47 | 46 | 2515.52 | 2.51 | 123 | 122 | 433.712 | 0.43 |
| 48 | 47 | 2872.43 | 2.87 | 124 | 123 | 3364.28 | 3.36 |
| 49 | 48 | 11912.2 | 11.91 | 125 | 124 | 1632.68 | 1.63 |
| 50 | 49 | 11595.7 | 11.59 | 126 | 125 | 8684.02 | 8.68 |
| 51 | 50 | 1613.04 | 1.61 | 127 | 126 | 2733.81 | 2.73 |
| 52 | 51 | 2183.75 | 2.18 | 128 | 127 | 1200.75 | 1.2 |
| 53 | 52 | 483.463 | 0.48 | 129 | 128 | 731.248 | 0.73 |
| 54 | 53 | 1179.62 | 1.17 | 130 | 129 | 1847.97 | 1.84 |
| 55 | 54 | 6074.51 | 6.07 | 131 | 130 | 1940.19 | 1.94 |
| 56 | 55 | 3498.28 | 3.49 | 132 | 131 | 781.87 | 0.78 |
| 57 | 56 | 1083.22 | 1.08 | 133 | 132 | 3266.87 | 3.26 |
| 58 | 57 | 1392.2 | 1.39 | 134 | 133 | 3431.3 | 3.23 |
| 59 | 58 | 4860.17 | 4.86 | 135 | 134 | 6371.79 | 6.37 |
| 60 | 59 | 692.896 | 0.69 | 136 | 135 | 2117.86 | 2.11 |
| 61 | 60 | 2035.19 | 2.03 | 137 | 136 | 2789.69 | 2.78 |
| 62 | 61 | 1252.08 | 1.25 | 138 | 137 | 2960.22 | 2.96 |
| 63 | 62 | 894.937 | 0.89 | 139 | 138 | 1048.54 | 1.04 |
| 64 | 63 | 484.814 | 0.48 | 140 | 139 | 1561.12 | 1.56 |
| 65 | 64 | 679.918 | 0.67 | 141 | 140 | 450.209 | 0.45 |
| 66 | 65 | 1870.06 | 1.87 | 142 | 141 | 251.939 | 0.25 |
| 67 | 66 | 2727.09 | 2.72 | 143 | 142 | 1603.57 | 1.6 |
| 68 | 67 | 1979.29 | 1.97 | 144 | 143 | 1927.41 | 1.92 |
| 69 | 68 | 2379.12 | 2.37 | 145 | 144 | 5075.58 | 5.07 |
| 70 | 69 | 2351.37 | 2.35 | 146 | 145 | 1980.39 | 1.98 |
| 71 | 70 | 1387.29 | 1.38 | 147 | 146 | 825.315 | 0.82 |
| 72 | 71 | 1255.34 | 1.25 | 148 | 147 | 1133.62 | 1.13 |
| 73 | 72 | 1332.39 | 1.33 | 149 | 148 | 1332.23 | 1.33 |
| 74 | 73 | 4655.61 | 4.65 | 150 | 149 | 2397.21 | 2.39 |
| 75 | 74 | 746.361 | 0.74 | 151 | 150 | 1134.04 | 1.13 |
| 76 | 75 | 383.452 | 0.38 | | | | |
| Total | | | | | | | 438.99 |
| Source: Estimated by Researchers | | | | | | | |

**TABLE NO. 2 ACCESSIBILITY OF SETTLEMENTS IN SATTARI TALUKA TO THE ADMINISTRATIVE AND MARKET CENTRE, VALPOI**

| Sr. No | Name of Settlement | Distance from valpoi (km) di | wi | Weight distance (di ×wi) | Sr. No | Name of Settlement | Distance from valpoi (km) di | wi | Weight distance (di ×wi) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Kudchire | 20.5 | 1 | 20.5 | 47 | Iver Bhuzruk | 14.7 | 1.5 | 22.05 |
| 2 | Podcem | 16.6 | 1 | 16.6 | 48 | Bhirondem | 6.8 | 1 | 6.8 |
| 3 | Ravan 1 | 21.1 | 1 | 21.1 | 49 | Nargargao | 6.7 | 1 | 6.7 |
| 4 | Paryam | 11.1 | 1 | 11.1 | 50 | Sirsodem | 14.3 | 1 | 14.3 |
| 5 | Ravan | 21.1 | 1 | 21.1 | 51 | Mauxi | 5.1 | 1 | 5.1 |
| 6 | Advoi | 7.88 | 1 | 7.88 | 52 | Ambeli | 13.6 | 1 | 13.6 |
| 7 | Derodem | 14 | 1 | 14 | 53 | Karmbol Buzurk | 10.6 | 1 | 10.6 |
| 8 | Satrem | 15.6 | 1 | 15.6 | 54 | velegem | 16.6 | 1 | 16.6 |
| 9 | Dhavem | 7.2 | 1 | 7.2 | 55 | Ambedem | 5 | 1 | 5 |
| 10 | Hedodem | 6 | 1 | 6 | 56 | Dabem | 5.2 | 1 | 5.2 |
| 11 | Ustem | 10 | 1 | 10 | 57 | Brahma Karmali | 7.8 | 1 | 7.8 |
| 12 | Rivem | 12.3 | 1.5 | 18.45 | 58 | Satodem | 5 | 1 | 5 |
| 13 | Sirolim | 21.5 | 1 | 21.5 | 59 | Saleli | 8.7 | 1 | 8.7 |
| 14 | Kumar khand | 7.62 | 1.5 | 11.43 | 60 | Pali | 10.4 | 1 | 10.4 |
| 15 | Panse | 16.8 | 1 | 16.8 | 61 | Nanodem | 11 | 1 | 11 |
| 16 | Maloli | 9.18 | 1.5 | 13.77 | 62 | Shingne | 12.2 | 1 | 12.2 |
| 17 | Kodal | 7.6 | 1.5 | 11.4 | 63 | Charavane | 21.4 | 1 | 21.4 |
| 18 | Zarme | 6.62 | 1 | 6.62 | 64 | Surla | 18.6 | 1 | 18.6 |
| 19 | Barajan | 4.8 | 1 | 4.8 | 65 | Ghoteli | 17.6 | 1 | 17.6 |
| 20 | Malpan | 15.3 | 1 | 15.3 | 66 | keri | 20.3 | 1 | 20.3 |
| 21 | Kankirem | 13.2 | 1 | 13.2 | 67 | Anjune | 25.9 | 1 | 25.9 |
| 22 | Kopardem | 5.9 | 1 | 5.9 | 68 | Kelavada | 22.7 | 1 | 22.7 |
| 23 | Vante | 12.7 | 1 | 12.7 | 69 | Pansuli | 17.6 | 1 | 17.6 |
| 24 | Paikul | 14.2 | 1 | 14.2 | 70 | Gulle | 25.4 | 1 | 25.4 |
| 25 | Bimbal | 8.9 | 1 | 8.9 | 71 | Gulei | 10.2 | 1 | 10.2 |
| 26 | Savordem | 16.2 | 1 | 16.2 | 72 | Bamber | 11.8 | 1 | 11.8 |
| 27 | Savorshem | 4.3 | 1 | 4.3 | 73 | Vanquelim | 12.2 | 1 | 12.2 |
| 28 | Thane | 10.5 | 1 | 10.5 | 74 | Shelpe Budruk | 10.9 | 1 | 10.9 |
| 29 | Naneli | 17.6 | 1 | 17.6 | 75 | Bhatwada | 18.9 | 1 | 18.9 |
| 30 | Saleli | 10.4 | 1 | 10.4 | 76 | Khadki | 3.95 | 1 | 3.95 |
| 31 | Bhuipal | 5.2 | 1 | 5.2 | 77 | Karnzol | 10.6 | 1 | 10.6 |

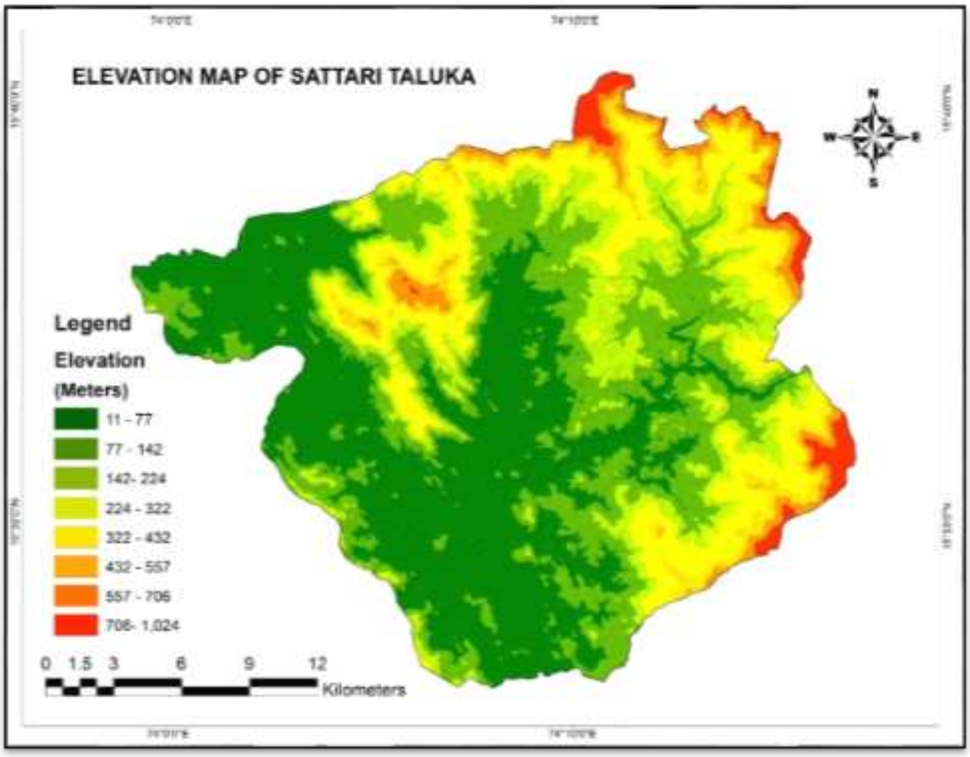
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 32 | Morlem | 14.4 | 1 | 14.4 | 78 | Shelpe | 15.5 | 1 | 15.5 |
| 33 | Honda | 8.7 | 1 | 8.7 | 79 | Murmune | 26 | 1 | 26 |
| 34 | Sonus | 12.7 | 1 | 12.7 | 80 | Gavane | 12.9 | 1 | 12.9 |
| 35 | Soliye | 17.6 | 1 | 17.6 | 81 | Naneli 2 | 17.6 | 1 | 17.6 |
| 36 | Pissurlem | 8.8 | 1 | 8.8 | 82 | Bayawada | 1.8 | 1 | 1.8 |
| 37 | Massordem | 2.4 | 1 | 2.4 | 83 | Bandwada | 8.2 | 1 | 8.2 |
| 38 | Velus | 3.6 | 1 | 3.6 | 84 | Bandri | 13.2 | 1 | 13.2 |
| 39 | Kumtol | 14.2 | 1 | 14.2 | 85 | Melavli | 15.3 | 1 | 15.3 |
| 40 | Sonal | 8.4 | 1 | 8.4 | 86 | Bhatwada | 20.3 | 1 | 20.3 |
| 41 | Assodem | 16.2 | 1 | 16.2 | 87 | Dhada | 16.9 | 1 | 16.9 |
| 42 | Wagure | 17.6 | 1 | 17.6 | 88 | Dhatwada | 15.2 | 1 | 15.2 |
| 43 | Dongurwada | 10.3 | 1.5 | 15.45 | 89 | Shail | 15.4 | 1 | 15.4 |
| 44 | Khotodem | 17.6 | 1.5 | 26.4 | 90 | Velawada | 12.6 | 1 | 12.6 |
| 45 | Gulelim | 10.2 | 1 | 10.2 | 91 | Hivrem | 22.2 | 1 | 22.2 |
| 46 | Kudshem | 18.3 | 1 | 18.3 | 92 | Padeli | 10 | 1 | 10 |
| ∑di×wi= 1215.9 | | | | | | | | | |
| Source: Estimated by Researchers | | | | | | | | | |

**FIGURES**




**Source: Generated by Researcher**

**Figure 1**

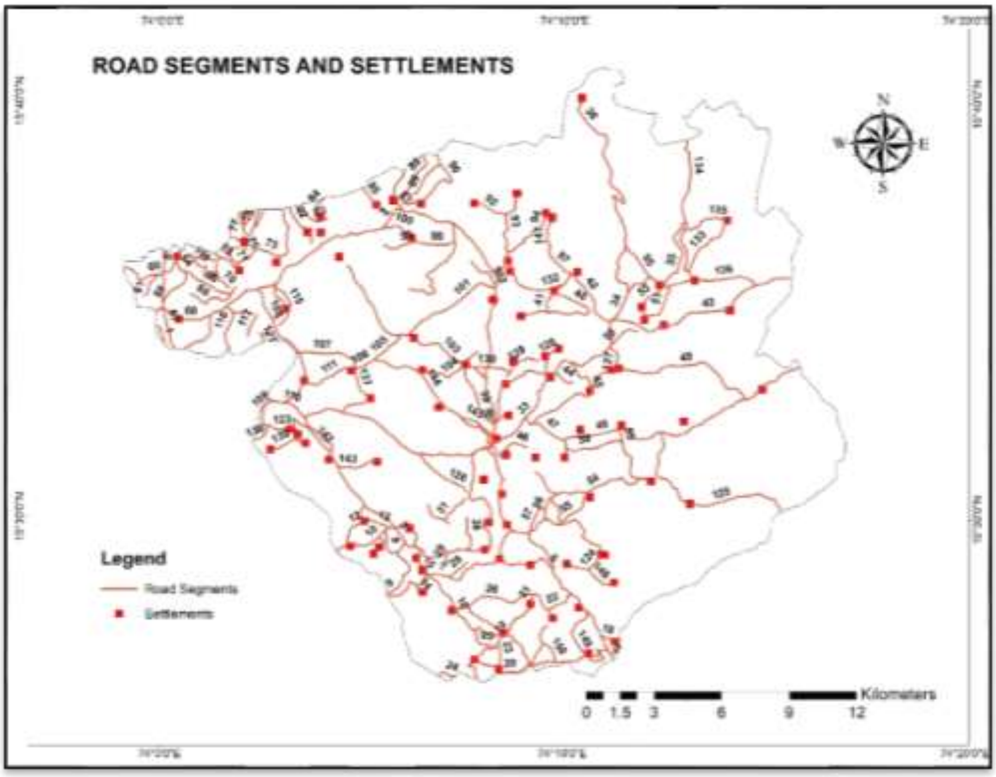



**Source: Generated by Researcher**

**Figure 2**


**Source: Generated by Researcher**

**Figure 3**




**Source: Generated by Researcher**

**Figure 4**

**FORMULAS**

**ROAD ROUTE DENSITY**

Road route density is the length of the road per unit area, which shows the part of the space acquired by the road network. It is the road network coverage in a specific geographical area and measured in km/km2. The formula to calculate Road route density is:

Road Route Density =Total Length of Roads (km)/ Total Area (sq. km)

Wherein:

Total Length of Roads = Sum of the lengths of all roads in the study area.

Total Area = Geographic area under consideration.

Higher road route density shows good transport efficiency and a well-developed transport network, whereas lower values indicate poorer network connectivity and require infrastructural developments.

**ACCESSIBILITY INDEX**

The formula to calculate the Accessibility index is,

$AI=1\sum i(di\times wi)$

Wherein, di= distance from settlement i to market

wi= Transport efficiency (Road Conditions) Paved Road=1, Unpaved Road=1.5, Poor Road=2, No direct road=3

**CONNECTIVITY INDEX**

The formula to calculate the connectivity index is:

$CI=\sum di/N$

Wherein:

$\sum di$ = Sum of degrees of all nodes (degree of a node is the number of edges connected to it).

N = Total number of nodes (settlements).

A higher value of the connectivity index shows better network connectivity with proper connectivity between all settlements, and lower values indicate poor network connectivity.

**FINDINGS AND DISCUSSION**

The road route density in the study region is 0.88 km/km2. This indicates that the region is not densely covered by road linkages. However, the value is an average estimation for the entire territory, it is clear from the digitized roads on the maps that the eastern part of the region has a lesser number of road links due to the higher and difficult terrain of the western ghats, where settlements are smaller in number and size. The Valpoi region, which is the administrative centre, has a very dense network of roads and isolated settlements in the eastern part, like Surla and Ivre Budruk which have lesser road route density. The Western and central parts of the region, where settlements seem to be more compact, have a relatively dense network of roads. It is clear from the study that the road route density in the region is lower than the national average. This results in slower economic growth as the movement of people takes a longer time to obtain public facilities. The part of the study area has reserved forest where there is less scope for construction activities, but the linkages can be further improved in the central part of the region. However, this lower value of road density can be justified in this case because of the presence of wildlife sanctuaries, reserved forests, and rugged topography with sparse settlements.

The estimated accessibility index of Valpoi, a market and administrative centre to 92 settlements in the study area, is 0.00082 based on the conditions of roads. This clearly states that the market area is not easily accessible to the majority of the settlements in the region. However, all the road linkages are in proper condition, and all roads are paved. Scattered and isolated settlements with rugged topography, along with dense vegetation, are some of the reasons for the low accessibility of Valpoi town in the Sattari region. This results in service delivery inefficiency in the Valpoi market, which further lowers the economic growth rate.

The connectivity index for all 92 settlements in the region is estimated by using a binary adjacency matrix, wherein a 1 value is assigned for direct connection and a 0 value is allocated for having no connection. Settlements may have multiple links, single links, or may be completely disconnected. The estimated value for the connectivity index is 92 that the number of road links is equal to the settlements, clearly stating that the network is minimally connected just enough to link all settlements in the region. There are a few multiple links or alternate paths for the settlements. This may create problems in the future during a landslide, floods, maintenance closure, infrastructure failure, etc. Thus, the region becomes more vulnerable to disruptions; therefore, it becomes important to introduce secondary roads.

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# THE IMPACT OF DIGITAL TRANSFORMATION ON ORGANIZATIONAL PERFORMANCE

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***Abstract***

*Digital transformation (DT) has emerged as a critical strategic priority across various sectors, profoundly altering how businesses function and create value for their customers. This study investigates the diverse effects of digital transformation on organizational performance. It delves into the key drivers, advantages, challenges, and outcomes linked to the adoption of digital technologies. Drawing upon recent academic literature, industry analyses, and case studies, the study finds that when implemented with a strategic focus, digital transformation can significantly improve operational efficiency, enhance customer interaction, foster innovation, and boost overall organizational effectiveness. Nonetheless, achieving these benefits demands a shift in organizational culture, strong leadership, and an ongoing commitment to innovation.*

***Keywords:*** *Digital Transformation, Organizational Performance, Innovation, Technology, Change Management*

## 1. Introduction

The advent of digital technologies has dramatically transformed the global business landscape. Innovations such as automation, artificial intelligence, and cloud computing have empowered organizations to enhance efficiency, drive innovation, and meet market needs with remarkable agility. Digital transformation (DT) entails the comprehensive integration of digital technologies across all facets of a business, leading to profound changes in how operations are conducted and value is delivered. This transformation extends beyond mere technological upgrades—it requires a cultural shift, the reimagining of business models, and the adoption of agile practices.

As organizations increasingly embrace digital strategies, understanding how digital transformation affects organizational performance is critical. This paper investigates the dimensions through which DT influences performance, emphasizing both enablers and barriers.

## 2. Conceptual Framework

### 2.1 Defining Digital Transformation

Digital transformation involves the comprehensive integration and application of advanced digital tools and technologies—such as big data analytics, artificial intelligence (AI), the Internet of Things (IoT), blockchain, and cloud computing—across various business functions. The primary objective is to enhance operational efficiency, improve decision-making, foster innovation, and generate new sources of value for customers and stakeholders.

This process includes several interconnected stages:

**Digitization** – the initial step, which refers to converting analog information into digital formats. For example, scanning paper documents into electronic files or using digital sensors to collect real-time data.

**Digitalization** – this phase goes beyond mere data conversion. It involves leveraging digital technologies to optimize and automate existing processes. For instance, implementing AI-driven customer service chatbots or using data analytics to improve supply chain efficiency.

**Digital Transformation** – the most comprehensive stage, encompassing organization-wide change that affects strategy, structure, culture, and business models. It often requires rethinking how the business operates, delivers value, and competes in a digital-first world. This may include adopting platform-based business models, enhancing customer experience through personalization, or creating entirely new digital products or services.

**2.2 Organizational Performance**

Organizational performance encompasses a company's overall effectiveness in meeting its strategic objectives while utilizing resources efficiently. It is a multidimensional concept that reflects how well an organization operates and competes in its market. Key aspects of organizational performance include:

**Financial Performance**: Indicators such as profitability, revenue growth, return on investment (ROI), and cost management, which measure the financial health and sustainability of the organization.

**Operational Efficiency:** Metrics like productivity, process optimization, cycle time, and resource utilization that evaluate the effectiveness of internal operations.

**Customer Satisfaction:** The extent to which a company meets or exceeds customer expectations, often measured through feedback, loyalty, and retention rates.

**Employee Engagement:** The level of motivation, involvement, and satisfaction among employees, which influences productivity and organizational culture.

**Innovation Capability:** The organization's ability to develop new products, services, or processes, adapt to change, and maintain a competitive edge.

**3. Drivers of Digital Transformation**

Several factors drive organizations to undertake digital transformation:

- **Market Competition**: Globalization and digital disruption force businesses to innovate to maintain a competitive advantage.
- **Customer Expectations**: Digitally empowered customers demand seamless, personalized experiences.
- **Technological Advancements**: The proliferation of affordable and scalable technologies makes transformation feasible.
- **Regulatory Changes**: Compliance with data protection and sustainability standards requires modern systems.
- **Pandemics and Crises**: Events like COVID-19 accelerated digital adoption for remote work and online service delivery.

4. Impact on Organizational Performance

**4.1** Operational Efficiency

Digital transformation improves process automation, reducing manual tasks and operational errors. Enterprise Resource Planning (ERP), Robotic Process Automation (RPA), and AI-driven analytics enhance decision-making and resource utilization. For example, DHL integrated IoT and predictive analytics in logistics, reducing delivery times and operational costs.

4.2 Customer Experience

Digitally transformed organizations deliver superior customer experiences through omnichannel platforms, chatbots, personalized recommendations, and faster service. Amazon and Netflix have set benchmarks in customer-centric digital models, enhancing loyalty and market share.

4.3 Innovation and Agility

DT fosters a culture of innovation, enabling rapid experimentation and iterative development. Cloud-based platforms and DevOps allow quicker product rollouts. For instance, Tesla continuously updates car features remotely through software updates, setting a new standard in the auto industry.

4.4 Financial Performance

While digital investments are significant, studies show positive returns over time. McKinsey (2022) found that digitally mature firms are 23% more profitable than their less advanced peers. Return on Investment (ROI) often increases due to efficiency gains, new revenue streams, and reduced overheads.

4.5 Employee Productivity and Engagement

Digital tools support collaboration (e.g., Slack, Microsoft Teams), remote work, and data-driven insights, improving productivity. AI-driven platforms can automate routine tasks, allowing employees to focus on strategic initiatives. However, reskilling is essential to maintain morale and relevance.

**5. Challenges in Digital Transformation**

Despite its advantages, digital transformation is complex and fraught with challenges:

- **Cultural Resistance**: Employees may resist change due to fear of job loss or skill mismatch.
- **Legacy Systems**: Older infrastructure may not support new technologies, requiring costly upgrades.
- **Data Privacy and Security**: Increased digitization heightens risks of cyberattacks and data breaches.
- **Talent Shortage**: Skilled digital talent is in high demand, creating competition for expertise.
- **Strategic Misalignment**: Without a clear vision, digital efforts can become fragmented and ineffective.

6. Case Studies

6.1 Siemens AG: Siemens, a global engineering firm, embarked on a digital transformation to improve its manufacturing and industrial services. Through AI, digital twins, and IoT integration, Siemens enhanced predictive maintenance and reduced downtime by 30%. Its digital industrial platform, MindSphere, has been central to this transformation.

6.2 Starbucks: Starbucks leveraged mobile apps, customer data, and AI to personalize marketing and streamline ordering. The result was a significant increase in customer retention and order frequency. Its “Deep Brew” AI engine supports supply chain and labor optimization, illustrating a holistic digital approach.

6.3 Government of Estonia:Estonia is considered a global leader in digital governance. The country offers nearly all public services online, including e-residency and digital voting. The result is increased efficiency, transparency, and public trust, with estimated annual savings of over 2% of GDP.

**7. Strategies for Successful Digital Transformation**

- **Leadership Commitment**: Transformation must be led from the top, with C-level executives driving vision and investment.
- **Clear Roadmap**: A well-defined digital strategy aligned with business objectives is critical.
- **Agile Methodologies**: Embracing agile frameworks allows iterative improvement and fast adaptation.
- **Talent Development**: Upskilling and reskilling programs are essential for workforce readiness.
- **Customer-Centric Design**: Digital initiatives should prioritize enhancing customer value and satisfaction.

8. Future Outlook

The future of digital transformation lies in convergence—where AI, blockchain, and IoT work in tandem to create intelligent, adaptive ecosystems. The rise of digital twins, metaverse applications, and autonomous systems signals the next frontier. Organizations that embrace continuous transformation and innovation will remain resilient and competitive.

## 9. Conclusion

Digital transformation is no longer optional—it is a strategic imperative for organizational survival and success. Its impact on performance is multidimensional, touching efficiency, innovation, customer satisfaction, and financial outcomes. While the path is complex, organizations that adopt a clear strategy, foster a digital culture, and invest in people and processes can reap significant rewards.

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# UNDERSTANDING SALIENCE IN INTERNET ADDICTION: A NARRATIVE REVIEW OF PSYCHOLOGICAL AND BEHAVIOURAL DIMENSIONS

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***Abstract***

*This narrative review explores salience through psychological and behavioural lenses, drawing upon theoretical models, with Internet Addiction. These frameworks position salience as both a precursor to and reinforcer of compulsive online engagement. The review examines salience across cognitive, emotional, behavioural and neurobiological dimensions, linking it to traits such as impulsivity, neuroticism, emotional dysregulation and the fear of missing out (FoMO). It further investigates behavioural expressions such as compulsive checking, digital multitasking and social withdrawal as key indicators of salience. This paper underscores the importance of personalised interventions, multi-method assessment strategies and the enhanced incorporation of neurobiological perspectives to effectively address salience within the broader context of internet addiction.*

***Keywords:*** *Salience, Internet Addiction, Behavioural Addiction, I-PACE Model, Internet Use Disorder*

## 1. Introduction:

The internet has revolutionised modern life, profoundly influencing how individuals communicate, access information, engage in education, and participate in entertainment. While the internet offers numerous benefits, the surge in digital engagement has raised significant concerns about maladaptive patterns of use, leading to what is now recognised as *Internet Addiction (IA),* a behavioural disorder characterised by excessive, uncontrollable internet use that results in psychological distress and functional impairment (Bisen & Deshpande, 2018). Although not formally listed as a distinct disorder in major diagnostic manuals such as the DSM-5, IA shares core clinical features with other behavioural addictions, including compulsivity, preoccupation, mood modification, tolerance, withdrawal, and relapse (Ding et al., 2022).

A particularly salient construct within the discourse on internet addiction is *salience*, which refers to the cognitive, emotional, and behavioural prioritisation of internet use to the extent that it becomes the most significant activity in a person's life (Schimmelpfennig et al., 2023). In Griffiths' 2005 Components Model of Addiction, salience occupies a central role, indicating the extent to which online engagement dominates the individual's thoughts (preoccupation), emotions (cravings), and actions (compulsive use). Contemporary theoretical frameworks, such as the I-PACE (Interaction of Person-Affect-Cognition-Execution) model, offer a more comprehensive understanding of salience in internet addiction. Proposed by (Brand et al., 2016),

The cognitive-affective centrality of salience also aligns with neuroscientific evidence indicating heightened activation in brain regions associated with the salience network, such as the anterior insula and anterior cingulate cortex, in individuals with high internet engagement (Brandtner et al., 2021; Chang & Lee, 2024; Wegmann & Brand, 2016) (Chang & Lee, 2024; Brandtner, Wegmann, & Brand, 2021). These neural responses support the argument that salience functions not only at a psychological level but is also rooted in neurobiological mechanisms, underscoring the multidimensional nature of the construct (Schimmelpfennig et al., 2023).

Despite its significance, salience in internet addiction remains relatively underexplored in terms of its conceptual boundaries, behavioural expressions, and integration into assessment and intervention frameworks (Lee et al., 2024).

This narrative review seeks to address this gap by synthesising current psychological and behavioural literature on salience as it pertains to internet addiction. Specifically, the paper explores salience as a multidimensional construct encompassing cognitive preoccupation, emotional dependency, behavioural rituals, and neurobiological sensitivity. By integrating insights from established addiction models, psychometric research, and neuroscientific findings, this review aims to offer a comprehensive conceptualisation of salience that enhances understanding of its role in the onset, maintenance, and potential relapse of internet addiction. In doing so, it also underscores the importance of salience-sensitive approaches in both assessment and intervention strategies for internet-use disorders.

### 1.1. Significance of the Study

The present narrative review offers a focused examination of salience as a central psychological mechanism in the development and persistence of internet addiction. Drawing on well-established theoretical models, including Griffiths' Components Model (Griffiths, 2005) and the I-PACE model (Brand et al., 2016), this study synthesises empirical findings to explain how cognitive, emotional, and behavioural aspects of salience contribute to compulsive digital engagement. Psychological traits such as impulsivity, neuroticism, and emotional dysregulation (Kuss et al., 2013; Montag et al., 2015) are highlighted for their role in reinforcing salience and problematic internet use.

This review also explores how salience manifests through specific behaviours, such as compulsive checking, digital multitasking, and social withdrawal. Standardised tools like the Internet Addiction Test (Young, 1998) and Compulsive Internet Use Scale (Meerkerk et al., 2009) are evaluated for their effectiveness in identifying salience-related symptoms. The findings stress the need for improved diagnostic precision and intervention strategies that address the psychological and behavioural roots of salience (Ahn et al., 2021; Cushnie et al., 2023). As internet use becomes increasingly embedded in daily life, these insights are critical for guiding clinical practice, digital health policy, and future research.

### 1.2 Aim of the Review

This narrative review aims to synthesise theoretical and empirical literature to understand the construct of salience as a core psychological and behavioural mechanism in internet addiction. The review seeks to examine the role of salience in mediating psychological vulnerabilities and influencing compulsive internet use, while also evaluating the explanatory strength of established addiction models.

### 1.3 Objectives of the Review

The primary objective of this narrative review is to explore the concept of *salience* as a central psychological and behavioural mechanism in internet addiction. The review aims to synthesise relevant theoretical models and empirical findings to:

1. Examine the psychological traits and emotional-cognitive processes that heighten the salience of internet-related activities.
2. Analyse how salience manifests in observable behaviours across different digital contexts, including social media, online gaming, and streaming platforms.
3. Evaluate the role of established addiction models, such as Griffiths' Components Model and the I-PACE framework, in conceptualising salience as both a precursor and reinforcer of compulsive internet use.

### 1.4 Scope and Research Questions

This review is confined to literature that investigates the psychological and behavioural dimensions of salience within the context of internet addiction. Emphasis is placed on how salience interacts with personality traits, emotional regulation, attentional processes, and real-world behaviour. The scope includes studies employing both qualitative and quantitative methods, incorporating psychometric assessment tools, theoretical frameworks, and neurobiological evidence.

Based on the stated objectives, the review is guided by the following research questions:

1. What psychological traits and cognitive-affective vulnerabilities contribute to the intensification of salience in individuals with internet addiction?
2. In what ways does salience manifest behaviourally across various forms of internet use, including social networking, gaming, and digital multitasking?
3. How do existing theoretical models explain the emergence, maintenance, and reinforcement of salience in problematic internet use?

## 2. Theoretical Foundations of Internet Addiction and Salience:

A comprehensive understanding of internet addiction necessitates a critical evaluation of the theoretical frameworks that position salience as a fundamental psychological mechanism. Among the most widely cited models in behavioural addiction research are Griffiths' Components Model of Addiction and the I-PACE (Interaction of Person-Affect-Cognition-Execution) model (Brandtner et al., 2021; Griffiths, 2005). Both models explicitly identify salience as a key driver in the initiation, escalation, and maintenance of addictive behaviours. Additionally, emerging insights from reinforcement theory and incentive-sensitization offer valuable neurobiological perspectives on salience in the context of compulsive internet use (Lee et al., 2024).

### 2.1 Griffiths' Components Model of Addiction

Griffiths, 2005 proposed a unified model for behavioural and substance addictions based on six core components: salience, mood modification, tolerance, withdrawal symptoms, conflict, and relapse. In this model, salience holds a central role. It refers to the degree to which an activity becomes the most important aspect of an individual's life, dominating their thoughts, emotions, and behaviour. In the context of internet addiction, this translates into persistent preoccupation with being online, uncontrollable urges to use the internet, and psychological distress when disconnected (Griffiths, 2005). This model underscores the psychological impact of salience, where digital engagement supersedes essential life domains such as sleep, nutrition, academic responsibilities, and interpersonal relationships. Behaviourally, this is reflected in compulsive browsing, excessive checking of devices, and significant disruptions to daily functioning.

### 2.2 The I-PACE Model (Interaction of Person-Affect-Cognition-Execution)

The I-PACE model, developed by Matthias Brand offers a multidimensional, process-oriented explanation of Internet Use Disorders (IUDs). It posits that addictive internet use arises from dynamic interactions among individual predispositions e.g. personality traits, affective and cognitive responses e.g. emotional regulation, cognitive distortions, and executive functioning e.g. impulse control (Brand et al., 2019). Within this framework, salience is conceptualised as both an outcome and a reinforcing mechanism (Brandtner et al., 2021). For instance, individuals with high levels of neuroticism or poor self-regulatory abilities may initially engage with the internet as a coping mechanism for negative affect (Ioannidis et al., 2019). Over time, this coping behaviour becomes emotionally and cognitively prioritised, reinforcing repeated use and further impairing executive control. Neurobiological studies supporting the I-PACE model also point to dysregulation in the salience network of the brain, particularly in regions such as the anterior insula and anterior cingulate cortex, which are associated with evaluating and prioritising stimuli (Brand et al., 2016).

### 2.3 Reinforcement Theory and Incentive-Sensitisation

An additional theoretical lens is provided by incentive-sensitisation theory (Berridge & Robinson, 1998), which distinguishes between liking (pleasure) and wanting (motivational salience). In internet addiction, individuals may continue to "want" digital engagement, manifested as persistent craving, even when the activity no longer provides significant enjoyment. This phenomenon highlights the motivational salience of internet-related cues such as notification sounds, social validation, or real-time updates, which acquire exaggerated importance through sensitised reward pathways (Ban et al., 2023; Schimmelpfennig et al., 2023).

Together, these theoretical perspectives highlight that salience is not merely a symptom but a dynamic and multidimensional process that plays a central role in the onset, reinforcement, and chronicity of internet addiction. The convergence of psychological and neurobiological evidence supports the view that salience operates as both a predictor and a perpetuating factor, warranting its prioritisation in assessment, prevention, and treatment frameworks (Ahn et al., 2021; Cushnie et al., 2023).

**Theoretical Models Explaining Salience in Internet Addiction:**

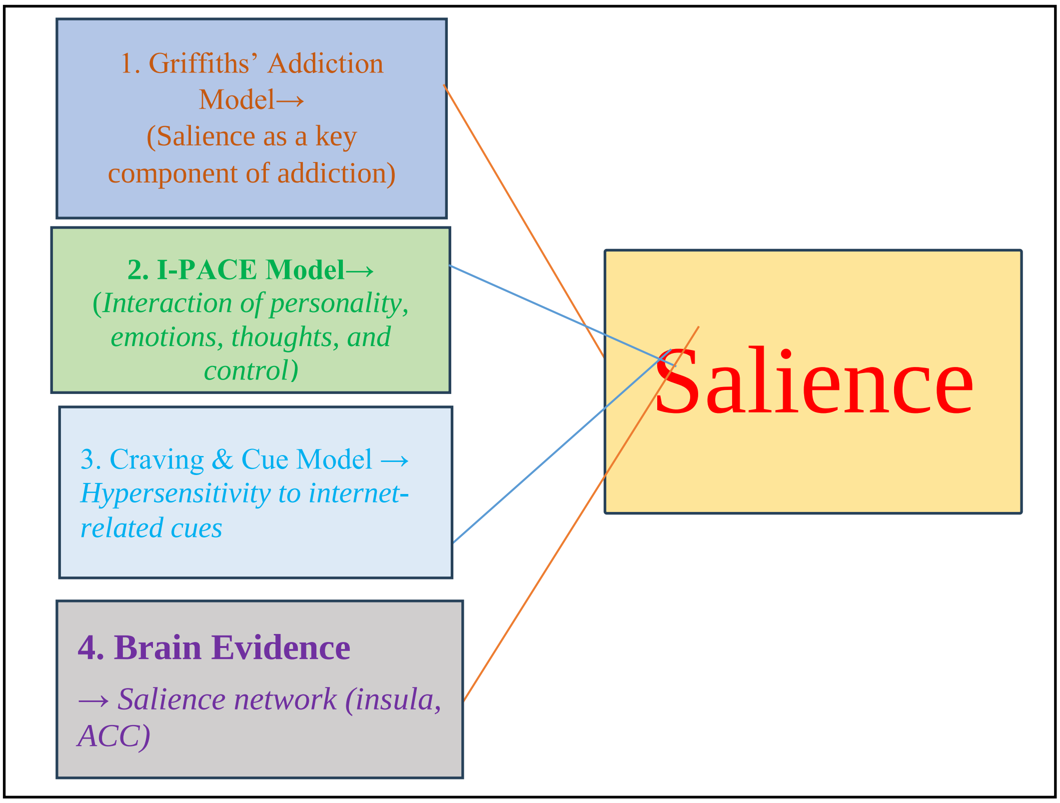


**Figure 1: Theoretical Models Explaining Salience in Internet Addiction**

## 3. Conceptualisation of Internet Addiction in Salience

### 3.1 Understanding Salience: Definitions and Dimensions

Salience is a core psychological construct that refers to the degree to which a specific stimulus, thought, or behaviour dominates an individual's awareness and motivational system (Cushnie et al., 2023). In the context of internet addiction, salience encapsulates the process by which internet-related activities such as social networking, online gaming, and streaming, gain disproportionate cognitive and emotional importance, often at the expense of offline functioning. This prioritisation results in a narrowing of attention and behaviour, where online engagement becomes a central organising feature of daily life (Ban et al., 2023).

According to (Griffiths, 2005), salience represents the first and most defining symptom of behavioural addiction. It is characterised by persistent preoccupation, craving, and the intrusive presence of digital activity in thoughts, emotions, and actions. In this heightened state, the internet ceases to function merely as a tool and instead becomes a psychologically central aspect of the individual's life. Individuals may obsessively plan their next online session, experience anxiety or restlessness when disconnected, and show a progressive neglect of non-digital domains.

### 3.1.1 Salience in Internet Addiction

Salience is inherently multidimensional, manifesting across cognitive, emotional, behavioural, and neurobiological domains:

**1. Cognitive Salience**

Cognitive salience refers to the persistent mental preoccupation with internet use. Individuals continuously think about past digital experiences or anticipate upcoming sessions. This disrupts their ability to concentrate on academic tasks, professional duties, or interpersonal interactions, indicating a shift in attentional priorities (Wang et al., 2017).

**2. Emotional Salience**

Emotional salience involves the affective attachment to online engagement. Positive reinforcement mechanisms—such as receiving likes, rewards, or social approval—amplify craving. Furthermore, individuals often use the internet as a coping mechanism to escape negative emotional states like stress, anxiety, loneliness, or boredom, reinforcing its emotional significance (Brand et al., 2016).

**3. Behavioural Salience**

This dimension is marked by compulsive patterns of internet use, including repeated checking of devices, automatic app engagement, and continued use in inappropriate contexts such as during classes or work meetings. Even when users recognise the adverse consequences, they may find themselves unable to regulate their behaviour, indicating the behavioural dominance of internet activity (Griffiths, 2005).

**4. Neurobiological Salience**

From a neurological perspective, salience is linked to the activity of the brain's salience network, particularly the anterior insula and anterior cingulate cortex. These regions are responsible for identifying and prioritising stimuli relevant to survival or reward. In individuals with internet addiction, these circuits may become hypersensitive to digital cues—such as notifications or platform-specific triggers—resulting in a heightened neurobiological response and reinforcing the addictive cycle (Brandtner et al., 2021; Chang & Lee, 2024).

### 3.2 Salience in Contrast with Related Constructs

It is essential to differentiate salience from other core constructs in addiction, such as tolerance and withdrawal. While tolerance refers to the need for increased exposure to achieve the same level of gratification, and withdrawal reflects the psychological or physiological distress experienced upon cessation, salience pertains to the dominance of the activity in the mental and motivational system. In many cases, salience emerges prior to tolerance and withdrawal and serves as the initial signal of addictive development (Griffiths, 2005).

**Enhanced Dimensions of Salience in Internet Addiction:**

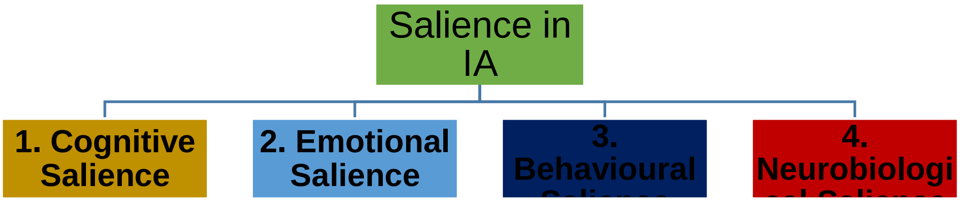


**Figure 2: Enhanced Dimensions of Salience in Internet Addiction**

## 4. Psychological Correlates of Salience in Internet Addiction

The emergence and dominance of salience in internet addiction is strongly influenced by various psychological factors. These traits and mental states interact with cognitive mechanisms and reinforce internet use as a salient behaviour. Below are the key psychological correlates associated with salience in problematic internet use:

### 4.1 Personality Traits

Personality traits play a significant role in influencing the salience of internet-related behaviours (Chung, 2019). Among these, **neuroticism** is strongly associated with internet addiction, as individuals high in this trait tend to experience emotional instability and negative affect, prompting them to seek relief through digital engagement. This behaviour reinforces the emotional salience of internet use, making it a primary coping mechanism (Kuss et al., 2013). Similarly, **low conscientiousness**, characterised by poor self-discipline, lack of organisation, and reduced impulse control, increases the likelihood of compulsive online behaviours and difficulty in disengaging from digital environments (Montag et al., 2015). Another relevant trait is **introversion**; introverted individuals often find online interactions more comfortable and less socially taxing than face-to-face communication, which heightens both emotional and cognitive salience (Grall-Bronnec et al., 2021). Empirical studies by (Kuss et al., 2013) and (Montag et al., 2015) have consistently demonstrated associations between these personality dimensions and salience-driven patterns of internet use, particularly in the contexts of social media and gaming.

### 4.2 Impulsivity and Self-Regulation Deficits

High impulsivity is linked to the inability to delay gratification, leading to habitual checking and extended internet sessions. Deficient self-regulation impairs the ability to inhibit online urges, increasing the risk of developing a salience-dominant pattern. These tendencies make individuals more susceptible to attentional biases toward internet stimuli, which in turn heightens salience (Ding et al., 2022).

### 4.3 Emotional Dysregulation and Coping Mechanisms

Individuals struggling to regulate emotions often turn to the internet as a form of emotion-focused coping. Online environments offer immediate distractions, mood elevation, or escape, reinforcing the emotional salience of being connected. This behaviour creates a feedback loop: negative emotions increase internet use, which in turn becomes more salient in the individual's psychological landscape (Bisen & Deshpande, 2018).

**4.4 Attentional Bias and Craving**

Research has shown that individuals with internet addiction display attentional biases toward online-related cues (e.g., app icons, notifications). These cues become triggers for craving, similar to substance addiction. Craving leads to repeated reinforcement, where the brain assigns increased importance to internet-related stimuli. This mechanism reinforces cognitive salience, driving obsessive thoughts and behavioural compulsion (Montag et al., 2015).

**4.5 Social Anxiety and Fear of Missing Out (FoMO)**

Socially anxious individuals may over-rely on online communication, giving rise to compulsive use patterns. FoMO, a common phenomenon in social media users, creates a persistent sense of urgency and salience, reinforcing frequent online checking and overuse (Zhang et al., 2017).

**Table 1: Psychological Correlates of Salience in Internet Addiction**

| PSYCHOLOGICAL FACTOR | IMPACT ON SALIENCE |
|---|---|
| NEUROTICISM | LEADS TO EXCESSIVE ONLINE USE FOR EMOTIONAL RELIEF, INCREASING SALIENCE. |
| LOW CONSCIENTIOUSNESS | POOR DISCIPLINE INCREASES COMPULSIVE ONLINE BEHAVIOR AND COGNITIVE SALIENCE. |
| INTROVERSION | PREFERENCE FOR ONLINE INTERACTIONS INCREASES EMOTIONAL SALIENCE. |
| IMPULSIVITY | DRIVES FREQUENT, UNCONTROLLED ONLINE ACTIONS; INTENSIFIES BEHAVIOURAL SALIENCE. |
| DEFICIENT SELF-REGULATION | REDUCES INHIBITORY CONTROL, REINFORCING COMPULSIVE INTERNET USE. |
| EMOTIONAL DYSREGULATION | PROMOTES INTERNET USE AS COPING STRATEGY; STRENGTHENS EMOTIONAL SALIENCE. |
| ATTENTIONAL BIAS | INCREASED FOCUS ON DIGITAL CUES ENHANCES COGNITIVE SALIENCE. |
| CRAVING | TRIGGERS REPEATED USE AND PRIORITIZATION OF ONLINE ACTIVITIES. |
| SOCIAL ANXIETY | ONLINE SPACES PERCEIVED AS SAFER; INCREASES RELIANCE AND SALIENCE. |
| FEAR OF MISSING OUT (FOMO) | URGENCY TO STAY CONNECTED FUELS COMPULSIVE CHECKING BEHAVIOR. |
| EMOTIONAL DYSREGULATION | PROMOTES INTERNET USE AS COPING STRATEGY; STRENGTHENS EMOTIONAL SALIENCE. |
| ATTENTIONAL BIAS | INCREASED FOCUS ON DIGITAL CUES ENHANCES COGNITIVE SALIENCE. |
| CRAVING | TRIGGERS REPEATED USE AND PRIORITIZATION OF ONLINE ACTIVITIES. |
| SOCIAL ANXIETY | ONLINE SPACES PERCEIVED AS SAFER; INCREASES RELIANCE AND SALIENCE. |
| FEAR OF MISSING OUT (FOMO) | URGENCY TO STAY CONNECTED FUELS COMPULSIVE CHECKING BEHAVIOR. |

**5. Behavioural Manifestations of Salience in Internet Addiction**

While salience begins as a cognitive and emotional prioritization of internet use, it becomes visible through a variety of observable behaviours. These manifestations reveal the extent to which digital activities dominate an individual's daily life, interfering with functioning and well-being.

### 5.1 Compulsive Checking and Repetitive Engagement

One of the most prominent behavioural expressions of salience is compulsive checking of internet platforms. Individuals frequently open social media apps, email, or messaging services even when there is no notification or external prompt. This behaviour reflects the internal urge to engage, driven by anticipatory pleasure or the fear of missing out (Zhu et al., 2024).

**Examples:** Refreshing feeds, re-opening apps seconds after closing, or habitually checking notifications during tasks.

**Reinforcement:** These actions are often reinforced by intermittent rewards (e.g., new likes, messages), increasing the reinforcement value and salience of these platforms.

### 5.2 Neglect of Daily Responsibilities

As salience intensifies, individuals begin to neglect academic, professional, and social responsibilities. Time spent online replaces time allocated for studying, working, or engaging in offline relationships. Even when individuals are aware of the negative consequences, they feel compelled to continue their online behaviour (Baloğlu & Çevik, 2008).

**Examples:** Skipping meals, losing sleep, missing deadlines, or avoiding real-world obligations due to prolonged internet use.

**Implication:** This behavioural neglect illustrates how salience overrides self-regulatory control and prioritization mechanisms.

### 5.3 Ritualistic Use Patterns

Individuals with high salience often develop rituals or routines around their internet use. These may include using specific apps at set times, starting or ending the day online, or following habitual content consumption sequences (Cash et al., 2012).

**Examples:** Always checking Instagram after waking up or ending the night watching YouTube.

**Behavioural Cueing:** These rituals are often cue-driven, where environmental or emotional triggers initiate the use cycle.

### 5.4 Digital Multitasking and Distraction

Salience also leads to difficulty in maintaining attention, especially in offline environments. The preoccupation with digital activities causes individuals to multitask—engaging in several online platforms simultaneously or to switch frequently between real-world and online stimuli (Noroozi et al., 2021).

**Examples:** Using social media while attending lectures or watching TV with multiple devices.

**Outcome:** This reduces the quality of offline engagement and contributes to cognitive overload and reduced task performance.

### 5.5 Persistence Despite Harm

A hallmark behavioural sign of addiction is continued use despite negative consequences. Salient internet users may face declining grades, health issues, strained relationships, or financial problems, but still fail to reduce their screen time (Kuss et al., 2013).

**Examples:** Arguing with family over screen time, ignoring physical symptoms like eye strain or sleep deprivation, or lying about usage habits.

**Cycle:** This perpetuates a negative reinforcement loop, where stress caused by overuse further drives internet use as an escape.

### 5.6 Social Withdrawal and Isolation

When salience reaches extreme levels, individuals may withdraw from in-person interactions, finding more satisfaction and control in the online world (Caplan, 2007).

**Examples:** Preferring virtual friendships over real ones, cancelling social plans, or feeling irritated during offline interruptions.

**Psychosocial Impact:** This results in reduced social intelligence, poor communication skills, and increased loneliness, further deepening dependency on the internet.

**Table 2: Behavioural Manifestations of Salience in Internet Addiction**

| BEHAVIORAL MANIFESTATION | DESCRIPTION |
|---|---|
| COMPULSIVE CHECKING AND REPETITIVE ENGAGEMENT | FREQUENT, URGE-DRIVEN CHECKING OF INTERNET PLATFORMS EVEN WITHOUT EXTERNAL TRIGGERS. |
| NEGLECT OF DAILY RESPONSIBILITIES | IGNORING ACADEMIC, PROFESSIONAL, AND PERSONAL DUTIES DUE TO EXCESSIVE ONLINE ACTIVITY. |
| RITUALISTIC USE PATTERNS | DEVELOPING ROUTINES OR FIXED PATTERNS OF INTERNET USE LINKED TO EMOTIONAL OR ENVIRONMENTAL CUES. |
| DIGITAL MULTITASKING AND DISTRACTION | SWITCHING BETWEEN MULTIPLE DIGITAL PLATFORMS OR REAL/ONLINE TASKS, REDUCING ATTENTION SPAN. |
| PERSISTENCE DESPITE HARM | CONTINUED INTERNET USE DESPITE KNOWN NEGATIVE OUTCOMES IN HEALTH, RELATIONSHIPS, OR WORK. |
| SOCIAL WITHDRAWAL AND ISOLATION | PREFERRING ONLINE INTERACTION OVER REAL-WORLD ENGAGEMENT; WITHDRAWAL FROM OFFLINE SOCIAL LIFE. |

## 6. Assessment Tools Related to Salience in Internet Addiction

The assessment of salience in internet addiction is often embedded within broader diagnostic frameworks for Internet Use Disorder (IUD) (Nakayama et al., 2017). These tools capture salience through specific items or subscales that measure preoccupation, compulsive use, craving, and emotional attachment to digital engagement. Though salience is not always an isolated construct in assessment instruments, its elements are clearly identifiable across cognitive, behavioural, emotional, and neurobiological domains (Young, 1998).

### 6.1 Internet Addiction Test (IAT)

Developed by (Young, 1998), The **Internet Addiction Test (IAT)** remains one of the most widely applied tools for measuring internet addiction. The IAT comprises 20 items, several of which specifically tap into the salience dimension. These include:

- “How often do you stay online longer than you intended?”
- “How often do you feel preoccupied with the Internet when offline, or fantasise about being online?”
- “How often do you try to cut down the amount of time you spend online and fail?”

These items assess both **cognitive salience** (mental preoccupation and intrusive thoughts) and **behavioural salience** (compulsive engagement), offering a comprehensive lens into how internet use becomes mentally prioritised (Widyanto & McMurran, 2004) .

### 6.2 Compulsive Internet Use Scale (CIUS)

The **Compulsive Internet Use Scale (CIUS)**, introduced by Meerkerk et al., 2009, is a brief and reliable instrument designed to measure the compulsivity and loss of control associated with internet use. Several CIUS items address salience through emotional and behavioural components, such as:

- "Do you find it difficult to stop using the Internet when you are online?"
- "Do you prefer to use the Internet instead of spending time with others?"

These statements evaluate **emotional salience** (craving, affective dependency) and **behavioural salience** (routine overuse and habitual patterns), making the CIUS a particularly useful tool for identifying early indicators of salience-driven dysfunction (Meerkerk et al., 2009).

### 6.3 Bergen Facebook Addiction Scale (BFAS)

The **Bergen Facebook Addiction Scale (BFAS)** by (Andreassen et al., 2012) is a platform-specific instrument adapted from Griffiths, 2005 components model of addiction. It includes direct references to salience, particularly in cognitive and anticipatory domains. A representative item includes:

- "You spend a lot of time thinking about Facebook or planning how to use it."

This question reflects **cognitive salience**, especially in the form of mental preoccupation, and provides insight into the motivational pull of specific digital platforms.

### 6.4 Neuroimaging Assessments

Beyond psychometric tools, **functional neuroimaging** methods such as fMRI have been employed to investigate **neurobiological salience** (Logothetis, 2008). Studies reveal increased activation in regions of the brain's **salience network**, notably the **anterior cingulate cortex** and **anterior insula**, in response to internet-related stimuli (Brand et al., 2016). Although not yet standard in clinical settings, neuroimaging offers compelling biological validation of salience as a measurable construct, reinforcing findings from behavioural self-reports (Schroeter et al., 2004).

**Table 3. Summary of Assessment Tools for Salience in Internet Addiction**

| ASSESSMENT TOOL | SALIENCE DOMAIN ASSESSED |
|---|---|
| INTERNET ADDICTION TEST (IAT) | COGNITIVE AND BEHAVIOURAL SALIENCE (E.G., PREOCCUPATION, COMPULSIVE USE) |
| COMPULSIVE INTERNET USE SCALE (CIUS) | EMOTIONAL AND BEHAVIOURAL SALIENCE (E.G., CRAVING, HABITUAL USE) |
| BERGEN FACEBOOK ADDICTION SCALE (BFAS) | PLATFORM-SPECIFIC COGNITIVE SALIENCE (E.G., OBSESSIVE PLANNING, MENTAL FOCUS) |
| FUNCTIONAL MRI STUDIES | NEUROBIOLOGICAL SALIENCE (E.G., HYPERACTIVATION OF THE SALIENCE NETWORK) |

These tools, particularly the IAT and CIUS, offer clinicians and researchers a structured approach to assessing the depth and breadth of salience across various domains. When used alongside behavioural data and, where possible, neurobiological evidence, they enhance the accuracy of diagnosis and the design of targeted interventions (Meerkerk et al., 2009; Widyanto & McMurran, 2004).

## 7. Discussion and Integration of Findings

The synthesis of theoretical, psychological, and behavioural literature consistently underscores the centrality of *salience* in the onset, maintenance, and escalation of internet addiction. Salience emerges not merely as a secondary symptom but as a pivotal psychological mechanism that bridges emotional vulnerability, cognitive prioritisation, and compulsive engagement (Cushnie et al., 2023). This section integrates the key insights from the reviewed models and findings to establish a comprehensive understanding of salience within the addiction framework.

### 7.1 Salience as a Precursor and Reinforcing Mechanism

Across the addiction framework, such as Griffiths, 2005 "Components Model (2005)" and the I-PACE model (Brand et al., 2016), Salience is positioned as both a *precursor* and a *reinforcer* of internet addiction. Initial engagement with the internet, often driven by entertainment, social connection, or emotional relief, gradually leads to an increasing cognitive and emotional prioritisation of online activities. Over time, this prioritisation transforms into compulsive and habitual behaviour, persisting even in the face of negative consequences.

This progression illustrates a self-reinforcing feedback loop wherein factors such as emotional vulnerabilities (e.g., anxiety, loneliness), personality traits (e.g., impulsivity, neuroticism), and external rewards (e.g., novelty, validation) intensify the salience of internet use. Repeated engagement strengthens these mechanisms, thereby making digital activity a dominant aspect of the individual's motivational system (Andreassen et al., 2012; Brand et al., 2016; Caplan, 2007).

**7.2 Cognitive-Behavioural Interdependence**

One of the key findings from the literature is the strong interconnection between *cognitive* and *behavioural* dimensions of salience. Cognitive salience is marked by intrusive thoughts, preoccupation, and anticipatory craving for digital interaction. Behavioural salience manifests as compulsive checking, multitasking, and neglect of offline responsibilities (Li et al., 2024a).

Importantly, even when behavioural expressions are temporarily managed (e.g., through screen time limits), unresolved cognitive salience, such as internal cravings or mental distraction may trigger relapse. This interdependence underscores the need for interventions that target both mental preoccupation and behavioural regulation (Li et al., 2024b).

**7.3 Population and Platform Variability**

Salience does not manifest uniformly across individuals or platforms. Age differences influence salience expression; for instance, adolescents are more prone to cognitive preoccupation, whereas adults may show higher levels of compulsive behavioural use. Platform type also matters, social media tends to induce *emotional salience* via validation mechanisms, while online gaming often fosters *ritualistic behavioural salience* through fixed use patterns and reward systems (Restrepo et al., 2020).

Cultural differences further modulate salience development. In collectivist societies, salience may be driven by social validation and conformity, whereas in individualist cultures, escapism and self-expression may serve as the dominant triggers. These patterns highlight the need for culturally and demographically sensitive interventions (Fatehi et al., 2020).

**7.4 Implications for Assessment and Intervention**

While psychometric tools like the IAT (Young, 1998), CIUS (Meerkerk et al., 2009) and BFAS (Andreassen et al., 2012) effectively capture elements of salience, most are limited by their reliance on self-report measures, which are prone to response bias and social desirability effects. Future research should integrate more objective methods, including:

- Digital behaviour tracking (e.g., screen time logs, in-app metrics)
- Neuroimaging and physiological monitoring (e.g., fMRI, galvanic skin response)
- Ecological Momentary Assessment (EMA) to capture real-time fluctuations in salience and engagement

Intervention frameworks should be equally multidimensional. Established approaches such as Cognitive Behavioural Therapy (CBT), mindfulness-based stress reduction, and structured digital detox programs should incorporate techniques that directly address salience. These may include attentional retraining, cue desensitisation, and cognitive reappraisal strategies aimed at reducing the psychological pull of digital cues (Kuss & Lopez-Fernandez, 2016; Montag et al., 2015).

**7.5 Gaps and Limitations in the Current Literature**

Despite growing research attention, several limitations remain:

- Lack of longitudinal studies restricts our understanding of causal pathways and developmental trajectories of salience.

- Neurobiological findings, though promising, are not yet scalable for routine clinical application.
- The boundary between functional salience (e.g., intensive use for professional or academic productivity) and dysfunctional salience (compulsive or maladaptive use) remains ambiguous and warrants further conceptual refinement.

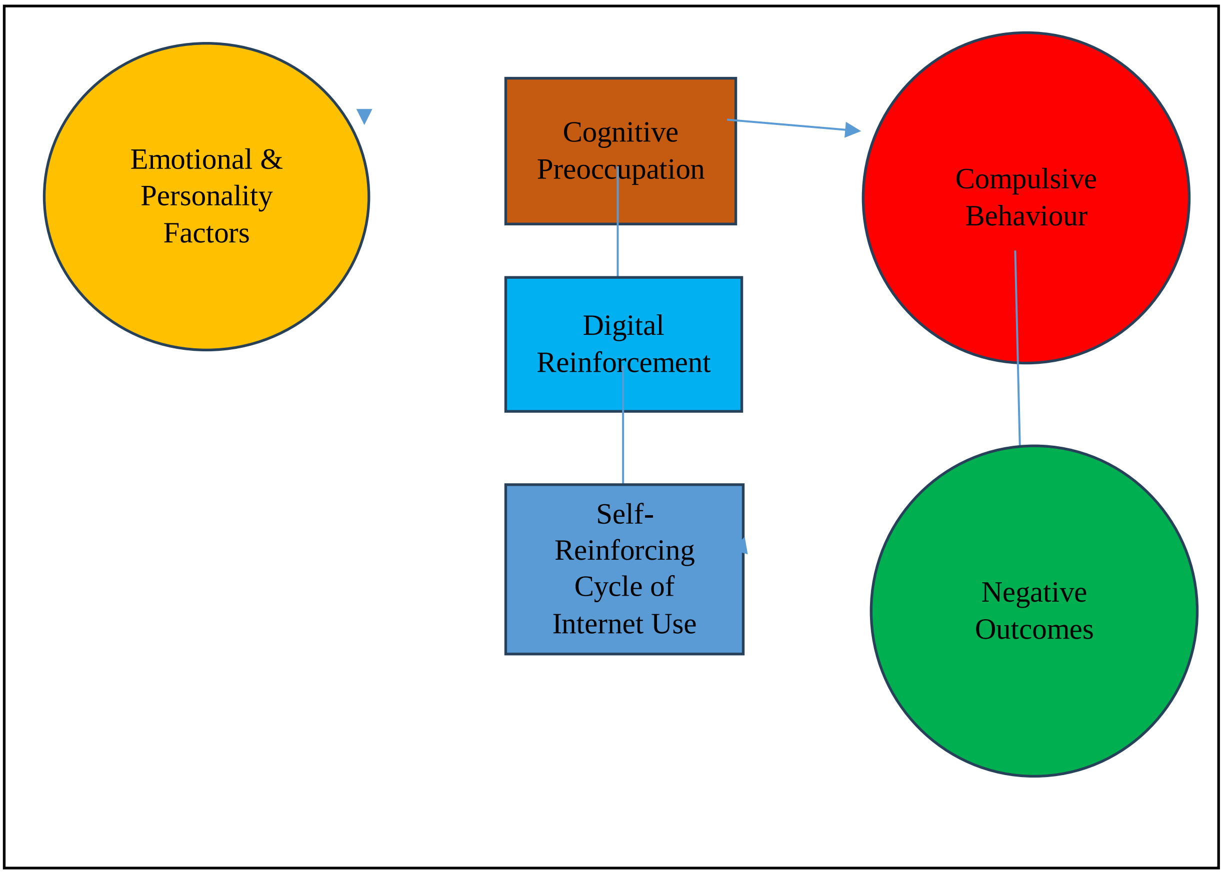


**Figure 3: Integrative flow chart for Salience for Internet Addiction**

## 8. Limitations and Future Directions

Despite the increasing recognition of *salience* as a core psychological and behavioural component in internet addiction, the existing body of literature is constrained by several notable limitations. Addressing these gaps is crucial for advancing both theoretical understanding and clinical application.

### 8.1 Overreliance on Self-Report Measures

A predominant limitation is the extensive reliance on self-report instruments such as the Internet Addiction Test (IAT) and the Compulsive Internet Use Scale (CIUS). While these tools offer valuable insight, they are subject to various biases, including social desirability and self-deception (Meerkerk et al., 2009; Widyanto & McMurran, 2004). This concern is especially pronounced among adolescent and young adult populations, where self-awareness and introspective accuracy may be limited. As a result, the degree and nature of salience may be underreported or inaccurately represented.

### 8.2 Lack of Longitudinal and Developmental Evidence

The majority of studies in this domain are cross-sectional, thereby capturing only a snapshot of behaviour and cognition. Such designs hinder the ability to trace the progression of salience over time, particularly in relation to addiction onset, intensification, maintenance, or remission. Longitudinal studies are essential to delineate causal pathways and to understand dynamic elements such as relapse, habit formation, and neurocognitive shifts (Brand et al., 2016).

**8.3 Cultural and Demographic Gaps in Representation**

Research to date has been largely concentrated within Western and East Asian adolescent cohorts. This narrow demographic focus limits generalisability across age groups, cultural traditions, and digital ecosystems. Socioeconomic status, family structure, digital access, and cultural attitudes towards technology use may all shape how salience manifests and is experienced. Broader and more inclusive sampling is required to construct a globally relevant understanding of internet addiction.

**8.4 Incomplete Integration of Neuroscientific Insights**

Although recent advances in neuroimaging have linked salience attribution with activity in the brain's salience network—particularly within the anterior cingulate cortex and insula—neuroscientific findings remain underutilised in clinical practice (Brandtner et al., 2021; Chang & Lee, 2024). The translation of such data into accessible diagnostic or therapeutic tools is currently insufficient. Moreover, neuroscientific research often focuses on substance-based addictions, leaving behavioural addictions comparatively underexplored.

**8.5 Future Research Directions**

To overcome these limitations and enrich the conceptual and empirical landscape, future research should prioritise the following:

1. **Adoption of Multi-Method Assessment Paradigms**
   Combine self-report tools with behavioural tracking (e.g., screen time logs, app usage metrics) and physiological data (e.g., heart rate variability, eye-tracking) to triangulate salience indicators more reliably.
2. **Cross-Cultural and Contextual Expansion**
   Extend research to underrepresented groups including middle-aged users, digital professionals (e.g., influencers, content creators), and individuals from varied cultural and socioeconomic backgrounds.
3. **Evaluation of Intervention Strategies**
   Explore targeted interventions such as digital mindfulness training, attentional control exercises, and cognitive-behavioural therapy (CBT) modules specifically designed to address salience and attentional bias (Kuss & Lopez-Fernandez, 2016).
4. **Strengthening Neuroscientific Contributions**
   The integration of neuroimaging, electrophysiological, and neurochemical studies to refine diagnostic criteria and support the development of precision-based treatment protocols (Brand et al., 2016; Brandtner et al., 2021).

**9. Conclusion**

Salience emerges as a central construct in understanding the development, maintenance, and relapse of internet addiction. Far from being a mere consequence of excessive internet engagement, salience represents a dynamic psychological and behavioural mechanism that transforms routine online activity into compulsive use. It operates through persistent cognitive preoccupation, emotional dependency, and ritualistic behaviours that reinforce maladaptive patterns of digital consumption.

Theoretical frameworks such as Griffiths' Components Model (Griffiths, 2005) and the I-PACE (Interaction of Person-Affect-Cognition-Execution) model (Brand et al., 2016) underscore the integrative nature of salience. These models situate salience at the intersection of personality traits (e.g., impulsivity, neuroticism), affective vulnerabilities (e.g., anxiety, emotional dysregulation), and cognitive distortions (e.g., attentional bias, craving), thereby offering a robust explanatory basis for the compulsive use of internet platforms.

Empirical findings further validate salience as a predictive and mediating factor in internet addiction. It is cognitively expressed through obsessive thoughts and impaired decision-making; emotionally, through the internet's function as a mood regulator; and behaviourally, through neglect of responsibilities, social withdrawal, and digital rituals (Andreassen et al., 2012; Cushnie et al., 2023; Montag et al., 2015). Such multifaceted expression necessitates a multidimensional approach to assessment and intervention.

Although standardised tools such as the Internet Addiction Test (IAT) (Widyanto & McMurran, 2004), Compulsive Internet Use Scale (CIUS) (Meerkerk et al., 2009), and Bergen Facebook Addiction Scale (BFAS) (Andreassen et al., 2012) provide useful metrics, they are limited by their self-report nature. Future research and clinical practice should incorporate objective indicators such as digital behaviour tracking, neuroimaging, and psychophysiological markers to more accurately detect and address salience-related dysfunctions (Brandtner et al., 2021; Chang & Lee, 2024).

Interventions must move beyond superficial screen time restrictions and instead focus on mechanisms that directly modulate salience. These include attentional control training, cue exposure and response prevention, emotional self-regulation techniques, and mindfulness-based strategies (Kuss & Lopez-Fernandez, 2016; Montag et al., 2015). Tailoring interventions to target salience explicitly may enhance treatment efficacy and support long-term digital well-being.

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# DIGITAL TRANSFORMATION: BRIDGING HUMANITIES, COMMERCE, SCIENCE AND MANAGEMENT IN THE AGE OF TECHNOLOGY

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***Abstract***

*Digital transformation, driven by technology, necessitates bridging traditionally separate fields like humanities, commerce, science and management to create a holistic and sustainable approach. In the era of rapid technological advancement, digital transformation has emerged as an essential force which reshape the every part of human activity. This transformation transcends traditional disciplinary boundaries, integrating humanities, commerce, science and management into a cohesive digital ecosystem. Digital transformation in the humanities involves leveraging technology to enhance research, teaching and the understanding of cultural heritage. While the integration of digital technology into all aspects of a business, is revolutionizing commerce and management, leading to significant changes in how businesses operate and interact with customers. Simultaneously, Digital transformation in science involves leveraging digital technologies to modernize scientific research and innovation, impacting areas like data analysis, automation and collaboration. This paper reviews that how digital transformation makes positive changes in the diverse fields like humanities, commerce, science and management.*

***Keywords:*** *Digital Transformation, Interdisciplinary Integration, Humanities and Technology, Commerce Innovation, Scientific Advancement, Management Strategy*

## INTRODUCTION

Digital transformation bridges humanities, commerce, science and management by integrating technology across various fields to create new value and improve efficiency. This involves using digital tools to transform existing processes, create new services and adapt to evolving customer needs. The goal is to enhance innovation, improve customer experience and optimize operations. The intersection between humanities and technology has led to exciting opportunities and raised important issues that require exploration and critical examination. The relationship between the Humanities and technology is multifaceted and complex. On one hand, technology has provided scholars in the humanities with powerful tools and methodologies for research, analysis and communication. Digital humanities, for instance, utilizes computational techniques, data visualization and digital platforms to expand the scope and possibilities of humanistic inquiry. It has enabled researchers to delve into large datasets, conduct text mining and analysis, and create interactive digital archives, fostering new approaches to studying culture, literature, history and more. Furthermore, technology has influenced the ways in which knowledge is produced, disseminated, and consumed. Online publishing platforms, open-access initiatives and digital repositories have facilitated greater access to scholarly resources and expanded the reach of humanities scholarship beyond academic circles.

The adoption of digital technologies has profoundly reshaped commerce and management education, transitioning from traditional methods involving blackboards and textbooks to a more dynamic, interactive approach enhanced by digital tools. This shift has redefined the roles of educators and institutions, emphasizing the need for integrating Information Technology (IT) into educational practices. Commerce is integral to contemporary society, influencing various domains including the economy, technology, science, and personal growth. Integrating Information Technology (IT) into commerce and management studies is essential for equipping students with skills in data-driven

decision-making, process automation, and digital asset protection. The update in teaching approaches, incorporating IT tools such as data analytics and FinTech, equips graduates to thrive in a technology-focused world, boosting their employability and leadership capabilities in the global business landscape.
The integration of digital technologies in Management leads to personalize customer interactions, provide self-service options, and improve overall customer satisfaction. Automation, data analytics, and cloud computing can optimize workflows, reduce costs, and improve efficiency. Real-time data analysis allows managers to make more informed decisions, track performance, and identify opportunities for improvement. Digital transformation fosters agility and adaptability, enabling businesses to respond quickly to changing market conditions and customer demands.
Digital technologies can create entirely new business models and revenue streams, disrupting traditional industries and creating new opportunities.
In Science Digital transformation enables faster and more efficient research by automating data analysis, utilizing simulations and facilitating collaborative research efforts. Large datasets can be analyzed to identify patterns, predict outcomes, and inform decision-making in scientific fields. Digital tools like machine learning, artificial intelligence, and bioinformatics are revolutionizing scientific research, enabling new discoveries and advancements. Digital platforms facilitate remote collaboration, knowledge sharing, and access to global research networks.
Digital transformation across multidisciplinary fields like humanities, commerce, management, and science offers numerous benefits. These include enhanced data collection and analysis, improved communication and collaboration, increased efficiency and productivity, and the potential for innovation and new revenue streams.

**DIGITAL TRANSFORMATION IN COMMERCE AND MANAGEMENT EDUCATION**

Digital tools and resources democratize learning by making educational materials available to students regardless of their geographic location or financial status. This inclusivity enables broader participation in commerce and management education, bridging gaps that previously existed.
With the advent of digital platforms, educators can personalize lessons to cater to individual students' needs. This tailored approach enhances learning outcomes by addressing diverse learning styles and paces, leading to more effective comprehension and retention of knowledge.
Online learning environments facilitate collaboration among students and professionals from around the world. This global network exposes learners to diverse perspectives and practices, enriching their understanding and expanding their professional networks.
Digital simulations and virtual laboratories provide hands-on experience in business scenarios. These engaging tools enable students to apply theoretical concepts to real-life situations, fostering essential skills like problem-solving and decision making, which are crucial in the business environment.
Utilizing digital tools allows for the gathering and examination of data regarding student performance. Educators can use these insights to monitor progress, pinpoint areas needing improvement, and make informed decisions to refine teaching methods and enhance learning experiences.
Online resources and platforms provide educators with opportunities for continuous learning and skill enhancement. Staying updated on the latest trends, technologies, and teaching methods helps educators improve their effectiveness and adapt to the evolving educational landscape.
Digital education can incorporate specialized courses on emerging topics such as digital literacy, e-commerce, and entrepreneurship. This alignment with industry demands ensures that students acquire skills that are directly applicable to the current job market.

Online platforms encourage entrepreneurial activities and innovation by providing students with resources and tools to develop and launch new ventures. This support for creative problem-solving and business creation is vital for nurturing the next generation of entrepreneurs.

Digital education offers flexible learning schedules and lifelong learning opportunities. Students can access educational resources at their convenience, accommodating diverse schedules and learning needs and supporting ongoing professional and personal development.

Collaboration between educational institutions, industry partners and government agencies can enhance commerce and management education. These partnerships help develop programs that address current trends and challenges, providing students with relevant and high-quality educational experiences.

Digital transformation enables businesses to collect and analyze customer data, market trends, and competitor information, leading to better informed decisions and more effective marketing strategies.

Digital transformation enables businesses to improve communication with customers, suppliers, and partners, streamlining operations and fostering better relationships.

Businesses can leverage digital technologies to create new products and services, expand into new markets, and develop innovative business models.

Data analytics and insights from various sources can help managers optimize decision-making, improve resource allocation, and enhance organizational performance.

Digital tools, like project management software and cloud collaboration platforms, enhance communication and collaboration among team members.

Digital tools can automate tasks like scheduling, reporting and budget tracking, freeing up managers to focus on strategic decision-making.

**DIGITAL TRANSFORMATION IN HUMANITIES AND SCIENCE**

Digital tools allow for the collection and analysis of vast amounts of textual data, enabling new insights into historical trends, cultural patterns and linguistic analysis.

Social media and online platforms can facilitate the sharing of research findings, discussions, and collaboration among scholars.

Digital tools can automate tasks like text analysis, citation management, and research documentation, freeing up time for more complex research.

Digitization of cultural heritage materials makes them accessible to researchers and the public worldwide.

Digital platforms provide flexible and accessible learning opportunities for students and lifelong learners.

Software and tools, developed by computer scientists, can assist humanities scholars in analyzing vast text datasets.

Digital archives and online platforms can ensure the long-term preservation and accessibility of valuable cultural artifacts.

Digital media and online platforms provide new avenues for cultural expression and engagement.

Digitalization can streamline processes, automate tasks, and improve efficiency in both science and humanities research.

Digital platforms facilitate global collaboration and knowledge sharing, fostering a more interconnected and diverse research community.

Efforts to ensure equitable access to digital tools and resources are crucial to make these opportunities available to everyone.

Embracing digital transformation is essential for higher education institutions and research organizations to stay relevant and competitive in an increasingly digital world.

Digital tools, like machine learning and AI, can analyze vast datasets, identify patterns, and accelerate scientific discovery.

Techniques like data visualization and statistical modeling, enabled by digital platforms, can provide deeper insights into complex data.

Online platforms and collaborative software can facilitate global collaboration among scientists, researchers and educators.

The creation of online repositories and databases makes scientific knowledge more accessible and easier to share, fostering a more inclusive and collaborative research environment.

Digital tools, such as virtual reality and 3D modeling, can create new ways for scientists to visualize and interact with complex scientific phenomena.

Digital tools facilitate the collection, storage and analysis of scientific data, accelerating research and discovery across various disciplines.

Online databases and collaboration tools facilitate knowledge sharing and research coordination among scientists.

Digital tools can facilitate the development of new technologies, applications and research methodologies, leading to scientific breakthroughs.

Digital tools can automate data collection, analysis and reporting, accelerating research and improving productivity.

## CHALLENGES IN DIGITAL TRANSFORMATION

Digital transformation presents unique challenges across humanities, science, commerce and industry. These include:

**Resistance to Change:** Employees and leaders may resist adopting new technologies and processes, fearing job displacement or the unknown.

**Organizational Culture**: A significant hurdle is adapting to a new digital culture within organizations. This requires employees to embrace innovation and continuous learning.

**Skills Gap**: There's often a shortage of skilled professionals with the expertise needed to drive digital transformation.

**Leadership Support**: Without strong leadership support, digital transformation efforts can falter.

**Legacy Systems**: Outdated systems can hinder the adoption of new technologies.

**Complex Technology**: Implementing new technologies can be complex and require specialized expertise.

**Security Concerns**: Ensuring the security of data and systems is crucial, especially with the increasing use of digital platforms.

**Data Management**: Managing large amounts of digital data effectively can be challenging.

**Digital Illiteracy**: A lack of digital literacy among employees can create barriers to adoption.

**Communication**: Effective communication is essential to ensure all stakeholders are aligned with the digital vision.

**Ethical Concerns**: Digital transformation raises ethical questions about data privacy, algorithmic bias, and job displacement.

**Budget Limitations**: Implementing digital transformation initiatives can be expensive.

**Lack of Resources**: A lack of resources, including skilled personnel and technology, can hinder progress.

**Lack of Strategy**: A clear digital transformation strategy is essential for success.

**Evolving Customer Needs**: Keeping up with evolving customer needs and preferences in the digital landscape is crucial.

**Market Challenges**: Digital transformation can impact business models, supply chains, and customer relationships.

**Economic and Societal Challenges**: Digital transformation can have broader economic and societal implications, including potential job losses and increased inequality.

## CONCLUSION

Digital transformation has profoundly reshaped science, humanities, commerce and management, acting as a stimulus for innovation, efficiency and global connectivity. In science, it has accelerated research through big data, AI and advanced simulations. In the humanities, it has expanded access to cultural knowledge, preserved historical materials digitally and enabled new modes of interpretation. Commerce has seen revolutionary changes with e-commerce and data-driven marketing, while management practices have evolved through digital tools, remote work platforms, and real-time analytics. Across all disciplines, digital transformation fosters interdisciplinary collaboration and democratizes information, but also demands critical reflection on ethics, data privacy, and inclusivity. As it continues to evolve, embracing digital literacy and adaptability will be key to leveraging its full potential responsibly.

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# CYBERSTALKING OF POLITICAL OPPONENTS: A GROWING THREAT AND THE ROLE OF CRIMINAL LAW

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***Abstract***

*Cyberstalking of political opponents has emerged as a serious and escalating threat to democratic engagement, freedom of speech, and political participation in the digital age. The shift from traditional stalking to sophisticated online harassment has enabled anonymous perpetrators to target politicians, activists, and dissenting voices with impunity, often resulting in psychological distress, reputational damage, and political silencing. This research investigates the nature and extent of cyberstalking in the political landscape, examining how digital tools, social media platforms, and bots are used to carry out persistent online harassment. Through a doctrinal and comparative legal methodology, the study critically analyzes the effectiveness of existing Indian laws such as the Information Technology Act, 2000 and IPC provisions, alongside international legal frameworks in the US, UK, and EU. The findings highlight significant legal gaps, enforcement limitations, and jurisdictional challenges, especially in cross-border digital abuse. The study further explores the role of social media platforms in enabling or failing to prevent such abuse. Concluding with policy-level recommendations, the paper advocates for comprehensive legislative reform, increased platform accountability, and improved law enforcement mechanisms to protect democratic integrity and ensure justice for victims of political cyberstalking.*

***Keywords****: Cyberstalking, Political Oppression, Criminal Law, Digital Harassment, Legal Reform*

## 1. Introduction

Cyberstalking occurs when someone harasses, intimidates, or threatens someone online. Threats, slander, identity theft, unwanted correspondence, and monitoring can cause psychological harm. Cyberstalkers can target victims anonymously, remotely, and at any time, making the crime more nefarious and harder to track than physical stalking (Alkasasbeh & Al Saleh, 2021). Due to cellphones, social media, and encrypted communication technology, cyberstalking, especially targeting celebrities, has become a big issue. Political opponents are being cyberstalked, which is concerning. Democracies depend on political debate and discussion for government and citizen engagement. Political cyberstalking dilutes opposing views, spreads misleading information, and incites intimidation and persecution, undermining basic goals. Trolling, doxxing, and deepfake content are common digital attacks against politicians, activists, journalists, and whistleblowers (Godavarthi et al., 2024). These attacks aim to discredit or coerce them. These sorts of harassment are obtrusive and damage public trust in government and democracy.

This research aims to determine whether political opponents use cyberstalking and whether present criminal laws can stop this growing digital menace. The study also seeks to illuminate law enforcement's challenges in investigating and prosecuting such crimes, as well as social media's importance and online anonymity. An review of how other democracies' legal systems have handled similar difficulties and suggestions for improving India's will also be provided. This study addresses cybercrime's political aspect, which has been neglected. India has cyberstalking laws (the Indian Penal Code and the Information Technology Act), however they are sometimes insufficient and conflicting for politically sensitive cases. Lawmakers, lawyers, and civil society activists working for digital liberty and accountability should research this topic. More digitalised politics make it important to reform and apply cyberbullying laws to protect political speakers.

2. **Understanding Cyberstalking in the Political Context**

Political cyberstalking involves utilizing the internet to harass, threaten, or undermine political opponents. Doxxing, hacking, impersonation, spreading false or libellous content, and social media trolling and abuse are aggressive forms. Political figures—especially opposition party members, activists, dissidents, and minority voices—are often cyberstalked because it can destroy reputations, suppress dissent, and distort democratic processes (Miftha, 2024). Coordinated online harassment, sometimes tied to anonymous organizations or political IT cells, involves large groups spewing hate speech, threats, and false information at a target. Another method is to use deepfake technology to modify videos, images, or audio to slander or shame someone. At worst, victims risk personal and professional assaults and physical and sexual violence.

Cyberstalking increases during political upheaval and elections. Online hate campaigns targeted opposition politicians and outspoken journalists during the Indian general elections and protest movements including the anti-CAA and farmers' protests. Troll armies and false news outlets slandered, misrepresented, and even accused people of terrorism and sedition (Haq & Zarkoon, 2023). These actions were often meant to influence public opinion or harm political movements. In democracies like the US, political candidates and journalists, especially women, have reported heavy internet abuse, often with racist or sexual charges. As demonstrated in the 2016 U.S. elections, foreign influence, particularly bot-driven content or fake accounts, has also been used to destabilise.

Political cyberstalking is perilous due of anonymity and digital tools. Fake accounts, encrypted chat apps, and VPNs make it hard to identify and prosecute criminals. Bots promote targeted attack engagement, giving the impression that the public is united against a person or cause. Through AI and data analytics, highly customized attacks can be created using a target's digital footprint. Social media algorithms promote contentious information, so hate campaigns can spread quickly. Online harassment like this has serious consequences (Chakan & Millenio, 2023). Victims may endure anxiety, depression, sleeplessness, and PTSD. Isolation or self-censorship of political beliefs may reduce their social participation in democratic processes. Cyberstalking in politics creates an atmosphere of fear and intimidation when the most vociferous or aggressive people are highlighted. This stifling effect promotes authoritarianism and lowers public conversation. Political cyberstalking must be studied to create effective laws and policies that safeguard internet freedom and hold politicians accountable.

**3. Legal Framework and Criminal Law Perspective**

Understanding the present legal norms and their efficacy in responding to cyberstalking is vital, especially in politics. The IT Act of 2000 and Indian Penal Code of 1860 are the main cyberstalking laws in India. In Shreya Singhal v. Union of India (2015), the Supreme Court recognized free expression and overturned Section 66A of the IT Act, which punished obscene internet messages. Sections 67 (obscene content), 66D (cheating by personation), and 66C (identity theft) now take precedence (Antai et al., 2025). Parts 354D (stalking), 506 (criminal intimidation), and 499 (defamation) of the Indian Penal Code provide remedies. Unfortunately, these rules are either insufficient or misused to harass political opponents online. This is especially true for psychological abuse and malicious digital content meant to harm a person's reputation.

Many countries have tightened cyberstalking legislation. The US has made cyberstalking a federal offence under 18 U.S. Code Section 2261A, which prohibits using internet communication to harass or intimidate others. Many states have anti-cyberstalking laws. The 1997 Protection from Harassment Act was amended to cover UK cyberstalking and stalking (Ikpegbu, 2024). While several EU member states have established cyber harassment laws, the EU's General Data Protection Regulation (GDPR) restricts data usage and privacy, providing indirect relief to victims. India's present laws lack victim protections, broad harassment definitions, and straightforward proof standards.

Indian judges have acknowledged the issue, but politically motivated cyberstalking law is still developing. In K.P. Madhusudhanan v. Kerala Kaumudi Daily (2004), the court recognized the importance of digital reputation protection but focused on defamation rather than digital harassment (Zahid et al., 2024). The courts have also understood the necessity of balancing privacy and free speech online, but they have not consistently enforced these principles. Political cases often involve partisanship, judicial system misuse, or inactivity in reaction to political pressure, which can lead to selective justice and cybercriminal impunity. Cyberstalkers who are anonymous or foreign raise jurisdiction and enforcement concerns. Extradition requests and mutual legal assistance treaties (MLATs) are complicated and often ineffective for worldwide cybercrimes. Many social media firms' headquarters are in other countries, so they're unwilling to export user data without strict legal procedures (Dodiya et al., 2024). Even after discovering high-profile political cases, prosecutors may be reluctant to seek charges due to public uproar or political bias. To solve these weaknesses, India must instantly strengthen its digital forensic skills, international cooperation, and legislative regulations by introducing more explicit definitions and methods.

**4. Role of Technology and Digital Platforms**

Technology can enable cyberstalking or provide a solution. Political cyberstalking is particularly common on WhatsApp, Instagram, Facebook, and Twitter (now X). On these platforms, individuals or organized groups may attack political opponents with mass trolling, disinformation campaigns, and manipulated or fabricated content (Okpako et al., 2023). One of the most worrying phenomena is doxxing, which publishes private information including addresses, phone numbers, and personal photographs of government figures and their families. Pegasus spyware has also tracked and intimidated political activists, journalists, and opposition leaders. These technologies go beyond harassment to full-blown surveillance, violating democratic rights and personal liberties.

Digital platforms are being blamed for cyberstalking. Some platforms claim to restrict harassment and hate speech, but it's hard to tell. Engagement-based algorithms promote controversial information, boosting cyberstalkers. Twitter is notorious for permitting anonymous harassment due to inadequate authentication, while Facebook has been criticised internationally for slow response to warning content. WhatsApp's end-to-end encryption makes it ideal for closed-group hate speech, fake news, and targeted abuse with little real-time moderation (Marcum & Higgins, 2019). Many internet businesses have tried content reporting, account blocking, and user education programs, but these measures are either insufficient or reactive to systematic abuse.

The anonymity of internet platforms makes political cyberstalking difficult to prohibit. Due to the simplicity of creating and operating trolls, bots, and false personas without identification verification, law enforcement finds it difficult to identify offenders. Dark web forums, encrypted communications, and VPNs complicate identification. Even for reported content, getting a court order to access platform user data might take months and require international cooperation. Due to the vast amount of daily content, proactive monitoring is impractical without investing in AI-driven moderation tools and human oversight (Adediran, 2021). New policy initiatives and technology advances offer hope despite these challenges. Machine learning techniques are being developed to detect bot activity and coordinated harassment patterns in real time. In the EU and Australia, the Digital Services Act (DSA) and Online Safety Act oblige digital services to disclose more data. New Indian IT guidelines (2021) require platforms to analyse messages and respond customer complaints more efficiently, yet monitoring and misuse concerns remain. Partnerships that verify facts, civic tech solutions that promote digital safety, and digital citizenship programs are also growing (Patchin et al., 2020). Unless there is a uniform worldwide framework and platform-level responsibility, technology will enable cyberstalkers quicker than victims can be helped. In a democratic society that values innovation, regulation, and individual rights, a medium ground is needed.

**5. Findings**

Several key conclusions from a political research of cyberstalking show the problem's severity and legal constraints. Public figures, especially minorities, activists, and political opponents, are being cyberstalked more, which is concerning. Reviewing the relevant statutes and case law shows that the Information Technology Act of 2000 and the Indian Penal Code (IPC) safeguard against politically motivated cyberbullying, but they are insufficient to address its prevalence and complexity. In political situations, the lack of a clear and comprehensive cyberstalking term leads to poor enforcement and variable legal interpretation. Many courts employ broad definitions like criminal intimidation or defamation that fail to grasp cyberstalking's widespread and emotionally destructive nature. Another crucial finding is significant legal voids in jurisdiction, anonymity, and platform accountability. Cyberstalkers may use foreign-hosted sites and hide their identity, making it hard for law enforcement to identify their content. Social media companies' reluctance to transmit user data without significant legal processes and their distinct legal jurisdictions contribute. Because technology changes and legal norms are unclear, judicial opinions, while often progressive, are inconsistent and do not set major precedents. This reduces conviction rates and gives perpetrators a sense of impunity, especially in cases involving power or politics.

Cyberstalking is more widespread against female politicians, marginalised people, and opposition leaders, research shows. This may indicate that the internet is being exploited to stifle opponents and prevent democracy. These victims often face psychological harassment, sexual abuse, doxxing, and threats of violence from troll networks. Other powerful political factions have done nothing or even tacitly encouraged such attacks, causing panic and repression of opposition. This discourages qualified people, especially minorities and women, from entering or staying in public service and degrades democracy. Despite some new AI and modest platform initiatives to detect misuse, these have primarily been reactive and have not prevented harm in real time. The lack of a comprehensive victim protection framework with digital evidence retention, timely grievance redressal channels, and psychological support causes victims to withdraw complaints or keep silent, distorting the situation. The results demonstrate the urgent need for legislative changes, improved institutional procedures, and global collaboration to recognise cyberstalking—particularly in political domains—as a serious threat to personal liberties and democracy.

**6. Discussion**

Cyberstalking is a political phenomenon that straddles free speech and internet platform harassment. Free and open debate and dissent are essential to democratic political discourse, but internet platforms that support free speech are being used to harass political opponents. Cyberstalking discussions must balance civil liberty and internet safety. Given the potential for internet communication to be used for intimidation, character assassination, and silencing opposition, there are fundamental issues about the right level of freedom that must be allowed without accountability. People find it harder to speak out and participate in politics when wrongdoers exploit insufficient regulatory oversight, jurisdictional gaps, and anonymity to avoid punishment.

Protecting personal freedoms from national security needs is another important issue. Governments must protect lawmakers, activists, and whistleblowers from cyberbullying, but they also risk violating individuals' privacy and free expression rights through imprecise legislation and overly expansive monitoring schemes. To strike the right balance, legislation must distinguish between permissible political criticism and damaging cyberstalking. Cyberstalking is complicated, and the IT Act and other IPC sections either don't address it or are being used to muzzle opponents. This requires clearer legal definitions, simpler reporting procedures, and stricter disciplinary measures for political online harassment while protecting legitimate opposition.

Global digital law enforcement best practices show that some countries are ahead of others. UK platforms must be accountable and delete harmful content faster under the Online Safety Bill. The EU's Digital Services Act (DSA) requires digital platforms to identify and mitigate systemic issues such political cyberstalking. In the meantime, federal regulations make cyberstalking over state lines unlawful and allow the FBI to intervene in serious cases. All three approaches emphasise digital business-law enforcement collaboration, victim-centered reporting, and platform responsibility. The Indian IT Rules (2021) have been criticised for overreach and lack of openness, and its implementation is inconsistent. These findings suggest the following policy recommendations: The Indian government must first establish a cyberbullying and online abuse protection law. This law must define political cyberstalking and set punishments. Second, social media abuse reporting, political page identification verification, and open and honest complaint resolution must be made easy.

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# CRITIQUE OF NATIVISM: A CULTURAL AND LITERARY PERSPECTIVE

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***Abstract***

*This research paper examines the notion of nativism from a cultural and literary perspective, focusing on its function in defining postcolonial identity and creative expression. Nativism, which is sometimes viewed as a reaction to colonial dominance and cultural erasure, prioritizes the recovery of indigenous languages, customs, and worldviews. While nativism is an effective weapon for cultural reclamation and resistance, this study contends that it may also lead to romanticizing the past and excluding hybrid or developing identities. This research examines literary texts and theoretical frameworks to emphasize contradictions between authenticity and flexibility, as well as tradition and modernity.*

*The study concludes that, while nativism is necessary for reclaiming cultural autonomy, it must be critically examined to avoid essentialism and promote a more inclusive and dynamic conception of cultural and literary identity in a globalized world.*

***Key words:*** *Nativism, Culture, Literature, Desivad, Language, social structures, diversity, Jati, etc.*

## Introduction:

Nativism, as a cultural and literary movement, emphasizes the importance of indigenous traditions, languages, and identities in response to the dominance of foreign or colonial influences. Rooted in a desire to reclaim cultural authenticity, nativism advocates for literature and artistic expressions that emerge within the native social and linguistic context. In postcolonial societies like India, where colonial legacies continue to influence intellectual and cultural discourses, nativism has gained prominence as a reaction against the Western paradigms that have historically shaped literary standards. Thinkers like Bhalchandra Nemade have championed *Deshivad* (nativism) as a way to assert regional narratives and resist the imposition of alien literary frameworks. However, while nativism seeks to restore cultural autonomy and voice, its scope and assumptions merit critical examination, particularly in a world characterized by globalization, hybridity, and intercultural dialogue.

This research paper aims to explore and critique nativism from both cultural and literary perspectives, questioning its relevance, limitations, and implications in contemporary society. By analyzing the theoretical foundations of nativism and examining the critiques offered by scholars such as Raosaheb Kasbe, the study interrogates the ideological tensions between cultural rootedness and openness to global influences. It seeks to understand whether nativism can serve as a sustainable model for literary production and cultural representation or whether it risks promoting exclusionary and rigid identities. Through an interdisciplinary lens combining literary criticism, cultural theory, and postcolonial studies, the paper offers a balanced inquiry into the potentials and pitfalls of nativism as a framework for interpreting literature and shaping cultural consciousness.

## Objectives of the study:

1. To investigate the theoretical underpinnings of nativism in cultural and literary contexts, including its essential ideas, motives, and history.
2. Critically investigate how nativist beliefs impact literary output and cultural discourse, particularly in postcolonial and nationalist contexts.
3. To examine the limitations and paradoxes of nativist ideas, particularly when faced with diversity, hybridity, and global literary interactions.

4. To examine the depiction of nativist philosophy in a few literary texts, including how authors support, criticize, or undermine nativist beliefs.
5. To offer alternatives to nativism that promote more inclusive, dynamic, and dialogic approaches to culture and literature.

**Methodology:**

This study adopts a qualitative interpretive method based on literary and cultural analysis. It comprises a thorough investigation of Nativism, the importance of language, and a few literary works that explicitly or implicitly address nativist ideals. A few texts are assessed for recurrent themes, narrative strategies, and symbolic representations that reflect or criticize nativist ideology. The study also applies relevant cultural theories, particularly postcolonial critique, to locate nativism within wider historical and geopolitical contexts. The study utilizes a critique of nativism and theoretical interpretation to analyze how literary stories build or deconstruct notions of cultural purity, authenticity, and belonging. In addition to textual research, the study employs a comparative approach to determine how different cultural contexts impact the articulation and reception of nativist viewpoints in literature. The critique is supported and contextualized using secondary resources such as scholarly articles, critical essays, and theoretical works by academics such as Frantz Fanon, Homi Bhabha, and Ngũgĩ wa Thiong'o. The study also uses discourse analysis to better comprehend the lexicon and rhetoric of nativism in literary and critical literature. This multimodal analytical method enables a comprehensive criticism of nativism, highlighting its cultural repercussions and literary forms across several historical and geographical contexts.

**Discussion:** Nativism, from a cultural and literary perspective, emphasizes the revival and assertion of indigenous traditions, languages, and identities in response to colonial or global influences. While it plays a crucial role in reclaiming cultural sovereignty and fostering pride in local heritage, a critical examination reveals certain limitations. Nativist movements can sometimes romanticize or essentialize tradition, presenting static or idealized versions of culture that may ignore internal diversity and contemporary realities. In literature, this can lead to exclusionary narratives that marginalize hybrid identities or suppress progressive voices within the native culture itself. Moreover, an overly rigid nativist stance may hinder intercultural dialogue and the natural evolution of language and literary forms. Therefore, while nativism is vital for cultural reclamation, it must be approached with a nuanced understanding that balances the preservation of identity with openness to change and inclusivity.

**Role of language in shaping literature and culture:**

There is a very granular interaction between literature and culture, which stems from language as a means through which language acts as a bridge connecting literature to culture. Language is much more than a means of communication, as it conveys culture. Language serves as a tool for preserving ethnic identity. In the context of collective memory, literature, language, and being woven together, the flow of life is so smooth. They all enable transformation, constructing sociocultural factors of identity. Language plays a crucial role in shaping and preserving cultural identity. It acts as a medium through which customs, values, and artistic expressions are conveyed. Literature, in particular, becomes a powerful tool for cultural preservation, reflecting the identities, myths, and histories of its people. The use of language in literature allows for the expression of local values, idioms, and storytelling techniques that resonate deeply with native audiences and affirm shared cultural norms. It is also instrumental in the transmission of traditions, especially through oral literature, which nurtures a sense of community and belonging. Furthermore, language influences how meaning is constructed in literary

works, as choices in words, grammar, and narrative style shape the reader's interpretation, often revealing cultural nuances unique to a specific linguistic context.
Beyond preservation, language in literature becomes a site of resistance and innovation. In contexts like nativism, authors may use native languages to challenge dominant narratives and assert cultural sovereignty, thereby reshaping their cultural identity. Multilingual societies often reflect this linguistic diversity through hybridized literary forms and code-switching, which enrich cultural narratives and inspire creativity. Language also facilitates global intellectual exchange, particularly through English, which serves as a bridge for sharing indigenous perspectives with international audiences. Through adaptation and transformation, languages evolve, and nativization allows cultures to integrate foreign influences without losing their core identity, ensuring both continuity and growth in literary expression.

**Features of Nativism**

Nativism encompasses a broad range of cultural, social, and literary characteristics that influence how communities perceive their identities and uphold their values in response to external pressures. It functions both as a celebration of cultural identity and a defensive mechanism against cultural erosion. At its core lies a deep-rooted bond with location, as people form strong attachments to local beliefs, languages, and customs that shape both personal and communal identities. This cultural rootedness reinforces the concept of "place" as central to the formation of cultural narratives. Nativist philosophies also reflect diverse value systems across different societies, whether in the resistance to cultural dominance seen in Wales and Scotland or in postcolonial responses from regions like Africa and Australia. Additionally, communities often express opposition to foreign influences to preserve indigenous practices, illustrating a necessary resistance in an increasingly globalized world. Social structures such as *des* and *jati* in India further illustrate how nativism manifests through institutionalized regional and communal identities, which challenge homogenized national narratives.
Moreover, nativism thrives on the principle of unity in diversity by valuing regional distinctions while fostering a collective cultural identity. This approach promotes internal coherence not through uniformity but through mutual respect for difference. In literature, nativism encourages the expression of local experiences and cultural authenticity, enabling native writers and readers to connect deeply with their environments and traditions. It also supports the process of "nativization," where foreign elements are selectively integrated into local frameworks, thereby reinforcing rather than diluting cultural identity. This adaptability highlights the dynamic nature of indigenous cultures. Furthermore, nativist thought insists on the importance of historical context in literary interpretation, acknowledging that major literary traditions are often shaped by specific historical and social conditions. Ultimately, nativism represents a resilient will to survive—it fosters a revitalized awareness of native customs, languages, and values in the face of globalization, empowering communities to safeguard their heritage and sustain their cultural richness.

**Challenge by modernists to nativism:**

The concept of nativism is challenged in several ways by modernist viewpoints, which also critically examine its meanings, ideals, and presumptions about literature and culture. Modernist viewpoints oppose nativism by advocating for a more dynamic, inclusive, and universal interpretation of literature and culture. They challenge the inflexibility of cultural identities by highlighting the value of international relationships and the complexity of contemporary life, which changes our perspective on cultural representation and authenticity. Modernism challenges nativism by advocating for a universalist approach to literature and identity, emphasizing shared human experiences over regional or culturally specific ones. While nativism upholds localized traditions and values, modernism seeks to transcend cultural boundaries by focusing on broader, more universal themes. This divergence is evident in the modernist critique of cultural essentialism, which questions the fixed nature of identity based on race, ethnicity, or place. Modernist thinkers propose fluid, multifaceted identities that reflect the complexities of modern existence (Childs 17). Additionally, themes of alienation and dislocation—common in modernist literature—underscore the psychological and cultural detachment individuals feel in a rapidly changing world. These themes expose the limitations of nativist ideologies, suggesting that strict adherence to regional identity may not resonate with those experiencing the upheavals of urbanization, globalization, and technological advancement (Levenson 52). Furthermore, modernism's emphasis on intertextuality and the integration of global influences undermines the nativist pursuit of cultural purity, revealing how literature is inherently shaped by diverse sources and interactions.

In rejecting the romantic nationalism often tied to nativist thought, modernism confronts the disillusionment and fragmentation of the modern world. It distances itself from idealized depictions of the past and instead explores the psychological and social impacts of modernity. Through critical engagement with modernization, modernist literature exposes how longstanding cultural forms are disrupted and reshaped by contemporary life (Bradbury and McFarlane 19). The modernist "crisis of representation" also contests the adequacy of traditional literary forms to express modern realities, implying that nativist reliance on local styles may fail to capture present complexities. Lastly, modernism's cosmopolitan ethos advocates for inclusiveness and intercultural exchange, promoting an open, global perspective in opposition to the rigid cultural boundaries favored by nativism. This cosmopolitanism encourages cross-cultural dialogue, asserting that such interaction enriches both literary production and societal development (Berman 38). In these ways, modernism offers a dynamic, pluralistic alternative to the culturally insular orientation of nativism.

**Principles of Nativism in the Construction of Literature:**

Nativism in literature centers on affirming local culture, language, and identity as essential elements in literary expression. At its core, it emphasizes cultural authenticity by incorporating folklore, traditional storytelling, and native languages to convey the lived experiences and beliefs of specific communities (Mukherjee 24). This approach strengthens regional identity by reflecting the geographic and social realities of a people, fostering cultural pride and a strong sense of belonging. Additionally, nativist literature often functions as a counter-narrative to colonialism, asserting indigenous voices and reclaiming cultural histories that have been marginalized or distorted by external forces (Thiong'o 15). Distinct narrative forms rooted in local aesthetics—such as non-linear storytelling or culturally specific symbolism—also emerge from this tradition, further distinguishing nativist works within the broader literary landscape. Moreover, the nativist perspective frequently links cultural identity with the environment, highlighting the influence of regional landscapes on cultural values and storytelling traditions (Sinha 88).

Themes of communal memory, solidarity, and belonging are central to nativist literature, reinforcing social bonds and deepening a collective cultural consciousness. This literary movement critiques globalization for its tendency to homogenize cultures, advocating instead for the preservation of cultural diversity and regional narratives (Boehmer 103). However, while it emphasizes the local, nativism in literature does not isolate itself from the global. Many nativist writers engage in intertextual dialogues that connect local traditions with broader human experiences, acknowledging that literature can simultaneously honor the particular and engage with the universal (Ashcroft, Griffiths, and Tiffin 119). By doing so, nativism contributes to a richer and more inclusive literary canon that resists colonial erasure and promotes indigenous perspectives. Ultimately, it not only preserves cultural heritage but also enriches global literature by offering nuanced insights into the human condition through the lens of specific cultural contexts.

**Challenges to nativism:**

Despite its aim to celebrate local identity and cultural authenticity, **nativism faces several significant challenges** that complicate its role in contemporary literary and social discourse. One of the foremost issues is its tendency toward **exclusionary or isolationist ideologies**, which may foster cultural bigotry and limit openness to diversity. An unwavering adherence to tradition can also lead to **cultural stagnation**, preventing communities from evolving and engaging with modern ideas. Furthermore, nativist ideologies can be **misappropriated by extremist groups** to justify exclusion, violence, or narrow nationalist agendas. In postcolonial contexts, writers often struggle to balance a reclaimed local identity with the residual influences of colonialism, revealing tensions within nativism that may undermine its authenticity. This **postcolonial dynamic** creates contradictions in how identity is constructed and represented, challenging the purist notions of what it means to be "native."

Additionally, **globalization and cultural exchange** continue to blur the lines of distinct cultural identities, making it increasingly difficult for nativism to define or defend static cultural boundaries. As ideas, practices, and people move across borders, the concept of "native" becomes more fluid and contested. Within communities themselves, **divergent interpretations of nativism** can result in internal conflicts over cultural ownership and representation. Moreover, in an era shaped by modernism and postmodernism, nativism faces a **crisis of representation**, as traditional narratives may no longer resonate with evolving realities. **Intellectual critiques from cosmopolitan and postmodern perspectives** question the rigidity of nativist frameworks, urging a more flexible and inclusive approach to identity. Ultimately, while nativism plays an important role in resisting cultural erasure, it must evolve to address these criticisms and engage meaningfully with the complexities of contemporary cultural life.

**Raosaheb Kasabe on Nativism:**

In his critical work ***Deshivad: Samaj ani Sahitya* (2016),** Raosaheb Kasbe presents a thorough and pointed critique of nativism, particularly within the spheres of literature and social theory. Kasbe argues that many of the foundational ideas of nativism are inconsistently formulated and lack a clear definition, which weakens their effectiveness as tools for cultural or literary analysis (Kasbe 24).

He is particularly concerned with the historical inaccuracy of nativist assumptions regarding concepts such as *desh* (country) and *jati* (caste), which he believes are often romanticized or oversimplified. By failing to reflect historical complexities, nativist ideologies risk perpetuating myths rather than uncovering truths. Kasbe also critiques the tendency of nativist thought to treat cultural systems as closed, self-contained units, ignoring the broader socio-political and international forces that shape them (Kasbe 37). Without a global and historical lens, he warns, nativism cannot offer a comprehensive or accurate account of cultural identity.

Moreover, Kasbe raises critical questions about the silence of nativist discourse on ‘internal cultural imperialism’ within India itself. He contends that by overlooking the oppressive structures within indigenous cultures, such as caste hierarchies, nativism often fails to offer a truly emancipatory vision (Kasbe 51). Additionally, he questions the sustainability of rigid nativist ideals in a rapidly globalizing world, arguing that cultural hybridity and exchange demand a more adaptive literary philosophy. Kasbe ultimately calls for an ‘interdisciplinary and historically grounded approach’ to cultural identity that engages with literature, sociology, and anthropology. He urges scholars and writers to move beyond static, nationalist paradigms and to embrace frameworks that account for the ongoing processes of cultural interaction, dominance, and evolution (Kasbe 64). His critique challenges both the relevance and utility of nativism in modern literary studies, advocating for a more nuanced and critical understanding of identity in a pluralistic world.

**Nemade on Nativism:**

Bhalchandra Nemade presents a compelling argument for nativism as an essential framework for literary and cultural authenticity. He emphasizes the importance of adhering to the “Code of the Land,” urging writers to ground their work in the cultural and social realities of their native context. According to Nemade, authentic literature must arise from a deep engagement with the local traditions, languages, and social structures, which he views as the foundation for intellectual integrity in literary production (Nemade, *Nativism* 45).

He critiques the uncritical adoption of external literary norms and argues that doing so leads to cultural alienation and superficial creativity. By advocating for a literature that grows organically from indigenous traditions, Nemade insists that writers should reject borrowed paradigms and instead develop a literary culture that reflects the lived experiences and unique values of their communities (Nemade, *Teeka Swayamvaracha* 82).

Nemade also highlights the global potential of culturally rooted narratives. He cites the example of *Pather Panchali* to demonstrate how deeply local stories can attain international recognition without compromising their cultural essence (Nemade, *Nativism* 48). He stresses the importance of translating regional literature into widely spoken languages like English to ensure that indigenous voices gain a broader audience while retaining their cultural integrity. Furthermore, he warns against the erosion of narrative authenticity under the pressures of globalization and Western validation. For Nemade, nativism offers a defense against cultural homogenization, promoting literary practices that remain true to their origins and are capable of enriching global literature from a position of rootedness. His conclusion is a passionate appeal for writers to embrace their cultural identity, preserve their linguistic traditions, and contribute to a vibrant and self-assured literary future for Indian literature (Nemade, *Sahityachi Bhasha* 67).

**Conclusion:**

In reaction to colonialism, globalization, and cultural hybridity, attempts to affirm cultural authenticity and identity are complicated and sometimes contradictory, as the literary and cultural critique of nativism makes clear. While nativism aims to recover and protect indigenous languages, customs, and values, it frequently does this by endorsing essentialist ideas of identity that can stifle variety and dynamic cultural change. This research has shown, via the examination of literary works and cultural discourse, that nativism can unintentionally reflect the exact systems of domination that it aims to challenge, despite its foundation in a desire for self-definition and resistance.

In the end, this study emphasizes the significance of shifting away from strict nativist frameworks and towards more dialogic, inclusive, and hybrid approaches to literature and culture. Authors and critics alike may create environments where many cultural perspectives can coexist and engage in fruitful interaction by acknowledging the malleable and created character of identity. In particular, literature is a potent vehicle for challenging rigid limits and redefining identity in terms of humanism and expansion. Therefore, the research promotes a critical approach to nativism, one that recognizes its historical necessity while simultaneously recognizing its limitations in a society that is increasingly becoming more globalized.

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# JOB SECURITY OF PRIVATE CONTRACTUAL- BASED TEACHERS IN PRIVATE SCHOOLS AND COLLEGES IN THANE AND MUMBAI

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***Abstract***

*The content of this research paper focuses on the greatest term of world TEACHER – A NATION BUILDERS. Is it true? This paper shows you the current situation of all private sector teachers and their job security in private colleges & Schools. It also elaborates the financial condition, job security and human wellbeing of all such teachers. It Uses Data Sampling Methods*

*As we all know teachers are directly responsible of developing the society and the generations but this research paper also highlighted the problems which are really very huge and the possible solutions and advises.*

*It also focuses on the government plans and policies towards private sector teachers. This paper helps to present the true picture of private sector teachers.*

***Keywords:*** *Teacher- A NATION BUILDERS, Job security, Government policies, working conditions, Employee Retention.*

## Introduction:

The great Chanakya quotes that :- Shikshak( Teacher )koi sadharan manushya(a person ) nahi hota, pralaya ( Destruction) or Nirman( Construction ) uski goad me palte hai. Teacher's role in developing the society in a creative manner is the most important aspect of the society. But on a saddest part today the conditions of teachers are very worst. This research paper will let u know the facts and figures of private sector teachers who are completely set aside because of commercialization of education. The NCRB data along National Institutes of Health State that rate of suicide among literate private sector teachers rises from 16% to 20% in last 5 to 6 years. https://pmc.ncbi.nlm.nih.gov/articles/PMC3554961/.

Moreover the private sector teachers are paid very less salaries compared to other professionals this demotivate the youths who wish to develop their career in teaching field as a successful teacher

The paper focuses and answers the basis needs and questions of private sector teachers who are serving their duties in various colleges and schools in Thane and Mumbai region of Maharashtra for longer periods of time. It also represented the primary data collected from various private sector teachers from thane and Mumbai areas. Job security is the basics needs of any person. The paper also reflects the views of private sector teachers on the plans and policies of government and the management of the private colleges.

There is a huge salary or pay scale gap between private sector teachers and government sector teachers. This also adds to the de motivating factors which result into unrest in the minds of private sector teachers. As we know the basis needs now a days includes job security along with other needs Hence salary and job security plays a very important role. Moreover, our Indian culture praises "guru"- above god. A famous saint Kabir das say's Guru Gobind Dou khade kaake lagu paye, balihaari guru aapno govind diyo bataye (When Guru and God both appears before me who's feet should I touch first? I bow to my Guru first for it is he who showed me the path to God).

This research paper tries to answer the above quotes. Are we justifying the above quote? As we are into the 21st century the private sector teachers constantly upgrading their skills, talent and capabilities but on the other hand are they equally paid and assured with job security? These are the basis questions which will have a great consequences If government will not take care of their teachers working in private sector. Moreover the fear of lossing the job is alarming day by day. As we all are aware about the unemployment rate of the nation. The paper suggest that the prime Focus must be given to the private sector teachers by proper job assurance and security along with equally work and Rewards . Currently because of high rate of unemployment there is huge number of people are easily available for the private sector colleges at very cheaper salary scale which affect the supply chain of human resource which effect the quality pay index on the part of employees.

Hence this research paper tries to elaborate the basis needs of private sector teachers and appealing to the state and central government to frame such policies, Rules and regulations for the private sector colleges a schools which provides Job security along with the good reasonable salary scale to the private sector because we all know A Teachers as a Nation builders.

**Literature Review:**

1. International Journal of Computer Science and Mobile Computing
   A Monthly Journal of Computer Science and Information Technology
   ISSN 2320–088X
   IJCSMC, Vol. 5, Issue. 12, December 2016, pg.48 – 55
   Changing Jobs: - Influencing Factors among Teachers in Private Schools Ahmednagar, Maharashtra, India
   Dr. Swati Ranbhor- Munot
   swatimunot@yahoo.com
2. A Comparative Study on Private
   Sector and Public Sector Teachers in the Period of Covid-19 Pandemic
   Silpa Joshy C
   Assistant Professor, St Aloysius College, Thrissur
   DOI: https://doi.org/10.34293/ commerce.v10iS1- Oct.6145.

**Objectives of the Study:**

1. To study the conditions of teachers working in private sector colleges and schools.
2. To study the job security and salary scale of private sector teachers.
3. To get attention from the government as well as from the private sector colleges on the mental health of the private sector teachers.
4. To study the unemployment as well as under employment ratio of Mumbai and Thane district, Maharashtra
5. To become the voice of private sector teachers and help them to live life stress free.
6. To analyse the facilities available for the private sector teachers
7. To regain the confidence of private sector teachers among themselves for better future and society.

**The Hypothesis of the Study:**

**Hypothesis**

H1 – There is a change in the mind set of private sector teachers with changes in the govt. plans and policies.

**Research Methodology:**

The study is based on Primary Data collected directly by the researchers from **60 respondents which come under qualitative research (ranges between 30 to 60 respondents)** from Thane district and Mumbai, Maharashtra region.

**Secondary data**

Collected from newspapers, e-magazines, websites, e-journals etc

**Nature of Study**

The present study is descriptive in nature and explores respondents' demographic profile, Educational background, and Exposure to which source of media, including current job status of the people and their current salary scale..

The study also maintains the confidentially of the respondent as during data collection the name and the personal detail of the responded is very well maintained and protected so that they can express their views very freely

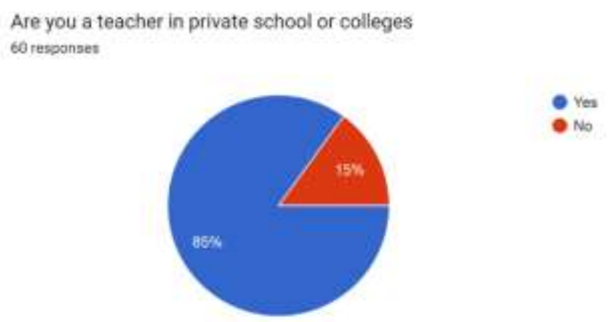
**Sampling Size & Technique**

For this research study, a sample size of 60 respondents was selected randomly from Ulhasnagar, Bhiwandi, Mumbra and Thane- Maharashtra it also includes major sample size data from Mumbai, Navi Mumbai – Maharashtra.

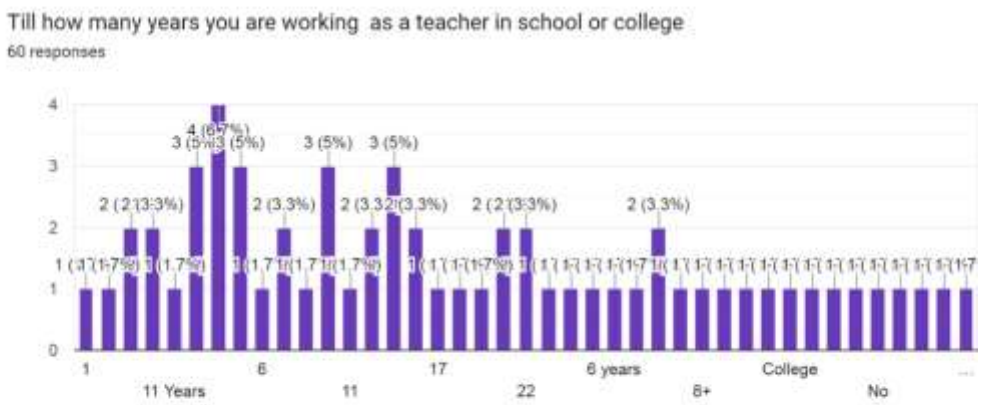
It includes highly professional's teachers' parents and businessman as a rational respondent.

The collected data are primary Android data through Google form

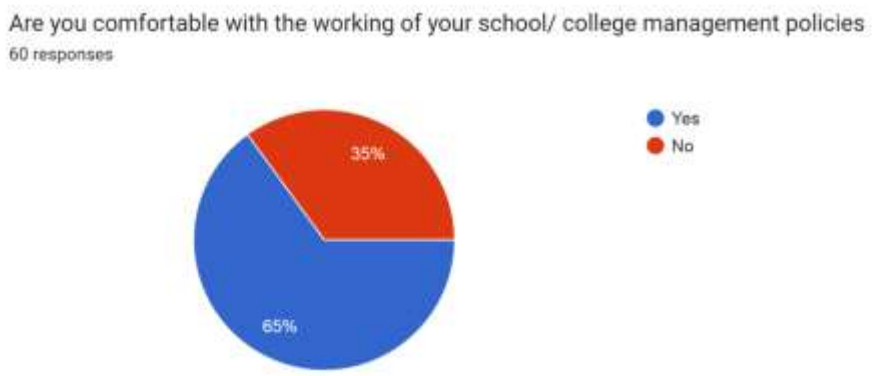
**Data Collection and Data Interpretation**



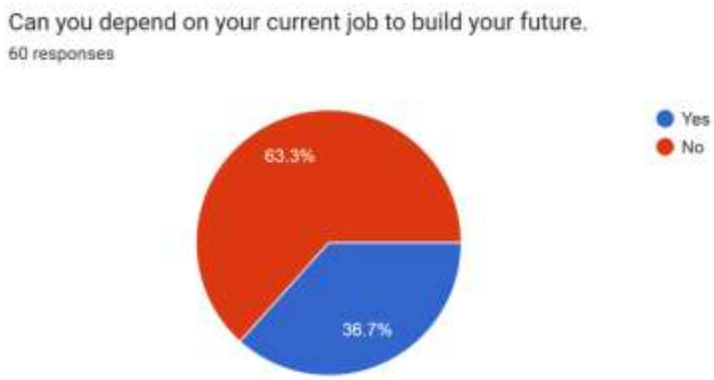

- The above pie diagram shows that 85% of data are from those who work in a private school or colleges. Whereas 15% includes others



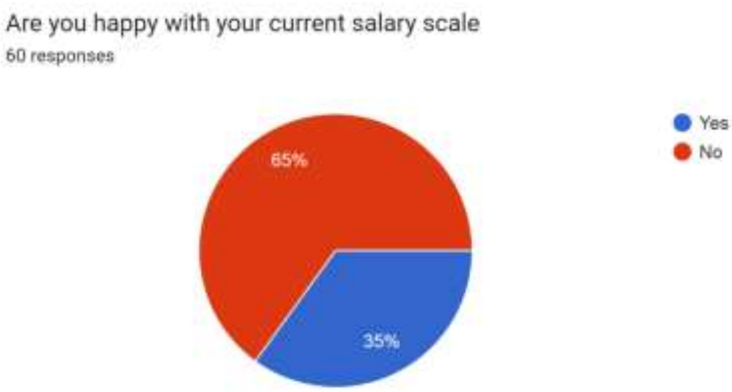

- The above graph shows that majority responses are collected from the private teachers with working experience lies between 6years to 11years. (reflected on y-Axis)



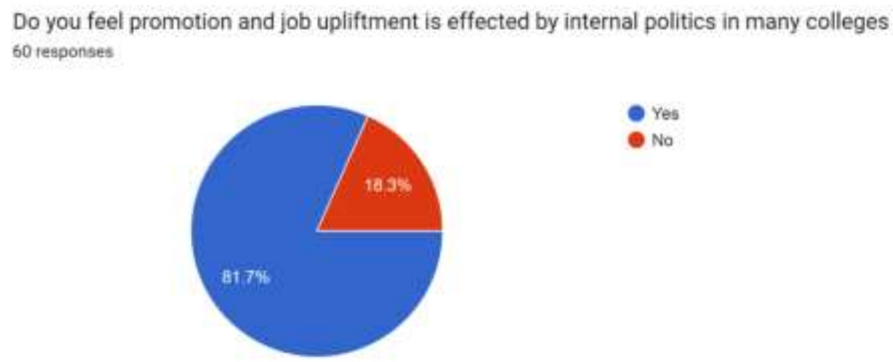

- The above pie diagram shows that **65%** of total respondent are not comfortable with the working of school or college policies. And **35 %** of total people are happy with the same.



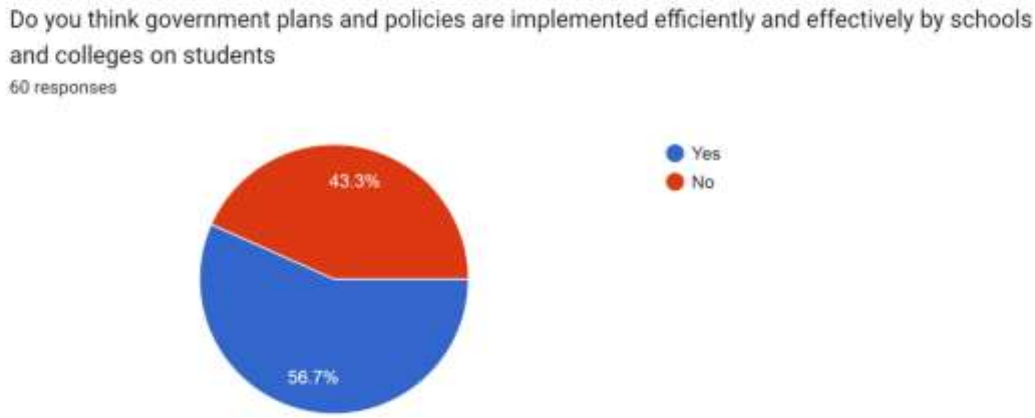

- The above pie diagram shows that **63.3%** of total respondent cannot depend upon their current job for future. Whereas only **36.7%** think that they can depend on the same.



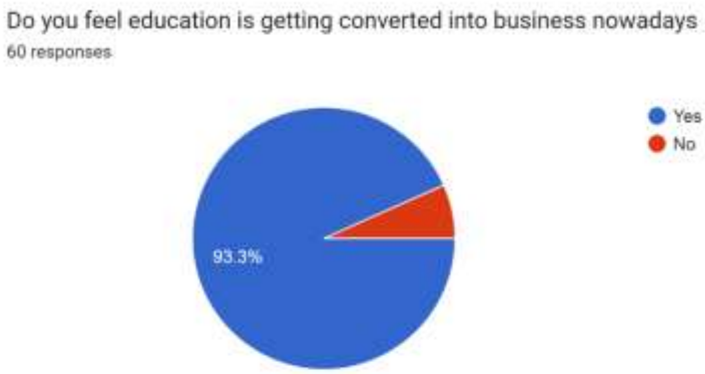

- The above pie diagram shows that **65%** of total respondent are not happy with their current salary scale. Whereas **35%** are happy.



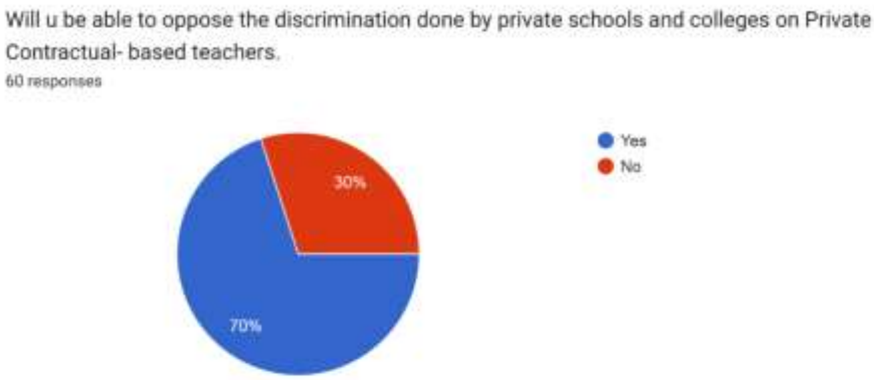

- The above pie diagram clearly shows that **81.7%** of total respondent think that internal politics affects the promotion and job upliftment and only **18.3%** disagree with the same.



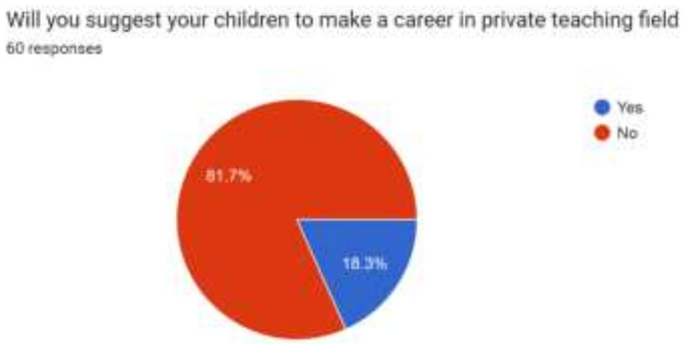

- The above diagram shows that **56.7%** of the total respondent believes that all govt. plans and policies are effectively implemented by schools and colleges. Whereas **43.3%** disagrees.



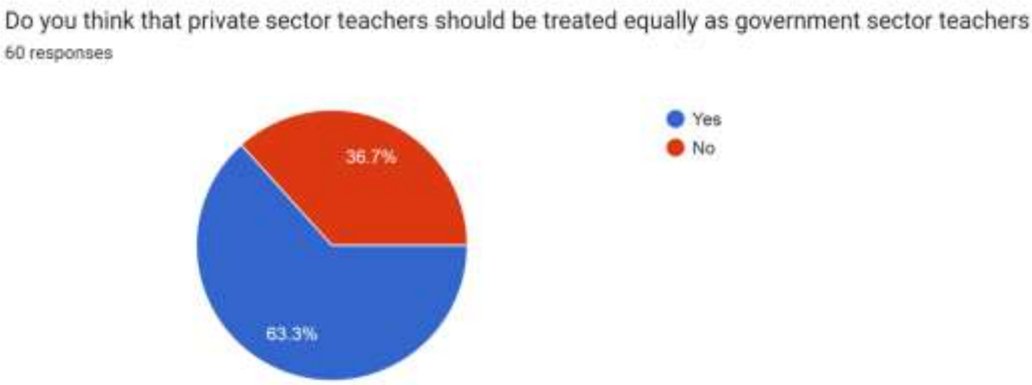

- The above diagram is alarming us that **93.3 % out of 100%** believe that education is converted into business nowadays.



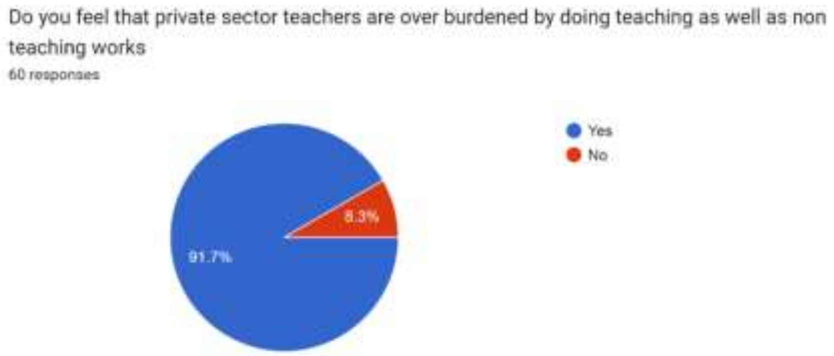

- The above diagram shows that **70%** of total respondent are willing to oppose the discrimination done by private sector schools or colleges and **30%** are not ready to come forward.



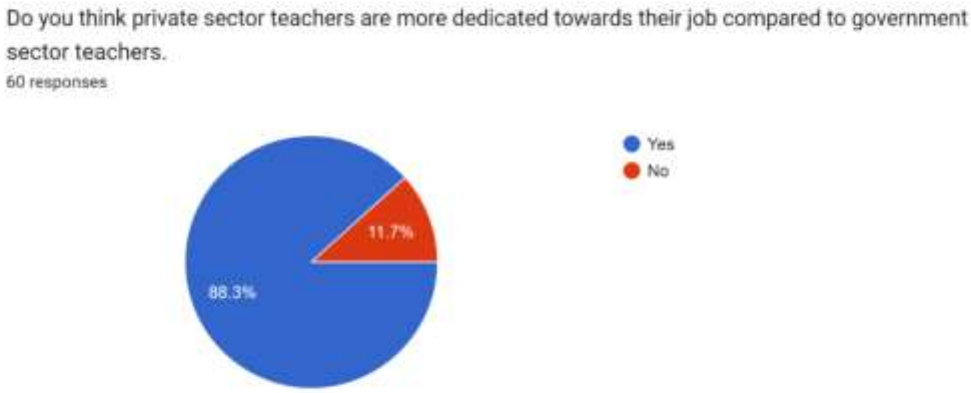

- The above diagram shows that **81.7%** of total respondent dose not wishes that their children should make career in teaching whereas **18.3%** are on a positive note.



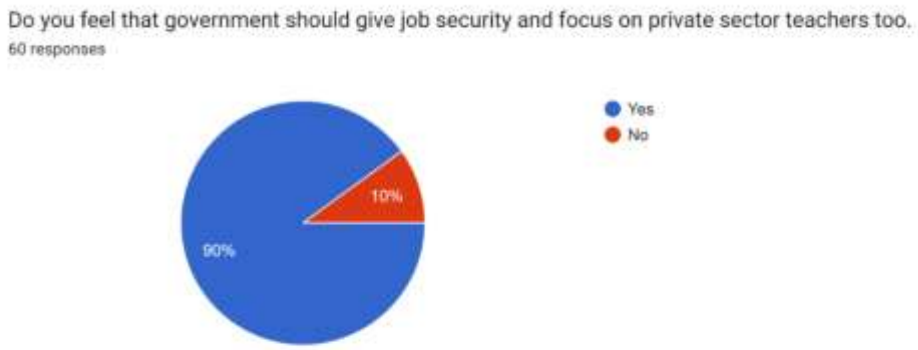

- The above diagram clearly indicates that **63.3%** of respondent thinks that govt. and private sector teachers should be treated equally. Whereas **36.7%** are not with this idea




- The above diagram indicates that **91.7%** of total respondent believe that private sector teachers are overburdened by teaching & non-teaching works. Whereas only **8.3%** does disagrees.




- The above diagram indicates that **88.3%** of total respondent believe that private sector teachers are more dedicated towards their job compare to govt. teachers. And only **11.7%** disagrees




- The above diagram shows that **90%** of the total respondent wants that the govt. should give job security and must focus on private sector teachers. Whwewas **10%** are not in the favour.


- The above chart explains that the responses are collected within thane Mumbai and navi Mumbai.

**Suggestions**

- Private sector teachers should be assured with job security and good working conditions.
- Private sector teachers should be provided with a better salary which matches their workload.
- Private sector teachers should be more qualified.
- Both private and public sector organisations should treat the teachers in a friendly manner.
- Public sector should have young blood in the teaching field.
- Private teachers should be provided with more benefits apart from salary.
- Government should provide tax benefits such as entertainment allowance to private teacher
- Private sector colleges and schools should not be affected by internal politics and baised decision making.

**Findings & Conclusion**

This study eloborate the major issue or private sector teachers working in different colleges and schools in Thane and Mumbai, Maharashtra. We can easily conclude that teachers of private sector are under huge mental as well as financial pressure as they are unable to contribute to the society to their best.
Job security is the major concern followed by payment scale is the issues faced by majority of private sector teachers according to this research paper. There is a sense of fear in every teacher working in private schools and colleges that although after serving their best duties they where easily removed or their terms where discontinued by the colleges or schools.

**So the quote Teachers – A nation builders. Is really a big question in front of all of us?**

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*https://www.hindustantimes.com/cities/mumbai-news/at-38-1-thane-education-department-dealing-with-excess-pupil-teacher-ratio-101642690951294.html?utm_source=ht_site_copyURL&utm_medium=social&utm_campaign=ht_site*

# THE THEME OF NATURE IN WILLIAM WORDSWORTH'S POETRY

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***Abstract***

*This paper explores the centrality of nature in the poetry of William Wordsworth, a foundational figure in the English Romantic Movement. It argues that Wordsworth's representation of nature extends beyond mere aesthetic appreciation to form a comprehensive philosophical and spiritual worldview. Through close readings of major poems such as Lines Written a Few Miles Above Tintern Abbey, The Prelude, Ode: Intimations of Immortality, and others, the study examines how nature serves as a moral guide, a source of emotional healing, a stimulus for the imagination, and a manifestation of the divine. Wordsworth's treatment of childhood as a time of profound spiritual connection to the natural world underscores his belief in nature's formative and redemptive power. The paper also considers Wordsworth's critique of industrialization and his celebration of rural simplicity, arguing that his work anticipates modern environmental consciousness. By engaging with a wide range of critical perspectives—from M. H. Abrams's concept of natural supernaturalism to eco-critical readings by Jonathan Bate and Greg Garrard—the study situates Wordsworth as both a literary innovator and a proto-ecological thinker. Ultimately, the paper contends that Wordsworth's vision of nature articulates a Romantic ethic of reverence, introspection, and resistance to cultural materialism—an ethic that remains urgently relevant in the context of contemporary ecological crises.*

***Keywords**: Romanticism, William Wordsworth, Nature, Moral Philosophy, Spirituality*

## Introduction:

William Wordsworth (1770–1850), a central figure in the English Romantic Movement, fundamentally transformed the purpose and form of poetry by positioning nature as both subject and source of inspiration. Unlike the Enlightenment's focus on reason, logic, and industrial advancement, Wordsworth returned to nature as a spiritual and moral compass. His works present the natural world not merely as a scenic backdrop but as an active force with the ability to guide, heal, and elevate the human spirit. In his vision, nature is divine—a manifestation of a higher power and a means of accessing eternal truths. This paper explores the intricate role nature plays in Wordsworth's poetry through thematic analysis of his major works, examining the moral, emotional, imaginative, and metaphysical dimensions of his vision. It also considers Wordsworth's critiques of industrialization, his portrayal of nature in relation to childhood and memory, and his influence on contemporary environmental thought. Through close readings and scholarly discourse, this study argues that Wordsworth's nature poetry articulates a coherent philosophical system grounded in reverence for the natural world.

## Literature Review:

Scholars have extensively explored the complex representations of nature in William Wordsworth's poetry. M. H. Abrams in Natural Supernaturalism (1971) posits that Wordsworth reinterprets Christian and Enlightenment ideas to present nature as a spiritual and moral force. Abrams argues that Wordsworth substitutes traditional religious structures with an immanent natural theology, making nature a source of revelation and ethical understanding.

Stephen Gill's William Wordsworth: A Life (1989) offers a biographical lens, tracing how Wordsworth's deep connection to the Lake District informed both his life and his literary output. According to Gill, Wordsworth's bond with nature was personal, rooted in early life experiences that shaped his poetic consciousness.

Nicholas Roe, in Wordsworth and Coleridge: The Radical Years (1988), examines how nature in Wordsworth's poetry is politically charged, serving as a pastoral alternative to the dehumanizing aspects of industrialism and empire. Roe suggests that Wordsworth's idealized natural landscapes are imbued with radical nostalgia, aiming to preserve a pre-industrial moral economy.

Harold Bloom, in The Visionary Company (1971), explores the metaphysical and imaginative dimensions of Wordsworth's work. Bloom highlights how Wordsworth internalizes nature to fuel poetic imagination, presenting landscapes as mirrors of the soul and mind.

Recent eco-critical interpretations (e.g., Bate 2000; Garrard 2012) have situated Wordsworth as a proto-ecologist. Jonathan Bate in Romantic Ecology (2000) identifies Wordsworth as an early voice in ecological consciousness, emphasizing the poet's insistence on humanity's interdependence with the environment. Greg Garrard in Ecocriticism (2012) further emphasizes Wordsworth's role in shaping ecological ethics, identifying his concern with sustainable and humble co-existence. Collectively, these perspectives reinforce the idea that Wordsworth's nature poetry transcends aesthetic appreciation, presenting a complex, layered vision that integrates ethical, autobiographical, political, and metaphysical dimensions.

Romanticism:

Romanticism was a literary and artistic movement that emerged in late eighteenth-century Europe as a response to the rationalism and mechanization of the Enlightenment and the Industrial Revolution. It emphasized emotion, individual experience, imagination, and the sublime beauty of nature. Rejecting classical ideals of order and symmetry, Romantic writers and artists sought instead to capture the mysterious, the infinite, and the deeply personal aspects of human life. Nature became a central theme, not as an object of scientific study but as a living presence capable of spiritual transformation. In literature, Romanticism often featured solitary figures—poets, wanderers, children—engaging deeply with the natural world. The movement also reflected a critique of industrial progress, urbanization, and the alienation of modern life. William Wordsworth, as one of Romanticism's most influential voices, embodied these ideals in his poetic philosophy, asserting that profound truth and moral insight could be discovered through personal communion with the natural world.

William Wordsworth: Life and Poetic Vision William Wordsworth (1770–1850) stands as one of the most influential poets in the history of English literature and a leading figure in the Romantic Movement. Born in the scenic Lake District of England, Wordsworth's early immersion in the natural beauty of the region profoundly shaped his worldview and poetic sensibilities. His poetry consistently reflects a deep reverence for nature, not merely as landscape, but as a spiritual and moral force central to human existence. Wordsworth's philosophical approach to poetry was rooted in the belief that the ordinary experiences of life—especially those found in rural and natural settings—held profound truths. Alongside Samuel Taylor Coleridge, he launched the Lyrical Ballads (1798), a landmark collection that redefined poetic language and subject matter, favoring simplicity, emotion, and the experiences of common people. Wordsworth's major works, including The Prelude, Tintern Abbey, and Ode: Intimations of Immortality, explore themes of memory, childhood, imagination, and the sacred qualities of the natural world. His appointment as Poet Laureate in 1843 acknowledged his enduring contribution to English letters. Ultimately, Wordsworth's poetry is a synthesis of personal reflection, philosophical depth, and spiritual insight, positioning him as both a literary innovator and a moral thinker whose reverence for nature resonates powerfully in the modern ecological age.

Nature, Moral Philosophy, and Spiritual Harmony Wordsworth's intertwining of nature, moral philosophy, and spirituality reflects a broader Romantic ethos that seeks harmony between humanity and the natural world. The ethical teachings of nature, combined with its spiritual significance, invite individuals to engage with the world in a manner that is both morally upright and spiritually fulfilling. This vision of nature as both a moral and spiritual guide provides a framework for understanding human existence in a more holistic and interconnected way. Nature in Wordsworth's poetry is not a separate realm but a living, breathing entity that shapes and nurtures human thought and experience.

1. Nature as a Moral and Spiritual Guide Wordsworth viewed nature as a moral teacher capable of nurturing the human conscience and ethical sensibility. In Lines Written a Few Miles Above Tintern Abbey (1798), he describes how nature instills "a sense sublime / Of something far more deeply interfused," suggesting that the natural world contains a spiritual essence that binds all living things. Nature acts not only as a physical presence but also as a moral force—"the guardian of my heart, and soul / of all my moral being." Similarly, in The Prelude, Wordsworth reflects on formative childhood experiences in the wilderness that cultivated awe and reverence. He writes, "I grew up / Fostered alike by beauty and by fear," indicating how both serenity and sublimity in nature contribute to a heightened moral awareness. For Wordsworth, ethical insight is grounded not in abstract reasoning but in lived, sensory engagement with the natural world. Nature, therefore, becomes a continuous guide—a surrogate for divine instruction in a secularizing age.

**2. Nature and the Innocence of Childhood**

**Wordsworth idealized childhood as a state of uncorrupted unity with nature. In Ode Intimations of Immortality from Recollections of Early Childhood (1807), he mourns the loss of a child's innate perception of the divine in nature**

"There was a time when meadow, grove, and stream, The earth, and every common sight, To me did seem Apparelled in celestial light." For Wordsworth, children are spiritually attuned to the natural world, perceiving its transcendent qualities with clarity that adults lose over time. This loss symbolizes the erosion of innocence and the increasing alienation from nature caused by societal and industrial pressures.

In The Prelude, he emphasizes how early experiences in the countryside shaped his consciousness. Nature, for the child, is both playground and oracle—a realm that fosters emotional honesty and imaginative vigor. By linking childhood to nature, Wordsworth presents both as sources of spiritual authenticity and truth.

**3. Nature as a Source of Solace and Emotional Healing Wordsworth frequently portrays nature as a refuge in times of sorrow and inner turmoil. In I Wandered Lonely as a Cloud (1807), he recounts an encounter with a field of daffodils**

"They flash upon that inward eye Which is the bliss of solitude."

**Here, memory transforms a fleeting moment into a lasting source of emotional comfort. The "inward eye" represents the imagination, which preserves and reactivates the restorative beauty of nature. This dynamic underlines nature's role not only in the immediate experience but in the long-term shaping of inner well-being.**

**In Elegiac Stanzas (1807), written in response to the death of his brother, Wordsworth turns to a stormy sea scene for solace, finding peace in the constancy and majesty of the natural world. Nature's endurance becomes a metaphor for emotional resilience, providing models for acceptance and grace in grief.**

**4. Nature and the Power of Imagination Wordsworth's conception of imagination is deeply tied to his experience of nature. In The Prelude, he describes imaginative faculties awakened through interactions with landscapes, forests, and rivers**

"Imagination!—lifting up itself Before the eye and progress of my song
Like an unfathered vapour."
Nature is not merely observed but transformed by the poetic mind into a visionary realm. Imagination becomes a creative force that bridges the inner self and outer world, allowing nature to be both real and symbolically rich. This process defines Wordsworth's unique brand of Romanticism—one that values emotional truth and intuitive insight.
His poetry thus reveals how the imagination, when nourished by natural surroundings, fosters philosophical understanding and spiritual depth.
**5. Pantheism and the Divine in Nature Many critics note that Wordsworth's poetry exhibits pantheistic tendencies—the belief that divinity resides within nature itself. In Tintern Abbey, he describes nature as**
"The anchor of my purest thoughts, the nurse,
The guide, the guardian of my heart, and soul Of all my moral being." This passage encapsulates his belief in an immanent divine presence—a sacred force that sustains human morality and emotional health. Rather than seeking God in church or scripture, Wordsworth finds spiritual truth in the rustling of leaves, the movement of rivers, and the stillness of mountains. His reverence for nature positions it as a form of religious experience, challenging conventional theological dogma and offering a more inclusive and experiential form of spirituality.
**6. Nature and Rural Simplicity**
Wordsworth saw rural life as more authentic and spiritually rewarding than the artificiality of urban existence. In Lyrical Ballads (1798), he often portrays common country folk as living in closer communion with nature, such as in Michael, a narrative poem about a shepherd who embodies virtues of sacrifice, labor, and familial love.
The characters in these poems exhibit moral integrity that Wordsworth links to their proximity to nature. They possess a quiet dignity and wisdom born of experience and simplicity. Through their stories, Wordsworth valorizes a pre-industrial way of life that is harmonious, sustainable, and ethically sound. His use of simple language and rustic settings democratizes poetry, making its moral and emotional truths accessible to all.
**7. Critique of Industrialization and Urban Life Wordsworth's deep love for nature led him to critique the industrial revolution's impact on both the environment and the human spirit. In The World Is Too Much with Us (1802), he writes**
"Getting and spending, we lay waste our powers:
Little we see in Nature that is ours;
We have given our hearts away, a sordid boon!"
These lines express his disillusionment with the capitalist values of acquisition and consumption. The mechanized city, with its noise, pollution, and spiritual emptiness, stands in sharp contrast to the tranquility and moral clarity of the countryside.
For Wordsworth, industrialization represents not just ecological destruction, but also a cultural and spiritual crisis—one that severs humanity from its ethical and imaginative roots.
8. Wordsworth and Environmental Thought Wordsworth's vision of nature anticipates many of the core tenets of contemporary environmentalism. His poetry emphasizes interdependence, reverence for the non-human world, and the dangers of exploiting natural resources. He implicitly calls for a more sustainable mode of existence, grounded in respect and restraint. Modern eco-critical scholars such as Bate (2000) and Garrard (2012) argue that Wordsworth's poetic ethos aligns with principles of deep

ecology, biocentrism, and environmental justice. His spiritual and ethical regard for nature offers an alternative paradigm to anthropocentrism and consumerism. In a time of escalating climate crisis, Wordsworth's work remains a poignant reminder of nature's centrality to human identity, culture, and survival.

**9. Solitude**

Solitude in William Wordsworth's poetry is a multifaceted theme that explores both the solace and the challenges that come with being alone. In his works, solitude is often depicted as a state that fosters reflection, personal growth, and a deeper connection with nature and the self. However, it is also portrayed as a space for emotional and spiritual vulnerability, where the poet confronts personal isolation, grief, and existential questions.

Solitude as a Space for Reflection and Connection with Nature For Wordsworth, solitude is not synonymous with loneliness or despair. Rather, it is a condition that allows for profound introspection and communion with the natural world. In Lines Written a Few Miles Above Tintern Abbey (1798), solitude serves as a catalyst for the poet's inner transformation. Wordsworth writes that in moments of solitude, nature becomes a spiritual guide, offering peace and a deep sense of connectedness to the universe. He reflects on the importance of solitude as a means of preserving one's mental clarity and spiritual health, noting that it is through isolation from the noise of everyday life that the mind becomes attuned to the eternal truths embedded in nature. This solitude is not empty or barren but is rich with possibility for self-discovery and transcendence. In I Wandered Lonely as a Cloud (1807), solitude allows Wordsworth to reconnect with the memory of a field of daffodils, which becomes an enduring source of comfort and joy. The poem conveys that even in physical isolation, the mind can access the beauty and emotional sustenance of nature, creating a lasting spiritual bond that transcends time and space. Here, solitude is depicted as a time when the imagination can thrive, reconnecting the poet to moments of beauty and wonder that continue to nourish his spirit even in solitude.

Solitude and the Poet's Emotional Growth Solitude also plays a key role in Wordsworth's emotional development. In The Prelude, solitude is depicted as a formative force in the poet's life, allowing him to reflect on his childhood and the experiences that shaped his creative consciousness. Wordsworth believes that solitude helps the mind grow in ways that society's distractions cannot, encouraging an individual to confront personal emotions and internal conflicts without the influence of external pressures. This reflective solitude enables the poet to process the past and uncover deeper truths about his identity and his place in the world. Through solitary moments, Wordsworth contemplates the larger questions of existence, morality, and the nature of the human soul. Additionally, solitude allows for emotional healing. In Elegiac Stanzas (1807), written in the wake of the death of his brother, Wordsworth turns to nature and solitude for solace. The natural world becomes a companion in his grief, offering a space for personal mourning while also facilitating a deeper understanding of life's impermanence. In solitude, the poet comes to terms with loss, finding comfort in the eternal cycles of nature that offer a sense of continuity and reassurance. Here, solitude provides a way to process complex emotions, such as grief, loss, and longing, in a way that leads to inner peace and acceptance.

Solitude as a Means of Intellectual and Creative Growth For Wordsworth, solitude is also closely tied to intellectual and creative growth. It is during moments of solitude that the poet is able to listen to his inner voice, allowing his imagination to flourish and giving rise to the creative energy necessary for his poetry. In The Prelude, Wordsworth describes how the natural world, when encountered alone, stimulates the imaginative faculties and generates a sense of awe and wonder that cannot be replicated in the presence of others. This solitude creates a space where the poet can engage with the natural world on a deeply personal level, drawing inspiration and insight that then translates into poetry. Moreover, solitude allows the poet to escape the constraints of societal norms and expectations, enabling him to engage with the natural world and his own inner experiences on his own terms. Wordsworth's belief in the power of solitude reflects his Romantic ideal of individualism and the importance of self-reliance in the creative process. By withdrawing from the distractions and demands of social life, the poet is free to explore his emotions, thoughts, and experiences without interference, ultimately producing more authentic and profound artistic work.

Solitude and the Double-Edged Nature of Isolation While solitude is often presented in a positive light in Wordsworth's poetry, it is not without its darker, more painful aspects. In some instances, solitude brings with it feelings of alienation and melancholy. In The Solitary Reaper (1807), the figure of the solitary reaper, singing alone in the field, evokes a sense of both beauty and sorrow. While the reaper's solitude is a source of poetic inspiration, it also highlights the isolation of the human soul, particularly when faced with the unknown or the unattainable. The reaper's song, while beautiful, remains a mystery to the poet, symbolizing the emotional distance that can exist even in solitude. In The Prelude, Wordsworth acknowledges that moments of solitude can also bring with them a sense of existential unease or doubt. The poet's isolation, while offering clarity and insight, can also lead to feelings of separation from others and from the world itself. This ambivalence towards solitude is central to Wordsworth's portrayal of the human condition, which acknowledges both the potential for spiritual growth and the pain of isolation.

**Conclusion**

William Wordsworth's poetic celebration of nature transcends mere pastoral description to form a comprehensive moral and spiritual philosophy. Nature, in his view, is teacher, healer, muse, and divinity. Through close, affective engagement with the natural world, Wordsworth believes one can attain ethical wisdom, emotional renewal, and imaginative insight. His vision connects humanity to the broader ecological web, warning against alienation brought on by industrialization, consumerism, and modernity.

Wordsworth's emphasis on childhood, memory, and solitude underscores his belief that nature is not only essential to the individual but to society at large. His pantheistic vision invites a sacred revaluation of the earth, while his political critiques offer a quiet but firm resistance to ecological degradation and cultural materialism.

In this way, Wordsworth emerges as both poet and prophet—a literary figure whose Romantic vision continues to influence environmental thought, spirituality, and literature. His legacy endures as a call to reawaken our bond with the natural world and to listen anew to the silent teachings of the earth.

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# THE ECONOMIC IMPACT OF SOCIAL MEDIA ON ZARI EMBROIDERY WORKERS: OPPORTUNITIES AND CHALLENGES

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***Abstract***

*This research analyzes the economic effect of social media on Zari embroidery artisans in India based on a critical review of secondary data. Social media like Instagram, Facebook, and WhatsApp have profoundly affected the livelihoods of artisans by opening up market access, allowing for direct interaction with customers, and changing historical income and marketing patterns. Based on academic literature, government reports, and NGO documents, the paper identifies how social media increases visibility and empowerment at the same time as it exposes artisans to digital exclusion, weak infrastructure, and design exploitation. The results identify the double-sided nature of digital integration in the Zari sector, necessitating inclusive policies to maximize gains and minimize risks.*

***Keywords:*** *Zari Embroidery, Social Media, Economic Opportunities, Digital Constraints & Literacy, Policy Recommendation.*

## Introduction

Zari embroidery is an ancient Indian textile art that entails the application of gold or silver threads to produce elaborate, decorative designs on cloth. Traditionally, this art was practiced in areas like Bareilly, Lucknow, and Varanasi, where it was supported by royal courts and upper classes. With time, migration and urbanization took Zari artisans to the urban cities, and South Mumbai became a major center for traditional as well as modern Zari work. In spite of their cultural and economic worth, many artisans are still stuck in informal networks, with great dependence on middlemen for sales and distribution, which reduces their profit margins and economic autonomy to a large extent (Tripathi & Saxena, 2023). The Ministry of Textiles (2022) states that India's handicraft industry, especially embroidered products, is one of the biggest jobs creators in the informal economy—though artisans themselves frequently experience low incomes, conducive working conditions, and limited market access.

Over the past few years, the establishment of digital technology and social media platforms such as Instagram, Facebook, and WhatsApp has opened new avenues for artisans to directly connect with consumers and increase their visibility. SEWA (2023) reports that women artisans using social media saw improved earnings and increased control in fixing prices. But, as observed by the Digital Empowerment Foundation (2022), this shift is not without problems: numerous artisans, especially those in rural areas, do not possess the digital literacy and infrastructure to engage comprehensively in the digital marketplace. This paper, grounded solely on secondary data, examines the economic contribution of social media to the livelihoods of Zari embroidery workers, focusing both on traditional hubs and new urban clusters such as South Mumbai. It examines the opportunities created by social media along with the structural barriers that limit inclusive access.

## Objectives

1. To evaluate the economic opportunities social media has opened up for Zari embroidery workers.

2. To analyze the constraints artisans experience when using digital platforms.
3. To study the impact of gender, infrastructure, and digital literacy in facilitating or limiting access.
4. To make policy recommendations for sustainable digital empowerment of the handicraft industry.

**Scope of the Study**

1.This research is centered on Zari embroidery workers in India, with a focus on the effects of social media.

2.It is focused on economic factors like income generation, marketing, and employment opportunities.

3.The study is based solely on secondary information, and hence it is appropriate for conceptual application and policy information.

4.The period covered by the secondary data is from 2018 to 2024, making it contemporary.

**Limitations of the Study**

1.The research is entirely based on secondary sources; primary data from field surveys or interviews is not provided.

2.Geographical constraints as most of the secondary data revolves around specific regions such as South Mumbai or Bareilly.

3. The digital influence is not measured statistically; rather, qualitative analysis is the focus.

4. The following challenges are not studied in-depth: algorithmic bias on social media or socio-cultural resistance.

5.Fast evolution of technology can make certain findings less relevant in upcoming situations.

**Research Methodology**

This research utilises a descriptive, qualitative design of research relying on secondary sources of data for investigating the financial implications of social media on Indian Zari embroidery workers. It does not entitle field surveying or interviewing but synthesises data from readily available literature as well as written case studies for formulating in-depth knowledge concerning the subject matter. The choice of secondary sources depended on relevance to the Indian handicraft industry, credibility (institutional reports authenticated and peer-reviewed journals), and time relevance (2020–2024). Recurring economic patterns, challenges, and social ramifications of digital engagement by artisans were coded from manual coding where every source was checked for repetition.

**Literature Review**

The increasing penetration of social media in India's informal economy has created a wave of new opportunities for conventional artisans, such as those in the Zari embroidery industry. The reviewed literature offers insight into both the positive economic effect and the socio-digital challenges of artisans moving to online platforms.

1. **Saha (2023)** highlights how social media platforms like Instagram have revived traditional embroidery practices, such as Aari and Zardozi, by providing artisans with broader market exposure and improved income through direct collaborations with couture designers.

2. **Tripathi and Saxena (2023)** emphasize the socio-economic significance of the Zari-Zardozi industry in Bareilly. They note that while traditional trading limits growth, social media has empowered women artisans by expanding their customer base and improving their household income through platforms like WhatsApp and Facebook.

3. **Garimella and Sakhinala (2024)** stress the role of gender-sensitive digital education in artisan communities. Their research shows that NGOs' efforts to provide women artisans with digital tools have

empowered them not only with market access but also with critical negotiation and financial literacy skills.

4. **Hellström (2020)** discusses the relationship between digital empowerment and mobility for home-based women workers. While digital tools have opened economic opportunities, limited mobility and exposure hinder many women from fully benefiting, despite their craftsmanship.

5. **Khan et al. (2023)** identify the challenges faced by artisans in regions like Srinagar, where poor internet connectivity, patriarchal restrictions, and reliance on intermediaries restrict artisans' autonomy in utilizing social media for business.

6. **Digital Empowerment Foundation (2022)** reports a significant digital divide in rural artisan communities, where many artisans, despite having smartphones, lack the knowledge to use basic digital tools, such as product photography or online communication, affecting their ability to market their products effectively.

**Opportunities Enabled by Social Media**

**1. Direct-to-Consumer Selling**

Social media has made it possible for Zari artisans to avoid conventional middlemen and interact with final consumers directly. As per the Ministry of Textiles (2022), artisans selling through digital channels indicated that their profit margins increased by as much as a 20–30% due to direct sales since they would not have to pay intermediary commissions and could access niche markets more effectively.

**2. Visibility and Worldwide Access**

Instagram and Facebook are increasingly being used as common tools for artisans to market their products to a wider market. Saha (2023) reports how couture fashion designers have started sourcing from solo Aari and Zardozi craftspeople found through online sites, thereby diminishing their reliance on agents. Overseas exhibitions like "India Handloom Week" have also showcased artisans found through social media (Digital Empowerment Foundation, 2022).

**3.Women's Economic Empowerment**

SEWA (2023) finds that women who underwent basic training in social media marketing earned 25–40% more income on average after one year of adoption. Garimella and Sakhinala (2024) highlight that digital exposure not only boosts income but also enhances women's negotiating capacity, control over financial decisions, and membership in community cooperatives.

**4.Access to Niche and Sustainable Markets**

Platforms such as Etsy and Instagram have provided artisans with access to environmentally conscious consumers seeking handmade, slow-fashion items. As per a DEF study (2022), artisan collectives such as Digikargha saw a doubling of monthly sales once they shifted to Instagram and WhatsApp catalogs, especially among NRIs and diaspora consumers interested in traditional crafts.

**Challenges and Risks Identified in Literature**

**1. Digital Divide**

Though social media gives the visibility, an overwhelming majority of Zari artisans—particularly women in rural contexts—are deprived of its advantage as a result of inadequate infrastructure and low digital knowledge. The Digital Empowerment Foundation (2022) has mentioned that more than 60% of artisans in rural communities possess smartphones but fewer than 30% of them know how to use such features as digital payments, taking photographs, or social media promotions. Gender norms also limit women's access, as most depend on male relatives to use digital devices (Khan et al., 2023).

**2.Platform Dependency and Algorithm Risks**

Artisans who rely only on platforms such as Instagram or Facebook are susceptible to algorithm updates and account suspension. Hellström (2020) points out cases where women artisans lost business after unexpected declines in post visibility or account suspension, without any customer redressal or platform intervention.

**3.Exploitation and Design Theft**

Design piracy is a serious issue for artisans displaying original work on the internet. Open access to posts enables wholesalers and manufacturers to copy handmade designs without permission. Khan et al. (2023) record several instances of artisans' embroidery designs being imitated and mass-produced by machine-based exporters, undermining the value of original craftsmanship. Even with the availability of IP protection, ignorance and procedural complexity restrict its application among artisans (Ministry of Textiles, 2022).

**4.Market Saturation and Price Undercutting**

With more artisans joining online marketplaces, there is increased competition, which results in price wars and reduced quality control. DEF (2022) cautions that customers tend to opt for cheaper, machine-made products instead of genuine handmade products, affecting income stability. Lack of standard pricing or certification processes makes it difficult for talented artisans to distinguish their work.

**Data Analysis**

The secondary source analysis identifies four major themes:

1. Economic Benefits – Skilled artisans gain from enhanced earnings streams and direct market access.
2. Digital Literacy Barriers – Most artisans are poor at using digital tools, constraining their presence and outreach on the web.
3. Gender Disparity – Social and domestic limitations usually prevent women from taking part in online platforms, establishing unequal opportunities.
4. Platform Vulnerability – Overdependence on social media algorithms and the risk of design theft create sustainability concerns.Although digital platforms have widened market access, the advantages are disproportionately captured. Urban and digitally literate artisans benefit more, while others continue to be marginalized. Collaborative frameworks driven by NGOs hold potential to fill these gaps, but there is still a need for extensive support in the form of organized training and legal protection for inclusive growth in the Zari embroidery industry.

**Policy Recommendations**

**1.Digital Literacy Campaigns Specifically for Artisans**

In spite of the growing use of smartphones among rural artisans, just 28% of the women artisans surveyed by the Digital Empowerment Foundation (2022) had received any type of digital training. Government programs like Skill India Mission and Digital India need to partner with NGOs like SEWA and Dastkar to roll out craft-specific digital literacy courses. These initiatives need to address social media marketing, product photography, pricing, customer communication, and protection against online frauds.

**2.Design Registration and Intellectual Property (IP) Support**

As per the Ministry of Textiles (2022), as few as 5–7% of artisans know about their IP rights, and fewer still have registered their designs successfully. The government should introduce a simplified, low-cost Artisan IP Registration Portal to facilitate protection for distinctive embroidery designs from piracy. Mobile vans and workshops in Zari clusters such as Bareilly and South Mumbai can also promote awareness.

**3.Subsidized Access to Internet and Digital Tools**

DEF's (2022) study reported that more than 45% of artisans named the expense of smartphones and data as one of the main deterrents from online access. The government schemes need to offer subsidies or interest-free loans to buy basic smartphones, internet packs, ring lights, or photography packages. Such equipment is a necessity for visibility of products on sites like Instagram and WhatsApp.

**4.Onboarding Assistance on Government Platforms**

Even though the Government e-Marketplace (GeM) and India Handmade Portal provide gratis digital storefronts, artisan participation is low owing to technical complexity. A report by Dastkar in 2023 came up with a shocking fact that only 12% of the registered artisans were able to list products successfully. Trained interns or volunteers can be deployed to help Zari workers create profiles, upload products, and process orders.

**5.Legal and Cybersecurity Support Cells**

Incidents of design pilferage, internet fraud, and payment forgery have grown with greater online exposure. An exclusive Artisan Cyber Helpline can provide quick relief, whereas district-level legal assistance cells in KVIC or Textile Clusters can facilitate registration of grievances and protection of rights.

## Conclusion

Social media holds great promise for the economic empowerment of Zari embroidery workers, especially in terms of greater visibility and direct-to-consumer sales. Saha (2023) finds that social media platforms such as Instagram have enabled artisans to engage in global markets and gain international customers, which has typically led to higher earnings. This opportunity is not, however, available to all artisans equally. Digital Empowerment Foundation (2022) indicates that more than 60% of rural artisans do not get to utilize digital resources to their best potential because of the digital divide, which is further compounded by gender-based impediments (Khan et al., 2023). Though urban artisans have access to infrastructure and thus receive substantial economic rewards, rural artisans still face limited digital literacy. The dependency on intermediaries and susceptibility to design theft also jeopardize the sustainability of business models online (Khan et al., 2023). Thus, in the absence of organized interventions through training programs, legal protection, and financial support, most artisans stand to be pushed to the periphery even as the opportunities presented by digital platforms seem real (Hellström, 2020). A multifaceted policy response based on digital literacy, intellectual property protection, financial accessibility, and governmental support for digital platforms is critical to filling these gaps and promoting fair growth for all Zari artisans. It is only with such support that the complete potential of social media can be achieved in a sustainable and inclusive way for India's Zari embroidery industry.

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# DECLINE OF THE MUGHAL EMPIRE AFTER AURANGZEB: CAUSES AND CONSEQUENCES

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***Abstract***

*The decline of the Mughal Empire following the death of Mughal emperor Aurangzeb in 1707 A.D. marks an interesting chapter in the history of early modern South Asia. This research paper investigates the multi-faceted causes that led to the disintegration of one of the most powerful empires in the world of that age. The paper highlights how the absence of capable successors, court factionalism, and the weakening of central authority eroded the administrative soundness established by earlier emperors.*
*The study also stressed on topics such as the breakdown of the Mansabdari system, the emergence of several autonomous regional kingdoms, and the inability of the empire to respond effectively to new political and military challenges posed by Marathas, Sikhs, and Afghan invaders. The repeated plundering raids on Delhi by Nadir Shah and Ahmad Shah Abdali further devastated the Mughal prestige. These failures created a political vacuum that enabled regional powers and European trading companies, particularly the British East India Company to gain influence and dominate large parts of the Indian subcontinent. The study not only analyses the various causes but also explores the consequences also. It shows that the decline of the Mughal Empire was not a sudden fall, but a gradual process.*

***Keywords: -***
***1)** Mughal Empire* ***2)** Decline* ***3)** Causes* ***4)** Consequences*
***5)** Regional Kingdoms* ***6)** East India Company*

## Introduction

The Mughal Empire, a symbol of power and prosperity, began to lose its strength after the passing of Emperor Aurangzeb in 1707. In the time of earlier emperors like Akbar and Shah Jahan, the empire was prosperous due to good administration, military strength, and religious tolerance. But Aurangzeb's passion for religious orthodoxy and prolonged wars, particularly the Deccan wars, drained the resources of the empire and dissolved its unity.

Failure to have a regular system of succession led to continuous fights among the successors, weakening the empire even further. Corruption within the nobility and the breakdown of the key systems, such as the Mansabdari and Jagirdari systems, plagued the empire. These were part of the problems of the Mughals in maintaining their vast territories.

Foreign invasions brought further devastation, as the invaders plundered wealth and opened up the empire for invasion. At the same time, local forces in several parts of India became autonomous and undermined the central authority.

With the decline of the Mughal Empire, it was the European powers, and particularly the British, who began to take over. The decline of the Mughal Empire ushered in massive political, social, and economic change in India, introducing colonial rule and rewriting the history of the Indian subcontinent.

## I - CAUSES FOR THE DECLINE OF THE MUGHAL EMPIRE

1. **Policy of Emperor Aurangzeb:** Aurangzeb's policies significantly contributed to the weakening of the Mughal Empire. His reimposition of the jizya tax on non-Muslims alienated the Hindu majority and strained the relationship between the state and its subjects. Moreover,

Aurangzeb's military campaigns, particularly in the Deccan, drained the empire's treasury. His conflict with the Marathas, led by Shivaji and later by Sambhaji, proved very costly. While Aurangzeb's predecessors had consolidated power in the north and central regions, his focus on the Deccan left the empire's heartland weak. This neglect allowed regional powers like the Rajputs and the Jats to assert greater autonomy, which weakened the empire's centralized control.

2. **Absence of Law of Succession:** The Mughal throne was often contested violently, with each succession crisis weakening the central authority and diverting resources of the empire. After Aurangzeb's death, the empire witnessed a series of succession struggles that weakened its governance. Bahadur Shah - I faced challenges to consolidate his power due to rival claims from other princes, such as his brothers Azam Shah and Kam Bakhsh. The intense battles had not only split the empire but also enabled regional governors to assert their autonomy. The lack of a clear and peaceful mechanism for succession created a state of uncertainty. Instead of focusing on administration and reform, each ruler's reign began with efforts to secure the throne, often through alliances with factions that demanded rewards in return for the help provided. For example, the Sayyid Brothers, who were the powerful nobles during Farrukhsiyar's reign, manipulated succession politics to enhance their power, prestige and influence, which led to the further weakening of the empire.
3. **Incapable Successors of Aurangzeb: -** Aurangzeb's successors lacked the vision, leadership, and administrative skills required to manage the difficulties of the Mughal Empire. Bahadur Shah I, who succeeded Aurangzeb, was a competent ruler but lacked the energy and resources to reverse the empire's decline. Subsequent rulers, such as Jahandar Shah and Farrukhsiyar, were largely ineffective. Jahandar Shah's indulgence in luxury and his reliance on courtiers like Zulfiqar Khan undermined the empire's governance. Muhammad Shah, who came to power in 1719, earned the title "Rangila" (pleasure-loving) for his focus on courtly entertainment rather than governance.
4. **Corruption in the Mughal Nobility: -** The Mughal nobility, once the backbone of the empire's administration and military, became increasingly corrupt and faction-ridden after Aurangzeb's death. Nobles and courtiers, driven by personal ambition, engaged in conspiracy and power struggles that damaged the central authority. Officials often misappropriated state revenues, neglected administrative duties, and exploited their positions for personal advantage. This widespread corruption weakened the empire's ability to collect taxes, maintain infrastructure, and fund military campaigns.
5. **Jagirdari Crisis: -** The Jagirdari system, a keystone of Mughal administration, granted land revenue rights to officials (jagirdars) in exchange for their services. Over time, this system became uncontrollable. By the 18th century, there was a severe scarcity of jagirs, leading to intense competition among nobles. The number of mansabdars entitled to jagirs increased dramatically. Also, jagirdars often exploited their lands by imposing excessive taxes on peasants to meet their financial responsibilities. This led to widespread peasant revolts, such as those in the Doab region, further declining the economic stability of the empire.
6. **Decline of the Mansabdari System: -** The Mansabdari system, which organized the Mughal military and bureaucracy, began to crumble after Aurangzeb's reign. This hierarchical system relied on the loyalty and efficiency of mansabdars, who were assigned ranks and land revenues to maintain troops. However, by the 18th century, corruption and inefficiency plagued the

system. Many mansabdars failed to fulfill their military responsibilities, preferring to side with the excess revenues instead of maintaining troops. For instance, during the rule of Muhammad Shah (1719–1748), the empire's inability to respond effectively to the Maratha incursions was partly due to the weakened Mansabdari system. The decline of the Mansabdari system was not just an administrative failure but also a key factor in the disintegration of the empire's political unity.

7. **Foreign Invasions: -** Foreign invasions during the 18th century dealt a heavy blow to the Mughal Empire, speeding up its decline. Nadir Shah's invasion in 1739 culminated in the sack of Delhi, during which the Persian ruler looted vast wealth, including the celebrated Peacock Throne and the Koh-i-Noor diamond. This event marked a turning point, exposing the empire's weakness to external threats. Similarly, in the mid-18th century, Ahmad Shah Abdali, the Afghan emperor, repeatedly invaded India and devastated the northern regions of the empire. His victory at the Third Battle of Panipat in 1761 dealt a severe blow to the Marathas, and also to the Mughal Empire's incapacity to assert control over its territories.

**II - CONSEQUENCES AFTER THE DECLINE OF THE MUGHAL EMPIRE**

1. **Rise of Regional Powers: -** The weakening of Mughal central authority created a power vacuum, and the regional powers took advantage to assert their ascendancy. Many provinces declared independence, creating a fragmented political structure in the Indian subcontinent. The regional powers are as follows.

a) **Bengal -** Murshid Quli Khan, appointed as the governor of Bengal, effectively became an autonomous ruler (Nawab) in 1717 by establishing independent control over revenue and administration. Bengal's strategic location and prosperous trade networks made it one of the richest provinces.

b) **Awadh -** Under Saadat Khan Burhan -ul- Mulk, the Awadh became an independent state in 1722. Its rulers continued nominal obedience to the Mughal emperor but effectively ruled autonomously, which led to the development of a thriving culture in Lucknow.

c) **Hyderabad -** Nizam-ul-Mulk Asaf Jah or Chin Qilich Khan established the Hyderabad state in the Deccan in 1724. They were surrounded by the Marathas and other powers while maintaining nominal ties to the Mughal court.

d) **Jats -** The Jats were led by a prominent leader, Suraj Mal, in the region of Bharatpur, presently in Rajasthan, who consolidated power and developed a strong agrarian economy, challenging Mughal authority in the area.

e) **Rajputs -** The Rajputs, particularly in Mewar and Marwar, regained the lost territories that were lost during the reign of Aurangzeb. The assertion of independence by such strong states was a blow to the prestige of the Mughal Empire.

f) **Marathas -** The Marathas, under the leadership of Chhatrapati Shivaji Maharaj and later the Peshwas, expanded their influence significantly. By the mid-18th century, they had established a confederacy, such as the Bhonsles of Nagpur, the Peshwas of Poona, the Gaikwad of Baroda, the Holkars of Indore, and the Scindias of Gwalior that controlled large parts of India, becoming a dominant force.

g) **Sikhs -** The Sikhs, under Guru Gobind Singh and later leaders like Maharaja Ranjit Singh, emerged as a noteworthy power in the Punjab, challenging Mughal and Afghan supremacy in the region.

These regional powers effectively ended the centralized rule, which was once known as the Mughal Empire.

2. **Interference of Foreign Powers: -**
   a) The French East India Company allied with southern powers like Mysore to challenge British dominance, particularly during the Carnatic Wars (1740 - 63).
   b) The British East India Company channelized its military strength and economic resources to intervene in regional disputes, such as the succession conflicts in Bengal and Hyderabad.

   The weakened Mughal authority made it easier for these powers to establish bases, laying the foundation for colonial rule.
3. **Strengthening of British Colonial Dominance: -** The fragmentation of the Mughal Empire facilitated the British East India Company's rise to power. The Battle of Plassey (1757) marked a turning point, as Robert Clive defeated the reigning Nawab Siraj-ud-Daulah, securing British dominance in Bengal. The Battle of Buxar (1764) further strengthened the British power, granting them the Diwani rights to collect revenue in Bengal, Bihar, and Orissa. The decline of the Mughal Empire thus directly contributed to the establishment of British colonial rule, reshaping the subcontinent's political and economic structures.
4. **Disruption of Trade and Agriculture: -** The administrative decline of the Mughal Empire disrupted traditional trade and agricultural practices, leading to economic stagnation in many regions. The Mughal Empire had maintained extensive trade networks that connected India to Central Asia, the Middle East, and Europe. With the decline of central authority, these routes became unsafe, which weakened Trade and Commerce in India. Over-taxation and warfare had also devastated the rural agrarian economy.
5. **Decline of Urban Centers: -** The decline of the Mughal Empire also led to the deterioration of urban centers, many of which had flourished as hubs of administration, culture, and commerce.
   a) Delhi: The city suffered invasions and plunder, losing its status as a lively capital.
   b) Agra: The decline of imperial support and trade routes diminished Agra's importance.
   c) Lahore: Once upon a time, it was a cultural center, but during the reign of the Later Mughal Emperors, it became a battleground for various competing empires.

**Conclusion**

The decline of the Mughal Empire marked a transformative period in South Asian history. The empire's collapse was not a sudden failure but a gradual process motivated by internal weaknesses and external pressures. Aurangzeb's policies, the absence of a succession law, weak successors, corruption, and Jagirdari crisis dismantled the once-robust administrative structure. This decline gave rise to local powers, invited foreign interference, and paved the way for British colonial dominance. The disruption of trade and agriculture and the decline of urban centres marked the socio-economic effects of this fragmentation. Finally, the Mughal Empire's fall restructured the political, cultural, and economic landscape of the Indian subcontinent.

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# A STUDY OF TECHNOLOGY, GLOBALIZATION AND IDENTITY IN AMITAV GHOSH'S THE HUNGRY TIDE

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***Abstract***

*This research paper explores the intricate relationships between technology, globalization and identity in Amitav Ghosh's acclaimed novel **The Hungry Tide**. Set against the backdrop of the Sundarbans, the narrative weaves together themes of environmental degradation, cultural displacement, and the complexities of human identity in the face of globalization. Through a critical analysis of the novel, this study examines how Ghosh portrays the impact of technological advancements and globalization on the lives of marginalized communities, particularly the Bon Bibi cult and the fishermen of the Sundarbans.*

*The research argues that Ghosh's work offers a nuanced portrayal of the tensions between traditional knowledge systems and modern technological advancements, highlighting the need for a more inclusive and sustainable approach to development. By exploring the intersections of technology, globalization and identity, this study sheds light on the ways in which literary narratives can inform our understanding of the complex challenges facing contemporary societies. Ultimately this research contributes to ongoing debates about the role of literature in shaping our understanding of globalization, technology and human identity.*

***Keywords**: Amitav Ghosh, The Hungry Tide, technology, globalization, identity, environmental degradation, cultural displacement.*

**Literary Review**: The Novel is studied through the lens of Ecocriticism and Environmentalism highlighting the complex relationships between humans and the natural world.

**Introduction**: Amitav Ghosh's The Hungry Tide is a thought- provoking novel that explores the complex relationships between humans and the natural world in the Sundarbans. The Novel is set against the backdrop of the Sundarbans unique ecosystem, where the boundaries between humans and nature are constantly blurred. Through the story of Piya, a marine biologist and Kanai, a translator, Ghosh examines the impact of globalization and technological advancements on the lives of marginalized communities in the Sundarbans.

**The Impact of Globalization on Identity**:

Ghosh's novel highlights the impact of globalization on the lives of marginalized communities in the Sundarbans. The forced evacuation of refugees from Morichjhapi 1979, serves as a backdrop for exploring themes of displacement , identity and belonging. Ghosh writes, " The refugees had come to Morinchjhapi in search of a place to live, a place to call their own" (Ghosh 2005,247). This quote highlights the desperation and resilience of the refugees, who are forced to flee their homes in search of a better life.

The Novel also critiques the exploitation of natural resources and the consequences of environmental degradation. Ghosh writes, " The tide country is a place where the boundaries between land and water are always shifting" ( Ghosh 2005, 6). This quote highlights the dynamics and fragile nature of the Sunderbans ecosystem, which is threatened by human activities such as deforestation and pollution.

**Technology and Knowledge Transfer**:

While technology is not a dominant theme in The Hungry Tide, Ghosh hints at its potential benefits, such as facilitating knowledge transfer and communication. Piya's research on the Irrawaddy dolphins is facilitated by her use of technology, such as GPS and cameras. Ghosh writes, "Piya had brought with her a small camera, and she took a few shots of the dolphins" (Ghosh 2005, 114). This quote highlights the role of technology in facilitating scientific research and knowledge transfer.

However, the novel also critiques the negative aspects of globalization, including the inhumane treatment to settlers by urban populations. Ghosh writes, "The settlers were seen as a threat to the forest, and the forest was seen as a threat to the settlers" (Ghosh 2005, 256). This quote highlights the tensions between the local ecological knowledge and globalized systems of power.

**Eco-Cosmopolitanism**: Ghosh's work promotes eco-cosmopolitanism, emphasizing the need for solidarity and exchange between people from diverse backgrounds. The novel highlights the importance of recognizing and respecting the knowledge and experiences of local communities. Ghosh writes, "The forest was not just a collection of trees, but a living breathing entity" (Ghosh 2005, 205). This quote highlights the importance of recognizing the interconnectedness of human and non-human life.

The Role of Myth and Folklore: The novel also explores the role of myth and folklore in shaping the identities of marginalized communities. The story of Bon Bibi, a revered figure in the Sunderbans, servers as a powerful symbol of resistance and resilience. Ghosh writes, "Bon Bibi was a goddess who protected the forest and its inhabitants" (Ghosh 2005, 181). This quote highlights the importance of myth and folklore in shaping the cultural and ecological knowledge of local communities.

The Novel also Critiques the impact of globalization on local economies, particularly the exploitation of natural resources and the displacement of marginalized communities. Ghosh writes, "The tide country's economy was based on the extraction of natural resources, such as timber and fish" (Ghosh 2005, 142). The quote highlights the unsustainable nature of the local economy.

**In Conclusion**, Amitav Ghosh's The Hungry Tide offers a nuanced portrayal of the complex relationships between technology, globalization and identity in the Sundarbans. Through a critical analysis of the novel, this study has highlighted the tension between traditional knowledge system and modern technological advancement, as well as the impact of Globalization on the lives of marginalized communities. Ghosh work promotes eco-cosmopolitanism, emphasizing the need for solidarity and exchange between people from diverse backgrounds. The novel also critiques the exploitation of natural resources and the consequences of environment degradation, highlighting the importance of recognizing the interconnectedness of human and non-human life. Overall, Ghosh's work offers a powerful critique of the dominant narratives of globalization and development, and highlights the need for a more inclusive and sustainable approach to development.

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# DIGITAL TRANSFORMATION IN URDU LITERATURE

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***Abstract***

*Digital technology's fast growth has transformed the way Urdu literature is created, spread and accessed. This research looks at how digital transformation affects Urdu literature, mainly by examining the change from traditional print to digital publishing, the use of social media platforms and AI-based literary tools in writing. The study shows how online platforms such as blogs, e-books, audiobooks, digital libraries and social media have given writers and readers more chances to read and discuss Urdu literature on a global scale. It also points out that problems in writing Urdu digitally and a lack of digital skills keep digital Urdu literature from becoming more popular.*

*AI applications in text recognition, speech synthesis, digital storytelling and multimedia literature are highlighted in the research as new tools that are transforming the future of Urdu literature. According to the research, the literary ecosystem in Urdu can be sustained by upgrading editorial practices, securing copyright, supporting digital education and encouraging the development of technology for Urdu digitization. The rise of digital writing has benefited Urdu, but it has led to new issues, for example, issues with quality, plagiarism, copyright breaches and the divide between those with and without digital access.*

*By looking at the positives and negatives of digital change, this research explains how Urdu literature can protect its heritage while using new technologies to stay relevant in the present digital world.*

***Key Words:*** *Digital Technology, Urdu Literature, transformation, Research.*

## Introduction:

With a long history and rich culture, Urdu literature has regularly influenced the content of books, periodicals and newspapers. Even so, digital technology has transformed the methods of using literature for writing, publishing and reading. Because the internet, social media and digital publishing have advanced fast, Urdu authors can now communicate with more readers from different regions.

The study examines what changes the digital revolution has brought to Urdu literature in terms of output and readership, thanks to online platforms, e-books, blogs and social media. It examines the changes happening to ancient literary genres such as Ghazal, Nazm and Afsana as they move into the digital age, along with the rise of micro fiction and digital writing.

The study also talked about the positives and negatives of digitalizing Urdu literature. Even as digital platforms make literature more available to everyone, they also lead to concerns about how quality is checked, who owns the rights and whether a work is genuine. Besides, the move from printed to digital books has changed how readers get involved and what they read, changing the way literature is understood and valued.

The purpose of this research is to understand how Urdu literature is changing because of digital technology and to see how that change affects future literature. This study examines how technology is changing the writing and sharing of Urdu literature to see what effects these changes have had over time.

## Evolution of Urdu Literature in the Digital Age:

Urdu literature has been greatly altered by the digital age, so more people can read and access it. Access to literature has grown because the internet, social media and digital publications have changed the classic system of publishing and distributing books. Traditionally, Urdu literature mainly grew by means of printed books, magazines and newspapers, and Baithaks and mushairas helped promote

literary works. Now that digital platforms exist, much of the literary activities have shifted online, including e-magazines, online journals, self-publishing and online mushairas and literary forums.
A lot of Urdu literature is now found on digital platforms, including blogs, personal websites, social networking platforms such as Facebook, Twitter, and Instagram, YouTube and podcasts. Because of the digital age, traditional literary forms have given rise to new and changed styles. Ghazal and Nazm, classical forms, are now available in many media, but micro-fiction and flash fiction are made for today's readers with little time.

**Influence of Digital Platforms on Urdu Literary Forms**

Urdu literary forms have been changed a lot by the influence of digital platforms on both the content and how literature is expressed. Traditional genres of literature such as Ghazal, Nazm, Afsana (short tale) and Dastan (folk narrative) have changed to suit the modern, participatory world of digital media. Because writers use social media, blogs and digital periodicals to speak with their readers, literary culture has become more alive and responsive. Because these platforms are open to everyone, writers without traditional publishing opportunities can now get their work out to readers.
A major development has taken place in Urdu poetry, mainly in Ghazals and Nazm. Classical poetry was exact in its matter and subject, but nowadays the internet has supported writers to experiment, use free verse and focus on subjects popular with today's readers. On Facebook, Twitter and Instagram, poets can share their work easily and often as short rhymes, couplets or micro-poetry. Spoken-word poetry on YouTube and podcasts has made poetic performance change, by combining traditional poetry styles with fresh narrative techniques.
Also, during the digital age, there are important changes in. Nowadays, the traditional short story (Afsana) appears in micro-fiction and flash fiction, meant for those reading online who have little time. More and more writers are combining traditional storytelling with new and unusual techniques. Because of online forums and digital magazines, authors can publish their work one part at a time, keeping readers interested over a period. Along with reviving the short story, this trend has added a two-way interaction, so readers can comment and communicate with authors.
Using multimedia has become a major feature of Urdu literature on the internet. More and more, writers are using graphics, animations and background music in their digital books to make literature more interesting. As an illustration, digital poetry films connect spoken poetry with artistic graphics to increase the feelings the lyrics create. Just as with films, audiobooks and podcasts have made Urdu literature accessible to people who had not read it before. The new technologies have increased the methods by which people can enjoy and admire Urdu literature now.
Internet platforms have given Urdu writers new chances, but they have also brought attention to concerns about realness and the quality of their writings. Because digital publication is so easy to access, there is now an overwhelming amount of information, making it hard to tell good writing from ordinary pieces.
Even with these challenges, Digital platforms have clearly changed Urdu literature. They have shown interest in Urdu literature, encouraged writers to use new styles and helped cover more topics than traditional literature. Because digital technology is always advancing, Urdu literature will also change and remain important in today's world.

**Digital Publication and Urdu Literature**

With digital publication, Urdu literature has become much easier for people all over the world to read. Urdu writers have historically used books, magazines and newspapers to get their work out. Nevertheless, using e-books, online journals and self-publishing sites on the internet has helped writers avoid many traditional publishing difficulties. Rekhta, UrduWeb, and Kitaab Ghar are now leading sites in digital Urdu literature, where you can find both old and new writings. Now, thanks to this change, new writers can publish their work without relying on the usual publishing channels.

A notable change in reader habits is one of the main results of digital publication. Many Urdu readers are now getting their literature by reading it on smartphones, tablets and e-readers. People like e-books and digital periodicals because they are simple to use, inexpensive and accessible from anywhere. Because of audiobooks and podcasts, Urdu literature has become available to a larger number of people who might not read books. Because of this change, writers have created interactive fiction and a series of digital stories that keep their audiences coming back for more.

**Challenges and Criticism of Digital Urdu Literature**

Even though the internet has made Urdu literature much easier to reach and provided new opportunities for writers, it has also faced several challenges and criticisms. A major problem is that there isn't enough focus on quality. The editors and literary critics of conventional publications keep their standards very high. Anyone is able to upload their writing to the internet without it being checked by an editor first. As a result, we now see more amateur writing, but some of it lacks both substance and clear language. Since self-publishing is simple, creativity and quality have sometimes taken a back seat, which worries some about the future of literary genius in the digital era.

Besides, the gap between those who can use technology and those who cannot has greatly limited the development of digital Urdu literature. While city and suburban readers quickly use digital books, many rural residents do not have the necessary skills to read or use the Internet. Because the Urdu script is complex and because it supports digital fonts, creating high-quality Urdu text on many devices is often a challenge. Because of this, digital Urdu literature is not easy for everyone to use and is not widely recognized. Still, actions are underway to control digital publishing, make it more accessible and preserve strong writing to help Urdu literature thrive today.

**Future of Urdu Literature in the Digital Era**

Urdu literature is set to thrive in the digital age, as new technology keeps changing the way books are created, made available and read. Urdu literature is expected to reach more people due to the rise of digital platforms, publishing on the internet and artificial intelligence which break down barriers related to place and language. Sites like Rekhta and UrduWeb are already helping to save both old and new Urdu books, so future generations can read them. More and more people are reading e-books, listening to audiobooks and listening to podcasts, giving literature greater access to many age groups and backgrounds.

The future of Urdu writing will be strongly affected by how we use artificial intelligence and automation. Advances in Urdu text recognition, translation and speech synthesis using artificial intelligence allow for easier digitization of historical texts, transcription of poetry and the creation of interesting literary activities. Machine learning approaches are being applied to Urdu language processing, so content is easier to find and reach many digital platforms. In addition, social media sites will guide the development of literature, leading to the rise of micro fiction, digital poetry and interactive stories. It is expected that these advances will bring Urdu literature into line with modern technology.

Although Urdu literature has made progress, it still faces some problems to survive in the digital world. The internet has created problems with controlling quality, preventing plagiarism and commercialising writing. In addition, because of the digital divide, some people in various countries are not able to use digital books. But if people keep gaining digital literacy, Urdu typing is improved, and copyright laws are tightened, Urdu literature can be both innovative and full of cultural value in the future.

## Conclusion

The digital age has completely changed the systems for producing, sharing and reading Urdu literature. Thanks to online platforms, e-books, social media and digital publishing, literature is now available to more people, helping both well-known and new authors reach a larger group of readers. Traditional forms such as Ghazal, Nazm and Afsana have developed, and new styles such as micro-fiction, digital poetry and spoken word have come into existence. Besides, using AI for text processing, making voices for text, and digital archives is now making it possible to save and promote Urdu literature better than ever before. Still, many issues continue to be a major challenge in this field. Urdu literature's reputation and ability to remain important in the digital age are threatened by quality control, plagiarism, copyright breaches and the digital divide.

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# COMMUNITY SENTENCING IN INDIA: A SHIFT TOWARDS RESTORATIVE JUSTICE UNDER THE BHARATIYA NYAYA SANHITA, 2023

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***Abstract***

*Community sentencing, also known as community service, represents a pivotal shift in criminal jurisprudence from retribution to reformation. Recognized globally as an effective non-custodial alternative, it aims to reduce prison overcrowding, lower incarceration rates, and facilitate offender rehabilitation. The inclusion of community service in India under the Bharatiya Nyaya Sanhita, 2023, marks a transformative moment in the nation's penal philosophy. For the first time, Indian law formally recognizes community service as a legitimate punishment for select minor offences, aligning with principles of restorative justice. This move is particularly significant against the backdrop of chronic prison overcrowding, with occupancy rates exceeding 131% and over 4.3 lakh undertrial prisoners in 2024 alone. Community service sentencing not only alleviates pressure on prison infrastructure but also offers offenders an opportunity for redemption through meaningful social contribution. Judicial pronouncements, including State of Gujarat v. Hon'ble High Court of Gujarat and Sunita Gandhawa v. State of Madhya Pradesh, underscore its reformative potential. However, challenges such as perceived leniency, inconsistent judicial application, and ethical concerns about forced labour persist. Successful implementation demands legislative clarity, judicial consistency, and community engagement. Moreover, public perception must evolve to appreciate the rehabilitative ethos behind such sentences. In a country grappling with prison reform and sluggish justice delivery, community sentencing offers a humane, pragmatic, and economically viable alternative, particularly for minor offenders. If structured and enforced judiciously, it has the potential to transform India's criminal justice landscape by prioritizing reformation over retribution and integration over isolation.*

***Keywords:*** *Community Sentencing, Restorative Justice, Criminal Justice Reform, Bharatiya Nyaya Sanhita 2023, Prison Overcrowding*

## Introduction

Community sentencing, also known as community service, is part of an array of alternative sanctions to imprisonment. It is also defined as a form of non-custodial punishment for offenders to undertake unpaid work for a certain number of pre-determined hours.[1] Thus, community service is a form of punishment that requires offenders to perform unpaid work for the benefit of the community as part of their sentence. Community service is used in many countries around the world, including various European countries, the United States, Canada, the United Kingdom and Australia. It is seen as effective in reducing prison overcrowding supporting rehabilitation and lowering incarceration rates, while allowing offenders to contribute positively to their communities. Community service as a form of punishment has been introduced for the first time under the Bharatiya Nyaya Sanhita, 2023 (BNS). The shift towards using community service as a punishment in India, as outlined in the Bharatiya Nyaya Sanhita, signifies a move away from solely punitive measures towards a more comprehensive and rehabilitative approach to justice. This change recognizes the need to address the underlying causes of criminal behaviour, promote rehabilitation and encourage individuals to take responsibility for their

[1] Anita Abdul Rahim et al, Community Service as an Alternative Punishment: The Extent of its Application on the Categories of Crime and Offender in Malaysia, 1 International Journal of Education and Research (July 2013)

actions, especially for minor offenses.[2] The concept of community service can be traced back to as early as 1553 in London, where it was used to deter idleness and vagrancy.[3] It was also utilized during and after World War II, with Judges in Alaska ordering community service as part of probation.[4]

Over the period of time and in the name of reforms, many alternatives to custodial sentences have been introduced in Indian Criminal justice system like use of open prisons, parole, probation, rehabilitation centres etc, but community sentencing has not been given much importance.[5] It was only recently, community service sentencing was introduced in India. Such introduction of community service as a punishment for offenders is a welcoming move.

It can be mentioned that, in community service sentencing, instead of simply being punished, offenders are given the opportunity to make positive contributions to the community, challenging their previous understanding of the consequences of their actions. This can lead to a more holistic perspective on their behaviour on society. It also serves as a tool for re-socialization by allowing offenders to reintegrate into society through positive action. By actively participating in community projects, offenders can gain a sense of purpose and belonging, which can contribute to their rehabilitation and reduce the likelihood of reoffending, additionally community service focuses on restitution and relationship through the concept of restorative justice. In the case of *State of Gujarat v Hon'ble High Court of Gujarat* [6] the court emphasized that the main objectives of punishment should be reformation aiming to turn the offender into a better individual. Similarly *in R.K.Anand v Registrar High Court Delhi*,[7] the court suggested that it would be beneficial to have offenders contribute to society in a utilitarian manner rather than simply sending them to jail.

Thus in Indian Criminal Law, the Bharatiya Nyaya Sanhita 2023 (BNS) has incorporated community service in addition to imprisonment or fine as a form of punishment for the following offences:

(i) Section 202; Public servant unlawfully engaging in trade.
(ii) Section 209 : Non appearance in response to a proclamation under section 84 of BNSS, 2023
(iii) Section 226: Attempt to commit suicide, to compel or restrain exercise of lawful power
(iv) Section 303(2) proviso: Theft where the value of the stolen property is less than five thousand rupees and a person is convicted for the first time and returns or restores the value of property.
(v) Section 355: Misconduct in public by a drunken person
(vi) Section 356(2): Defamation

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[2] M.K. Guru Prasath and T. Charumathi, ' A Critical Study on Community Service Sentencing and its Significance in the Indian Criminal Justice System', International Journal of Legal Science and Innovation, Vol 6 Issue 4; 505.
[3] Pease, K. (1985). Community service orders. In M. Tonry & N. Morris (Eds.), Crime and justice: An annual review of research (Vol. 6, pp. 51–94). University of Chicago Press
[4] McDonald, D. C. (1986). Punishment without walls: Community service sentences in New York City. Rutgers University Press.
[5] Gupta, P. (2021). Community service: As a part of sentence in India. SSRN. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3850264
[6] AIR 1998 SC 3164
[7] AIR 2013 SC 670

Reformation is a fundamental objective of criminal punishment, in *Babu Singh v State of Uttar Pradesh* [8] the court observed the significance of reformative devices. The court noted the innovative value of mediative duties or study classes in the redemption of offenders. The structure and condition of Prison administration system in India compels considerations to better alternatives of punishment in order to lighten the load of the prison population and unburden the prison infrastructure and facilities in India. Community services, by virtue of its reformative, pragmatic and economical value, proves to be a better alternative to imprisonment especially in the case of minor and petty offences as it helps such categories of persons in learning of rehabilitation and reintegration into the society.[9]

Earlier in India, the only existing provision for court ordered community service was under the Juvenile Justice Act of 2015, allowing the Juvenile justice Board to assign child offenders to perform community service. The concept of corrective labour was introduced in the 42nd Law Commission Report, while the penal code Amendment Bill of 1978 included provisions for community service for offenders over 18 years old. This bill allowed for up to 1000 hours of community service for offenders convicted of crimes with less than three years of imprisonment. Despite the lack of clear legislation on community sentencing in Indian Penal Laws, the judiciary has used its discretionary powers under Sec 482 of the Criminal Procedure Code to implement community service. However, the discretionary nature of their action has led to ambiguity. To ensure consistent application and transparency, specific legislation on community sentencing was needed to fully leverage its benefits.[10]

Overcrowding of prisons has been a long-standing issue in Indian prison administration. The occupancy of Indian prisons was calculated to be over 131% in 2024.This shows that the number of prisoners has already exceeded the actual capacity of the prison significantly, it is also worth noting that the number of undertrial prisoners in the year 2024 is 434,302.[11] A major concern with imprisonment of persons accused/convicted of petty or minor offences is their treatment in prisons in the context of overcrowding and poor infrastructure and facilities of Indian prisons. Such conditions have far-reaching implications on the health of such class of prisoners. Community service is an effective manner of shielding such prisoners from the conditions of prisons and at the same time providing them with productive and restorative devices for the benefit of the society. Community service would also protect such prisoners from poor treatment at the hands of other prisoners who may be hardened criminals.[12] In the case of *Sunita Gandhawa v State of Madhya Pradesh & Anr*,[13] highlighted the importance of community service in the form that – ' it gives a chance in some cases to melt the ego of an accused who facing trial of those offences which gave psychic gains or accused while committing such crimes…the C/WPPIL/108/ accused can again be assimilated into the mainstream society and would

[8] 1978 AIR 527

[9] Bagaria, K. (2023). Analysing the significance of community service as an alternative form of punishment. International Journal of Human Rights Law Review, 2(S.I.), 192–198.

[10] Aafreen, A. (2024). Community sentencing in India: A reformative approach to criminal justice. Jus Corpus Law Journal.

[11] Ministry of Home Affairs. (2024, December 4). Undertrials Among Indian Prisoners [Unstarred Question No. 1039]. Government of India. https://www.mha.gov.in/MHA1/Par2017/pdfs/par2024-pdfs/RS04122024/1039.pdf

[12] Agarwal, M. (2019). Beyond the prison bars: Contemplating community sentencing in India. NUJS Law Review, 12, 119.

[13] 2020 SCC Online MP 2193.

be accepted by the community…ingrained attributes of Love, Compassion, Mercy and Service can be rekindled through the concept of community service'.

The court has to determine the number of hours of community service based on the offence. Criticism towards using community service as a punishment for crime stems from its perceived leniency and inconsistent application by different judges. The lack of uniformity in sentencing offenders to community service leads to a sense of unfairness and inequality within the justice system. Ethical concerns also arise, particularly regarding concerns of forced labour when assigned tasks do not directly address the harm caused by the crime.[14]

Hence, implementing community sentencing can be complex. One key challenge is recidivism, where offenders may not fully grasp the consequences of their actions when given community service as an alternative to prison. Moreover, the public in India have mixed perceptions about the introduction of community sentencing. Some see it as a positive step towards rehabilitation, while others view it as a lenient punishment.[15] The criminal justice administration system continues to be sluggish in India. Inclusion of community service sentencing will undoubtedly bring some positive changes in the justice delivery system of India.

The inhuman conditions in prisons and the exposure to hardened criminals can lead to the release of damaged individuals after the completion of their sentences. Even after the release of the offender of the stigma of serving a prison sentence persists, and the society shuns them as an outcast.[16] The socio-economic implications continue throughout the life of the offender even after serving a sentence, inhibiting progress in their chance of re-integration into the community.[17]

Community sentencing is the key tool to help offenders reform, boost their self-esteem and provide valuable resources to society. Further, since many offenders come from underprivileged background, community service can also act as a means of providing training to them and acquired new skills,[18]while residents of open prisons would largely have to depend on their existing skills to gain employment outside the prison premises. Therefore, given these relative benefits of community sentencing over the system of open prisons, which is being readily embraced as an alternative to the rigorous custodial imprisonment regime.[19]

[14] Md. Imran Wahab. (n.d.). Analysing community service as a mode of punishment in Bharatiya Nyaya Sanhita. Legal Service India.

[15] Areesha. (2024, August 27). Community sentencing in India: A reformative approach to criminal justice. Jus Corpus Law Journal.

[16] Jason Schnittkes & Andrea John, 'Enduring Stigma: The Long-Term Effects of Incarceration on Health', 48(2) JOURNAL OF HEALTH & SOCIAL SCIENCE (2007)

[17]Keene, D. E., Smoyer, A. B., & M. Kim. (2018). Balancing stigma, housing, and identity after prison. The Sociological Review, 66(4), 792–807. https://doi.org/10.1177/0038026118777441

[18]Royal Borough of Greenwich. (2019, March 18). Offenders are helping to make a difference with community pay-back. Royal Borough of Greenwich. Retrieved from https://www.royalgreenwich.gov.uk/news/article/1415/offenders_are_helping_to_make_a_difference_with_community_payback

[19]Hindustan Times. (2017, December 12). SC tells states to consider setting up an open prison in each district. Hindustan Times. Retrieved from https://www.hindustantimes.com/india-news/sc-tells-states-to-consider-setting-up-an-open-prison-in-each-district/story-tnLIw076tAKIso8wKamUJ.html

## Conclusion

It is to be noted that successful implementation of community service sentencing requires careful planning to address issue like absenteeism and ensure the smooth reintegration of offenders into the community. Moreover, the judiciary would have to play the role of a vanguard to ensure strict compliance with the orders. The court must also ensure that the discretion vested with them should not be misused for administering justice not only to the offenders but also to the public at large.

# EMPOWERING RURAL LIVELIHOODS: THE ROLE OF SELF-HELP GROUPS IN SUSTAINABLE MINOR FOREST PRODUCE-BASED ENTERPRISES

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***Abstract***

*Self Help Groups plays an important role in empowering economically and socially marginalised groups through promotion of collective entrepreneurship, financial inclusion, and sustainable resource uses. They have resulted in improved livelihoods through the intervention of Self Help Groups (SHGs) based on Minor Forest Produce (MFP) for rural and tribal communities more particularly in North East India. This paper will thus analyze how SHGs bring in MFP-based livelihoods, focusing on their economic contributions, capacity building initiatives and market linkages. Moreover, it includes analyses around the policies, institutional linkages, and challenges facing SHGs for the scaling up of MFP enterprises. Some successful case studies and best practices are presented in the study with strategic recommendations towards enhancing SHGs' participation in the MFP sector. These groups can use government support, innovations in the market, and sustainable harvesting to promote economic growth, while conserving biodiversity and cultural heritage. The findings reveal that sound institutional support, intensification of financial assistance, and infrastructural development are important for ensuring that the SHG-led MFP efforts are sustainable in the future.*

***Keywords:*** *Self-Help Groups (SHGs), Minor Forest Produces (MFPs), Rural Livelihoods, Sustainable Development, Market Linkages*

**Methodologies:**

The study uses qualitative research methods, secondary data analysis, and case study examination to study the role of SHGs in promoting MFP-based livelihoods. Data for the secondary analysis were gathered from government reports, policy documents, research papers, and articles dealing with SHG-led MFP enterprises in North East India. Successful SHGs were further reviewed through case studies developed to study their best practices, challenges, and implications for policy. Cross-case analysis was done to study the comparative position of several government schemes such as the Van Dhan Yojana in their possible impact on the participation of SHGs in the MFP sector. Literature on sustainable resource management, financial inclusion, and community empowerment has, in turn, been analyzed. By weaving these disparate sources together, the study presents a comprehensive picture of the extent to which SHG-led MFP-based livelihoods can be restrained and promoted.

**1. Introduction: Understanding Minor Forest Produces (MFPs) and Self-Help Groups (SHGs):**

Minor Forest Produces (MFPs) are diverse forest resources excluding timber, which are an important livelihood source for rural and tribal communities. These products mainly include medicinal plants, resins, bamboo, honey, lac, tendu leaves, and wild fruits, among others, sourced from nature. MFPs specify significant functions in the economic sustenance of forest-dependent communities, where they afford food security; material for traditional crafts and income through collection and trade. India recognizes MFPs through the various schemes, including Minimum Support Price (MSP) for MFP, which helps ensure a fair price and market for tribal collectives (Ministry of Tribal Affairs, 2022). MFPs would thus play in society not only in the economic wellbeing of forest communities but also in biodiversity conservation and sustainable resource management because they are renewable resources of culture.

MFPs act as a buffer to the economy in favor of rural and tribal communities, very much needed for the economically weaker sections that lack access to major agricultural or industrial jobs. MFPs provide a seasonal income that helps the community deal with financial uncertainties. The ecological balance and conservation of forests through sustainable harvesting of MFPs are also impactful in realizing the global sustainability goals (FAO, 2021). Nonetheless, there are hurdles to MFPs achieving their full economic potential, from inadequate market linkages, through exploitation by middlemen, to lack of value addition. This implies that the more we can strengthen community-based enterprises and cooperatives, the better will be the advantages from MFP collecting as a source of financial security for forest-dwelling people.

As small local organizations, self-help groups (SHGs) empower economically disadvantaged people, particularly women, to save, access credit, and create opportunities for income-generating activities. The SHG movement began in India as below-the-radar grassroots work for financial inclusion, focused on mutual support, self-help, and democratic decision-making. Thanks to the links with banks and microfinance institutions, credit is available to be accessed by members of SHGs for investment in income-generating activities like small-scale industries, agriculture, and craft production (NABARD, 2020). Success stories of the SHG model in projects like the National Rural Livelihood Mission (NRLM) go a long way in establishing its significance as an institution for economically empowering the rural poor, thus reducing their dependence on informal moneylending activities.

SHGs go beyond the realm of financial inclusion to also impact skill development, entrepreneurship, and leadership among marginalized communities for the socio-economic development of the states. In addition, women-oriented SHGs have proven to be a powerful vehicle for increasing gender empowerment and community development. Collectively, decision-making brings forth confidence; economic activities give women a stronger voice to negotiate better wages and participate in local governance (Singh & Sharma, 2021). With these linked livelihoods of SHGs and MFP, there comes a transformational potential allowing rural community knowledge/information and forest resources to thrust economic development in a sustainable manner. For this, there is a need for policy support, capacity-building programs, and improved access to markets and technology.

The integration of self-help groups (SHGs) with livelihood activities based on minor forest produce (MFP) is important for sustainable economic development and the conservation of forest resources. SHGs provide a platform for collective bargaining, so market access is improved and exploitation by intermediaries of forest produce products is reduced. In value addition processes like processing, packaging, and branding of MFPs, SHG members can increase the market value of forest products and provide SHG members with more money in their pockets (Das & Goswami, 2023). SHGs are instrumental in linking cooperatives, government schemes, and private sector enterprises, thus enforcing fair trade and enabling economic self-sufficiency for the tribal and rural populace.

From environmental sustainability, SHGs might enable eco-friendly and community-based harvesting of MFP, which is essential for the conservation of biodiversity and forest ecosystem. Such sustainable management of MFPs occurring with combining traditional knowledge of indigenous communities and modern scientific techniques would be great (Kumar et al., 2022). In addition, SHGs could facilitate the development of MFP-oriented eco-friendly products including herbal medicines, organic dyes, and biodegradable packaging materials that correspond with national and global sustainability goals. Therefore, strengthening generating livelihood from MFPs through SHGs is indispensable through capacity- building programs, financial incentives, and policy support for an inclusive and sustainable model of development.

**2. SHGs as Catalysts for Economic Empowerment through MFP-Based Livelihoods:**

By organizing marginalized communities into cooperative networks, Self-Help Groups (SHGs) foster collective entrepreneurship in processing and marketing of Minor Forest Produce (MFP). These groups allow small-scale producers, particularly women and members of tribal communities, to pool their resources, share knowledge, and put their skills into collectively adding value to forest-based products by drying, grading, packaging, and branding activities. Working under the SHG umbrella enhances the bargaining power of these members while reducing their dependence on middlemen and ensuring fair prices for their products (National Bank for Agriculture and Rural Development [NABARD], 2021). SHGs also contribute to local employment and income enhancement through their cooperative business models.

On the other hand, marketing is another area that comes under the important contribution of SHGs. They act as a bridge between rural producers and urban markets and connect traditional products to a broader consumer base. Under government schemes like the Van Dhan Vikas Yojana (VDVY), SHGs are trained in branding, quality control, and digital marketing so that they can establish their presence in local and national markets (Ministry of Tribal Affairs, 2022). Also, e-commerce and fair-trade networks throw in new opportunities for SHG-led businesses to the sustainable economic empowerment of the forest-dependent communities.

Microfinance transfigures the self-help groups into self-starting microenterprise vehicles with regard to marketing of MFP products. The SHG-BLP mechanism opens up the low-cost credit option for members to be able to invest in infrastructure for source materials, processing unit, transport, and marketing a product. These revolving funds and working capitals provided by financial institutions like NABARD and regional rural banks promote entrepreneurship development among SHG members (Rao and Patel, 2020). Using these financial facilities-to-micro-women, SHGs would raise themselves from a subsistence level of collection of forest produce to business models generating income in the structured way.

The self-supporting business enterprises in MFP-based structures also advocate the manufacture of eco-sustainable and socially responsible production units. Profits are reinvested in community development, ensuring long-run sustainability as several SHGs also take cooperative ownership structures. Besides, the SHGs receive their businesses scaled up while remaining environmentally sustainable through partnerships with NGOs, CSR initiatives, and government agencies (Sharma and Dutta, 2022). Through training programs on financial literacy, business management, and product diversification, SHG members are equipped with skills for sustaining and growing their business enterprises over time.

Multiple SHGs in Northeast India have been able to convert MFP-based livelihoods into highly successful businesses, thus supporting the local economic development. The "Meira Paibi SHG" in Manipur is one such good case of cooperative marketing of medicinal herbs and organic honey. The SHG had support from government schemes as well as NGOs to extend its marketing reach to urban centers, thereby ensuring steady income for the members (Das & Goswami, 2023).

Kaziranga Bamboo Crafts SHG in Assam is another example dealing with bamboo handicrafts and furniture. By utilizing traditional skills and modern design, this SHG has evolved into a sustainable business model with buyers from local and international markets. Apart from this, initiatives like the "Van Dhan Vikas Kendras" in Arunachal Pradesh have been instrumental in training tribal women in the processing of wild fruits and resin, thereby significantly augmenting their earnings (Kumar et al., 2022). The case studies thus demonstrate the capability of SHGs to sustain transitions from forest-based livelihoods into viable economic opportunities, provided that adequate financial and institutional support exists.

**3. Capacity Building and Skill Development Initiatives for SHGs:**

Capacity building of selected training programs is very important to improve the capacities of self-help groups engaged in the livelihood related to minor forest produce. Along with all of this, sustainable harvesting techniques have to be learned to achieve the highest possible income from forest resources without troubling the ecology. Training programs educate SHG members to follow responsible collection methods like rotational harvesting, non-destructive extraction methods, or conservation of high-value species (Das & Choudhury, 2021). The training includes other initiatives to disallow overexploitation of the forest resources and their long-term sustainability.

The next component of the SHG training is value addition. Many of the MFPs such as medicinal plants, wild honey, and bamboo products cannot be marketed unless processed. They conduct workshops on grading, packaging, preservation, and branding that enhance product quality and thereby competitiveness in the market. Other important items include digital literacy and marketing training, which enable SHG members to make use of e-commerce, social media, and direct consumer sales (Ministry of Tribal Affairs, 2022) in extending the reach for marketing beyond the local area. Skill development enhances the knowledge and expertise of SHGs in establishing profitable and sustainable minor forest produce enterprises.

The SHGs development in the MFP sector is being actively supported mainly by government departments, NGOs, and research and educational organizations. MFP-based livelihoods SHGs receive training, infrastructure support, and financing through programs such as National Rural Livelihood Mission (NRLM) and the Government of Van Dhan Vikas Yojana (VDVY) (NABARD, 2021). The programs also feature provisions for capacity building measures-related initiatives such as technical inputs, skill-development workshops, access to credit, and market linkages.

They conduct training mobilization programs for the grassroots towards improving market accessibility to products from SHGs. This is an important role that NGOs play in complementing government efforts. For example, the Self-Employed Women's Association (SEWA) has helped SHGs in Northeast India establish sustainable business models by integrating traditional knowledge with modern business practices Sharma & Dutta (2022). Research institutions are engaged in developing innovative processing methods, providing scientific validation for traditional MFP-based products, and advocating for supportive policies toward SHG-led enterprises. The coordinated action of all responsible parties is necessary to strengthen SHG capacities and ensure MFP entrepreneurship becomes sustainable over time.

MFP-based entrepreneurship must necessarily marry modern technology with traditional knowledge if it were to be successful. Since time immemorial, indigenous communities have depended on their intensive knowledge of forest ecosystems, herbal medicine, and environmentally-friendly harvesting. Knowledge on seasonal variations, soil conditions, and plant properties adds to the already rich knowledge of these communities on sustainable management of forest resources (Rao & Patel, 2020). Nonetheless, to forward integrate production and market demand with processing, SHGs must also recognize to use modern scientific principles and processing technologies.

Methods including advanced drying, cold storage, bio-based preservatives, and mechanization will be used to enhance operational efficiency, quality, and expiration of shelf life of MFP products. In parallel, quality certification and standardization facilitated by FSSAI regulations will lend credibility to the SHGs in a wider market (Kumar et al., 2022). The challenge will be to ensure a win-win situation in marrying traditional knowledge with modern technology. This marriage will lead to the development of unique high-end products with the highest assurance of authenticity and sustainable practices sustaining MFP-based livelihoods.

**4. Market Linkages and Value Chain Development:**

One of the main problems confronted by SHGs in Minor Forest Produce (MFP)-based livelihoods is that they do not have access to markets where they may be able to sell their products at remunerative prices. Many SHGs, particularly in the remoter tribal pockets of Northeast India, have no market linkage at all and are dependent on middlemen who pay hefty marks, low prices for HMP raw material (Das & Bhowmick, 2021). The dependency on the intermediary practically thins down the profit margins and plants barriers for SHG members from realizing the full potential of the economic returns from their products.

Another barrier affecting SHGs in accessing bigger consumer bases is the lack of storage, transport and organized markets to meet SHG needs. Prices of MFPs are also believed to fluctuate in seasons, as some of them become very much in demand in abundance at the time of harvesting which causes a drop in prices (Reddy et al., 2022). When they face such competition from the organized private sector and are unable to avail themselves of fair compensation through collective bargaining, SHGs would probably be left to face cheaper prices. Thus, market access prevention forces into a diversion on improving the economic sustainability of SHG-led MFP enterprises.

To facilitate market access for SHG produce MFPs, cooperatives and e-commerce platforms play greater roles in government policies. Cooperatives help SHGs aggregate their produce and gather market information for better prices and access to larger markets through collective bargaining. Successful models such as the Van Dhan Vikas Kendras (VDVKs) established under the Van Dhan Yojana have empowered SHGs through centralized processing, packaging, and marketing support (Ministry of Tribal Affairs, 2022). Through cooperatives, SHGs transition from raw material suppliers to processors of value-added products, thereby improving their earnings.

The emergence of e-commerce brings another opportunity for SHGs to access metropolitan consumers without brokers. Integrating availing relevant portals such as TRIFED's Tribes India, Amazon Saheli, and Flipkart Samarth to facilitate publicity and marketing via e-commerce to a broad national audience, since possibly even an international audience (Sarma & Devi, 2023). Steady government initiatives such as NRLM and Deendayal Antyodaya Yojana also directly finance strengthen SHGs capacities with it by equipping them with finances, training, and infrastructures to match the demands of market competition. Keeping these initiatives abreast while extending digital literacy among SHG members will avail them of better access to markets and fair price opportunities.

To compete in larger markets, branding, certification, and value addition are critical strategies for self-help groups (SHGs). Branding distinguishes MFPs by accentuating their authenticity, traditional methods, and eco-friendly techniques of production. It seeks to provide an attractive packaging identity to these products through storytelling and geographical indication tagging. This would make the products more appealing for conscious consumers (Kumar et al., 2022).

Certification is vital in shores of gaining consumer confidence and accessing higher-end markets. Organic certification, Fair Trade certification, and compliance with FSSAI ensure that MFP products are adequately judged on health, safety, and environmental standards to compete more vigorously in domestic and world markets (Rao & Chatterjee, 2021). Value addition strategies through processing raw MFPs into finished products such as herbal teas, essential oils, or organic skin care products enable SHGs to increase the price and profit margin. Training, technology, and cooperative marketing networks will help SHGs upgrade these MFPs into highly valued products that will attract both local and foreign markets.

**5. Policy Support and Institutional Frameworks for SHGs in the MFP Sector:**

Modernization under the government programs is thus said to have greatly empowered the self-help groups in the livelihoods based on minor forest produce or other related activities. The Van Dhan Yojana (VDY) is one flagship scheme initiated by the Ministry of Tribal Affairs under TRIFED (the Tribal Cooperative Marketing Development Federation of India) for enhancement into value addition and marketing viability of MFPs. It emphasizes financial assistance, training, and infrastructure for the processing, packing, and marketing of forest products for SHGs (Ministry of Tribal Affairs, 2022). VDY has brought SHGs within the fold of Van Dhan Vikas Kendras (VDVKs), giving them an opportunity to exploit the technical knowhow as well as linkages in the market and curtail their dependence on middlemen.

The impact of Van Dhan Yojana has been enormous in the northeast, where tribal societies are forest resource dependent. The scheme urges self-help groups to process and brand their MFPs, thus mostly raising their incomes and enhancing their market bargaining power (Sarma & Das, 2023). It ensures improved environmentally friendly harvesting methods thus maintaining an ecological balance for the future. Nevertheless, bureaucratic delays and lack of awareness among members of SHGs and access to technology are constraints acting against the objectives of the program. Thus, addressing these issues through better implementation and training would strengthen SHG involvement further in MFP-based livelihoods.

Institutional collaboration among government bodies, NGOs, educational institutions, and the private sector would be required to strengthen SHG-led MFP enterprises. Convergence of SHG affairs with rural development programs such as the National Rural Livelihoods Mission (NRLM) and Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) enables comprehensive support for financial inclusion, infrastructure development, and capacity building (Reddy et al., 2022). Integration of these programs with MFP-based- enterprises allows SHGs access to training, financial assistance, and market networks that build their economic viability.

NGOs and academic institutions also conduct research for sustainable utilization of MFP with new value addition techniques and skill development programs for SHGs. Linkage establishment by SHGs with agricultural universities in Assam has facilitated the exchange of information regarding organic certification, quality control, and branding strategies (Kumar & Devi, 2021). Strengthening such institutional linkages can help build an ecosystem for SHGs, which in turn can create an environment for the spirit of innovation and resilience in MFP-based entrepreneurship.

On the other hand, policy reforms for strengthening SHGs in MFP livelihoods have to be formulated in such a way as to ease access to resources and finances, strengthen market links, and promote sustainable practices. Firstly, enhanced financial support from micro-credit programmes and subsidised loans, thus allowing investments by SHG members, could extend to better processing units, branding, and marketing activities (Rao & Chatterjee, 2021). Government policies should do everything to help SHG members gain direct entry into the MFP markets by developing MFP marketplaces, e-commerce platforms, and cooperative marketing arrangements to reduce the level of exploitation by intermediaries.

Training programs in entrepreneurship and skill development must also find their way into policy frameworks, ensuring members are equipped with modern-day business techniques while still appreciating their traditional knowledge. Equally, an assured strengthening of legal systems relating to the protection of forest-based intellectual property, for example, GI tracking of indigenous MFP products, may also ensure better price and recognition of these products in the market for the SHGs. Furthermore, sustainability-enhancing policies will focus on community participation in forest management, ensuring that MFP extraction is made ecologically sound and economically beneficial to the SHG members in the long run. Overall, these recommendations will ensure that SHGs are engaged in more rural development and economic empowerment through MFP enterprises.

**6. Challenges in Scaling Up MFP-Based Livelihoods through SHGs:**

One more important sustainability issue is expanding MFP-based livelihoods through self-help groups. While MFPs indeed generate some income for rural and tribal communities, unsustainable practices of harvesting could easily lead to over-extraction, suffering the forest ecosystems and threatening biodiversity. A number of SHGs, concerned about immediate economic needs, may engage in the overharvesting of many resources: medicinal plants, honey, bamboo, and wild fruits. Therefore, the depletion of these forest products is a rampant problem (Sharma et al., 2022). As it stands, the primary reason for deforestation due to MFP exploitation is the absence of sustainable harvesting guidelines, which eventually endangers the livelihood of future generations depending on forest resources.

Thus, for the respective issues to be addressed, it becomes imperative to introduce conservation strategies within SHG-based MFP enterprises. Sustainable harvesting practices, community-based forest management, and upholding norms to protect biodiversity would help minimize environmental degradation (Kumar & Joshi, 2021). Such efforts could encourage SHGs to carry out agroforestry activities and seed indigenous species for replanting in support of long-term sustainability of MFPs. Training to SHGs in the sustainable management of the resources could also be promoted in partnership with the forest department, NGOs, and research institutions to help with the return to ecological balance and economic development.

SHGs creating MFP-based livelihoods are chiefly hindered in their growth by financial constraints. Numerous SHGs are unable to receive sufficient funding for product value addition, quality improvement, and packaging, as these are essential areas for improving product competitiveness in larger markets (Reddy & Verma, 2023). Their inability to obtain affordable credit in a timely manner, coupled with an absence of structured financing arrangements, restricts smooth operations. Even though microfinance institutions and government schemes do provide some respite, red tapes and extended approval processes delay the disbursal of funds under such schemes.

Another aspect aside from financial barriers is that agricultural producer groups often lack the technical knowledge of modern processing, branding, and promotion of MFP products. Many groups without skill promotion training are limited to selling raw produce at throwaway prices and forgoing the opportunities for value addition (Sarma & Deka, 2022). This is related to underdeveloped infrastructure, poor storage, lack of transport, and a very limited reach of electricity to the remote areas, which adds to the problems where SHGs were hardly able to process and then distribute their product. Such problems will require targeted investments into rural infrastructure and skill development as well as a better access to finance for SHGs to empower them to scale-up their enterprises.

Governance and socio-business culture followed by MFP-based enterprises SHG Ana constitute other barriers to growth and inclusiveness. These women, members of self-help groups (SHGs) crucial for forest-based livelihoods, are sometimes denied the right to participate in decision-making by traditional norms and power structures (Rao & Chakraborty, 2021). Asset ownership discrimination, mobility restriction constraints, and limited access to education and skill training further squeeze women from the entrepreneurs' arena, weakening SHGs' efforts to engender inclusivity.

Policies should follow suit by designing their interventions to promote women's leadership in SHG activities. Facilitating mixed SHGs with equal representation, stimulating financial incentives targeting women entrepreneurs, and running awareness programs on gender discrimination will further promote an inclusive ecosystem (Borah & Das, 2023). Henceforth, the road toward effective SHGs will go through sensitization of community members to counter the existing socio-cultural bias. Potentially, this will endow SHGs with capacities for economic empowerment and social transformation.

**7. Future Strategies for Enhancing SHG-Based MFP Livelihoods:**

It is an essential condition for productivity and market competitiveness that SHG-led enterprises incorporate the fruits of technology and innovation in Minor Forest Produce (MFP) processing. Conventional modes of processing limit the quality, shelf life, and competitiveness of the products in wider markets. MFP-based products value and their durability can be improved by adopting modern techniques such as solar drying, cold storage, mechanized grading, and environmentally friendly packaging (Sharma & Reddy, 2022). Digital platforms and mobile applications can also enhance market access by linking SHGs to buyers directly and reducing dependence on intermediaries.

This diversification of products is yet another aspect of viable livelihoods from MFP. Most SHGs do not harvest revenues as they mainly sell raw or minimally processed products from the forests. By motivating SHGs to venture into value-added products-herbal cosmetic, organic food supplements, and plant-based medicines-the profitability potential of the SHGs can be enhanced manifold (Kumar & Das, 2023). Training in food safety standards, branding, and sustainable packaging is essential for SHGs to penetrate niche markets such as the eco-conscious consumers and the wellness industry. Blockchain and traceability solutions add further quality to this by providing an even greater transparency and authenticity around the ethical sourcing of MFPs, thus ensuring superior pricing for these products.

Strengthening SHG networks and fostering collaboration with the private sector can augment the impact of MFP-based livelihoods. SHGs work in more or less isolated clusters and have little bargaining power in the supply chain. By federating and forming cooperatives, SHGs will achieve economies of scale, negotiate better prices, and streamline distribution channels (Rao & Chakraborty 2021). Networking with established cooperatives like those in the Van Dhan Vikas Kendra initiative can provide SHGs with technical assistance, capacity-building programmes, and financial linkages.

Another possibility for strengthening SHG enterprises would be collaboration with the private sector. Corporate partnerships through CSR (Corporate Social Responsibility) initiatives and social enterprises can provide financial investment, technology transfer, and market linkages to SHGs (Verma & Singh 2022). They can even directly buy MFPs from SHGs on a large scale through retail and e-commerce, giving them assured demand at fair prices. Incubation and business mentoring for SHGs will help them to build scalable models in rural areas, gain quality certification and enter the formal economy.

It is important to ensure that any livelihood model for SHG-led MFP enterprises creates an enduring socio-economic impact; therefore, sustainability must be at the core. Sustainable harvesting methods, community-based resource management, and participatory decision-making are crucial for the enduring viability of MFP-based livelihoods (Borah & Das, 2023). Examples of regenerative practices that can be promoted among SHGs include afforestation of keystone MFP species, efforts to conserve biodiversity, and developing guidelines for ethical sourcing so as to divert any threats of forest resources over-exploitation.

Moreover, integration of MFP livelihoods with eco-tourism and rural handicrafts can provide SHG members with alternative income-generating avenues. Eco-tourism models that are community-based will bring in earning opportunities through forest-based experiences, herbal product showcases, and conservation of cultural heritage while conserving the MFPs and involving the community in the traditional knowledge systems (Sarma & Deka, 2022). The SHGs should be supported by the government and the institution; develop policies that can help SHGs, set up infrastructure, and implement educational programs to enable them to become self-sustainable players. Empowering the SHGs will lead to them playing a vital role in moving toward building highly resilient communities existing through the forest sector by bringing together the best practices for ubiquitous economic, social, and environmental sustainability.

**8. Findings:**

1. **SHGs play a pivotal role in MFP-based livelihoods.** The SHGs empower most importantly the forest dependent communities by networking them to collective entrepreneurial endeavours in the MFP- processing, value addition and marketing.
2. **Economic empowerment by microfinance:** Enabling self-sustaining business models and easy access to micro finance, SHGs start, grow and stabilise their MFP enterprises thereby enhancing income and livelihood security.
3. **Capacity Building for Sustainability:** Training in sustainable harvesting and value addition techniques as well as marketing would help SHGs improve productivity and ensure the sustainability of livelihoods based on MFP.
4. **Market Access Remains Major Challenge:** Competitive market access is hindered by exploitation by middle men, no exposure to branding, and thin infrastructure for either processing or storage for SHGs.
5. **Government Schemes are Significant Support:** The much successful schemes include Van Dhan Yojana and others, which have financially benefited SHGs and given technical training for strengthening MFP-based business avenues and further market linkages.
6. **Technological Innovation Contributes to Value Addition:** Modern processing, new technology employed, digital marketing and all adopting and employing e-commerce help SHGs increase the quality of their products, diversify their portfolio, and reach out to many more consumers.
7. **SHG Enterprises Strengthened by Private Sector Collaborations:** Solicitations and partnerships with corporate massive metropole cooperatives or social enterprises cast a broad net over SHG investment and mentoring, as well as better access to micro and macro-level markets.
8. **Challenges Towards Growth of SHG-based Enterprises:** Lack of financial resources, limited technical capacity, poor infrastructure, and socio-cultural factors especially hinder the large-scale proliferation of MFP-related SHG initiatives.
9. **Sustainability and Biodiversity Conservation Needed:** Over-extraction of MFPs leads to depletion of the resource; SHGs thus need to practice sustainable harvesting and income generation modes from conservation.
10. **Need for a Holistic Policy Approach:** A well coalescing policy framework integrating monetary incentives, institutional partnerships, and skills development programs could enhance the role of SHGs in the MFP livelihoods linkages and empower communities in the long run.

## 9. Suggestions:

1. **Organize elaborate training programs:** The SHGs should be trained systematically so as to develop aspects of sustainable harvesting methods, value addition, branding, and digital marketing in MFPs.
2. **Strengthening the Financial Support System:** Microfinance, government subsidy, and soft loans should be easily accessed by the SHGs for their sustainable growth in MFP-based enterprises.
3. **Market Linkages and Fair Trade Practices:** Through cooperatives, e-commerce platforms, and procurement systems supported by the government, promote direct access to the markets for SHG-made MFP products at fair prices.
4. **Encourage Technology Transfer and Innovative Development:** Create an environment for supporting the adoption of modern processing methods, digital payment methods, and online marketing strategies to enhance competitiveness for SHGs.
5. **Promote Institutional Linkages:** Strengthen linkages between self-help groups (SHGs), government agencies, research institutions, and private enterprises to ensure better skill development, infrastructure, and marketing linkages.
6. **To Support Sustainable Resource Management:** Enjoy community-based conservation programs, to avoid unsafe harvesting, and eco-friendly harvesting practices of NTFPs.
7. **Improving Infrastructure and Logistics:** Build proper storage, cold chain, and transportation networks to minimize post-harvest losses and ensuring increased supply chain efficiency of the products of MFP.
8. **Encourage Gender-Responsive Strategies:** Enhance women's leadership in SHGs and extend targeted support to female entrepreneurs in the MFP-based enterprise for socio-economic empowerment.
9. **Support and Implementation of Policy at Scale:** Strengthen the implementation of existing government schemes such as Van Dhan Yojana and develop new ones that address the SHG-specific challenges in the MFP sector.
10. **Promotion of Sustainable Livelihood Models:** Develop sustainable strategies for SHG-based MFP enterprises that address conservation and rural development and economic sustainability.

## 10. Conclusion: The Way Forward for SHGs and MFP-Based Livelihoods:

In the MFP-based livelihoods scenario, the SHG plays a critical role in sustaining economic development and empowerment of communities in North East India. The SHGs provide access to finance while capacity-building and collective marketing opportunities act as agents for economic and social upliftment of rural and tribal people. However, there are several matters with the potential of SHGs, such as marketing accessibility, financial-related issues, policy concerns, and sustainability of resources. These matters need to be addressed in conjunction with all stakeholders including government, institutions, and private sector involvement. Enhancing SHG networks, developing the necessary infrastructure, and promoting sustainable harvesting practices will strongly support the viability of MFP-based enterprises. If endowed with proper interventions and strategic planning, SHGs can truly become a catalytic agent for the realization of Viksit Bharat @2047 goals of inclusive growth and sustainable livelihood for forest-dependent communities.

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# GENDER AND IDENTITY IN REGIONAL AND GLOBAL WRITING

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***Abstract***

*This research paper explores the gender and identity issues faced by Indian Society at different levels. I have considered African American writer Damon Galgat's The Promise to depict the same issues prevalent in African society where people went through social and mental separation and trauma due to looks and colour. Temsula Ao who is a leading North East writer has vividly pictured the gender and identity issues faced by Northeast people in India. Indian Society had seen social issues like patriarchal system, male dominance, women suppression and identity issues related with caste, creed and skin tone. There has been critical gender dynamics of male and female child. Regional language, Hindi and English Literatures in Indian perspective has always touched this emotion where there were disparities, deep issues of acceptance, social inequalities based on gender caste, creed, language, skin tone and feature. To state it is the same in African literature as well where these issues common people also faced which Damon Galgat pictures in The Promise. Geetanjali Shree Reit Samadhi draws the outline of the modern women who are educated and rejects the old established practised norms of society. She is the true emblem of educated Indian liberated women.*

*This research paper delves into the intricate gender issues in different social systems through writing, focusing on oeuvres of Geetanjali Shree Reit Samadhi, The Promise by Damon Galgat and Temsula Ao short stories of North east India.*

***Key Words**: - Gender, identity, social issues, inequalities, emotions.*

**Introduction:-** Experiences in human life play vital role in developing the thought process of human being. Writers web the world of stories with the experiences they met in their life. Writer's experience within the family and around social circle help them create and pen the character which we as reader associate with. Over the years we have witnessed a fast change in the social system from orthodox to modern rejuvenated and upgraded social milieu. Earlier women were considered only for household choruses. There were prohibited areas in society where people belonging to certain caste were not allowed. Certain customs were not allowed to be processed by the restricted communities.

Writer's experiences within the family or around them in the social circle. Over the years the social system has evolved from many orthodox to modern rejuvenated and upgraded social milieu where women are considered for many unconventional or prohibited area. The experiences of moder women have evolved in Indian socio-cultural landscape. Men also addressed the inequalities, contrast differential biased prejudices in their writings. From love for nature to culture, the writing got a new focus on human being especially the women who met the imbalances created by cultural roots, beliefs and practices.

The research analysis that I employed here is textual that is a qualitative approach to examine and interpret text and content. Through the writings gender and identity issues are analyzed prevailing in the society. The focus to examine is to highlight the issues prevalent in Indian as well as other country literature.

**Data Source**: Literary Texts and Novels are the primary data source which belong to both Indian English and American literature. A diverse range of texts has been carefully chosen to represent different gender and other contexts. The text considered here are *The Promise* by Damon Galgat, *Reit Samadhi* by Geetanjali Shree and Temula Ao and her short stories collections *These hills called Homes: Stories from War Zone.*

The new literature after independence in India shifted its focus from conventional themes to representation of women, feminism, gender intersectionality with caste and class, challenges to stereotypes, sexuality and identity, postcolonial perspectives, cross-cultural influences, homosexuality, gay, LGBTQ, honor killing and the dynamic interplay between language and identity.

Literature is the mirror of society and the writing also helped acknowledged the transformation needed for women. The focus was laid on understanding the women and the third gender also. This study also held me highlight common man's perception about third gender. This research lays emphasis on the regional language and dialects commonly accepted as a part of communications.

The study also highlights how literature has helped transformed societies perceptions of cross exchange of cultural ties. The study examines coordination and connections between relationships and cultural, language and identity. If to say literature acts and mediates as a tool for social changes

**Gender and Writings**: **-** Gender in Indian English literature represents identities, roles, responsibilities and interests. Male and female they are not only the matter of discussion in literature. LGBTQ, third gender are the new themes writers explore. I must admit that through literature acceptance to these two new genders or complex relations has become possible to shake away the Taboo the society was in. It was always a restricted prohibited concept to talk about. Now people do not feel shame or restricted in talking about queers or third genders.

*The Promise* by Damon Galgat is a story of unkept promise given by a *White to a Black* in Pretoria but fulfilment took almost 40 year to commence, exposing juxtaposition of inner and outer world of Africa. Its main plot is woven round a South African Family a Black woman Salome and a Promise. South Africans had diversity of cultures and religion. There were riffs and differences because of language, religion and belief. Nelson Mandela was anti-apartheid activist who fought for the blacks. The hatred for human being, racial difference Black and White, and religious contempt Jews and Christian can be felt. Apartheid is a symbol of oppression of Blacks. It confronts the racist history of native country, the period of apartheid and election of Nelson Mandela. After the leadership of nelson Mandela African started living freely and were given due access to every opportunity. Had this not been written, none would have ever come across the discrimination or the differences the Blacks or the Whites had. They were not accepted by the Whites because of the discriminations or hierarchy. They fought against all odds to live a sanctioned life. This novel reflects the oppressions the blacks met and the social boycotts whites gave to the blacks, even though the land belonged to the blacks still they went through.

The society was classified according under race, complexion, Black, Indians Coloured and Whites and many more. The whites were mostly the descendants from the Dutch's and settled in Africa. The Whites made themselves the superiors. Millions were forcefully removed from homes and restricted and confined to their Tribal homelands. Blacks were not allowed to participate in elections, politics and even higher studies. Because of these restrictions internal resistances grew amongst these groups. After the long Liberation struggle with protest their leader Nelson Mandela was released from prison in 1990 to ease and pacify the restlessness.

*"I have fought against white domination and I have fought against black domination"*

*Nelson Mandela*

The crisis did not end here. This novel has many aspects of psychological, social and financial disparities. Psychological complexes expose the emotions and distraught characters their normal and abnormal behaviour in different situations who are replicating humans of apartheid. There were religious outrages as well Christians over Jews. '*Jesus is only a metaphor'* under these circumstances '*A Christian never goes back to world'* ,this is how Marina Pa's sister expresses her hatred for Ma, Rachel ,Christianity Salome and Blacks. She is '*adept at pouring oily phrases on to turbulent depths that threatens to spill over* .For her Rachel "*will always be in past tense now* ". She always voiced her hatred for Rachel for being a Jews.

Geetanjali Shree in The Reit Samadhi pictures many set of females. Ma Chandra Prabha Devi a life less mother is shown as lying on the bed. She revisits her past and she opened her heart and the most hidden secret for years. Rosy Bua a eunuch whom her Bahu never liked much, her Beti welcomed her for her mother's sake. Rosie Bua brought the joy, happiness, and the light in Ma's life which had forgotten after her husband's death. In the company of Rosie Bua, she became cheerful and looked back in her life which had lost essence. Bahu bete's wife is a typical Indian women who is happy in her gossips and her web which is self-centred and she is jealous of her sister in law, Beti as she is a freebee, living a life of luxury and freedom away with KK her boyfriend. In this novel the writer has given a vivid description of Indian Family where the boys hold the authority. Her son who is always called as Bete is a govt employee and he reserves the right to decide the will for the family. Beti left her Ma's house in pursuit of life ahead the governance of her brother and she preferred living with KK in live in rather than marrying a man and become subject of his will like her sister in law is doing. This pictures a challenge a women face who tries not to follow the set norms of social system and that discriminatory voice or criticism to break the stereotype rises within the family. Beti preferred modern open ways of living over the traditional and complex web. There were complexities in adjustments with Ma and Rosy Bua's ways of thinking and living but she accepted open heartedly as she new it was a phase of life that would also subside once she recovers. Here literature reflects the cross roots of complexities that people created out of jealousy and inabilities to understand the new forms. This novel in Hindi reflects the attitude of society for the genders and the ways of language. In North Indian families usually do not call sons with the names they are mostly named as bhaiya, bade, bete, bhai or so. Here also in novel his name is never taken except Bete or Saheb as he is a govt employee.

The next writer I have researched for my research article is Temsula Ao and her love for the Northeast. She is one of the voices from Northeast who gave us a deep understanding about the life and the complexities people face due to geographical, facial and racial differences. Northeast is geographically beautiful and tough region not only this the life here is way different from others because of their different looks and tribal customs. Even after 7 decades people of this region find it difficult to get acceptance in other parts of India. Because of their looks like Mongols they are made to feel different. This area is one that is surrounded by natural beauties and the tribals. They are rich in their cultural traits and heritage and restore and practise their traditions. They live in hills or in remote areas. Life in these hilly areas depend on many geographical conditions. Society is also not fully organised. There is an impact of Christianity Buddhism Islam and Indo Mongoloid stocks. Incredible natural beauty, cultural diversity, tribal distinctions, racism, patriarchal system and neglection by the outer world all these were the realties. The women of this area face a variety of problems ranging from minor to major and these incidents were the real teachers to teach them the lessons of life. They behave differently in different situations. Their behaviour is influenced by many factors some are biological and some are social in nature.

In one of the collections of the short stories **These hills called Homes: Stories from War Zone**, *The Jungle Major* opens with the love making of the Punaba and Khatila two different people of two different world, tied together in the eternal ties of marriage. Khatila a tall fair and slim and girl with most charming smile is married to Punaba a short dark and buck teeth driver who belongs to minor clan in the village. She belonged to upper educated class where as Punaba has no such family background. Here also male dominant society is shown where is women are hardly considered.

To sum up we can say that by going through all these writings gender representation in Indian writings is now a matter of interest where women and their life is reflected , social attitude for their identities is highlighted .

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# TESTIMONY OF SPACES IN SALMAN RUSHDIE'S WRITINGS

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***Abstract***

*This study explores the fundamental significance of space in Salman Rushdie's writings, emphasizing how spatial concepts are vital for understanding contemporary social realities. The study looks at how Rushdie's works' intellectual, psychological, and physical settings impact people's identities and experiences. He illuminates the ongoing processes of cultural appropriation, displacement, and belonging in a globalized culture through his depictions of fractured geographies, forced migrations, and diasporic circumstances. These spatial aspects serve as story settings and dynamic venues for contesting and redefining meanings, reflecting modernity's complex issues.*

*The study explores how Rushdie's depictions of space interact with more general concerns of power, ideology, and resistance by drawing on the spatial theories of Henri Lefebvre, Edward Soja, and Michel Foucault. The examination shows how his writings highlight colonial and postcolonial systems of marginalization, exclusion, hybridization, and cultural negotiation. The study contends that Rushdie's fiction provides a rich 'testimony of space', a narrative technique that articulates the intricacies of identity, power, and cultural hybridity in a constantly changing global landscape, emphasizing the spatial dynamics buried in historical and political confrontations.*

***Keywords**: Space theory, psychological locations, colonialism, postcolonialism, marginalization, etc.*

## Introduction:

The interplay of place, identity, and culture has deeply influenced Salman Rushdie's writings. His narratives are characterized by fragmented geographies, shifting borders, and transnational movements that mirror the complexities of postcolonial cultures. In Rushdie's fictional worlds, space is never a passive backdrop; it is an active agent in the construction of meaning, identity, and power. Whether through the dislocated urban centers of *Midnight's Children*, the surreal landscapes of *The Satanic Verses*, or the diasporic tensions in *Shame*, Rushdie presents space as deeply symbolic and politically charged. His treatment of space transcends physical geography to include emotional, cultural, and ideological terrains, revealing the layered ways in which people experience location, exile, and belonging in a globalized world.

The concept of space in Rushdie's work resonates with the spatial theories of Henri Lefebvre, Edward Soja, and Michel Foucault, all of whom argue that space is socially produced and ideologically inscribed. Rushdie's fictional spaces become sites of struggle where colonial legacies, nationalist ideologies, and global diasporas intersect. His characters often navigate liminal zones between nations, cultures, and identities, highlighting the tensions and possibilities within hybrid and contested spaces. This spatial dynamism allows Rushdie to interrogate power structures, challenge cultural essentialism, and explore themes of marginalization, resistance, and transformation. Through a careful examination of these spatial dimensions, this study seeks to uncover how Rushdie uses space not only as a narrative device but also as a critical lens to engage with the enduring complexities of postcolonial modernity.

**Objectives of the study:**

1. To investigate the significance of spatial representation in Salman Rushdie's works, including how physical, metaphorical, and psychological places impact characters' identities and experiences.

2. To examine how Rushdie's novels address issues of displacement, migration, and diaspora, as well as how these geographical movements contribute to larger postcolonial discourses about belonging and alienation.
3. To investigate the confluence of space, power, ideology, and resistance using the theoretical frameworks of Henri Lefebvre, Edward Soja, and Michel Foucault.
4. To look at how Rushdie's depiction of fractured geographies and hybrid places challenges colonial and postcolonial frameworks, exposing the disputed nature of identity and cultural authenticity.
5. To analyze Rushdie's spatial imagination as a narrative device, showing how space serves as a witness to historical tragedy, cultural negotiation, and the complexities of contemporary global reality.

**Methodology:**

The research uses a qualitative and interpretive literary analysis method, drawing on theoretical frameworks from postcolonial and spatial studies, as well as attentive textual reading. The method involves a critical examination of several of Salman Rushdie's books, including The Satanic Verses, Shame, Midnight's Children, and The Moor's Last Sigh, to identify and investigate how multiple spatial dimensions, physical, metaphorical, and psychological, function in his works. These works will be investigated to see how Rushdie constructs, destroys, and reinterprets spaces related to identity, belonging, displacement, and power.

The spatial theories of Michel Foucault (heterotopias and specialized power), Edward Soja (thirdspace and spatial justice), and Henri Lefebvre (the production of space) will all have an impact on the study. The sociopolitical uses of space in Rushdie's works will be decoded using their concepts. Additionally, postcolonial theory—particularly the works of Edward Said and Homi K. Bhabha will improve research on colonial legacies, cultural negotiations, and geographical hybridity. The contextual and theoretical framework will be enhanced with secondary materials, including academic articles, critical essays, and relevant literary criticisms. We will be better able to understand how Rushdie's novels' spatial arrangements represent postcolonial tensions and global modernity thanks to this multidisciplinary and textual approach.

**Discussion:**

This paper explores how space in Salman Rushdie's novels is not merely a passive backdrop but a socially produced and actively constructed entity, shaped through interactions between individuals, cultures, and power structures. In Rushdie's narratives, space is dynamic and constantly evolving, reflecting the complex social realities of postcolonial and immigrant experiences. Characters engage with their environments in ways that both reinforce and challenge existing social orders, often transgressing physical and metaphorical boundaries. This transgression of space allows for the questioning of dominant ideologies and offers new possibilities for identity formation and cultural negotiation.

The study also delves into marginalized spaces and liminal spaces within Rushdie's fiction, highlighting how these zones enable the emergence of hybridity in immigrant communities. Marginalized spaces, those pushed to the periphery by social, political, or cultural exclusion, become sites of resistance and redefinition for characters who grapple with displacement and alienation. Liminal spaces, on the other hand, function as transitional zones where cultural boundaries blur, allowing hybrid identities to flourish. By examining these spatial constructs, the paper reveals how Rushdie's works provide a nuanced understanding of the immigrant condition, illustrating how individuals navigate between worlds, forge new identities, and challenge traditional notions of belonging and home.

**Space Theory at A Glance:**

Space and time are two of the most fundamental elements influencing human perception, yet time has historically taken precedence over space in narratives and philosophical thinking, owing primarily to historicism, which emphasizes temporal movement, linear development, and chronological occurrences. This prioritization has frequently resulted in a relative disregard of space in the social imaginary. However, contemporary theoretical studies by philosophers such as Henri Lefebvre, Michel Foucault, and Edward Soja have refocused emphasis on space, specifically geographic contextualization and its social construction, representation, and control in connection to power. These spatial theories investigate how geography impacts government, societal behavior, and power dynamics, highlighting the importance of physical settings in influencing human experiences. Furthermore, the politics of space, particularly in times of global tension and societal change, show how cartographic borders and territorial disputes are inextricably linked to geopolitical conflicts, cultural revolution, and evolving social connections.

**Spatial Imperative in Rushdie's Novels**:

In addition, this essay uses a "spatial imperative" as a critical framework to analyze how space functions in Salman Rushdie's books, namely 'The Enchantress of Florence', 'The Satanic Verses', The Moor's Last Sigh', and 'Midnight's Children'. Themes of identity, migration, history, and memory are all intimately woven throughout these pieces, and they are all rooted in spatial experiences. The research shows how Rushdie's stories reflect and critique larger socio-political and cultural realities by examining how he creates and depicts actual and fictional settings. The study examines a variety of geographical constructions, including lived, othered, and liminal places, drawing on interdisciplinary spatial theories by Henri Lefebvre, Michel Foucault, and Edward Soja. Each of these constructs sheds light on how displaced people fight marginalisation and negotiate hybrid identities. The approach emphasizes Rushdie's representation of postcolonial and diasporic existence by framing place as dynamic 'scapes' affected by memory, mobility, and globalization. Through this geographical lens, Rushdie's fiction stands out as a stunning testament to the modern world's fluid, disputed, and sometimes shattered character of belonging and cultural identity.

**Spatial Shift in Literary Criticism**:

Literary criticism has increasingly embraced the spatial shift, which acknowledges place as an active element in influencing story, character, and theme. This movement, motivated mostly by Marxist theory in the 1980s, emphasizes how spatial arrangements reflect power systems, class divides, and ideological domination. Space in literature is today regarded as socially created and symbolically laden, exhibiting patterns of inclusion, exclusion, and opposition. Critics get a better understanding of cultural identity, social relationships, and the material realities that support literary works by examining how space is portrayed and experienced.

**Theoretical Concepts: Heterotopia:**

According to Michel Foucault, "other places" are "real but symbolically charged spaces of disruption, reflection, or difference" that exist both inside and outside of social norms. These include graves, jails, ships, and gardens, each of which represents a different interplay between imagination and reality. Foucault divides heterotopias into categories that reflect and subvert prevailing social structures, including crisis spaces, spaces of deviation, and spaces of illusion or compensation. Heterotopias become essential tools for comprehending how marginalized groups construct places of resistance and hybrid identity in multicultural urban environments, illuminating the relationship between power, space, and cultural diversity.

**Theoretical Concepts: Third Space:**

Building on the ideas of Henri Lefebvre and Michel Foucault, Edward Soja's theory of Third Space provides a dynamic view of space that transcends the distinction between the conceptual (second space) and physical (first space) domains. Third Space embraces contradiction, hybridity, and the interaction of power, culture, and identity while fusing imagined possibilities, lived experiences, and physical realities. It shows how human interaction, memory, and imagination continuously modify place. In line with Homi Bhabha's theories on cultural hybridity, Soja's Third Space becomes a space for negotiation and change where underrepresented voices may gain traction and new, hybrid identities can take shape.

**Review on Space in Rushdie's Novels:**

Many scholars have examined the concept of space in Salman Rushdie's works, applying a range of theoretical frameworks to illuminate the spatial dynamics in his works. For instance, Roy and Roy analyze how Rushdie's characters navigate cities, challenging established power structures and creating new meanings through everyday movements, particularly about migration and displacement, using Michel de Certeau's concept of "Walking in the City." Cristina Sandru emphasizes the value of creativity and imagination, arguing that Rushdie's use of magical realism and mythology creates a "third in-between space," which is consistent with Homi Bhabha's concept of cultural hybridity, in which boundaries between cultures dissolve and hybrid identities emerge.

In her analysis of post-independence Indian literature by diasporic authors, Ananya Jahanara Kabir Datta shows how Rushdie's spatial representations reframe conversations about national identity, cultural memory, and historical consciousness while addressing themes of displacement and transnationalism. Future study expands on these ideas by looking at how gender, migration, and globalization interact with spatial dynamics in Rushdie's works. Sarah Upstone examines how Rushdie creates re-created spaces where power and gender roles are renegotiated to defy colonial patriarchal spatial constraints. Frederik Tygstrup focuses on immigrant experiences, highlighting how individuals navigate transitional spaces that reveal tensions between hybridity and displacement. Roy also explores various international contexts in Rushdie's writing, emphasizing adaptable, transnational identities that transcend strict notions of place. Scholars such as Thiara and Ozturk-Yagci analyze how Rushdie's works deal with cultural hybridity, geographical constructs, and the evolving notion of "home," particularly in historical and postcolonial contexts. Collectively, these approaches help us better understand how Rushdie explores place, identity, and hybridity in his literary work.

**Rushdie's Novels and Spatial Analysis:**

Numerous academics have studied the function of space in Salman Rushdie's books, emphasizing how different locales influence history, identity, and cultural hybridity. To depict issues of migration, displacement, and transition, his stories frequently conflate real and fictional settings. Scholars examine how Rushdie creates physical, psychological, and symbolic places to examine topics like colonialism, nationalism, and exile by approaching these spatial dynamics from historical, political, and cultural viewpoints. For instance, Midnight's Children depicts national fragmentation and the effects of political turmoil on individuals by mirroring the journey from British colonial control to independence and Partition through changing geographical locations, from colonial Bombay to recently independent India and Pakistan.

Similar to this, The Satanic Verses emphasizes themes of alienation, exile, and cultural hybridity through characters like Saladin Chamcha by using geographical metaphors to depict the experience of immigrants in London. By fusing real and imaginary places, Rushdie's subsequent books like The Moor's Last Sigh and The Enchantress of Florence continue this spatial complexity by challenging colonial legacies, family histories, and East-West cross-cultural interactions. A landmark postcolonial work, Midnight's Children offers a profound commentary on India's independence and the painful Partition of 1947 by fusing personal and national histories. Independence is portrayed in the book as both liberating and fragmenting, encapsulating the psychological and geopolitical upheavals that people like the protagonist, Saleem Sinai, go through as their identity is symbolically linked to the destiny of the country. Rushdie examines the religious tensions and communal violence that arose after Partition in great detail, considering how these influenced both individual and community identities. The novel's portrayal of Partition as a catastrophe creating new mental and physical borders is emphasized by academics such as Homi Bhabha and Gyanendra Pandey. Midnight's Children has received critical acclaim for its inventive fusion of historical fiction, magical realism, and postmodern narrative approaches. It has won prestigious accolades like the Booker Prize and solidified its enduring influence on literary and postcolonial studies.

**Destruction, Homicide, and Displacement:**

More than 15 million people were forced from their homes as a result of the partition, which caused widespread bloodshed and intercommunal riots, making it one of the biggest mass migrations in history. Because entire villages were destroyed and families were split apart, the magnitude of the devastation produced a feeling of instability and insecurity. According to Yasmin Khan, the Partition was a "human catastrophe, with bodies littering train stations and streets" in addition to being a political split (The Great Partition: The Making of India and Pakistan 94). Through Saleem's experiences, Rushdie dramatizes this turbulence in Midnight's Children, demonstrating how his family and identity were shattered by the geopolitical upheaval.

**Themes of Betrayal, Loss, and Hatred:**

Rushdie's novel captures the **emotional and psychological toll** of the Partition by depicting **grief, betrayal, and enmity** among its characters. The violent separation of India and Pakistan is reflected in the **fractured relationships, personal betrayals, and deaths** that Saleem witnesses throughout his life. His narrative serves as an allegory for the broader suffering of the Indian subcontinent. Timothy Brennan suggests that Rushdie's work **"turns national history into personal trauma, where the wounds of Partition manifest as broken families, lost identities, and unresolved grief"** (Salman Rushdie and the Third World: Myths of the Nation). Saleem's deteriorating memory and body serve as metaphors for the disintegration of **post-Partition India**.

Through its **historical depth and personal storytelling**, Midnight's Children encapsulates the **trauma and disillusionment** that followed Partition, offering a poignant critique of **violence, loss, and the challenges of national identity**.

**Space, Global Tensions, and Social Issues in Rushdie's Works:**

In Salman Rushdie's novels, space emerges as a central theme through which ideological conflicts and sociopolitical struggles are articulated. His work explores how the contestation and control of space, particularly in postcolonial contexts, lead to exclusion, marginalization, and displacement. Drawing on Edward Said's assertion that no one is beyond the struggle over geography, *Midnight's Children* illustrates this through the violent reshaping of space during the partition of India, disrupting characters' identities and sense of belonging. Similarly, Rushdie reveals that space is not merely physical but profoundly cultural and political. As Homi Bhabha's concept of hybridity suggests, characters like

Saladin Chamcha in *The Satanic Verses* inhabit “third spaces,” navigating fractured identities and cultural alienation in diasporic settings.

The social production and globalization of space further deepen the thematic complexity in Rushdie’s fiction. Influenced by Henri Lefebvre’s theory that space is shaped by societal forces, Rushdie presents cities like Bombay in *The Moor’s Last Sigh* as layered sites of historical, colonial, and economic influence. Globalization introduces new dynamics, as Arjun Appadurai notes, creating fluid cultural landscapes and hybrid identities. In *The Enchantress of Florence*, the interweaving of Mughal India and Renaissance Florence exemplifies these global interconnections. Through such portrayals, Rushdie not only reflects spatial tensions but also uses them as a lens to examine identity, power, and cultural negotiation in a rapidly globalizing world, urging readers to reconsider how space structures human experience and social inequalities.

**Conclusion:**

The works of Salman Rushdie are a powerful testament to the complex structure of space, showing how identity, power, and resistance both influence and are influenced by it. The spatial aspects of postcolonialism, migration, and globalization are highlighted in his literature, which portrays space as a place of both alienation and belonging. Rushdie examines how people and societies traverse fractured worlds through the shifting of characters, disputed geographies, and the layering of historical and cultural landscapes. These places reflect larger social and ideological conflicts because they are liminal, hybrid, and frequently politically fraught. A rewriting of historical narratives and cultural identities is made possible by his use of magical realism, which intensifies the instability and fluidity of space.

This study has shown that Rushdie’s depiction of space goes beyond the physical world and becomes a crucial instrument for examining the connections between memory, history, and power by interacting with theoretical viewpoints from Edward Said, Homi Bhabha, Henri Lefebvre, and Arjun Appadurai. In his works, cities, borders, and imagined landscapes are dynamic constructions that highlight the conflicts of postcolonial and globalized life rather than static locations. In the end, Rushdie’s spatial narratives force readers to reconsider place politics and the lived experiences of people who dwell in marginal or transitional areas. In addition to attesting to the social construction of space, his fiction affirms the timeless value of spatial experience in comprehending cultural change and human activity.

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# DIGITAL DISRUPTION IN RURAL MARKETS: ASSESSING THE SOCIO-ECONOMIC IMPACT OF ONLINE SHOPPING ON LOCAL RETAILERS IN NAMSAI, ARUNACHAL PRADESH

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**_Abstract_**

*Digital disruption refers to the transformation that occurs when digital innovations-like online shopping, mobile apps or digital payments system challenge and often replace traditional ways of doing business. The growth of online shopping has transformed the retail landscape globally and locally. This study investigates the socio-economic effects of digital disruption on local retailers in Namsai, Arunachal Pradesh, focusing on the rise of online shopping. Utilizing a mixed-methods approach including surveys to assess changes in sales patterns, interviews and secondary data analysis, the research explores how e-commerce influences consumer behaviour, retail operations or shopkeeper revenues alongside personal experiences, coping mechanisms and perceptions of market changes. Through data collection it is found that many local shopkeepers have experienced a decline in sales, attributed to the convenience, variety and competitive pricing offered by online retailers. Findings reveal a complex interplay between opportunities for growth and challenges related to digital literacy, infrastructure and market access. The study underscores the need for inclusive digital strategies to support local retailers in adapting to the evolving marketplace.*

***Key words:*** *E-Commerce, Online Shopping, Local retailers, Digital disruption, Socio-economic impact*

## Introduction

In the past decade, online shopping has grown rapidly, becoming a major part of the global economy. Platforms like Amazon, Flipkart and others have made it possible for consumers to purchase almost anything from the comfort of their homes. This growth has been driven by increasing internet access, digital payment options, and the convenience of home delivery (KPMG, 2020; Statista, 2023). While online shopping offers many benefits to consumers, it has brought serious economic challenges for local shopkeepers (NASSCOM, 2021).

One of the most noticeable impacts is the decline in foot traffic to traditional stores. As more people shop online, fewer customers visit local markets and small retail stores. This leads to a drop in daily sales and, over time, can result in businesses shutting down. Many local shopkeepers, especially those who run family-owned stores, cannot compete with the deep discounts and wide product range offered by large online platforms (FICCI, 2022).

Moreover, online retailers often have the advantage of lower operating costs. They don’t need to maintain expensive storefronts or employ as many staff, which allows them to sell goods at cheaper prices. Local shopkeepers on the other hand have to cover rent, electricity and salaries, making it difficult for them to match online prices (Deloitte, 2021).

The economic impact is not just limited to individual shopkeepers. When small businesses close, local economies suffer. There are fewer job opportunities, especially for people who rely on retail work for a living. Local governments may also see a drop in tax revenue which can affect public services.

Additionally, the loss of small shops can hurt the social fabric of communities as these businesses often play a key role in building personal relationships and local identity (World Bank, 2020; Sharma & Gupta, 2023).

The advent of e-commerce has transformed retail landscapes globally with rural markets in India experiencing significant shifts. Namsai district in Arunachal Pradesh exemplifies this transition where traditional retail practices intersect with emerging digital platforms. This study aims to assess the socio-economic impact of online shopping on local retailers in Namsai exploring both the challenges and opportunities presented by digital disruption.

**Objectives of the study:** The objectives of the current study are as follows:

- To examine the impact of online shopping on local shopkeepers.
- To investigate the growth and trends of online shopping in the district.
- To identify the key challenges faced by local shopkeepers due to online shopping.

**Literature Review**

S. Schiffling et al. (2015) in their article, "Local shops vs. Online retailers: Competition or Synergy", the study found that local shops on Scottish islands are vital for communities, particularly elderly residents due to their close connection and ability to respond to demand. The research explores the issues, stores in Scottish small island communities face due to the residents' increased opportunities for 'virtual mobility' and highlights strategies for their economically sustainable operation. Elevated transport costs and lack of economies of scale lead to high prices for local shops making it challenging to compete with online retailers.

Lim et al. (2016) in their article, "Factors Influencing Online Shopping Behavior: The Mediating Role of Purchase Intention" explored the factors influencing online shopping behavior among Malaysian university students, focusing on subjective norms, perceived usefulness and purchase intention. The study found that while subjective norm and perceived usefulness significantly impacted purchase intention, only purchase intention had a strong, direct influence on actual shopping behavior. The findings support the need for e-commerce platforms to improve user experience, trust and promotional strategies to attract and retain customers, especially in culturally conservative markets like Malaysia.

Siyuan Fan (2021) in her article, "Analysis on the Impact of Shopping Online on the Real Economy" she stated that the main reasons for consumers choosing online shopping is that consumers have more choices of products. In addition, they can shop at any time and any place and they can save time and money. The study also found that the low-cost advantage of online stores makes small and medium-sized enterprises face the risk of bankruptcy, thus discouraging the enthusiasm of entrepreneurship leading to a decrease in the demand for physical stores.

Hyunbae Chun et al (2023) in their article, "E-commerce and local labor markets: Is the "Retail Apocalypse" near?", the research state that the rapid growth of e-commerce is widely blamed for job losses in brick-and-mortar retail. The study found that the rise in the share of online spending from 2010 to 2015 decreased county-level retail employment by about 4.9 percent. The study also found that employment shifted from offline retail to other local businesses, such as restaurants and personal services. Thus, the rapid growth of e-commerce has dramatically changed the modern retail sector over the last few decades.

Asikni Garodia (2024) in her article, "The Economic Impact of Online Fashion Portals on Brick-and-Mortal Retail in India", the study found that online shopping has become an attractive option for consumers, particularly in the fashion sector. This shift poses challenges for physical stores, affecting their revenue, customer footfall and market share. The convenience and accessibility of online shopping has given rise to industry giants such as Myntra, Ajio and Flipkart Fashion etc. who have capitalized on the widespread smartphone and internet adoption in the country. The study also found that COVID-19 pandemic has been credited for the surge with online sales growing by more than 30% (Ministry of Commerce, 2023).

Saksham Lamba and Dr. Priyanka Gupta (2024) in their article, "Impact of E-Shopping on Small Businesses", the study found that online platforms allow small businesses a more cost-effective way to display their goods and offerings than expensive brick-and-mortar stores. It is also found that online marketing affect on small businesses, obstacles to success and practical suggestions for assisting small firms in thriving in an increasingly digital economy is desperately needed. This study aims to give small businesses with actionable insights and practical advice, a guidance to improve the impact of their online marketing efforts and prosper in an increasingly digitally centric business climate by getting a deeper awareness of these problems.

K K Ramachandra and K K Karthick (2019) in their article, "Effect of Online Shopping in Local Market of India", the study found that online shopping has made easy way of shopping for each person in India. It is very convenient to all from doorstep delivery to great exchange return policies. The study also found that the largest consumers of online shopping are people who do not live in big cities and have no access to malls or proper showrooms. Online shopping works boon for them and also it saves their time. Online shopping has shown negative impact on the local market of India. Therefore, further study needs to be continued to find of good solutions for the retailers or local shopkeepers of India.

Dr Rekha Joshi and Aditi Sahni (2022) in their article, "Impact of Online Shopping on Retail Business: With Special Reference to Haldwani city in Nainital District of Uttarakhand", the study found that the online shopping has led to a decline in sales for traditional brick-and-mortar stores with many consumers preferring the convenience and competitive prices offered by e-commerce platforms. Local retailers face significant challenges in competing with online retailers, citing issues with pricing, product variety and delivery times. The lack of digital literacy among traditional retailers hinders their ability to adapt to online shopping trends.

Shetty and Soujanya (2021) in their article, "Impact of Online Shopping on Retail Business: A Study with Reference to Udupi District", the researcher explored the impact of online shopping on traditional retail businesses in Udupi, highlighting how the rise of e-commerce has led to reduced foot traffic and sales in offline stores. The study found that while e-stores attract consumers with discounts and variety, retail stores still play a vital role in local economies. The findings suggest that integrating online platforms with physical stores and improving customer trust are key to sustaining retail growth in India.

Chandrakhanthan et al. (2021) in their article, "Impact of Online Shopping on Retail Stores", the study found that online shopping offers customers convenience, competitive pricing and a wider range of products, significantly affecting foot traffic in physical stores. The research also outlined the benefits of e-commerce for businesses, such as lower operational costs and global reach and noted the challenges faced by small retailers in competing with online giants. The authors suggest that both online and offline retail sectors can coexist by embracing digital transformation.

**Methodology**

A mixed-methods approach was employed combining both quantitative surveys with qualitative interviews. Survey was conducted with 100 local retailers in Namsai to gather data on sales trends, customer demographics and digital engagement. In-depth interviews with 20 retailers provided insights into personal experiences and perceptions regarding e-commerce. Secondary data from government reports, articles, journals and academic studies supplemented primary data.

**Result and Discussion**

The collected data from 100 respondents were analyzed to meet the objectives of the research by using tables and diagrams to understand about the rise of online shopping and its economic impact on the local shopkeepers. The results of the research are discussed below:

***Impact on online shopping on sales:*** The diagram shows how online shopping sales have been affected over time, highlighting key trends and changes in consumer behavior.


The data clearly indicates that online shopping sales have experienced a notable impact with the majority of respondents 49% acknowledging moderate effects. A smaller portion 29% reported a low impact while only 22% observed a very low impact. This suggest that online shopping continues to be a significant trend through the extend of its impact varies among users.

***Product types preferred online:*** The rise of e-commerce has shifted consumer shopping habits with various products being preferred online. This table highlights the most commonly preferred product types for online shopping, reflecting consumer buying trends'

| Sl. No. | Product Types Preferred Online | No. of Respondent | Percentage |
|---|---|---|---|
| 1 | Electronics and Gadgets | 4 | 4% |
| 2 | Clothing and Accessories | 92 | 92% |
| 3 | Other | 4 | 4% |
| | Total | 100 | 100 |

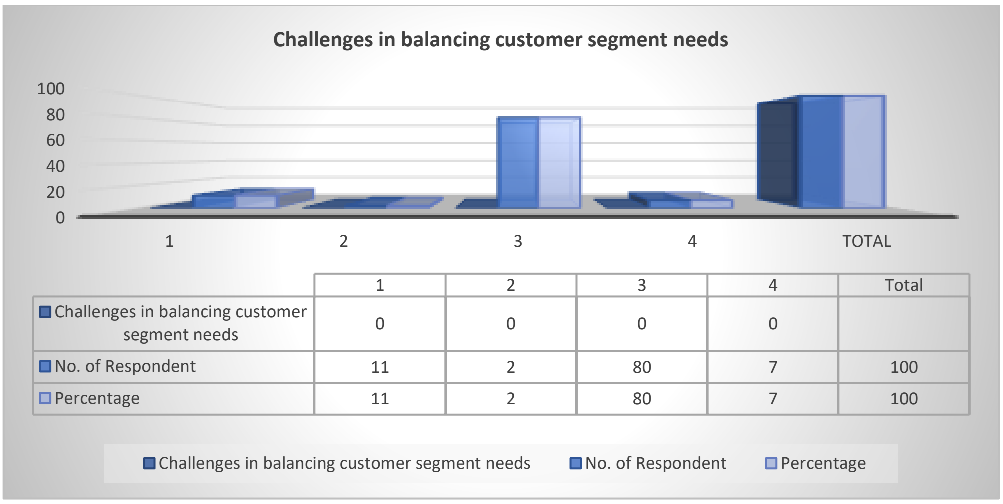
The chart shows that a vast majority of respondent 92% prefer a specific product like clothing and accessories when shopping online while 4% prefer for electronics and gadgets and others respectively. This highlights a strong consumer preference for certain product types in the online market, indicating focused demand in particular areas.

***Challenges Faced by Local Businesses:*** Local businesses face various challenges in today's competitive market, including adapting to changing consumer behaviors and technological advancements. The table below is the issues commonly encountered by local businesses:

| Sl. No. | Challenges Faced by Local Businesses | No. of Respondent | Percentage |
|---|---|---|---|
| 1 | Pricing | 88 | 88% |
| 2 | Convenience | 3 | 3% |
| 3 | Product Variety | 8 | 8% |
| 4 | Other | 1 | 1% |
| | Total | 100 | 100 |

The result shows the challenges faced by local businesses with majority 88% identifying a single significant challenge. The data suggests that local businesses are primarily concerned with one key issue i.e., pricing. This indicates a consensus among local businesses regarding the most pressing challenge they face.

***Challenges in balancing customer segment needs:*** Local businesses struggle to balance the needs of different customer segments requiring them to adapt to diverse preferences and expectations. The graph below outlines some of the key challenges businesses face in balancing customer segment needs.




| | 1 | 2 | 3 | 4 | Total |
|---|---|---|---|---|---|
| Challenges in balancing customer segment needs | 0 | 0 | 0 | 0 | |
| No. of Respondent | 11 | 2 | 80 | 7 | 100 |
| Percentage | 11 | 2 | 80 | 7 | 100 |

The data reveals that the most significant challenge faced by businesses is managing customer expectations and feedback as indicated by 80% of respondents. This suggests that while other issues such as catering to both online and offline customers and adapting to evolving trends are relevant, aligning with customer expectations remains the most pressing concern. Addressing this challenge effectively is crucial for businesses aiming to deliver consistent and satisfying customer experiences across different segments.

***Challenges faced by local shopkeepers due to online shopping:*** Local shopkeepers face significant challenges due to rise of online shopping including reduced sales and increased competition. The table below highlights the issues they face in competing with e-commerce

| Sl. No. | Challenges | No. of Respondent | Percentage |
|---|---|---|---|
| 1 | Limited customer | 35 | 35% |
| 2 | Increased competition on price | 15 | 15% |
| 3 | Not enough knowledge about e-commerce | 44 | 44% |
| 4 | Other | 6 | 6% |
| | Total | 100 | 100 |

The primary challenges faced by local shopkeepers due to online shopping are limited customers 35% and lack of knowledge about e-commerce 44%. These two factors combined account for 79% of the total challenges, highlighting their significance in the impact of online shopping on local businesses.

***Opportunities for Local Businesses in Future Retail:*** The evolving retail landscape presents local businesses with exciting opportunities to innovate, adapt and thrive in the future of retail. The table shows key opportunities local businesses see in the future retail landscape, based on survey responses.


The chart highlights that building strong relationships with customers and the community is the most significant opportunity for local businesses in future retail accounting for 88% 0f the total opportunities.

***Strategies to retain customers:*** Local businesses can implement strategies such as creating a digital presence, offering discounts and deals, personalized service and community engagement to retain customers and maintain a competitive edge. Given below graph shows the strategies to retain customers


The data highlights by 69% focusing on customer service and loyalty, businesses can significantly increase customer retention rates. While offering discounts and deals 23%, improving store experience 7% and 1% creating a digital presence are also relevant strategies. Businesses seeking to improve customer retention should prioritize this key strategy to drive long-term growth and success.

**Finding of the study:** From the study conducted the researcher drew the following major findings:

- Digital Literacy: Many retailers lack the skills to effectively utilize digital tools, hindering online engagement.
- Infrastructure: Inconsistent internet connectivity and limited access to digital devices impede e-commerce participation.
- Trust and Security: Concerns about online payment security and fraud deter both retailers and consumers.
- Risk Marginalization: Digital platforms offer avenues for business expansion; they also exacerbate existing disparities among retailers. Those with access to resources and digital skills benefit, while others risk marginalization.

- Impact on Traditional Retail: Retailers not engaged in e-commerce reported a decline in foot traffic and sales, attributing losses to consumer preference for online shopping. However, some retailers have adapted by offering unique, locally-sourced products and personalized services to retain customers.
- Many respondents stated that online shopping has led to a decline in local businesses and decreased their customer base. They also stated that customer preferences are clearly shifting towards online shopping.
- Some retailers have integrated online platforms into their business models, primarily using social media and local e-commerce apps. These retailers reported an average sales increase attributing growth to broader market reach.

**Recommendations:**

- Digital Training and Skill Development: Partner with NGOs or government schemes like Digital India to implement capacity- building initiatives.
- Encourage Hybrid Retail Models: Develop a local e-commerce platform or app for Namsai retailers to showcase their products and offer doorstep delivery.
- Government and Policy Support: Implement policy interventions to protect vulnerable traditional business during digital transitions.
- Local Brand Promotion and Consumer Awareness: Launch “Buy Local” campaigns to encourage people to support nearby business.
- Improve Digital Infrastructure: Invest in better internet connectivity and mobile network coverage.
- Form Retailer Cooperatives: Encourage the formation of local shopkeeper associations or cooperatives to negotiate with suppliers, share delivery resources and build collective digital presence.
- Market Research and Feedback Systems: Help shopkeepers adapt inventory and pricing based on current market demand influenced by online trends.
- Retailers can create attractive, enjoyable in-store experiences such as workshops, products demonstrations or loyalty events to draw customers physically to the store.
- Providing flexible payment methods easy returns and convenient delivery options can help traditional businesses match the convenience offered by online competitors.
- Local businesses can appeal to environmentally-conscious customers by promoting sustainable practices like eco-friendly packaging, local sourcing and waste reduction.
- Since many businesses rely heavily on word-of-mouth promotion, retailers should encourage satisfied customers to leave online reviews and share their experiences on social media.

**Conclusion**

The rapid growth of e-commerce has transformed the retail landscape, posing significant challenges for local shopkeepers worldwide. Online shopping has become increasingly popular driven by advancements in technology, changes in consumer behavior and the convenience of shopping from anywhere. As a result, local shopkeepers are facing increased competition from online retailers which can offer lower prices, a wider range of products and the convenience of doorstep delivery.

The rise of online shopping has emerged as a double-edged sword for the retail economy of Namsai district. On one hand, it has empowered consumers with greater choice, convenience and cost savings. On the other, it has posed significant challenges to traditional shopkeepers who now face reduced footfall, lower sales and increased competition from large-scale e-commerce platforms.

Digital disruption in Namsai's retail sector underscores the transformative power of e-commerce in rural markets. To harness its benefits, concerted efforts are needed to bridge digital divides, build trust in online transactions and support local retailers in adapting to the evolving landscape.
Through field surveys and interviews this study has highlighted several critical insights. Consumers are rapidly shifting towards digital platforms for both essential and non-essential purchases. Local shopkeepers meanwhile struggle to keep pace due to limited digital literacy, lack of online presence and insufficient awareness of government schemes or technological tools. However, the lack of localized support, training and infrastructure in districts like Namsai exacerbates the problem. The study concludes that while the impact of online shopping is inevitable, its consequences can be mitigated through inclusive digital education, access to government support schemes and encouragement of hybrid retail strategies. Policies tailored to the needs of rural business owners coupled with community awareness programs could help bridge the gap and ensure that local retailers are not left behind in the digital economy.

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# शिक्षा व्यवस्था में कृत्रिम बुद्धिमत्ता (AI) का प्रभाव तथा चुनौतियाँ

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***सारांश***

*वर्तमान शिक्षा व्यवस्था में स्मार्ट उपकरणों तथा गूगल क्लासरूम वेब आधारिक पाठ्यक्रमो के कारण वर्तमान शिक्षा व्यवस्था में काफी बदलाव आ रहा है। जो छात्र तथा शिक्षक दोनों के लिए उपयोगी है। कृत्रिम बुद्धिमत्ता (AI) में शिक्षा व्यवस्था को बदलने की क्षमता है । हालांकि मनोवैज्ञानिकों, शिक्षकों ,माता-पिता , शिक्षा व्यवस्था के नीति निर्धारकों के मध्य चरणीय विषय यह है कि बच्चों का स्क्रीन टाइमिंग को कैसे काम किया जाए। जबकि इस बात से बिल्कुल इनकार नहीं किया जा सकता है कि कृत्रिम बुद्धिमत्ता एआई के माध्यम से शिक्षा में नए- नए संभावनाओं की खोज की जा सकती है । शिक्षण प्रशिक्षण के क्षेत्र में तेजी से हो रहे हैं। इस बदलाव की वजह से शिक्षा व्यवस्था को कई चुनौतियों तथा जोखियों का सामना करना पड़ सकता है ।*

***मुख्य शब्द*** *– कृत्रिम बुद्धिमत्ता , मशीन लर्निंग , निर्देशनात्मक सामग्री*

**प्रस्तावना** –

"कृत्रिम बुद्धिमत्ता" शब्द वास्तव में 1956 में गढ़ा गया था। उस वर्ष, डार्टमाउथ कॉलेज के प्रोफेसर जॉन मैकार्थी ने एक महत्वपूर्ण कार्यशाला आयोजित की, जिसमें "कृत्रिम बुद्धिमत्ता" शब्द गढ़ा गया और इसका उद्देश्य तर्क करने और मानव भाषा का उपयोग करने में सक्षम मशीनें बनाना था। एक तेज़ शुरुआत के बाद, कुछ दशकों तक AI में शोध की रुचि ठंडी पड़ गई, फिर 1990 के दशक में कंप्यूटर प्रौद्योगिकी में विकास ने मशीन लर्निंग और न्यूरल नेटवर्क में प्रगति के साथ फिर से उभार दिया। 2022 में चैट GPT की सार्वजनिक रिलीज़ ने एक महत्वपूर्ण मील का पत्थर साबित किया, जिसने प्राकृतिक भाषा समझ और निर्माण में अभूतपूर्व क्षमताओं का प्रदर्शन किया और AI में आगे की प्रगति को बढ़ावा दिया। आज, AI स्वास्थ्य सेवा से लेकर वित्त, विनिर्माण और परिवहन तक विभिन्न क्षेत्रों को महत्वपूर्ण रूप से प्रभावित करता है। कई लोगों का मानना है कि यह शिक्षा में भी क्रांति लाने के लिए तैयार है।

शिक्षा व्यवस्था में नित नूतन बदलाव होते रहते हैं । और इसी को शिक्षा भी कहते हैं जो निरंतर चलती रहती है।शिक्षा को बेहतर बनाने में प्रौद्योगिकी ने महत्वपूर्ण भूमिका निभाई है ।परंतु अगर बात की जाए कृत्रिम बुद्धिमत्ता (AI) की तो वह अब तक की सबसे बेहतरीन तकनीकी है । वैज्ञानिकों ने भविष्यवाणी की है कि अमेरिका जैसे विकसित देश में शिक्षा के क्षेत्र में आर्टिफिशियल इंटेलिजेंस उपयोग में 47.5% की वृद्धि होगी ।शिक्षाविदों का यह कहना है कि इसका अर्थ यह बिल्कुल भी नहीं है कि (AI) शिक्षकों का स्थान ले लेगी किंतु इस सत्य से भी इनकार नहीं की जा सकती है कि शिक्षा व्यवस्था में निश्चित ही महत्वपूर्ण और क्रांतिकारी बदलाव होगा ।

यह क्रांतिकारी तकनीकी अध्यापकों के सीखने के तरीकों में बदलाव के साथ ही विद्यार्थियों के शिक्षा ग्रहण करने के तरीकों में भी परिवर्तन कर रहा है । बाजार अनुसंधान इंजन के रिपोर्ट के अनुसार पूरे विश्व मे प्रतिवर्ष 45% लगभग की लोग शिक्षा में कृत्रिम बुद्धिमत्ता का उपयोग कर रहे हैं जो आने वाले 2025 में बढ़कर के 5.80 अरब डॉलर से अधिक बढ़ने का अनुमान लगाया जा रहा है ।

- **शिक्षकों की ज्ञान में वृद्धि करना** – हम सभी इस बात को जानते हैं कि शिक्षा जीवन पर्यंत चलने वाली प्रक्रिया है। और शिक्षक इस प्रक्रिया का महत्वपूर्ण हिस्सा है इसलिए उसका जीवन पर्यंत सीखना अति आवश्यक है । अगर वह खुद को नई तकनीकी से दूर रखेगा तो आज के समय की विद्यार्थियों की मांगों को पूरी तरह से पूरा नहीं कर पाएगा आंखों के इसी समस्या के समाधान आर्टिफिशियल इंटेलिजेंस वरदान साबित हो रहा है । आज अध्यापक अपनी उंगली के एक क्लिक पर ज्ञान के अथाह सागर मे डुबकी लगा रहे हैं ।

- **कक्षा में आ रही समस्या को पहचाना** - आर्टिफिशियल इंटेलिजेंस आने के बाद सबसे बड़ा उसने यही बना हुआ है कि क्या वह आने वाले समय में अध्यापकों का स्थान ले लेगा किंतु ऐसा नहीं है वह अध्यापकों का सहयोगी बनेगा शिक्षक उसके सही उपयोग से अपनी कक्षा की समस्याओं का समाधान करने में सक्षम होंगे ।जैसे कुछ छात्र किसी विशेष समस्या कको कैसे देखते हैं।,वह अध्यापक को यह सचेत करता है कि छात्र अभी पढ़ाए गए वस्तु को नहीं समझे हैं उसे फिर से पढ़ाया जाने की आवश्यकता है तथा शिक्षक को अपने शिक्षण विधि में परिवर्तन करने की भी आवश्यकता है । कृत्रिम बुद्धिमत्ता शिक्षक की छात्रों के प्रति जवाब देही को बढ़ाता है।
- **रोबोटिक** - शिक्षा के क्षेत्र में रोबोटिक का उपयोग एक सराहनीय कम है ऐसा नहीं है कि रोबोट शिक्षक से बेहतर है किंतु इस बात से भी नकारा नहीं जा सकता है रोबोट बिना थके कई घंटे तक किसी विषय को अलग-अलग शिक्षण विधियां के माध्यम से पढ़ सकता है कर सकता है । अतिरिक्त आवश्यकता वाले छात्रों के लिए भी रोबोटिक एक वरदान साबित हो रहा है । रोबोटिक इंजीनियरिंग के विद्यार्थियों को यह बताता है। कि इंजीनियरिंग केवल चटाई पर ड्राइंग बनाने तक ही सीमित नहीं है बल्कि छात्र अपने प्रयास के अंतिम परिणाम को साकार रूप में देख सकते हैं ।
- **हर समय सहायता उपलब्ध** – कृत्रिम बुद्धिमत्ता एआई के आ जाने से केवल शिक्षक ही नहीं छात्रों को भी बहुत लाभ मिल रहा है । जहां किसी विषय के अध्ययन में आ रहे कठिनाई के समाधान के लिए छात्र को अध्यापक व प्रोफेसर का चक्कर काटना पड़ता था । तथा अगली कक्षा का इंतजार करना पड़ता था। अब छात्रों को इतना इंतजार की आवश्यकता नहीं है। अध्ययन के बीच में आ रही समस्या समाधान चैट बॉक्स मैं टाइप करके तुरंत समाधान प्राप्त कर सकते हैं। बिल्कुल वैसे ही आपकी समस्याओं का समाधान करता है जैसे एक अध्यापक छात्रों की समस्याओं का समाधान करता है ।
- **वैयक्तिकृत शिक्षण**- शिक्षा में AI व्यक्तिगत छात्र की ज़रूरतों के हिसाब से निर्देशात्मक सामग्री तैयार करके व्यक्तिगत सीखने की सुविधा प्रदान करता है, जिससे छात्रों, शिक्षकों और संसाधन-विवश स्कूलों को लाभ मिलता है। यह दृष्टिकोण छात्रों को अपनी गति से आगे बढ़ने, अपनी सीखने की शैली से जुड़ी गतिविधियों में शामिल होने और अपनी शैक्षिक यात्रा पर अधिक स्वायत्तता प्राप्त करने की अनुमति देता है। असाइनमेंट को अलग करने और डेटा-संचालित, अनुकूली प्रथाओं को तैयार करने के लिए AI सहायकों का उपयोग करने से शिक्षक के कार्यभार में न्यूनतम वृद्धि के साथ समग्र सीखने का अनुभव बढ़ता है।
- **स्वचालित ग्रेडिंग और फीडबैक** - लिखित कार्य के लिए पारंपरिक ग्रेडिंग में अक्सर व्यक्तिपरकता और पूर्वाग्रह होते हैं, क्योंकि शिक्षकों के मूल्यांकन व्यक्तिगत प्राथमिकताओं, मनोदशाओं और अचेतन पूर्वाग्रहों से प्रभावित हो सकते हैं। वस्तुनिष्ठता की इस कमी के परिणामस्वरूप असंगत और अनुचित मूल्यांकन हो सकते हैं। इसके अतिरिक्त, बड़ी संख्या में असाइनमेंट को ग्रेड करने की समय लेने वाली प्रकृति शिक्षकों की पूरी तरह से प्रतिक्रिया देने की क्षमता को सीमित करती है, जिससे संभावित रूप से छात्रों की पढ़ाई में बाधा उत्पन्न होती है।

ग्रेडिंग प्रक्रिया में एआई को एकीकृत करना छात्र के प्रदर्शन का मूल्यांकन करने के पारंपरिक तरीकों में क्रांतिकारी बदलाव ला रहा है। एआई ग्रेडिंग समय को काफी कम करके और तत्काल, विस्तृत प्रतिक्रिया प्रदान करके ग्रेडिंग दक्षता, सटीकता और निष्पक्षता को बढ़ा सकता है। यह शिक्षकों को अधिक लेखन कार्य सौंपने और समय पर, रचनात्मक प्रतिक्रिया देने की अनुमति देता है, जो छात्रों में बेहतर लेखन कौशल को बढ़ावा देता है।

कृत्रिम बुद्धिमत्ता चुनौती के रूप में – नई-नई तकनीकियों का शिक्षा में आना ही आवश्यक नहीं है। बल्कि शिक्षक को उसका प्रयोग करना आना भी आवश्यक है ज्यादातर अध्यापक ऐसे हैं जिन्हें नई तकनीकियों के उपयोग में मुश्किलें आ रही हैं। उन्हें किसी ऐसे व्यक्ति की आवश्यकता पड़ रही है जो इन तकनीकियों का उपयोग उन्हें बता

सके व सिखा सके जब अध्यापक की सही ढंग से इन आधुनिक तकनीकियों के प्रयोग को नहीं सीख पाएगा तो वह अपने विद्यार्थियों को कैसे इसके प्रयोग के विषय में बताया तथा इसका लाभ ले पाएगा। प्रशिक्षण डेटासेट के आधार पर AI द्वारा तैयार की गई सामग्री पक्षपातपूर्ण हो सकती है। संकाय को छात्रों को AI सामग्री का आलोचनात्मक मूल्यांकन करने के लिए प्रोत्साहित करना चाहिए ताकि यह सुनिश्चित हो सके कि यह नैतिक और समावेशी मानकों के अनुरूप है। पूर्वाग्रह को कम करने की रणनीतियों में पूर्वाग्रह जागरूकता प्रशिक्षण प्रदान करना और स्पष्ट नैतिक दिशा-निर्देश स्थापित करना शामिल है।

**निष्कर्ष** - कृत्रिम बुद्धिमत्ता शिक्षक छात्र तथा शैक्षिक नीति निर्धारकों के साथ-साथ अभिभावकों के लिए भी एक वरदान से काम नहीं है । अक्सर अभिभावक अपने बच्चों के विद्यालय जाने के पश्चात यह जानने के लिए इच्छुक तथा चिंतित रहते हैं कि उनका बच्चा विद्यालय में क्या कर रहा है ?कैसे माहौल में है? उसके साथ क्या व्यवहार किया जा रहा है वह कैसे सीख रहा है?और भी बहुत से सवाल तथा जिज्ञासा होते हैं उनके मन में आर्टिफिशियल इंटेलिजेंस इन सभी समस्याओं का समाधान अभिभावकों के समक्ष प्रस्तुत करता है। शिक्षा में बदलाव के लिए आर्टिफिशियल इंटेलिजेंस एक अति महत्वपूर्ण चालक है सभी छात्रों का आर्टिफिशियल इंटेलिजेंस पर समान पहुंच होगा चाहे उसके सीखने की क्षमता अधिक हो या सामान्य इस तकनीकी का विद्यार्थियों के सीखने के गति के ऊपर बहुत फर्क पड़ता है क्योंकि सभी विद्यार्थी एक समान गति से नहीं सीखते हैं ।इस तकनीकी की मदद से विद्यार्थी अपने दिखने में आ रही समस्याओं का तत्काल निदान का लेता है यह (AI) तकनीकी विद्यार्थियों के लिए वरदान है।

## संदर्भ

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# INVESTIGATING THE DYNAMICS OF SOCIAL MEDIA ENGAGEMENT AND INTERPERSONAL SKILLS

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***Abstract***

*The rise of social media platform has changed the way humans have been interacting. Social media is a form of mass media where communication happens over internet through social networking and microblogging, where users share information, ideas, personal messages, and other content (APA, n.d.; Britannica, 2025). The journey of social media, which started in in 1960s has reshaped how we communicate. Interpersonal communication has always been important in building string relationship, sharing information, resolving conflicts, building trust and respect and promoting harmony. It has also played important role in enhancing personal and professional life. Though, this interpersonal communication has found a new means to connect with the people defying geographical boundaries and time. It has provided a platform where one can express themselves and share their thoughts and experiences with others. But, this has also opened the gates for potential challenges, like neglecting face-to-face interactions, superficial interactions, diminishing empathy and understanding, etc., which have been important social skills to develop and maintain relationships. Researches have reported that the social media engagement has impacted interpersonal skills, reducing face-to-face communication and changed self-perception (Cinarsih, n.d.; Wajahat, 2024). Studies have shown that social media engagement influence the interpersonal relationships in families also, leading to misunderstanding, where it effects family dynamics more than students-teacher interaction (Solanki & Kaushik, 2024). This paper investigates the dynamics of social media engagement and how it impacts the interpersonal communication, which is the building block of human interactions.*

***Keywords:** Social media engagement, Interpersonal skills*

## Introduction

As we have entered the digital age, social media has taken centre stage to redefine how youth communicate and interact with each other globally. They experience this digital environment largely through social media interaction, which is defined most simply as the types of interaction that users have with content on social media sites, such as; comments, likes, post shares, or messaging. These types of interactions show the level of user engagement, but also tell us how discoverable or reachable the content is across networks (Hootsuite, 2024).

There has also been rapid growth in the field of electronic communication, and with it continues the importance of interpersonal skills i.e. the behaviours that make interactions with people effective and harmonious. The term interpersonal skills refer to the necessary behaviours of communication, empathy, teamwork, and conflict resolution that are required to succeed, both personally and professionally (Corporate Finance Institute, no date).

India, with its large population, majorly including youth, is at the forefront of this digital revolution. I was reported by Internet and Mobile Association of India (IAMAI) in 2023 that 398 million young people use social media in India, with teenagers spending more than 2-3 hours on platforms like Instagram and YouTube. By January 2025, India had an estimated 491 million social media users which accounts for 33.7% of the total population (DataReportal, 2025). It is notable that on average Indian users are interacting on approximately 6.7 unique platforms each month and are active for about 2 hours 30 minutes per day (GrabOn, 2025).

Although social media has its value in communication and information dissemination, concerns about the effect on interpersonal and social skill development in young people are ever on the rise. There is a growing focus from employers on the value of soft skills (e.g. interpersonal skills), as well as employability skills, at the workplace. It has been observed that despite having good technical skills, many graduates in India lack soft skills, and therefore, face difficulties in achieving employability (Duke Corporate Education, 2025). This gap in technical and soft skills is also highlighted by initiatives like the TCS iON Placement Success Programme which is working towards filling the skill gap by highlighting the importance of technical and soft skills in the work environment (Times of India, 2025). The high levels of social media usage and the focus on improved interpersonal skills are raising deep questions regarding the influence of communication on interpersonal skills and social interaction in young adults

*Social media engagement* is the spectrum of user interactions on digital platforms including likes, comments, shares, direct messages, content creation and much more. These types of user activity demonstrate not only the user's interest and involvement, but also the quality of the user's social engagement online (Hootsuite, 2024). Simply engaging or interacting with digital platforms demonstrates a user's active involvement in shaping social dialogue and maintaining digital relationships that are often virtual substitutes rather than supplements to real-life social interaction.

*Interpersonal skills* include attributes to one-on-one communication skills, group collaboration skills and the abilities to form meaningful relationships in a variety of interpersonal contexts. This would include verbal and written communication skills, non-verbal communication skills, empathy, listening, conflict resolution and teamwork. The development of interpersonal skills is fundamental to one’s own individual development and success, enhancing success in academic and work-related tasks and is a requirement for successful participation in a team or in service and leadership roles (Corporate Finance Institute, n.d.).

**Theoretical Foundations**

This interplay of social media engagement and interpersonal have explained through media richness theory and social presence theory.

*Media Richness Theory* by Daft and Lengel (1986) indicates the various media deliver different opportunities for delivering information. Media are considered "rich" if they enable immediate feedback, multiple cues (e.g., tone of voice, body language), personalization, and language variety. Face to face interaction is the richest media, emails and social media interactions are less rich.

Applied to social media, there are differences in richness across, for example, video calls (e.g., Instagram Live, Whats App Video) and text messaging (e.g., Twitter, Whats App Chat). This means that the youth who use the leanness of the social media channels may find it difficult to learn the full set of interpersonal skills, especially decoding emotional cues and managing complex interpersonal situations. This theoretical framework is useful for understanding how media use in both intensity and choices influence the quality of social interaction and understanding of interpersonal skills.

*Social Presence Theory*, introduced by Short, Williams, and Christie (1976) is the degree to which a communication medium allows users to perceive that others are psychologically present. High social presence allows emotional closeness, trust, and empathy to be established, which is critical to effective interpersonal relationships.

Although any social media channel can create a professional social presence, video-based media such as Zoom or YouTube live streams tends to provide a sense of social presence than text-only or asynchronous media. However, over reliance and dependence on digital presence without live interaction can produce superficial social relationships that do not create deeper interpersonal development.

The combination of media richness theory and social presence theory presents an interesting construct to analyze the extent to which modes of digital communication, used extensively by youth, are influencing the development of interpersonal skills. Indian youth spend an average of 2 hours and 30 minutes daily on approximately 6.7 social media platforms (GrabOn, 2025), and their communication experiences occur in a wide range of combination of rich and present process. However, we do not know much about the overall effects of exposure on social skills for the physical world.

Recruiters have identified interpersonal skills is among the top skills of employability. In India, social skills including teamwork and communication skills are in demand with high growth in higher education and technological advancements (Duke Corporate Education, 2025). Initiatives like TCS iON as well as NASSCOM's FutureSkills initiatives have increasingly prioritized development of interpersonal skills to prepare individuals for employment (Times of India, 2025).

Therefore, it is important to understand how the youth engagement in the different mediums can assist or impede interpersonal skills.

**Review of Related Literature**

Social media interactions, which include likes, comments, sharing, and messaging, are one way that an individual engages with digital platforms both as a behaviour and an emotional state. These engagements on social media are not passive activities but show constructive online activity and digital identity-construction (Avci, Baams & Kretschmer, 2024; Patki, 2023). Meanwhile, interpersonal skills like empathy, verbal and non-verbal communication, active listening, and emotional control continue to be the cornerstones in fostering personal relationships, academic achievement, and work efficiency (Pimienta et al., 2024). The rise of universal digital interaction, particularly among young people, has made their connection all the more important to educators, employers, and mental health practitioners.

A growing body of research suggests moderate social media usage can be beneficial in interpersonal growth, especially in keeping long-distance relationships alive and enhancing communication between peers (Kuske, 2020). Carlson et al. (2016) suggested that moderate social media usage can positively impact relationship-building behavior and overall communicative openness. However, over usage appears to limit face-to-face communicative ability, suggesting a point at which digital communication begins to entirely replace, rather than supports, physical connection. Alloway and Alloway (2012) found that excessive use of text-based or image-based platforms can actually reduce cognitive empathy because these forms of platforms act to limit complex, emotionally complex exchange. Kross et al. (2013) examined passive consumption, such as scrolling through one's feeds without interacting, and they found it positively related to lower subjective well-being and loneliness, which inherently limit one's ability for meaningful engagement in the offline world. There have been found the disconnection between self-rated and peer-rated interpersonal ability among high users of social media, suggesting that greater comfort in self-presentation in the digital environment could be no guarantee of the same presence when face-to-face social skill is required. When in face- to-face situations these users tend to overestimate their ability to communicate and engage with others particularly when empathy was required, or spontaneous conversation was involved (Pontes et al., 2018).

Concerns of about over-connectedness in educational contexts, indicated that while social media would allow for informal peer communication, it detracted from their academic focus or even qualitative person-to-person development and/or learning if social media is being utilized in unrestrained ways (Saini & Mir, 2023). Raghuvanshi and Pandey (2025) found an over-connectedness of university students with social media was linked to student anxiety and lower self esteem, that adversaly affect interpersonal confidence and relationship management.

Young people in different sociocultural contexts exhibit different motives and consequences of online engagement. According to a study by Kidindima and Andrea (2025) on university students in Tanzania, 66% of the students utilized social media every day, mainly for stress relief, networking, and accessing information. While such uses confirm a functional utilization of social media, time spent in it does not necessarily create interpersonal depth, except if designed purposely. Payasi and Jain (2025) stated that excessive high-frequency usage of social platforms by young people is leading to decreased face-to-face ability, increased social anxiety, and the inability to maintain close interpersonal relationships. Their research supports the requirement for teaching interventions in offline communication and empathy-building tasks.

A humanist-constructivist perspective on education is advocated by Ochoa Pimienta et al. (2024) which suggests that developing interpersonal skills should be made explicit in students' development. Their study suggests that empathy and quality of relationships has become more influenced by ways of living and screen-based forms of interaction. Researches have also shown that fear of missing out and its proximity to impulsivity, social comparison, and the superficiality of digital communication might encourage real interpersonal connection (Altuwairiqi, Jiang & Ali, 2019; Cham, et al., 2019).

Social media can once facilitate social connection and emotional expression, while also minimizing communication, diminishing empathy, and encouraging passive, less engaging forms of interaction. The solution lies in consuming social media consciously and positively, with educational and mental health programs to direct youth toward a more positive integration of online and offline social activity.

Analysis and Discussion

The effect of social media connection on interpersonal ability is complicated since positive and negative factors are involved.

**Positive Impacts of Social Media Engagement on Interpersonal Skills**

Social media can potentially enhance connectivity in that users are able to sustain relationships irrespective of distance and time zone. These social media websites, including WhatsApp, Facebook, and Instagram, enable standard, frequent, and real-time contacts to facilitate emotional proximity and connection with those who are like you (Carlson et al. 2016; Kuske, 2020; Pimienta et al., 2024). Researchers have gone so far as to note that this virtual closeness has the ability to enable emotional support and social bonding of university students and young adults (Solanki & Kaushik, 2024).

Social media also helps to bringh people together with varied points of view, cultures, and contexts. Hence, interaction with multiple online communities, enable the young people to develop intercultural sensitivity and tolerance (Alloway & Alloway, 2012). The quality of this exposure could have triggered empathy and perspective taking, both of which are characteristics of interpersonal intelligence. Indeed, more recent research has indicated that users, in particular users who are active in product or constructive conversation, can potentially build new forms of digital empathy - the capacity to recognize and react to others' emotional states through online interaction (Collins, 2014). Social media also helps to provide a relaxed environment to to a shy or socially anxious person to start and maintain social interaction, helping them to build confidence with communication (Payasi & Jain, 2025). In certain schools, social media have also been discovered to offer an environment for facilitating collaborative learning and peer support (Ansari & Khan, 2020).

**Negative Impacts on Interpersonal Skills**

Although these benefits exist, excessive or erroneous use of social media is often associated with reduced face-to-face communication competencies. There is evidence that passive use of social media including but not limited to scrolling without interactivity or engagement is related to diminished subjective well-being and social engagement (Kross et al., 2013), while both direct personal interactions and group communications can empower and deepen connectedness. Interpersonal relationships are constructed around elements of non-verbal behavior, body language, and situational awareness. Heavy reliance on online interactions can further reduce our capacity to communicate meaningfully, which diminishes emotional style and depth (Raghuvanshi & Pandey, 2025).

Signs of disengagement can lead to compromised social competence in the physical world, growing social anxiety, and a persistently diminished social capacity especially among youth who primarily engage in social atmospheres virtually (Payasi & Jain, 2025). Empirical research indicates frequent users of social media sites often overestimate their interpersonal competence. In a study by Pontes et al. (2018) suggested that there were significant discrepancies between users' self-perceptions and peer-rated interpersonal competencies in terms of empathy, and active listening traits.

Aspects of social media's content filtration and distribution systems designed around algorithms used on sites like Instagram and TikTok can potentially create a situation of perception and engagement in an echo-chamber that are creating little new exposure or opinion and widening emotional dislocation (Putri1, Purnomo & Khairunissa, 2024). These aspects might sustain convictions and limit opportunities for constructive dialogue or the management of conflict, both central to interpersonal growth.

**Implications**

Given the fast-moving nature of social media in youth culture, educators must be ready to include social media communication skills as part of their teaching. Educators and parents need to think about learning beyond interpersonal skills and incorporate digital literacy skills, which may include effective online communication skills, emotional intelligence in the virtual environment, and the capacity to critique about the content that we come across online. Classroom strategies that incorporate collaborative online and in-person projects can be a way for students to extrapolate their digital empathy back into the real world. Schools should also help students and parents develop awareness about the possible social anxiety level and shallow forms of communication they may be harvesting due to excessive social media use (Payasi & Jain, 2025).

Parents and mentors by communicating openly about both the positives and negatives associated with social media use, can develop self-regulation and critical thinking among young people (Raghuvanshi & Pandey, 2025). It is important to develop an appropriate balance between digital interaction and face-to-face social interactions. There must be limits on the amount of screen time available and promote offline social activities that build essential interpersonal skills. There is need to impart education about well-balanced digital citizen who are made aware of empathy, respect, and authenticity on the web, particularly in the fight against the adverse effects of echo chambers and emotional dissociation (Kross et al., 2013).

Formal education also should take initiatives to develop policies to serve young people in developing ways to navigate and make sense of the digital media environment for themselves. This could include initiative on raising awareness about social media fatigue including the psychological effects of social media use like stress, anxiety, self-esteem, social comparisons, etc. with mental health professionals (Raghuvanshi & Pandey, 2025). Policy makers should use opportunities for research and funding that may encourage intervention studies that could promote balanced social media use, and support youth development of skills to build relationships off-line. Policies regarding curriculum should consider digital-comic information and social skills training that prepare youth to be employable, adaptable and flourish within social environments both digitally and physically (Payasi & Jain, 2025).

## Conclusion

The interplay between social media usage and interpersonal skill development among youth is complex. The findings indicate that social media does allow unprecedented access to connection, diversity, and even new forms of digital empathy; however, it also comes with challenges such as superficial communication, diminished face-to-face skills, and emotional disconnection. As such, social media engagement in and of itself is neither good, nor bad; rather, it matters how it is used and used in conjunction with offline social development. There is need to include digital literacy, develop emotional intelligence in online spaces, and positive support for interpersonal skill development both in educational contexts and in homes, to make a more responsible digital generation. Educators, parents, guardians, mentors, or policymakers need to respond responsible to the challenges and opportunities of social media and at large with digital world, to shape an upcoming generation that utilizes social media, with the potential for both positive experiences and risks. There is need for balanced approach to prepare young people for functioning interpersonally and being well-rounded humans in the 21st century.

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# THE IMPACT OF PROJECTION MAPPING IN ADVERTISING: A VISUAL TRANSFORMATION

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***Abstract***

*The advertising industry has undergone a transformation thanks to projection mapping, a complex technique that transforms real-world areas into dynamic visual experiences. This study examines the significant effects of projection mapping on advertisements, audience attention, brand recall, and the efficiency of its use to encourage consumer involvement. This study uses projection mapping to explore the potential of emergency events to produce memorable and successful brand interactions through a comprehensive assessment of the literature and empirical analysis.*

***Keywords****: Projection mapping, Advertising, New Technology, Media.*

## Introduction:

In the continuous developing area of advertising, brands are looking for a constant innovative way to capture the attention of the audience and release a permanent impression. The technology of image and video projects on the surface has emerged as a powerful tool to create a projection mapping, visually amazing and immersed advertising experiences. (Fujimoto, 2018) By converting ordinary seats into an abnormal canvas, projection mapping offers a unique opportunity to engage customers on an emotional level and increase brand loyalty.

Projector mapping, a sophisticated technology, converts real locations into dynamic view experiences, it has completely changed the advertising industry. This paper closely sees how projection mapping affects the mapping ads and how well it attracts the audience, enhances the brand recall, and how it enhances customers' participation. Through the broad review of literature and empirical analysis, this study projection investigates how a meaningful and memorable brand creates interaction through emergency experiences.

## Literature Review

Projecting projection mapping can capture and maintain the audience's attention, with the confusion of traditional advertising, visually attractive and unexpected experiences. (IWAI, 2023)

The immersed experience created by projection mapping can increase brand recall by stimulating many senses and creating strong emotional relationships.

By creating a sense of surprise and enthusiasm, projection maping can affect the behavior of the customer, which increases the purpose of buying, a positive brand association, and finally, the purpose of purchase.

## Empirical studies

An additional study investigated how the project of projection mapping affected consumer emotions and discovered that it evoked feelings of wonder, excitement, and awe, which resulted in positive brand perceptions. Explored the Impact of Project of Projection Mapping on Consumer Emotions and Found that IT Evoked Feelings of Awe, Wonder, and Excitement, Leading to Positive Brands. (Hein, 2021)

## How Projection Mapping is used

Ordinary Outdoor Projection projecting pictures onto a flat surface, such a building. A pre-production procedure is necessary for projection mapping in order to render images to a 3D graphic model of the building. They "Wrap" over the physical elements of the building when projected onto it, giving the impression that I have been more—or am a part of—it. (IWAI, 2023) Technically, these applications only function well if the projected images can faithfully reproduce the intended appearance on the real-world surface. This is challenging, though, because your projection targets are often unsuitable for transmission and are uncontrollable surfaces (such as textures and non-planners). The projected image suffers significant damage if it is not carefully considered.

In the art form of projection mapping, many kinds of video projects are used to create an intriguing 3D illusion. It is a creative method that turns variously shaped and sized materials into a visually appealing screen for projecting videos. From shoes to huge skyscrapers, projection displays have been utilized by advertisers to market a variety of goods. A unique software that works with the projector to integrate the image of the object's surface intact creates this eye-catching effect of video projection mapping. By including extra dimensions and optical illusion, which gives the impression that the thing itself is there, artists can improve the experience.

Even though projection mapping is a great way to advertise at a high cost, it's crucial to speak with a lawyer to fully grasp the law and project mapping. Prior to setting up projection mapping, make sure you are aware of local rules. Depending on where you intend to use and install projection mapping, stage permits might be necessary. Regarding any potential design copyright infringements, speak with a copyright attorney as well. Permission to utilize the building or location where the projections will be shown is also required. (Handa, 2012)

On a smaller scale, projection mapping is also employed in the marketing industry. For instance, projecting virtual clothes onto mannequins or using photos of shoes, clothes, and cars to mimic variations in their color and fabric.

By producing a very immersive and interactive experience, projection mapping improves user engagement.

Visual stimulus can entertain, enthrall, and impart fascinating information. (Krautsack, 2011)


Figure 1 https://iiclab.com/blogs/how-projection-mapping-is-transforming-retail/

**Different kinds of projection mapping exist, including:**

1. On a level surface, planar projection mapping is displayed.
2. To make the round projection appear unbroken, multiple projectors are used in a circular projection mapping.
3. A horizontal video projection is produced by panoramic projection mapping.
4. Waing is a projection technique that synchronizes music with images.
5. Interactive projection mapping modifies the projection in real time by using feedback that is recorded by participants and objects.


Figure 2 projection displays

**Changing Retail Environments**

Retailers may display products in previously unheard-of ways thanks to projection mapping. Consider a vehicle showroom where various models and features are emphasized through eye-catching visual storytelling, or a shoe exhibit where the color and style of the shoes change in front of your eyes.

Store layouts can become dynamic and flexible with projection mapping. A seamless and interesting shopping experience can be created by transforming the walls and flooring to lead clients through various areas.

Companies may design completely immersive settings that highlight their values and tell their narrative. A travel firm may use projected landscapes to give customers a sneak peek at potential destinations, while a sportswear retailer could take customers to a virtual stadium..

Retailers may provide individualized experiences by combining projection mapping with additional technology like motion sensors and artificial intelligence. Displays may alter as clients browse the store to present items based on their choices.

Window displays are given new life by projection mapping, which makes it possible to create dynamic, eye-catching showcases that are instantly updated without requiring any physical modifications. (Neil Cumins, 2023)

Figure 4 Projection Mapping Advertisement of Shoes


Figure 3 For Advertisement of car

**Methodology**

Approaches: this study combined quantitative and qualitative research approaches in mixed methods approach.

**Quantity Research**: To gather information on consumer retention, approach, and behavior regarding projection mapping advertising, a survey was carried out.

The global market for projection mapping grew by 5% to reach $1.8 billion in 1, according to Global Market Insurance. Furthermore, given the early adoption of virtual reality technology, the need for emergency entertainment, and, of course, high-profile advertising campaigns, it is certain that India will play a major role in the industry's expansion.

**Qualitative Research:** Advertising professionals and consumers are interviewed in-depth to gain information regarding how well projection mapping works to generate a memorable brand experience. The next step in the development of projection mapping is probably going to be interaction. By coming closer or touching the projects, visitors can interact with the pictures displayed in the exhibition space. Without the visitor donning a headgear, this experience will resemble virtual reality. "There are new platforms that allow the audience to use vision, sound, touch and insert able technology to affect the audience in real time," Nix stated. (Jung, 2015)

Figure 5 on top video projection for restaurant

The study's findings and discussions demonstrate that projection mapping significantly affects how effective advertising is. Attention: By avoiding the distraction of typical advertising, projection mapping may be used to create an unexpected and visually stunning experience that will draw in and hold the attention of the audience. (Schuemie, 2001) Improved brand recovery: projection mapping allows brands to expand their identity by appealing to a variety of senses and forging deep emotional bonds. Increasing Customer Participation: Projected mapping can produce consumer experiences that foster a deep connection with the brand and increase customer participation. Positive brand retention: By fusing excitement, creativity, and innovation, projection mapping can produce a positive brand image.

**Conclusion**

By prov

completely transform the advertising sector. Brands can develop memorable and successful campaigns that increase sales and brand loyalty by using the power of experiential experiences. We may anticipate seeing more inventive and imaginative uses of projection mapping in advertising as technology advances.

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# THE REGIONAL AND CLASSICAL LANGUAGES IN THE DIGITAL AGE AND OTT PLATFORMS

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***Abstract***

*In the era of digital transformation, Over-the-Top (OTT) platforms have become crucial mediums for promoting linguistic diversity and cultural expression. This paper examines the evolving role of regional and classical languages in the digital age, with a focus on how OTT platforms support their growth and visibility. Languages such as Kannada, Marathi, Bengali, Tamil, and even classical languages like Sanskrit are finding renewed space through web series, films, and documentaries streamed to global audiences. Digital tools such as subtitling, dubbing, and AI-based content suggestions have expanded the reach of vernacular content, enabling cross-cultural engagement and broader accessibility. The paper highlights how regional content creators are leveraging these platforms to tell stories rooted in local traditions, identities, and histories. Despite these positive trends, challenges such as algorithmic bias, limited funding for non-mainstream languages, and commercialization pressures continue to affect the representation of diverse linguistic voices. By analyzing case studies from Indian and international OTT platforms, this study underscores the importance of inclusive digital practices and policies that support language preservation. Ultimately, the paper argues that OTT platforms hold significant potential to bridge linguistic gaps and foster a more pluralistic and culturally rich digital media environment.*

***Keywords****- OTT platforms, Regional Languages, Classical Languages, Digital Media, Linguistic Diversity.*

**In my proposed paper,** this paper investigates how regional and classical languages are being reshaped and revitalized in the context of the digital age, particularly through Over-the-Top (OTT) platforms. With the rapid growth of internet-based streaming services, languages such as Kannada, Tamil, Bengali, and Marathi, along with classical languages like Sanskrit, are receiving renewed attention and wider reach. These platforms have emerged as inclusive spaces where linguistic diversity can thrive, offering content that reflects local cultures, traditions, and identities. The paper aims to analyze how OTT media supports the preservation and contemporary relevance of these languages through original programming, dubbed and subtitled content, and genre diversity. It also explores the broader cultural impact, including how regional storytelling is gaining visibility and reshaping audience engagement. By examining content trends, platform strategies, and viewer responses, this study highlights the role of digital media in fostering a multilingual cultural ecosystem that values both heritage and innovation.

## 1.1 Introduction:

The advent of the digital era has brought transformative changes to the way content is created, shared, and consumed. Over-the-Top (OTT) platforms, which deliver media content directly via the internet, have become powerful tools in reshaping the media landscape. These platforms are not only expanding access to entertainment but are also playing a crucial role in the preservation and promotion of regional and classical languages. Services such as Netflix, Amazon Prime Video, and regional-specific platforms like Aha, Namma Flix, and Hoichoi have opened up new avenues for linguistic and cultural expression. In a media environment previously dominated by global or national languages, regional languages like Kannada, Bengali, Malayalam, and Marathi, as well as classical languages such as Sanskrit and Tamil, are now gaining renewed importance. OTT platforms enable diverse linguistic communities to tell their own stories, grounded in local traditions, values, and socio-cultural contexts. This has allowed for the inclusion of voices and narratives that were often sidelined in mainstream cinema and television.

Moreover, classical languages—although not commonly spoken daily—are experiencing a digital revival through educational programs, literary adaptations, and cultural documentaries available online. This has helped foster a sense of cultural continuity among both native speakers and diaspora communities. The integration of subtitles and dubbing technologies has also made such content accessible to wider audiences, thus promoting cross-cultural understanding and appreciation.

Importantly, the relative creative freedom offered by OTT platforms encourages experimentation with themes, formats, and language use, often bypassing the restrictions faced in traditional media. This has led to a surge in authentic, vernacular storytelling that reflects the socio-political realities of various communities.

Overall, digital media is playing a vital role in preserving linguistic diversity and ensuring that regional and classical languages continue to evolve and remain relevant in contemporary discourse.

### 1.2 Problem Statement:

In the expanding digital media ecosystem, regional and classical languages often struggle for representation amid the dominance of globally and nationally prominent languages. Many Over-the-Top (OTT) platforms prioritize content in widely spoken languages, leading to the underutilization of vernacular and heritage languages in digital storytelling. This imbalance poses a threat to linguistic diversity and the transmission of cultural knowledge. The proposed study seeks to explore how OTT platforms can better support and promote regional and classical language content, ensuring inclusive media practices and broader cultural engagement in the digital age.

### 1.3 Objectives:

1. TO investigate how regional and classical languages are currently featured and distributed across various OTT platforms.
2. To explore the contribution of digital streaming services in safeguarding and renewing interest in linguistic and cultural traditions.
3. To understand viewer perceptions and levels of interaction with content presented in regional and classical languages.
4. To identify the key obstacles encountered by creators and producers working in underrepresented language segments.
5. To propose actionable approaches for enhancing linguistic diversity and cultural representation within the digital streaming ecosystem.

## 2. Methodology:

This research uses a mixed-method approach to explore how Kannada and classical languages appear on OTT platforms in Karnataka. An online questionnaire was shared with 100 participants from different parts of the state to understand their language choices and content consumption patterns. In addition, interviews were conducted with local filmmakers, media professionals, and scholars familiar with language use in digital media. The study also reviewed the content libraries of regional OTT services to assess the presence of Kannada and classical language programming. Relevant academic and industry materials were examined to support and contextualize the primary data findings.

## 3. Results:

In Karnataka, the study revealed a strong preference for Kannada-language content on OTT platforms. Most respondents expressed greater interest in watching films and series in their native language, citing cultural familiarity and emotional connection as key reasons. Platforms like Zee5 Kannada and Voot Kannada have seen increased viewership due to their focus on regional stories and web series. However, classical languages such as Sanskrit remain marginal, featured mainly in niche religious or educational content. Content creators noted challenges in producing classical language material, including low demand and limited funding. Overall, Kannada content is flourishing, while classical languages require more targeted support.

**4. Findings**

The rise of OTT platforms in the digital era has transformed how regional and classical languages are represented in media. These platforms have expanded the reach of local-language content, allowing stories in Kannada, Tamil, Sanskrit, and others to find wider and more diverse audiences. While subtitles and dubbing help in accessibility, they often miss cultural and linguistic subtleties. Algorithms on major platforms tend to promote dominant languages, limiting exposure for lesser-known ones. Despite these issues, OTT services have opened new avenues for preserving and promoting linguistic heritage, highlighting the potential for greater inclusivity in the global entertainment landscape.

**5. The Importance**

Regional and classical languages are vital for maintaining cultural identity and preserving traditions. Their inclusion on OTT platforms helps safeguard linguistic diversity and provides a space for authentic local narratives. These languages enable communities to express their unique experiences and values, reaching audiences beyond geographic boundaries. Digital exposure not only strengthens cultural pride but also creates opportunities for regional creators and actors. By promoting content in multiple languages, OTT platforms encourage inclusivity and reflect the richness of linguistic heritage. Supporting these languages in digital spaces is key to ensuring their survival and relevance in an increasingly global and technology-driven world.

**6. The future**

The future of regional and classical languages on OTT platforms appears promising, driven by increasing demand for diverse content and cultural representation. As audiences grow more appreciative of authentic stories rooted in local contexts, streaming services are investing in multilingual productions. Emerging technologies like AI-driven subtitles, voice recognition, and regional content recommendation systems will further enhance accessibility and engagement. Independent filmmakers and creators are also finding greater freedom to produce content in native languages, bypassing traditional distribution barriers. However, the challenge lies in ensuring equal visibility for lesser-spoken languages amidst algorithm-driven platforms that often favor mainstream content. Policy support, audience awareness, and platform responsibility will be crucial in maintaining linguistic diversity. If nurtured thoughtfully, digital media can play a transformative role in revitalizing endangered languages and strengthening cultural identities. Ultimately, the digital space holds great potential to bridge linguistic gaps and celebrate the richness of India’s multilingual heritage.

**7. Literature Review**

The literature review explores the impact of OTT platforms on regional and classical languages, highlighting challenges, opportunities, and the role of digital media in promoting linguistic diversity and cultural representation.

1. **Kumar (2020)** discusses how digital platforms are reshaping language hierarchies, enabling non-dominant languages to gain recognition through local storytelling. OTT platforms provide underrepresented languages a global stage, allowing viewers to explore content in diverse linguistic contexts, thus fostering cultural appreciation (Kumar, 2020).

2. **Sharma & Iyer (2019)** explore the role of subtitles and dubbing in OTT content, emphasizing that while they enhance accessibility, they often fall short in preserving the linguistic authenticity and cultural nuances of regional languages (Sharma & Iyer, 2019).
3. **Banerjee (2022)** argues that classical languages like Sanskrit and Tamil face significant challenges due to limited content and smaller audiences. Despite their cultural significance, these languages struggle to find a platform in the crowded digital landscape (Banerjee, 2022).
4. **Patil (2021)** highlights how regional-language web series help younger generations reconnect with their linguistic roots. These platforms serve as a bridge for the younger population to engage with their heritage through digital content (Patil, 2021).
5. **Rao (2020)** observes that algorithm-based content curation on OTT platforms often disadvantages less popular languages, unless actively promoted. This makes it difficult for regional languages to gain traction without targeted efforts (Rao, 2020).
6. **Singh (2021)** focuses on the audience reception of regional language content, showing strong emotional engagement and loyalty. Viewers tend to form deep connections with content in their native languages, often resulting in sustained viewership (Singh, 2021).
7. **Desai (2018)** explores the economic potential of regional content on OTT platforms, arguing that it attracts niche markets and advertisers seeking to target specific linguistic communities. Regional content thus becomes a profitable avenue for both creators and marketers (Desai, 2018).
8. **Menon & Thomas (2020)** emphasize the importance of policy support and government funding to ensure the survival of classical languages in the digital space. They suggest that without institutional support, these languages may fade from the digital media landscape (Menon & Thomas, 2020).

Conclusion In conclusion, OTT platforms have revolutionized the representation of regional and classical languages, offering new opportunities for cultural expression. While challenges like algorithmic biases persist, continued support and collaboration can ensure these languages thrive, fostering greater linguistic diversity and preserving cultural heritage in the digital age.

8. Theoretical framework

   The theoretical framework for this study is grounded in Cultural Imperialism Theory and Postcolonial Theory. According to Cultural Imperialism Theory (Tomlinson, 1991), global media platforms, like OTT services, often prioritize dominant languages and cultures, potentially marginalizing regional and classical languages. This theory helps explore how OTT platforms might inadvertently contribute to the dominance of global languages, such as English, while underrepresenting indigenous or regional languages. On the other hand, Postcolonial Theory (Spivak, 1988) highlights the resistance of marginalized communities in reclaiming their language and cultural identity. It emphasizes the role of regional content in challenging cultural hegemony, offering an avenue for linguistic preservation. By applying these frameworks, the study critically examines how OTT platforms balance global content and the promotion of regional languages, contributing to both cultural homogenization and resistance through localized storytelling.

9. **Approach**

   This study adopts a **qualitative approach**, focusing on the portrayal of regional and classical languages on OTT platforms. It utilizes **content analysis** to evaluate the representation of lesser-known languages and the impact of digital media in their visibility. By examining the differences in content from dominant and regional languages, this study seeks to understand the challenges faced by regional languages in gaining recognition. Interviews with content creators, filmmakers, and industry professionals will offer firsthand insights into the strategies used to promote regional content. Combining both primary and secondary data, the study will provide a nuanced understanding of how OTT platforms engage with local languages, the cultural implications of such portrayals, and how technology influences language dynamics. This multifaceted approach will highlight the evolving relationship between language, culture, and digital media.

## 10. SCOPE OF THE STUDY

This research focuses on the representation of regional and classical languages on major OTT platforms, particularly looking at Indian languages like Kannada, Tamil, Sanskrit, and Marathi. The study explores how these languages are integrated into original programming, subtitling, dubbing, and language-based adaptations. The research will assess the accessibility of regional language content and examine how it is affected by platform algorithms, content curation, and audience reception. The scope also includes a deeper look at the challenges and opportunities for regional languages within a digital media landscape increasingly dominated by global content. Moreover, the study will consider the role of governmental policies and corporate strategies in promoting regional language visibility on digital platforms. By focusing on Indian regional languages, the study will shed light on the broader global trends in preserving linguistic diversity and fostering cultural exchange in the digital era.

## 11. HYPOTHESIS

The hypothesis of this study explores the role of OTT platforms in promoting regional and classical languages. It examines whether these platforms enhance visibility for non-dominant languages (H1) while also considering the potential limitations caused by algorithmic content curation (H2).

**H1:** OTT platforms contribute significantly to increasing the visibility and reach of regional and classical languages, enabling them to access a wider audience.

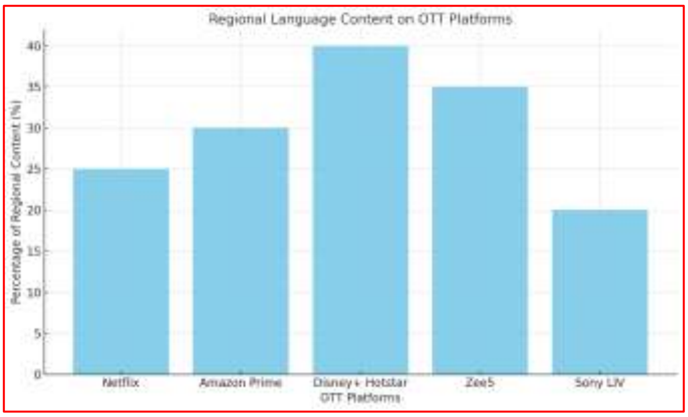
**H2:** Algorithmic content recommendations on OTT platforms disadvantage regional language content, limiting its visibility and engagement with global audiences.

**Result**

The findings reveal that OTT platforms have indeed facilitated the expansion of regional language content (supporting H1). However, algorithmic curation tends to prioritize more mainstream languages, making it harder for regional content to gain widespread visibility (supporting H2). While niche audiences engage deeply with regional language content, discoverability remains a key issue due to platform algorithms.

**Data Analysis**

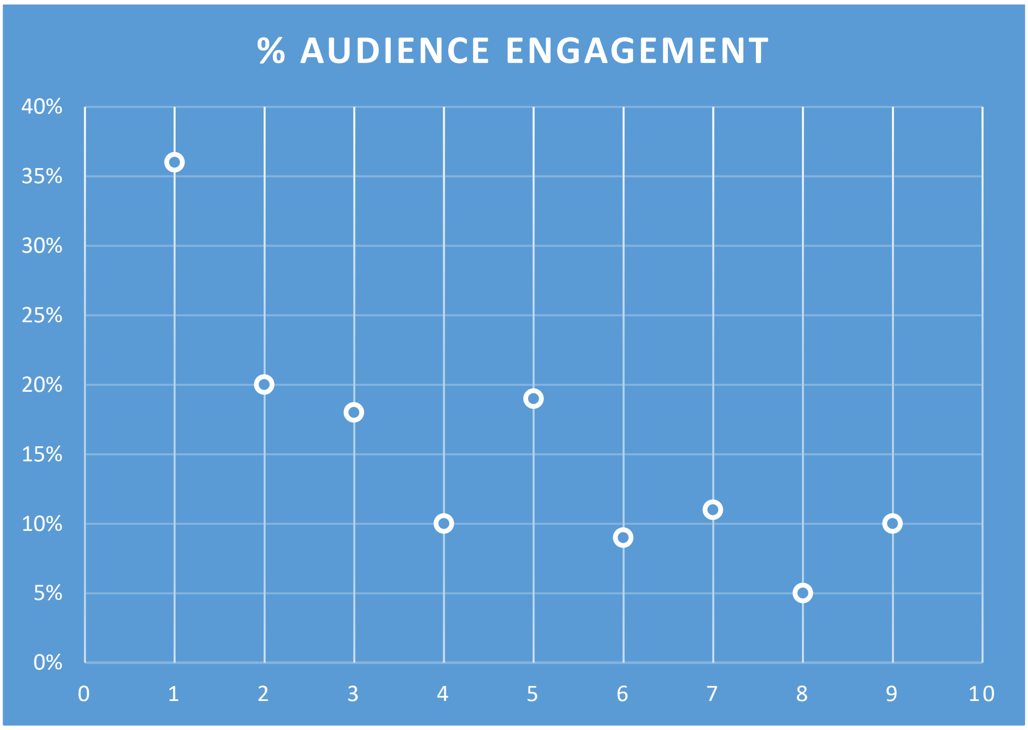
**Graph 1: Regional Language Content on OTT Platforms**



Here is the bar graph illustrating the percentage of regional language content available across different OTT platforms. This provides a visual comparison of how regional content is distributed on platforms like Netflix, Amazon Prime, Disney+ Hotstar, Zee5, and Sony LIV.

**Graph 2: Audience Engagement by Language**

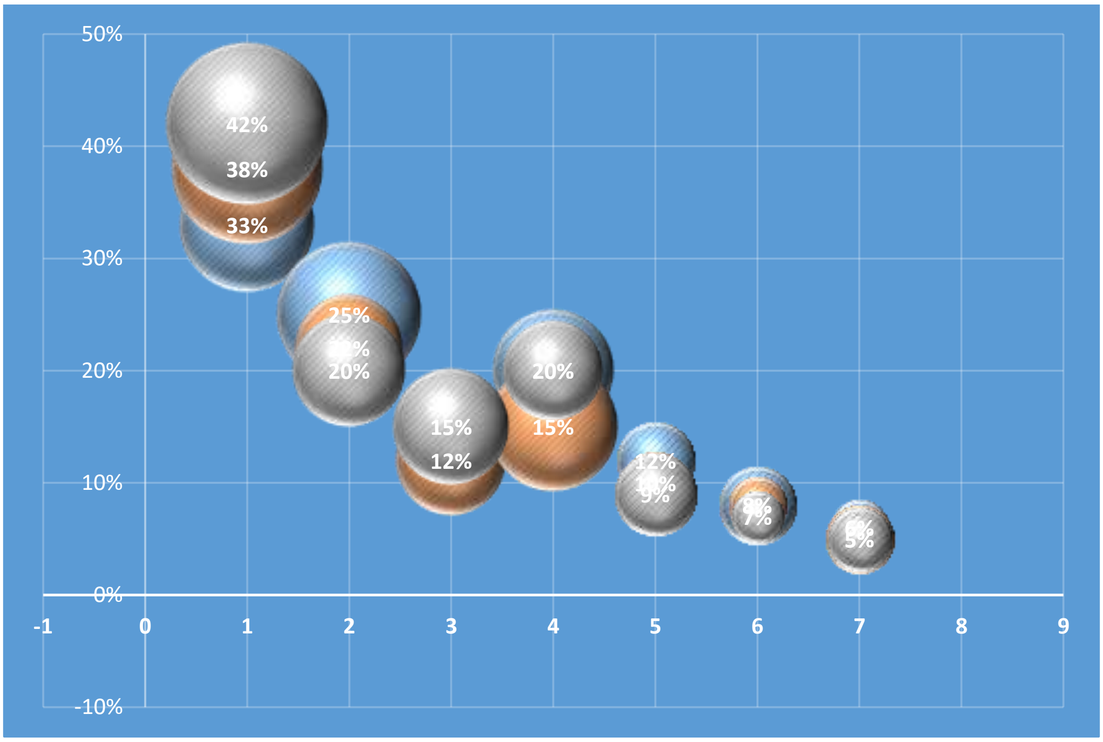
| Language | % Audience Engagement |
|---|---|
| Hindi | 32% |
| Tamil | 15% |
| Telugu | 14% |
| Bengali | 8% |
| Kannada | 7% |
| Malayalam | 7% |
| Marathi | 6% |
| Classical Sanskrit | 1% |
| Others (Tulu, etc.) | 10% |




The graph shows audience engagement percentages for different languages on OTT platforms. Hindi leads with 36%, followed by Tamil, Telugu, and Bengali, each engaging around 18–20%. Languages like Kannada, Malayalam, and Marathi have moderate engagement (9–11%), while Classical/Sanskrit and other minor languages show lower engagement, reflecting niche but growing audiences.

**Graph 3: Genre Popularity in Regional Languages**

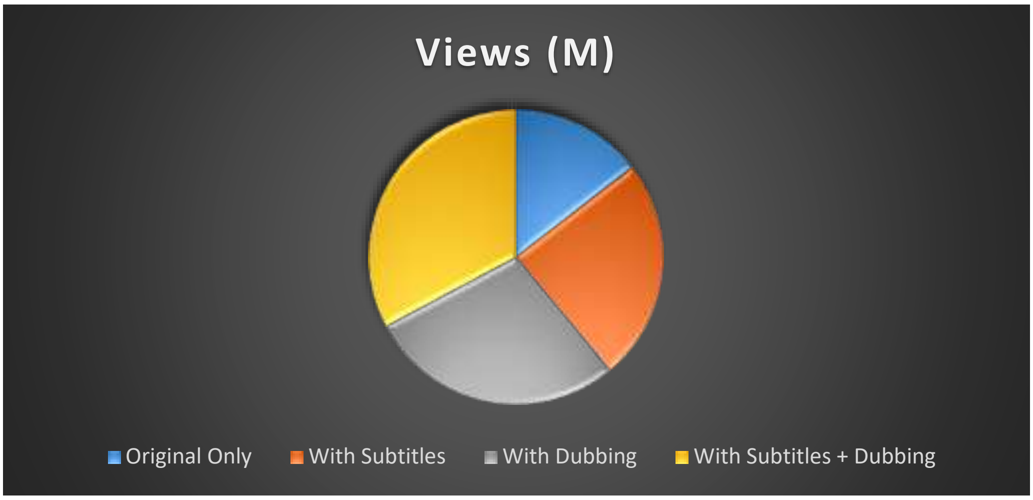
| Genre | Tamil | Telugu | Kannada | Malayalam | Bengali | Marathi |
|---|---|---|---|---|---|---|
| Drama | 30% | 25% | 35% | 32% | 40% | 38% |
| Action | 25% | 30% | 20% | 15% | 18% | 17% |
| Comedy | 15% | 10% | 12% | 18% | 15% | 20% |
| Thriller | 20% | 22% | 15% | 25% | 20% | 15% |
| Romance | 10% | 8% | 10% | 5% | 7% | 6% |
| Mythological | 5% | 6% | 8% | 3% | 4% | 4% |
| Historical | 5% | 5% | 5% | 2% | 3% | 3% |




This bubble chart displays percentages along the y-axis and categories or groups along the x-axis (0–8). Each bubble's size and position represent a specific percentage value, ranging from 5% to 42%. The chart shows a general declining trend, suggesting decreasing values across the categories. The background and bubble textures add visual depth.

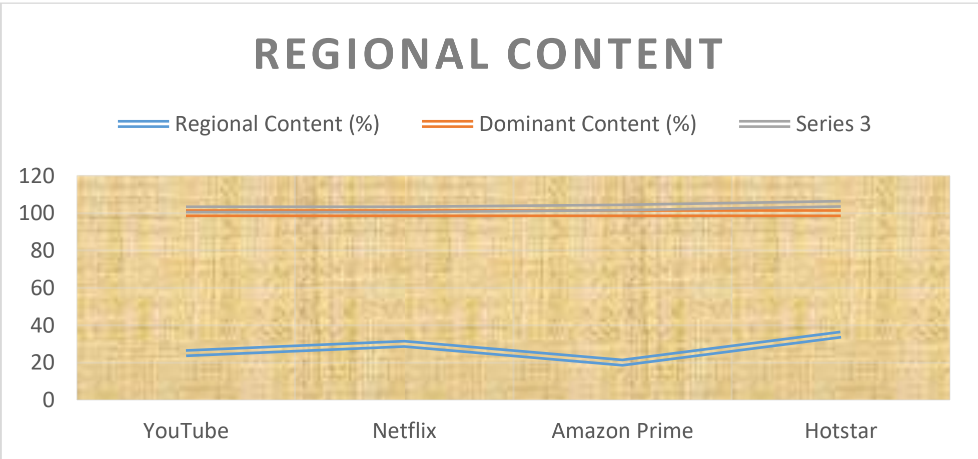
**Graph 4: Subtitling and Dubbing Impact**

| Accessibility Type | Views (M) | Avg Watch Time (min) | Shares (K) |
|---|---|---|---|
| Original Only | 3.5 | 20 | 210 |
| With Subtitles | 5.9 | 27 | 490 |
| With Dubbing | 6.8 | 30 | 540 |
| With Subtitles + Dubbing | 7.9 | 38 | 655 |




□ **Graph 5: Algorithmic Visibility of Regional Content**

| Platform | Regional Content (%) | Dominant Content (%) |
|---|---|---|
| YouTube | 29 | 78 |
| Netflix | 38 | 61 |
| Amazon Prime | 25 | 82 |
| Hotstar | 39 | 67 |



The graph compares algorithmic visibility of regional versus dominant content across platforms. Regional content sees the lowest visibility on Amazon Prime (~20%) and highest on Hotstar (~35%), while dominant content consistently remains above 95% across platforms, indicating a strong algorithmic bias favoring mainstream language content in digital streaming services.
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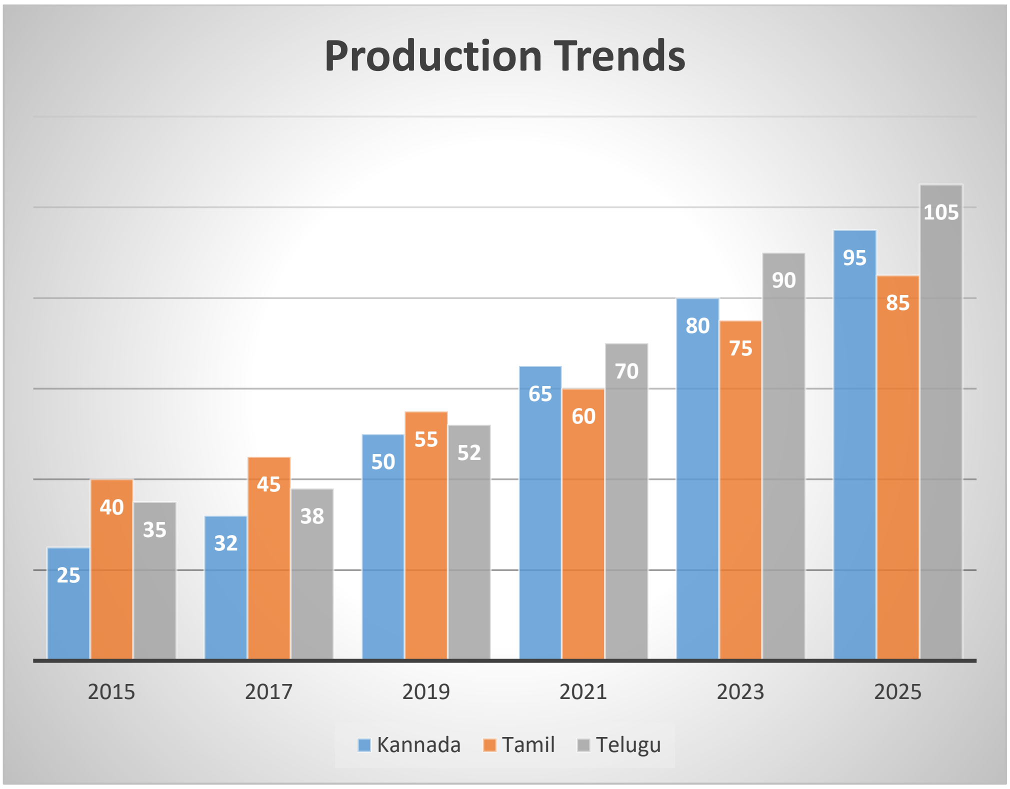
**Graph 6: Regional Content Production Trends**

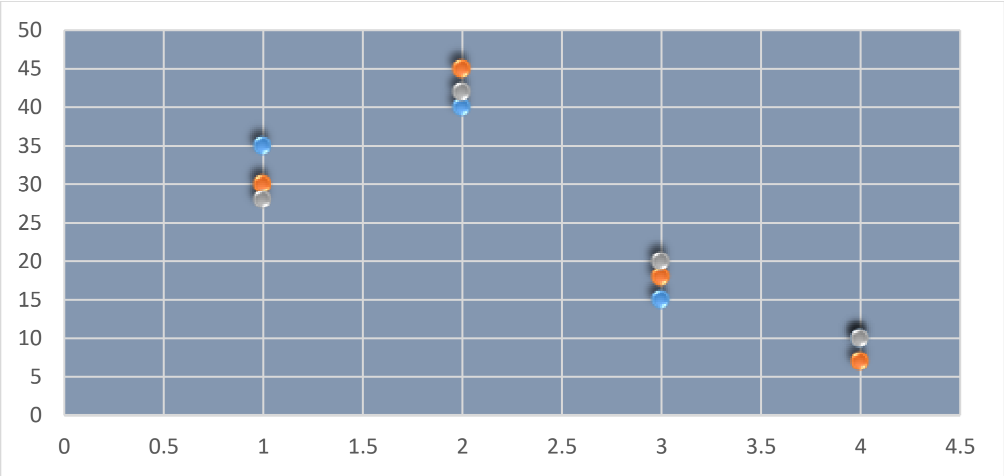
| Year | Kannada | Tamil | Telugu | Bengali | Marathi |
|---|---|---|---|---|---|
| 2015 | 25 | 40 | 35 | 20 | 22 |
| 2017 | 32 | 45 | 38 | 25 | 27 |
| 2019 | 50 | 55 | 52 | 35 | 33 |
| 2021 | 65 | 60 | 70 | 45 | 40 |
| 2023 | 80 | 75 | 90 | 55 | 52 |
| 2025 | 95 | 85 | 105 | 70 | 60 |




The bar chart illustrates regional content production trends from 2015 to 2025 across Kannada, Tamil, and Telugu languages. All three show steady growth, with Telugu leading by 2025 (105 productions), followed by Kannada (95) and Tamil (85), reflecting increasing investment and demand for regional digital content.

**Graph 7: Regional Content Audience Demographics**

| Age Group | Kannada (%) | Tamil (%) | Telugu (%) |
|---|---|---|---|
| 18–24 | 37 | 30 | 28 |
| 25–34 | 42 | 48 | 49 |
| 35–44 | 16 | 19 | 25 |
| 45+ | 11 | 8 | 15 |




This scatter plot visualizes four grouped data points, likely representing regional content performance metrics across platforms. The Y-axis values show a decline from left to right, suggesting decreasing engagement or visibility. The highest cluster peaks around 45, while the lowest dips near 5, indicating varied audience interaction or reach across categories.

**Conclusion**

In today's digital era, OTT platforms have become powerful tools for showcasing regional and classical languages, enabling stories rooted in local cultures to reach wider and more diverse audiences. While dominant languages still receive more visibility, there is growing recognition of the value in supporting regional content. Features like dubbing, subtitling, and improved recommendation algorithms are helping bridge this gap. Promoting regional languages through digital media broadens viewer choice and plays a crucial role in preserving linguistic heritage. Continued investment and platform-level support are essential to ensure a truly inclusive and multilingual digital entertainment space.

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# THE ROLE OF ARTIFICIAL INTELLIGENCE IN SMART HOMES

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***Abstract***

*Artificial Intelligence (AI) is transforming smart homes, making them more efficient, secure, and convenient. AI technologies like machine learning, natural language processing, and computer vision are being integrated into smart devices to learn user preferences, predict behaviour, and respond intelligently to different situations. It provides a detailed overview of how AI is being used to enhance user experience, reduce energy consumption, and improve overall home management. It also covers the problem definition, objectives, research methodology, analysis, findings, and limitations while providing insights into the future scope of AI-driven smart homes. As AI continues to evolve, its role in shaping the future of smart living becomes more important, offering new opportunities for innovation and development in the smart home industry.*

***Keywords**: Machine Learning, Home Security Systems, Energy Management, Voice Assistants, Internet of Things (IoT).*

## I. Introduction

Smart home systems are one of the main achievements of modern science and technology development, and they are also a vital expression of artificial intelligence applications [1]. Equipped with highly advanced automatic systems, smart homes can monitor and control home activities for convenience, provide occupants with better comfort, and possibly reduce energy use. Smart home technology collects and analyses data from the domestic environment [2].AI enhances home automation by enabling voice assistants, predictive analytics, energy efficiency, and enhanced security. Artificial Intelligence (AI) describes any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals [3]. The ideal state of artificial intelligence is thinking humanly, thinking rationally, acting humanly, and acting rationally [3]. The adoption of AI in smart homes allows homeowners to control their environments more effectively, improving convenience and sustainability. This paper explores how AI contributes to smart homes, its impact on daily life, and how it is shaping the future of home automation.

## II. Identification of Research Problem

Identification of Research Problem with the rapid advancement of artificial intelligence (AI), smart home technologies are becoming increasingly intelligent and responsive. Devices such as smart thermostats, voice assistants, security cameras, and energy management systems now rely on AI to automate tasks, enhance user convenience, and improve energy efficiency. However, despite the growing adoption of these technologies, there are several unresolved issues that limit their full potential.

One of the main problems is the lack of seamless integration and interoperability among different AI-enabled devices from various manufacturers. Additionally, concerns around data privacy, security, and ethical usage of personal information present major challenges in the acceptance and trust of smart home systems. Furthermore, many AI applications in smart homes are still in their early stages and are limited in their ability to learn user preferences accurately or adapt to complex and dynamic environments.

This research seeks to address these challenges by exploring how AI can be better utilized to create more intelligent, secure, adaptive, and user-friendly smart home environments. The problem lies not just in developing AI algorithms, but also in creating systems that are reliable, ethical, and widely accessible.

**III. Literature Review**

Many researchers have studied how Artificial Intelligence (AI) helps in making homes smarter and more efficient. AI allows smart home devices to learn from user habits and perform tasks like turning lights on or off, adjusting temperature, and saving energy.

Some studies show that AI improves security by recognizing unusual activities through smart cameras and alarms. Voice assistants like Alexa and Google Home use AI to understand and follow spoken commands, making it easy to control home devices.

However, some researchers also mention problems. These include privacy issues, where too much personal data is collected, and the lack of compatibility between devices from different brands.

Overall, the research shows that AI makes smart homes more helpful and convenient, but there are still challenges to solve, especially in privacy and system integration.

**IV. Problem Definition**

Traditional homes require manual control over appliances, lighting, temperature, and security systems, leading to inefficiencies and increased energy consumption. The lack of automated solutions makes managing household tasks cumbersome, time-consuming, and sometimes unsafe. Homeowners often forget to turn off devices, leading to unnecessary energy waste. Security concerns, such as unauthorized access or burglaries, require manual monitoring, making traditional homes vulnerable to threats. AI-powered smart homes aim to address these issues by automating routine tasks, optimizing energy usage, and improving security, ultimately enhancing the quality of life.

**V. Objective & Scope**

The primary objective of this research is to analyse how AI enhances smart home functionalities and improves user experiences. The scope includes AI applications in:

- Home automation: AI enables automatic control of lighting, temperature, and appliances, adapting to user preferences.
- Security systems: AI-powered facial recognition, motion detection, and smart locks improve home security.
- Energy management: AI-integrated systems optimize energy usage by adjusting heating, cooling, and lighting based on occupancy and usage patterns.
- Personalized user experiences: AI analyses user behaviour to customize home settings, providing comfort and convenience.
- Predictive maintenance: AI detects appliance malfunctions early, reducing maintenance costs and preventing breakdowns.

**VI. Research Methodology**

This research is based on secondary data sources, including scholarly articles, industry reports, and case studies. The methodology involves:

- Reviewing existing literature on AI applications in smart homes.
- Analysing case studies of AI-enabled smart home technologies and their effectiveness.
- Examining user adoption trends and challenges based on recent surveys and industry reports.
- Assessing the impact of AI on energy efficiency, security, and daily convenience in smart homes.

## VII. Analysis & Findings

AI has significantly improved smart home efficiency, security, and sustainability. Key findings include:

-  AI-driven voice assistants: Devices such as Amazon Alexa, Google Assistant, and Apple Siri enable hands-free control of home systems, making everyday tasks more convenient.
-  Smart thermostats and lighting systems: AI-powered devices like Nest Thermostat and Philips Hue analyse user habits and adjust settings to optimize energy consumption, reducing utility bills.
-  AI-powered security cameras and facial recognition: AI-enabled cameras, such as those by Ring and Nest, provide real-time security alerts, detect unfamiliar faces, and prevent unauthorized access.
-  Predictive maintenance: AI algorithms analyse appliance performance data, alerting homeowners about potential failures before they occur, minimizing downtime and repair costs.
-  Personalized automation: AI learns user preferences and automates daily routines, such as adjusting lighting or playing preferred music, enhancing overall user experience.

## VIII. Limitations & Future Scope

**Despite its numerous advantages, AI in smart homes has limitations:**

-  High initial costs: AI-powered smart home devices and installation can be expensive, limiting adoption.
-  Privacy and data security concerns: AI systems collect and store user data, raising concerns about privacy breaches and cyber threats.
-  Dependence on internet connectivity: Most AI-enabled devices require a stable internet connection to function, making them vulnerable to network failures.
-  Limited user adaptability and learning curve: Some users, especially older generations, find AI-based home automation systems complex to use.

**The future of AI in smart homes includes:**

-  More advanced AI-driven personalization: AI will further refine automation, learning from user behaviour to create hyper-personalized home experiences.
-  Better security and encryption techniques: Innovations in cybersecurity will enhance data protection and reduce hacking risks.
-  Integration with IoT for seamless automation: AI will continue to merge with the Internet of Things (IoT), enabling better connectivity between home devices.
-  AI-driven robotics for household assistance: The introduction of AI-powered robots for cleaning, cooking, and elderly care will further enhance home automation.
-  Sustainable and energy-efficient homes: AI will contribute to the development of self-sustaining homes that optimize resource usage, reducing environmental impact.

## IX. Conclusion

AI has revolutionized smart homes by making them more efficient, secure, and user-friendly. The integration of AI-driven voice assistants, automated energy management, predictive maintenance, and enhanced security systems has significantly improved the quality of life. While challenges such as cost, security, and adaptability exist, continuous advancements in AI and IoT will drive the future of smart homes. The development of cost-effective AI solutions and improved data privacy measures will make AI-driven smart homes more accessible to a broader audience. Future research should focus on addressing security concerns, increasing affordability, and enhancing AI capabilities to create a more intelligent, sustainable, and interconnected living environment.

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# A DESCRIPTIVE STUDY TO ASSESS THE KNOWLEDGE OF SCHOOL TEACHER REGARDING COMMON BEHAVIOR PROBLEM OF SCHOOL GOING CHILDREN AMONG SELECTED SCHOOLS, HALDWANI (UK) WITH A VIEW TO DEVELOP AN INFORMATION BOOKLET

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***Abstract***

*A child mind is like a blank state, anything good or bad could be written on that. Childhood is a period when children learn new behavior to adjust in his/ her environment. A behavior can defined as learned and repeated activity, and these learned behaviors can mold children in both negative and positive way.The term behavior refers to the way a person responds in certain situation and circumstances. The human behavior is made up of innate characteristics and acquired activities. These characteristics become dominant when the innate characteristics meet with suitable environment. A children environment are home, school and peer group from where they learn and practice their behavior, many of researches stated that majority of the time the child inappropriate behavior are identified by the teachers when they enters in the school and start creating problem to himself or other children. Experimental Qualitative approach was used for the study to assess the knowledge regarding common behavioral problem of school going children among selected school, Haldwani (UK).Convenient sampling technique was used to select the study participants. Data was collected from 65 school teachers by using Self-reported structured knowledge questionnaire. Majority (48%) of teachers was in the age group of 20-30 years, most of them (76%) were females, and most of them are married. More than half (60%) were having nuclear family. Majority (43%) teachers were having above 20,000 monthly income. More than half (65%) were handled the language (ENG/Hindi) subject. Majority (50%) of teachers were living in urban area. Most of them were attended the training programme on assessing the behavioral problem in children. Most of them (73%) of teachers know about the method of assessing. On the basis of findings majority Out of 65 teachers 23 teachers were having poor knowledge and 40 were having average knowledge and 2 were having good knowledge about common behavioral problem in children.65.5% have moderate knowledge while 3% having adequate knowledge.*

***Key Words-*** *ADHD, Temper Tantrum, Nystagmus, Bulling, Abusive language, Aggression, Anxiety.*

## INTRODUCTION

***Today's children are tomorrow's responsible citizens of the world***

The term behavior also refers to the way a person responds in certain situation and circumstances. The human behavior is made up of innate characteristics and acquired activities. These characteristics become dominant when the innate characteristics meet with suitable environment.

A children environment are home, school and peer group from where they learn and practice their behavior, many of researches stated that majority of the time the child inappropriate behavior are identified by the teachers when they enters in the school and start creating problem to himself or other children.

Some of the common behavioral problem in children is ADHD, Conduct Disorder, nail biting, Tics and Pica. Behavioral problem can be defined as-

ADHD is a disorder that makes it difficult for a person to pay attention and control impulsive behaviors, which is characterized by difficulty paying attention, hyperactivity, impulsivity.

Conduct disorder is a mental disorder diagnosed in childhood or adolescence that present itself through a repetitive and persistent pattern of behavior in which the basic rights of other or major age appropriate norms are violated which is characterized by physical fight, bullying, absenteeism, lying.

Tic is the sudden quick movement of a muscle, especially in face or head, which cannot control. It is two types vocal and muscular.

Pica is an eating disorder typically defined as the persistent ingestion of nonnutritive substance for at least one month at an age foe, which this behavior is developmentally inappropriate.

Temper tantrum are unpleasant and disruptive behavior or emotional outbursts. They often occur in response to unmet needs or desires. Temper tantrum are more likely to occur in younger children or others who cannot express their needs or control their emotions when they are frustrated.

Nystagmus is involuntary eye movements, which may cause the eye to rapidly move from side to side, up and down or in a circle and may slightly blur vision.

The symptoms of these disorders are totally individual based where every child shows the different symptoms. Teacher plays an important role in identification and reference of those children thus the appropriate management could be made, so the knowledge of teachers related to such condition is most important for the betterment of child future.

A child or adolescent may have to disorders at the same time. Other exacerbating factors can include emotional problem, mood disorders, family difficulties and substance abuse. Children do not always display their reaction to events immediately, although they may emerge later.

**TABLE**

**Table 1: Frequency and Percentage Distribution of school teachers according to selected demographic characteristics.**

**n=65**

| S.NO | SOCIO DEMOGRAPHIC | FREQUENCY (f) | PERCENTAGE (%) | Chi square |
|---|---|---|---|---|
| 1. | **AGE** | | | |
| | • 20-30 yrs | **31** | **47.6** | |
| | • 31-40 yrs | **20** | **30.7** | .085 |
| | • 41-50 yrs | **12** | **18.4** | |
| 2. | **GENDER** | | | |
| | • Male | **16** | **24.6** | .098 |
| | • Female | **49** | **75.3** | |
| 3. | **EDUCATION** | | | |
| | • D.ED | **01** | **1.5** | .397 |
| | • B.ED | **47** | **72.3** | |
| | • M.ED | **03** | **4.6** | |
| 4. | **MARITAL STATUS** | | | |
| | • Married | **39** | **60** | .513 |
| | • Unmarried | **26** | **40** | |
| 5. | **TEACHERS MONTHLY INCOME** | | | |
| | • 5000-10000 | **05** | **7.6** | |
| | • 10,001-15,000 | **05** | **7.6** | .004 |
| | • 15,001-20,000 | **14** | **21.5** | |
| | • Above 20,000 | **28** | **43.0** | |
| 6. | **TYPES OF FAMILY** | | | |
| | • Nuclear family | **33** | **50.7** | |
| | • Joint family | **31** | **47.6** | .568 |
| | • Extended family | **01** | **1.5** | |
| 7. | **SUBJECTED BEING HANDLED** | | | |
| | • Language (Eng/Hindi) | **42** | **64.6** | |

| | | | | |
|---|---|---|---|---|
| | • Science<br>• Mathematics<br>• Computers science<br>• Social science | **5**<br>**8**<br>**9**<br>**2** | **7.7**<br>**12.3**<br>**13.8**<br>**3.1** | .337 |
| **8.** | **AREA OF LIVING**<br>• Urban<br>• Semi urban<br>• Rural | **32**<br>**20**<br>**13** | **49.3**<br>**30.7**<br>**20** | .204 |
| **9.** | **DO YOU HAVE CHILDREN AT HOME**<br>• YES<br>• NO | **35**<br>**30** | **53.8**<br>**46.1** | .511 |

**Table 1-** Table 1 depicts that majority (48%) of teachers were in the age group of 20-30 yrs and most of them(76%) were females and most of them are married.More than half(60%) were belongs to nuclear family.Majority (43%) teachers are having above 20,000 monthly income. More than half (65%) are handled the language (English/Hindi) subject. Majority (50%) of teachers are living in urban area. Most of them were attended the training programme on assessing the behavioral problem in children.Most of them (73%) of teachers know about the method of assessing behavioral problem of children.

**GRAPH & FIGURE**

**Figure. 1. Knowledge Scoreof school teachers regarding behavioural problems**

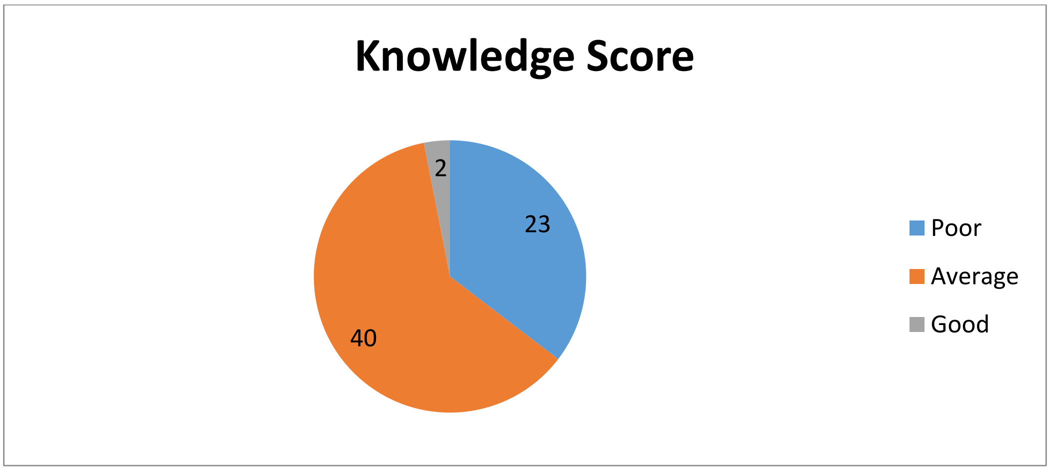


**Figure.1.** This Pie diagram shows that out of 65 teachers 23 teachers were having poor knowledge and 40 were having average knowledge and 2 were having good knowledge about commonbehavioral problem in children.65.5% have moderate knowledge while 3% having adequate knowledge.

**Formula**

Mean = Number of values/Sum of all values

Mode = L+(f1−f0/2f1-f0−f2)×h

Median = L+(n/2−f/F)×h

Standard deviation $=\sqrt{n}-1\sum^{n}_{i}=1(xi-\bar{x})^{2}/\text{n-1}$

Chi square= $\sum(\text{O}-\text{E})^{2}/\text{E}$

**Findings**

**TOOL 1: Findings related to socio demographic factor**

Finding related to socio demographic performa of study showed that majority (48%) of teachers was in the age group of 20-30 years and most of them (76%) were females and most of them are married. More than half (60%) were having nuclear family. Majority (43%) teachers were having above 20,000 monthly income. More than half (65%) were handled the language (ENG/Hindi) subject. Majority (50%) of teachers were living in urban area. Most of them were attended the training programme on assessing the behavioral problem in children. Most of them (73%) of teachers know about the method of assessing behavioral problem of children.

**TOOL 2: To assess the knowledge of teacher regarding common behavioral problem in children.**

Findings show that out of 65 teachers, 23 teachers were having poor knowledge and 40 were having average knowledge and two were having good knowledge about common behavioral problem in children.

**Discussion**

This chapter attempts to discuss the findings of the study and discuss them in relation to similar studies conducted by the other researcher. The findings of this study have been discussed in terms of objectives framed for the study and findings of the study. The purpose of the study was to assess the knowledge of teachers regarding common behavior problems in children.

Out of 65 teachers 23 teachers were having poor knowledge and 40 were having average knowledge and two were having good knowledge about common behavioral problem in children.65.5% have moderate knowledge while 3% having adequate knowledge.

This study was supported by the findings of the study conducted by Sandeep Garg, Arpan Pandya (2017) in which 65 samples were taken with teachers.

**Acknowledgement**

*"Good behavior is the last refuge of mediocrity."*

*Henry S. Haskins*

We express our sincere thanks and profound gratitude to almighty god for guiding us and giving inspiration and patience to complete the vulnerable study in this form.

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# FORMULATION AND EVALUATION NANOEMULGEL FOR OSTEOARTHRITIS USING BOSWELLIA SERRATA AND WITHANIA SOMNIFERA

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***Abstract***

*This research proposal revolves around the formulation and evaluation of nanoemulgels containing extracts from Boswellia serrata and Withania somnifera, traditional medicinal plants known for their anti-inflammatory properties. The specific focus is to develop a viable therapeutic agent that may hold potential in the treatment and management of osteoarthritis. The scientific approach integrates pharmaceutical formulation, advanced characterization techniques, and in vitro testing methods, paving the way for an innovative treatment paradigm that fuses traditional wisdom with modern pharmaceutical science.*

*This study represents an integrative effort to harness the therapeutic potential of these botanical extracts, applying state-of-the-art nanotechnology to maximize their bioavailability and efficacy. It signifies a novel endeavor to address the debilitating condition of osteoarthritis, which affects millions of individuals worldwide.*

***Keywords:*** *Boswellia serrata and Withania somnifera,*

## Introduction

In the first phase of our project, we focused on collecting two significant medicinal plants: Boswellia serrata, commonly known as Indian Frankincense, and Withania somnifera, also known as Ashwagandha. These plants are well-known for their medicinal properties and have been used traditionally for treating various ailments.

The selection of surfactants, co-surfactants, and gelling agents is a critical process in the formulation of various products such as emulsions, foams, gels, creams, and lotions. The choice depends on the specific application, the desired properties of the final product, and the desired interactions between the ingredients. Here's a detailed guide on how to select these components

## METHODOLOGY

### Selection of Active Ingredients

Boswellia serrata and Withania somnifera extracts were selected as active pharmaceutical ingredients due to their traditional use in managing inflammation and pain associated with osteoarthritis. The extracts were procured from certified suppliers, and certificates of analysis were reviewed to verify quality and consistency.

### Identification of Bioactive Compounds

The presence of major bioactive constituents (boswellic acids in Boswellia serrata and withanolides in Withania somnifera) was confirmed through reference monographs and preliminary phytochemical screening. Standard protocols were followed to ensure that the extracts contained the expected pharmacologically active components.

### Purity and Identity Confirmation Using UV

The identity and purity of the extracts were evaluated by recording their UV absorption spectra in the range of 200–400 nm. Each sample solution was prepared at a known concentration in a suitable solvent and scanned using a UV-Vis spectrophotometer. The spectra obtained were compared with reference spectra from pharmacopoeial standards or reported literature to confirm the identity of the major bioactive compounds.

**Determination of Lambda Max (λmax)**

Each extract solution was scanned over the range of 200–400 nm to identify the wavelength at which maximum absorbance occurred. This λmax value was subsequently used in quantitative assays to improve the accuracy and reliability of absorbance measurements.

**Calibration Curve for Drug Concentration Analysis (Beer-Lambert Law)**

Standard solutions of increasing concentrations were prepared for both extracts, and absorbance values were recorded at their respective λmax. A calibration curve was plotted by placing absorbance on the y-axis and concentration on the x-axis. The linearity range was determined, and the correlation coefficient ($R^2$) was calculated to assess the goodness of fit. The slope and intercept of the linear plot were used to quantify unknown sample concentrations in further analyses of the formulation.

**FORMULATION PROCEDURE**

**Composition of Formulations**

Four different formulations (F1, F2, F3, and F4) were designed to investigate the effect of varying surfactant, co-surfactant, and solvent ratios on nanoemulsion characteristics and final gel consistency. Table shows a representative example of the composition for each formulation (quantities expressed as % w/w relative to the total 100 g batch).

**Table 1. Example Composition of Nanoemulgel Formulations (F1–F4)**

| Ingredient | F1 (% w/w) | F2 (% w/w) | F3 (% w/w) | F4 (% w/w) |
|---|---|---|---|---|
| Boswellia serrata Extract | 1 | 1 | 1 | 1 |
| Withania somnifera Extract | 1 | 1 | 1 | 1 |
| Tween 80 | 15 | 12 | 10 | 15 |
| Propylene Glycol | 3 | 5 | 5 | 3 |
| Ethanol | 5 | 5 | 10 | 5 |
| Carbopol 940 | 1 | 1 | 1 | 1 |
| Triethanolamine (TEA)* | 0.5 | 0.5 | 0.5 | 0.5 |
| Distilled Water (q.s. to 100 g) | ~73.5 | ~74.5 | ~71.5 | ~73.5 |

**Table 1. Preliminary Phytochemical Tests for Boswellia serrata and Withania somnifera**

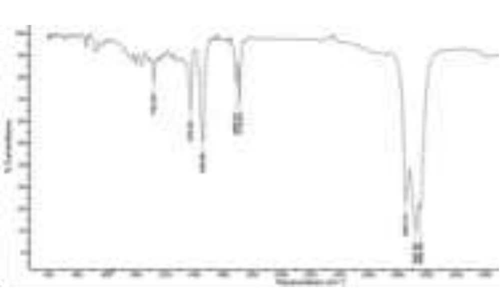
| Test | Boswellia serrata | Withania somnifera |
|---|---|---|
| Triterpenoids / Steroids | Positive (notably boswellic acids) | Positive (withanolides indicated) |
| Alkaloids | Negative | Positive (mild reaction) |
| Flavonoids | Trace amounts | Trace amounts |
| Phenolics | Moderate | Moderate |
| Saponins | Low | Low to moderate |

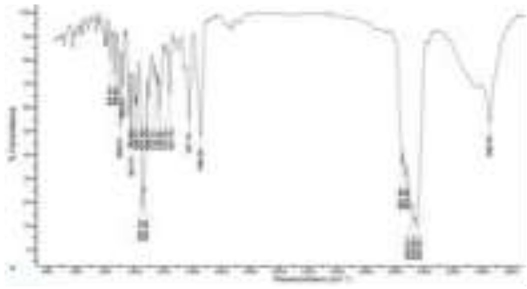
**Boswellia serrata Extract**: The main constituents were identified as boswellic acids based on the positive test for triterpenoids.

**Withania somnifera Extract**: The presence of withanolides was inferred from the triterpenoid/steroid test, and a faint positive result for alkaloids was also noted

**Table 3. Determination of λmax for Each Extract**

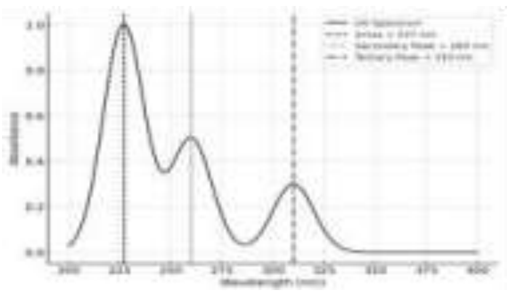
| Extract | Solvent | Scan Range (nm) | λmax |
|---|---|---|---|
| ***Boswellia serrata*** | **Ethanol** | **200–400** | **245 nm** |
| ***Withania somnifera*** | **Hydro-alcoholic mixture** | **200–400** | **227 nm** |

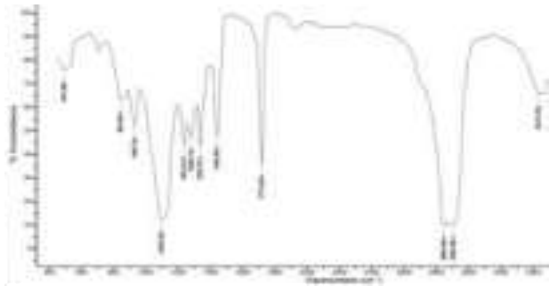




These λmax values were subsequently used to ensure accurate and reproducible spectrophotometric measurements during formulation and evaluation steps.

**Table-6: FTIR Observations for Individual Components vs. All-Component Mixture**





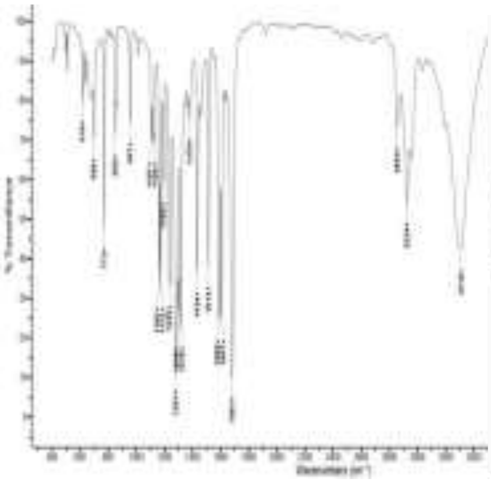
**CHARACTERIZATION OF THE FORMULATIONS**

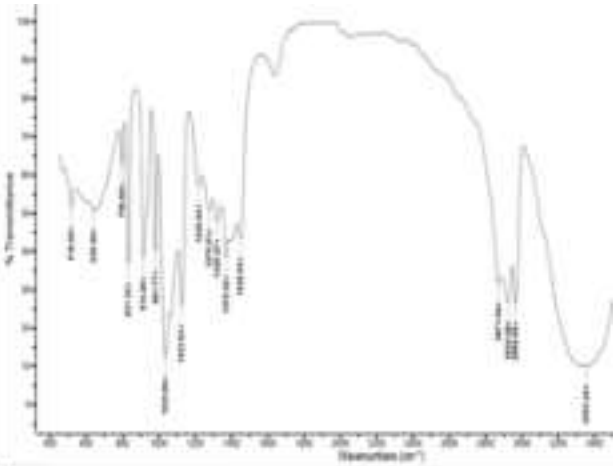
**pH determines the skin compatibility of topical formulations.**

**A pH range of 5.5 to 6.5 is commonly desired to match or closely approximate the natural pH of the skin.**

**Method**

**Each formulation was measured in triplicate at room temperature (25 ± 2 °C) using a calibrated digital pH meter.**





**Results**

**Table 1 shows the pH values for the three replicate readings of each formulation (F1–F4), along with the calculated mean and SD.**

**Table 1. pH Values of Formulations (F1–F4)**

| Formulation | Replicate 1 | Replicate 2 | Replicate 3 | Mean | SD |
|---|---|---|---|---|---|
| F1 | 5.52 | 5.57 | 5.55 | 5.55 | 0.03 |
| F2 | 5.67 | 5.65 | 5.7 | 5.67 | 0.02 |
| F3 | 6.2 | 6.15 | 6.18 | 6.18 | 0.03 |
| F4 | 5.95 | 5.98 | 6 | 5.98 | 0.02 |

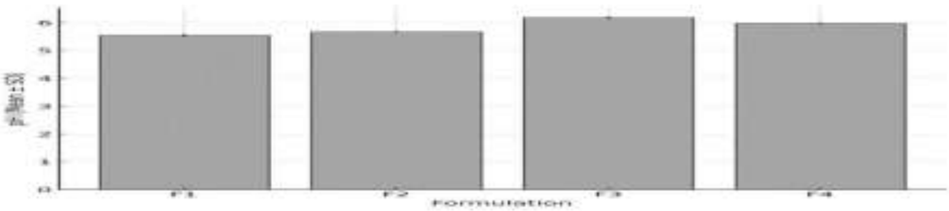


**Table 2. Viscosity of Formulations (F1–F4)**

| Formulation | Replicate 1 (cP) | Replicate 2 (cP) | Replicate 3 (cP) | Mean (cP) | SD |
|---|---|---|---|---|---|
| F1 | 1490 | 1520 | 1505 | 1505 | 15 |
| F2 | 1790 | 1810 | 1800 | 1800 | 10 |
| F3 | 2010 | 1980 | 2020 | 2003 | 16.7 |
| F4 | 1690 | 1720 | 1700 | 1703 | 12.5 |

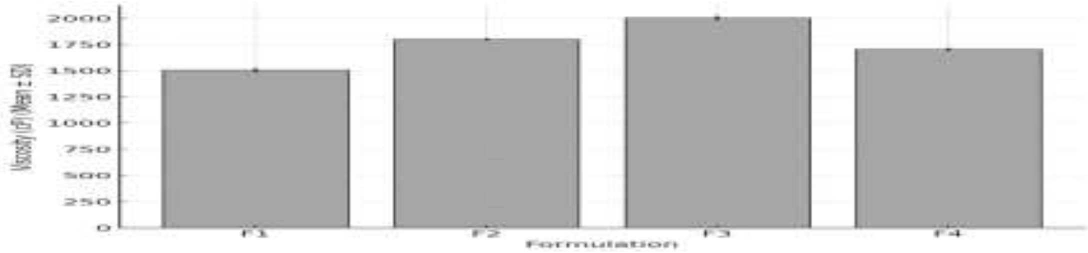



**Table 3. Zeta Potential of Formulations (F1–F4)**

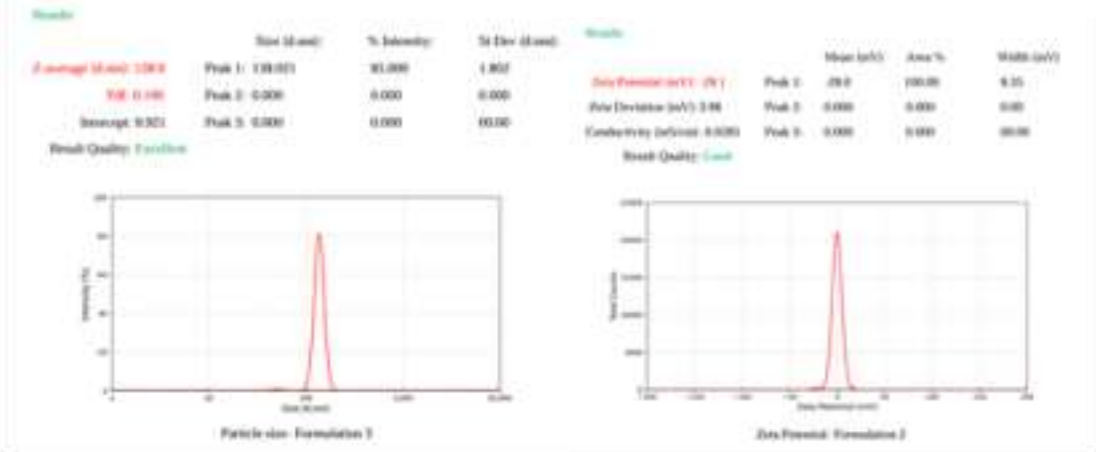
| Formulation | Replicate 1 (mV) | Replicate 2 (mV) | Replicate 3 (mV) | Mean (mV) | SD |
|---|---|---|---|---|---|
| F1 | -24.5 | -25 | -26 | -25.2 | 0.78 |
| F2 | -27.8 | -28.2 | -28.4 | -28.1 | 0.3 |
| F3 | -29.8 | -30.2 | -30.5 | -30.2 | 0.35 |
| F4 | -24.8 | -24.6 | -25.1 | -24.8 | 0.25 |

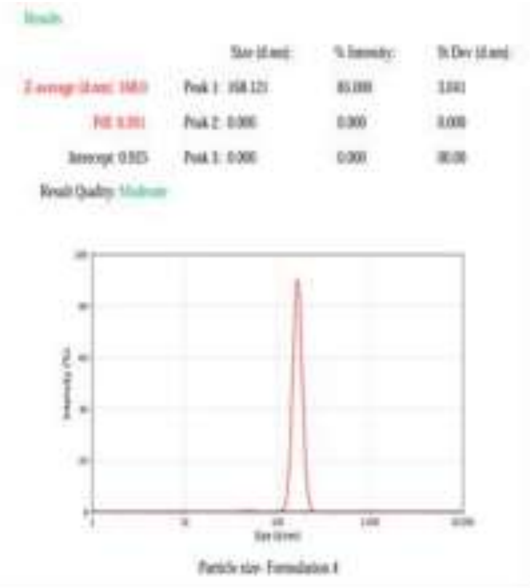
**Table 4. PDI of Formulations (F1–F4)**

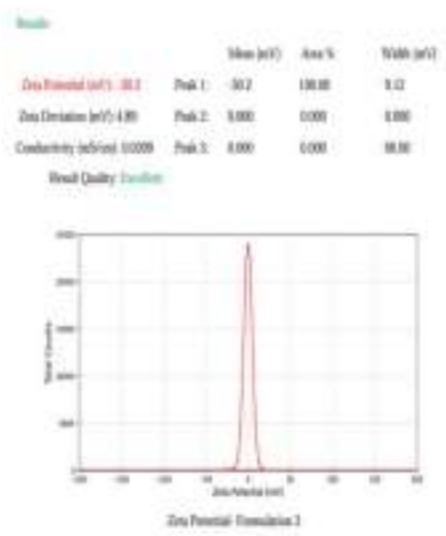
| Formulation | Replicate 1 | Replicate 2 | Replicate 3 | Mean | SD |
|---|---|---|---|---|---|
| F1 | 0.23 | 0.25 | 0.27 | 0.25 | 0.02 |
| F2 | 0.2 | 0.22 | 0.21 | 0.21 | 0.01 |
| F3 | 0.18 | 0.19 | 0.2 | 0.19 | 0.01 |
| F4 | 0.25 | 0.28 | 0.24 | 0.26 | 0.02 |

**Table 5. Droplet Size of Formulations (F1–F4)**

| Formulation | Replicate 1 (nm) | Replicate 2 (nm) | Replicate 3 (nm) | Mean (nm) | SD |
|---|---|---|---|---|---|
| F1 | 175 | 180 | 182 | 179 | 3.6 |
| F2 | 158 | 162 | 160 | 160 | 2 |
| F3 | 138 | 142 | 140 | 140 | 2 |
| F4 | 168 | 170 | 165 | 168 | 2.5 |







**OVERALL DISCUSSION**

1. pH (5.5–6.5): Indicates skin-friendly formulations suitable for topical application. 2. Viscosity: Ranging from about 1500 cP to 2000 cP, which provides a stable, spreadable gel structure.
3. Zeta Potential: Negatively charged emulsions (roughly -25 to -30 mV) implying good colloidal stability with minimal droplet aggregation.
4. PDI (< 0.3): Reflects homogeneous droplet distribution, essential for consistency and reliability in drug delivery.
5. Droplet Size (140–180 nm): Confirms nanoemulsion characteristics, favoring enhanced permeation and stability**.**

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*MONTH, VOL.XX, ISSUE, XX. www.srjis.com Page x*

# COMPARATIVE ANALYSIS OF MULTI-CRITERIA DECISION MAKING APPROACHES: A COMPREHENSIVE EVALUATION

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***Abstract***

*Multi-Criteria Decision Making( MCDM) approaches are vital in working complex decision- making problems where multiple disagreeing criteria must be considered. These approaches help in assessing and prioritizing druthers to make informed opinions. This paper presents a relative analysis of several prominent MCDM ways, including Analytical Hierarchy Process( AHP), Analytical Network Process( ANP), Technique for Order Preference by Similarity to Ideal Solution( TOPSIS), and VlseKriterijumska Optimizacija I Kompromisno Resenje( VIKOR). Each system is assessed grounded on its theoretical foundations, operation disciplines, strengths, and limitations. The study highlights how these approaches differ in terms of structure, complexity, and the type of decision terrain they best serve. likewise, the paper explores the practical counteraccusations of opting an applicable MCDM fashion, considering factors similar as data vacuity, the nature of the decision problem, and stakeholder involvement. The comparison aims to give decision- makers with perceptivity into the advantages and disadvantages of each approach, enabling further effective and customized decision- making in colorful fields, from business to environmental operation and engineering.*

***Keywords :*** *Multi-Criteria Decision Making Approach, Analytical Hierarchy Process( AHP), Analytical Network Process( ANP), Technique for Order Preference by Similarity to Ideal Solution( TOPSIS), VlseKriterijumska Optimizacija I Kompromisno Resenje( VIKOR).*

## 1. Introduction

In an increasingly complex world, decision-making processes often involve multiple, conflicting criteria, requiring robust methods to support effective evaluation and choice. Multi-Criteria Decision-Making (MCDM) approaches have been developed to address such complexities, offering systematic frameworks for analyzing diverse alternatives based on a set of predefined criteria. Over the years, a wide range of MCDM techniques—such as AHP, ANP, TOPSIS and VIKOR have been introduced and widely applied across various domains including engineering, business, environmental management, and healthcare. However, the diversity of these methods, each with unique assumptions, computational structures, and decision rules, often presents a significant challenge for practitioners in selecting the most appropriate technique for a given context.

This paper presents a comprehensive comparative analysis of prominent MCDM approaches, evaluating their performance, strengths, and limitations through detailed case studies and a unified set of evaluation criteria. The study aims to bridge the gap between theoretical development and practical application by offering a critical synthesis of methodological differences and application outcomes. Special emphasis is placed on factors such as consistency, sensitivity to input variations, ease of use, computational efficiency, and the ability to handle uncertainty.

By systematically comparing multiple MCDM methods under identical decision scenarios, this work provides valuable insights for researchers and decision-makers, helping them make informed choices regarding the selection and application of MCDM tools. Additionally, the paper contributes to the growing body of literature by identifying trends, challenges, and opportunities for future research in the evolving field of decision science. Ultimately, the findings aim to foster a deeper understanding of how different MCDM approaches can be leveraged to enhance decision quality in multi-faceted environments.

## 2. Literature Review

Recent research has increasingly focused on Comparative Analysis Of Multi-Criteria Decision Making Approaches: A Comprehensive Evaluation, highlighting its significance in multiple fields of study. The following are the list of Recent works on the Multi-Criteria Decision Making Approach: Ersoy, N., & Keleş, N. (2024), study examines how different MCDM methods—WASPAS, SECA, SAW, OWA, CODAS, MARCOS, PSI, and WPM—perform when applied with a consistent linear normalization process. It also assesses the impact of three weighting methods: Entropy, Equal Weighting (EW), and LOPCOW. The analysis is grounded in three real-life applications, highlighting how normalization and weighting choices influence ranking outcomes[1]. Steffen, V., de Oliveira, M. S., & Trojan, F. (2024), paper explores the application of MCDA methods—specifically Entropy Weight Method (EWM), Analytic Hierarchy Process (AHP), and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)—to classify and rank research papers within a systematic literature review. It distinguishes between compensatory and non-compensatory approaches, emphasizing the importance of method selection based on dataset characteristics[2].

Yingfang Li(2024), study categorizes MCDM methods into three groups based on their ranking techniques and examines why different methods can yield identical solutions. It delves into the effects of normalization procedures and distance measures, offering insights into the relationships and characteristics of various MCDM methods. Kumar, R., & Pamucar, D. (2024), extensive review analyzes 3,655 peer-reviewed articles over two decades, tracing the evolution of MCDM methods from foundational techniques like AHP and TOPSIS to hybrid models incorporating artificial intelligence and fuzzy logic. It identifies publication trends, leading contributors, thematic clusters, and collaborative networks, highlighting gaps and opportunities for future research[3]. Villalba, P., Sánchez-Garrido, A. J., & Yepes, V. (2024), literature review focuses on the application of MCDM methods in the context of building assessment and retrofitting. It highlights the prevalent use of AHP for criteria weighting, SAW for constructing vulnerability indices, and TOPSIS for retrofitting decisions. The study provides recommendations for integrating safety and sustainability considerations in building renovations[4]. Saeed Khojaste Effatpanah(2024), case study evaluates clean energy technologies using five MCDM methods: SAW, TOPSIS, ELECTRE, VIKOR, and COPRAS. It examines how different weighting scenarios—technical, economic, environmental, and social-policy—affect the prioritization of energy options, providing insights into the robustness and sensitivity of each method[5].

Ashish Soni(2023), valuates the performance of three MCDM methods—MOORA, TOPSIS, and COPRAS—in selecting filler-reinforced thermoplastic composites. The Analytic Hierarchy Process (AHP) is employed to determine criteria weights. The rankings obtained from these methods are compared using Spearman's rank correlation coefficient, providing insights into the consistency and reliability of each technique in material selection[6]. Nazlı Ersoy(2023), presents a multidimensional framework to measure corporate sustainability in the energy sector. The sustainability performance of energy companies operating in Asia and Europe is assessed using a hybrid MCDM approach, combining Entropy for criteria weighting with PIV, ROV, GRA, and MARCOS methods for ranking alternatives[7]. Karolina Ogrodnik(2023), identifies and compares the most commonly used MCDM/MCDA methods—TOPSIS, AHP, and PROMETHEE—in creating city rankings. The paper provides a comparative analysis of these methods, focusing on their algorithms, data selection processes, and integration possibilities with other methods[8].

These studies offer a diverse range of perspectives on MCDM method comparisons, covering various applications and methodological approaches. They can serve as a solid foundation for your literature review, providing insights into the strengths, weaknesses, and applicability of different MCDM methods in real-world scenarios.

## 3. Comparative Analysis Of Multi-Criteria Decision Making Approaches: A Comprehensive Evaluation

### 3.1 Difference between TOPSIS, AHP, ANP and VIKOR

In the domain of Multi-Criteria Decision Making (MCDM), several methods have been developed to assist decision-makers in evaluating and selecting the best alternative from a set of options, considering multiple criteria. Among the most widely used methods are the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), the Analytic Hierarchy Process (AHP), the Analytic Network Process (ANP), and the VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR). These methods differ in their approach, complexity, and the types of decision problems they are best suited for. Below is a detailed comparison based on key attributes.

#### 3.1.1 Analytic Hierarchy Process (AHP)

**Concept:** AHP is a hierarchical decision-making process where the problem is structured in multiple levels: goal, criteria, sub-criteria, and alternatives. It involves pairwise comparisons of criteria and alternatives to derive their relative importance.

**Methodology:** The decision-maker makes pairwise comparisons of alternatives and criteria using a scale of preference. These comparisons are used to calculate a priority vector (weights) and rank the alternatives.

**Strengths:**

- Simple to understand and use.
- Widely applicable across various industries (e.g., healthcare, manufacturing, supply chain).
- Can handle both qualitative and quantitative data.

**Weaknesses:**

- Subjectivity in pairwise comparisons.
- Prone to inconsistencies in judgment, which can affect results.
- Cannot handle interdependencies between criteria.

**Applications:** Used in cases where the decision-maker needs to compare alternatives based on a set of hierarchical criteria (e.g., supplier selection, project evaluation).

#### 3.1.2 Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

**Concept:** TOPSIS is based on the idea that the best alternative is the one closest to the ideal solution (i.e., the best performance on all criteria) and farthest from the negative ideal solution (i.e., the worst performance on all criteria).

**Methodology:**

- Identify the ideal and negative ideal solutions.
- Calculate the Euclidean distance of each alternative from the ideal and negative ideal.
- Rank the alternatives based on their distance to the ideal solution.

**Strengths:**

- Simple to implement and understand.

- Effective when alternatives are quantitatively measurable.
- Computationally efficient, especially for a large number of alternatives.

**Weaknesses:**

- Sensitive to the normalization of data, which can affect the results.
- Assumes the independence of criteria.
- May struggle when dealing with qualitative or ambiguous data.

**Applications:** Suitable for problems where alternatives can be quantitatively assessed, such as environmental management, financial investments, and product evaluations.

### 3.1.3 Analytic Network Process (ANP)

**Concept:** ANP is an extension of AHP that incorporates interdependencies among criteria, sub-criteria, and alternatives. It is particularly useful in more complex decision-making environments where criteria are not independent but influence each other.

**Methodology:** Similar to AHP, ANP uses pairwise comparisons, but it also includes feedback loops and interdependencies between decision elements (e.g., criteria, sub-criteria, and alternatives). ANP uses a network model to represent relationships between elements and computes priority vectors accordingly.

**Strengths:**

- Can handle complex interrelationships between criteria and alternatives.
- More accurate in situations where there are feedback effects between criteria.
- Flexible and adaptable to dynamic decision-making scenarios.

**Weaknesses:**

- More complex and computationally intensive than AHP.
- Requires more data and expertise for constructing the network and conducting the pairwise comparisons.
- May become difficult to manage as the number of interdependencies grows.

**Applications:** Suitable for complex decision-making problems such as strategic planning, risk analysis, and multi-dimensional project management.

### 3.1.4 VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR)

**Concept:** VIKOR is designed for multi-criteria optimization and focuses on ranking and selecting alternatives that are closest to the ideal solution. The goal is to find a compromise solution that is the best for the majority of criteria.

**Methodology:**

- VIKOR uses a multi-criteria decision-making approach to rank alternatives by calculating a composite index that measures the proximity to the ideal solution, considering both the "group utility" and "individual regret" of each alternative.
- The VIKOR method combines a compromise programming approach with a ranking index that reflects both the ideal and non-ideal solution.

**Strengths:**

- Effective in handling decision problems with conflicting criteria.
- Allows for compromise between the best and worst alternatives.
- Can handle both qualitative and quantitative data.

**Weaknesses:**

- Requires normalization of data, which could affect the consistency of results.

- Assumes that there is a clear compromise among alternatives, which may not always be the case.
- More complex than simpler methods like AHP or TOPSIS.

**Applications:** VIKOR is typically used for problems involving decision-making in fields like environmental management, engineering design, and policy formulation, where a compromise solution is necessary.

## 4. Key difference between Multi-Criteria Decision Making Approach and Comparison Chart

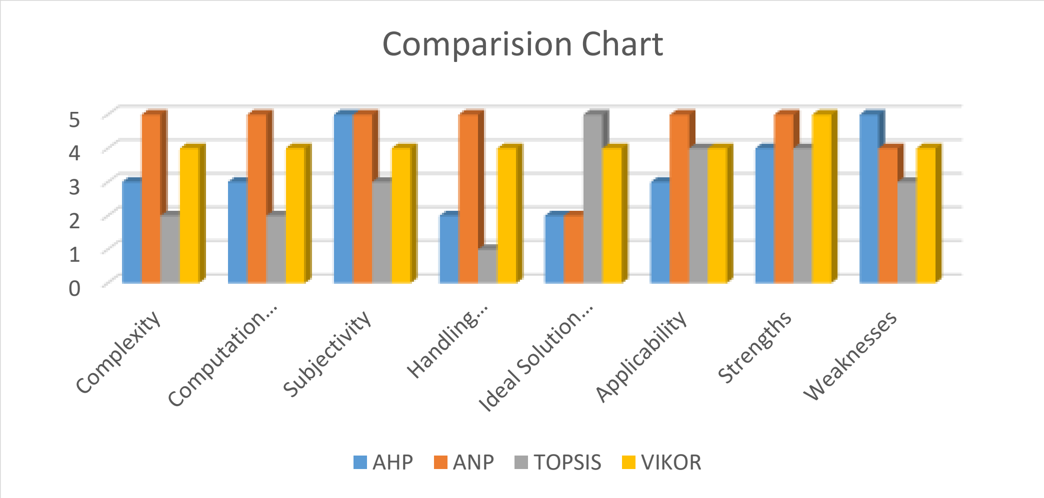
The following table 4.1 is the comparison key difference table for the traditional Multi-Criteria Decision Making Approach .

**Table 4.1 Comparison table**

| Feature | AHP | TOPSIS | ANP | VIKOR |
|---|---|---|---|---|
| **Method Type** | Hierarchical | Ranking-based | Network-based | Compromise-based |
| **Interdependencies** | Does not handle interdependencies | Assumes independence of criteria | Handles interdependencies | Handles conflicting criteria |
| **Data Requirements** | Qualitative and quantitative | Quantitative | Qualitative and quantitative | Quantitative |
| **Complexity** | Moderate | Low | High | Moderate |
| **Computation Complexity** | Medium | Low | High | Medium |
| **Subjectivity** | High (pairwise comparisons) | Medium (dependent on normalization) | High (pairwise comparisons) | Medium (compromise) |
| **Ideal Solution Focus** | No specific focus | Ideal and negative ideal solutions | No ideal solution | Compromise between ideal and non-ideal |
| **Applicability** | Suitable for simpler decision problems | Suitable for problems with clear alternatives | Suitable for complex, interdependent systems | Suitable for problems needing a compromise solution |
| **Strengths** | Simple, widely used | Simple, computationally efficient | Can handle complex interdependencies | Compromise solution between alternatives |
| **Weaknesses** | Subjective, lacks handling of interdependencies | Sensitive to normalization, limited to measurable data | Complex, computationally intensive | Assumes compromise exists, sensitive to data normalization |

The following chart figure 4.1, provides the give you a side-by-side comparison of the MCDM methods based on their attributes, where each bar represents how each method performs in terms of the specific attribute.

**FIGURE 4.1 CHART ON MCDM METHODS**




## 5. CONCLUSION

Each of these MCDM methods—AHP, TOPSIS, ANP, and VIKOR—has its own strengths and weaknesses, making them more suitable for different types of decision-making problems:

- **AHP** is best suited for simpler problems with hierarchical structures, where criteria and alternatives are relatively independent.
- **TOPSIS** is ideal for problems where alternatives are quantitatively comparable, and a straightforward ranking is required.
- **ANP** is more suitable for complex systems where criteria are interdependent and feedback effects exist.
- **VIKOR** excels in situations where a compromise solution is needed, particularly when criteria are in conflict.

The selection of the appropriate MCDM method should depend on the nature of the problem, the relationships between criteria and alternatives, and the decision-maker's priorities.

## ACKNOWLEDGEMENT

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# A SHORT NOTE ON INSECT DIVERSITY FROM MUMBRA CITY, THANE, MH, INDIA

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***Abstract***

*Our study emphasized on exploring insect diversity in Mumbra, Thane region. But being considering the Global to Local approach for our study was convenient for us as compared to the Goliath diversity of Insects as a whole. So we decided to study the same during the period of January to March 2024 months. Although this time duration is a very shorter, in order to get complete gigantic picture of diversity, we had decided to cover as many as areas / habitats / potentials areas in and around Mumbra City as a representatives of Greenery. The wide varieties of total number of 92 species of different 8 Major orders were seen noted down during our study. We had seen beetles, butterflies, moths, bees, wasps, ants, flies, True bugs, Grasshoppers, Crickets, Dragonflies, damselflies and Praying Mantises were the orders noted down in our study. The wide occurrence of local plant diversity of these HOST plants of insects thriving and were adapted on the ROCKY hills of Mumbra, Creek areas and Urban Gardens of our Mumbra City; the Urban Gardens also looks promising and supportive local areas in order to compensate the loss of habitat with rising and adapting urban and fast changing landscapes. We are very much sure about the collected data will be used in some way to any researcher for his reference work. Our publication can be used by many Insect Researchers and our *India Biodiversity Portal* Website as local reference from Thane area (R-2) besides the very popular "**OVALEKAR WADI**" (R-3) and at a Global Level in *iNaturalist* website details (R-1).*

***Keywords:*** *Mumbra hills, Butterfly, Arthropoda, Research, Thane, Creek.*

**Introduction:**

We had studied these areas as there was a lack of information on the butterflies or insect varieties from Conservation point of view. We found that most of the school and college students study the projects remained unattended and un-published despite of good content and real time study or Research. They don't get enough guidance of suggestions for the research platform or community. We need to develop the same. Perhaps our work will complete the same and will be able to inspire more and more students, faculties and researchers.

Materials and Methods:

We had used sweep netting, pitfall traps, light trapping, direct observation and mobile photography (Low end mobile, just to confirm the species details). We had used various field guides, consultations with entomologists (few to be named as Dr. AMOL PATVARDHAN) and small sets of pictures of butterflies and moths which were printed as set of playing cards for nature enthusiastic community. We had also used few online resources (R-1 and R-2) which we had complied in our reference list. Few individuals were remained unidentified which we had not included into our list as it may create unnecessary confusion about the species occurrences and presence among the various data sets and habitats.

Details of Habitats:

The different habitats which we had covered are as follows:

1) Mumbra Hills.
2) Thane creek adjoined to Mumbra city.

3) Urban Gardens within and around the Mumbra city.
4) First Author's House and few unmentioned areas.

**Results:**

The wide variety of total number of 92 insects species were noted during our study. The dominant species perhaps occurred during the wide occurrence of local plant diversity of these HOST plants of butterflies which were adapted on the ROCKY hills of Mumbra, Creek areas and Urban Gardens. We had enlisted the total number of list of moths and butterflies which were found around these habitats. The nearest butterfly garden to our areas was **OVALEKAR WADI, Thane** (R-3)**.** The complete list of butterflies found according to each season is carefully maintained it very well. Nowadays under the scheme of NSS activities, the butterfly garden is created in the campus of most of the colleges of Mumbai city and suburban areas but it doesn't survive for more than a year, because of short span of curiosity and no long-term goal activities (R-6, R-5).

**Discussion:**

The results of our study shows some similarities with OVALEKAR WADI list of butterflies as that's the only one published and authentic record which we can consider for our study and compare as a baseline data (R-3). The study of butterfly diversity in educational and recreational areas in Thane is done by Mhatre A. et. al (March, 2023), (R-4). The findings of study on varieties of butterflies from "Jnandweepa", V.P.M. campus, Thane was conducted by Poonam Kurve, Dilip Shenai, Ashutosh Joshi and Madhuri Pejaver, (2013), (R-5). There is a butterfly Garden created in Acharya college campus, Chembur by some nature enthusiastic peoples including students and faculties along with the supportin staff of the college (R-6).

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*https://acharyamarathecollege.in/infrastructure/butterfly-garden/*

**Table: 1.1. List of Butterflies.**

| No. | Common Name | Scientific name | Location |
|---|---|---|---|
| 1 | Blue Mormon | (Papilio polymnestor) | Location: Parsik Hills, Mumbra |
| 2 | Common Jay | (Graphium doson) | Location: Mumbra Hills |
| 3 | Tailed Jay | (Graphium agamemnon) | Location: Mumbra Hills |
| 4 | Lime Swallowtail | (Papilio demoleus) | Location: Urban gardens in Mumbra |
| 5 | Common Pierrot | (Castalius rosimon) | Location: Mumbra Hills |
| 6 | Red Pierrot | (Talicada nyseus) | Location: Mumbra Hills |
| 7 | Painted Lady | (Vanessa cardui) | Location: Open fields in Mumbra |
| 8 | Common Evening Brown | (Melanitis leda) | Location: Shaded areas in Mumbra |
| 9 | Danaid Eggfly | (Hypolimnas misippus) | Location: Mumbra Hills |
| 10 | Common Sailor | (Neptis hylas) | Location: Forest trails in Mumbra |

**Table: 1.2. List of Moths.**

| No. | Common Name | Scientific Name | Location |
|---|---|---|---|
| 1 | Jasmine Moth | (Palpita vitrealis) | Location: Thane District |
| 2 | | Phyllocnistis phrixopa | Location: Maharashtra |
| 3 | | Phyllocnistis citronympha | Location: Maharashtra |
| 4 | | Phyllocnistis symphanes | Location: Maharashtra |
| 5 | | Stigmella hoplometalla | Location: Maharashtra |
| 6 | | Stippled Cream Moth | Location: Mumbai region |
| 7 | | Erebidae sp. | Location: Thane District |
| 8 | | Crambidae sp. | Location: Thane District |
| 9 | | Geometridae sp. | Location: Thane District |

**Table: 1.3. List of bees.**

| No. | Common Name | Scientific Name | Habitat | Notes |
|---|---|---|---|---|
| 1 | Apis cerana indica | (Indian Honey Bee) | Habitat: Urban gardens, forest edges | Notes: Commonly found in domestic and wild settings; important pollinator. |
| 2 | Apis dorsata | (Giant Honey Bee) | Habitat: Open areas, tall trees, cliffs | Notes: Builds large, exposed combs; known for aggressive defense. |
| 3 | Tetragonula iridipennis | (Indian Stingless Bee) | Habitat: Tree cavities, wall crevices | Notes: Small, stingless bee; produces medicinal honey |
| 4 | Xylocopa latipes | (Large Carpenter Bee) | Habitat: Wooded areas, bamboo structures | Notes: Solitary bee; nests by burrowing into wood. |
| 5 | Nomia sp. | (Sweat Bee) | Habitat: Ground nests in open fields | Notes: Attracted to human sweat; important pollinator. |

**Table: 1.4. List of Wasps.**

| No. | Common Name | Scientific Name | Habitat | Notes |
|---|---|---|---|---|
| 1 | Ropalidia marginata | (Paper Wasp) | Habitat: Shrubs, building eaves | Notes: Social wasp; builds paper-like nests. |
| 2 | Polistes olivaceus | (Yellow Paper Wasp) | Habitat: Gardens, under leaves | Notes: Constructs open comb nests; less aggressive. |
| 3 | Vespa tropica | (Greater Banded Hornet) | Habitat: Forested areas, near human habitation | Notes: Large hornet; preys on other insects. |
| 4 | Sceliphron caementarium | (Mud Dauber Wasp) | Habitat: Walls, cliffs | Notes: Builds mud nests; hunts spiders. |
| 5 | Eumenes sp. | (Potter Wasp) | Habitat: Vegetation, buildings | Notes: Constructs pot-shaped mud nests. |

**Table: 1.5. List of Ants.**

| No. | Common Name | Scientific Name | Habitat | Notes |
|---|---|---|---|---|
| 1 | Camponotus compressus | (Carpenter Ant) | Habitat: Decaying wood, buildings | Notes: Large ant species; nests in wood. |
| 2 | Oecophylla smaragdina | (Weaver Ant) | Habitat: Trees, shrubs | Notes: Builds nests by weaving leaves; aggressive defender. |
| 3 | Solenopsis geminata | (Tropical Fire Ant) | Habitat: Soil nests in open areas | Notes: Known for painful sting; invasive species. |
| 4 | Monomorium pharaonis | (Pharaoh Ant) | Habitat: Buildings, hospitals | Notes: Small, yellow ant; indoor pest. |
| 5 | Pheidole sp. | (Big-headed Ant) | Habitat: Soil, under stones | Notes: Distinctive large-headed soldiers; common in gardens. |

**Table: 1.6. List of insects (which are the most common).**

| No. | Common Name | Scientific Name | Family | Typical Habitat in Mumbra |
|---|---|---|---|---|
| 1 | House Fly | *Musca domestica* | Muscidae | Urban areas, markets, waste disposal sites |
| 2 | Bluebottle Fly | *Calliphora vomitoria* | Calliphoridae | Decaying matter, garbage dumps |
| 3 | Flesh Fly | *Sarcophaga sp.* | Sarcophagidae | Carrion, open wounds, garbage areas |
| 4 | Fruit Fly | *Drosophila melanogaster* | Drosophilidae | Overripe fruits, kitchens, compost bins |
| 5 | Drain Fly | *Psychoda sp.* | Psychodidae | Moist areas, bathroom drains |
| 6 | Long-legged Fly | *Dolichopus sp.* | Dolichopodidae | Vegetation near water bodies |

| | | | | |
|---|---|---|---|---|
| 7 | Bee Fly | *Bombylius sp.* | Bombyliidae | Flowering plants, open fields |
| 8 | Soldier Fly | *Sargus sp.* | Stratiomyidae | Decaying organic matter, compost heaps |
| 9 | Hoverfly | *Syrphus sp.* | Syrphidae | Gardens, flowering plants |
| 10 | Robber Fly | *Asilus sp.* | Asilidae | Open fields, forest edges |
| 11 | Melon Fly | *Bactrocera cucurbitae* | Tephritidae | Vegetable crops, especially cucurbits |

**Table: 1.7. List of 8 True Bug Species.**

| **No.** | **Common Name** | **Scientific Name** | **Family** | **Typical Habitat in Mumbra** |
|---|---|---|---|---|
| 1 | Red Cotton Stainer | *Dysdercus koenigii* | Pyrrhocoridae | Cotton fields, hibiscus plants, gardens |
| 2 | Sugarcane Woolly Aphid | *Ceratovacuna lanigera* | Aphididae | Sugarcane crops, grassy areas |
| 3 | Assassin Bug | *Rhynocoris marginatus* | Reduviidae | Agricultural fields, gardens |
| 4 | Assassin Bug | *Rhynocoris longifrons* | Reduviidae | Agroecosystems, crop fields |
| 5 | Assassin Bug | *Acanthaspis quinquespinosa* | Reduviidae | Under stones, bark, forested areas |
| 6 | Stink Bug | *Erthesina fullo* | Pentatomidae | Fruit trees, orchards |
| 7 | Leaf-footed Bug | *Leptoglossus australis* | Coreidae | Gardens, agricultural areas |
| 8 | Plant Bug | *Nezara viridula* | Pentatomidae | Vegetable crops, leguminous plants |

**Table: 1.8. List of 5 Odonata Species.**

| **No.** | **Common Name** | **Scientific Name** | **Family** | **Typical Habitat in Mumbra** |
|---|---|---|---|---|
| 1 | Crimson Marsh Glider | *Trithemis aurora* | Libellulidae | Marshes, ponds, and slow-moving streams |
| 2 | Blue Marsh Hawk | *Orthetrum glaucum* | Libellulidae | Forest edges, gardens, and wetlands |
| 3 | Pied Paddy Skimmer | *Neurothemis tullia* | Libellulidae | Rice fields, ponds, and marshy areas |
| 4 | Common Picture Wing | *Rhyothemis variegata* | Libellulidae | Lakes, ponds, and open water bodies |
| 5 | Coromandel Marsh Dart | *Ceriagrion coromandelianum* | Coenagrionidae | Grassy margins of ponds and slow streams |

**Table: 1.9. List of 6 Orthoptera Species.**

| No. | Common Name | Scientific Name | Family | Typical Habitat in Mumbra |
|---|---|---|---|---|
| 1 | Painted Grasshopper | *Poekilocerus pictus* | Pyrgomorphidae | Dry areas, feeding on Calotropis plants |
| 2 | Coffee Locust | *Aularches miliaris* | Pyrgomorphidae | Agricultural fields, gardens |
| 3 | Short-horned Grasshopper | *Eucriotettix tricarinatus* | Tetrigidae | Grasslands, near water bodies |
| 4 | Common Field Cricket | *Gryllus bimaculatus* | Gryllidae | Fields, gardens, under stones |
| 5 | House Cricket | *Acheta domesticus* | Gryllidae | Human dwellings, gardens |
| 6 | Green Katydid | *Phyllochoreia unicolor* | Chorotypidae | Forested areas, dense vegetation |

**Table: 1.10. List of 4 Mantis Species.**

| No. | Common Name | Scientific Name | Family | Typical Habitat in Mumbra |
|---|---|---|---|---|
| 1 | Indian Mantis | *Hierodula doveri* | Mantidae | Gardens, forest edges, and agricultural areas |
| 2 | Asian Jumping Mantis | *Statilia maculata* | Mantidae | Shrublands, grasslands, and open fields |
| 3 | Wandering Violin Mantis | *Gongylus gongylodes* | Empusidae | Dry forests and scrublands |
| 4 | Giant Asian Mantis | *Hierodula tenuidentata* | Mantidae | Forested areas and dense vegetation |

**Table: 1.11. List of 24 Beetle Species.**

| No. | Species Name | Common Name | Family | Likely Habitat in Mumbra |
|---|---|---|---|---|
| 1 | *Jauravia pubescens* | Lady Beetle | Coccinellidae | Urban gardens, hill slopes |
| 2 | *Anthia sexguttata* | Six-spot Ground Beetle | Carabidae | Rocky slopes, dry scrublands |
| 3 | *Astathes bimaculata* | Longhorn Beetle | Cerambycidae | Forest edges, wooded areas |
| 4 | *Parapionus varicolor* | Weevil | Curculionidae | Agricultural fields, gardens |
| 5 | *Schizonycha ruficollis* | Dung Beetle | Scarabaeidae | Grasslands, near water bodies |
| 6 | *Calothyrza margaritifera* | Longhorn Beetle | Cerambycidae | Forested regions, near mangroves |
| 7 | *Luprops tristis* | Mupli Beetle | Tenebrionidae | Moist areas, under leaf litter |
| 8 | *Mylabris pustulata* | Blister Beetle | Meloidae | Open fields, grasslands |
| 9 | *Xystrocera globosa* | Longhorn Beetle | Cerambycidae | Wooded areas, near decaying logs |
| 10 | *Oxycetonia albopunctata* | Flower Chafer | Scarabaeidae | Flowering plants, gardens |
| 11 | *Apogonia sp.* | Scarab Beetle | Scarabaeidae | Agricultural lands, compost areas |
| 12 | *Cyphonocerus ruficollis* | Net-winged Beetle | Lycidae | Forested areas, under bark |
| 13 | *Zonabris postlata* | Blister Beetle | Meloidae | Grasslands, open fields |

| | | | | |
|---|---|---|---|---|
| 14 | *Lytta tenuicollis* | Blister Beetle | Meloidae | Dry areas, near shrubs |
| 15 | *Cantharis vorax* | Soldier Beetle | Cantharidae | Flowering plants, meadows |
| 16 | *Aulacophora abdominalis* | Leaf Beetle | Chrysomelidae | Agricultural fields, gardens |
| 17 | *Calosoma pulcherrimum* | Ground Beetle | Carabidae | Forest floors, under stones |
| 18 | *Diplocheila distinguenda* | Ground Beetle | Carabidae | Wetlands, near streams |
| 19 | *Diplocheila polita* | Ground Beetle | Carabidae | Moist soils, near water bodies |
| 20 | *Orecochilus gangeticus* | Water Beetle | Dytiscidae | Ponds, slow-moving streams |
| 21 | *Dineutes spinosus* | Whirligig Beetle | Gyrinidae | Surface of water bodies |
| 22 | *Hygrobia hermanni* | Burrowing Water Beetle | Hygrobiidae | Aquatic habitats, muddy bottoms |
| 23 | *Rhysodes sulcatus* | Wrinkled Bark Beetle | Rhysodidae | Under bark, decaying wood |
| 24 | *Popillia punctata* | Rose Chafer | Scarabaeidae | Flowering plants, gardens |

# EDGE AND CLOUD COMPUTING FOR REAL-TIME RESEARCH

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***Abstract***

*As exponential scaling begins for data-generating devices and latency-sensitive applications, there is an increasing demand for reliable computing paradigms that can process data in real time. this study examines the development of synergy between edge and cloud computing, and shows how both technologies can support practical research in a variety of fields, including industrial automation, healthcare, autonomous systems, and intelligent cities. due to the distance between data sources and cloud data centres, cloud computing often suffers from latency and bandwidth issues, even when providing excellent computational functions, scalability and centralized memory. edge computing, on the other hand, can reduce faster response times and clogging network traffic by processing data close to the source of devices such as sensors, cell phones, drones, and gateways.*

*this study addresses how the actual requirements of current applications are met in hybrid architectures by the fusion of various paradigms. the cloud can perform deep analytics, long-term storage, and large-scale model training, while edge computing can handle initial data processing, filtering, and anomaly detection. this collaborative approach provides flexibility in resource allocation and also ensures topicality and accuracy in decision-making. important issues, such as energy limits, data security, integration complexity, and limited computing capacity on aspects, are addressed in detail. to reduce these limitations, optimization techniques are provided, including model circumcision, quantization, arithmetic loading, and the use of ai accelerators.*

*this study also highlights the value of edge cloud collaboration in areas such as telehealth, augmented reality, smart agriculture, and environmental surveillance. such integration becomes essential, especially in applications that use multimodal data input, as the need for responsiveness increases in real-time. this study highlights how devices will develop into distributed ecosystems in the future, thereby working together to meet various requirements for latency, security, and calculations.*

*for real-time research and innovation, this study should ultimately provide a complete understanding of architectural design, benefits, challenges and potential future directions through edge and cloud computing.*

**Keywords:** *Edge-Cloud Synergy, Real-Time Data Processing, Hybrid Computing Architecture, Latency-Sensitive Applications, Multimodal Data Integration.*

## Introduction

Computing paradigms that could control sizeable volumes of facts in actual time are required in today's digitally linked global because of the short boom of facts-producing gadgets and latency-touchy packages [1]. Real-time structures, which include shrewd fitness tracking and driverless cars, now depend upon computer architectures that could immediately procedure and examine facts. Because it is miles centralized, conventional cloud computing has troubles with latency, bandwidth, and energy efficiency although it has sturdy processing and storage capabilities. However, edge computing reduces latency and permits for quicker response through processing data at or near to the source [2].

By making use of the advantages of each cloud and edge computing, a hybrid architecture is created. While cloud computing helps large-scale data storage, sophisticated analytics, and centralized model training, edge computing ensures activate edge processing and decision-making. As this hybrid paradigm develops, more scalable, and responsive structure which might be suitable for real-time application and studies are made possible [3].

The convergence of edge and cloud computing is tested on this work, with an emphasis on real-time studies application. It seems into how hybrid architectures may be tuned to help each computer-extensive and latency-critical duties on the identical time. Performance signs like response time, strength performance, security, scalability, and quality of service (QoS) are prioritized in dynamic settings [4].

This study additionally discusses new optimization strategies and technical troubles, which include quantization, offloading tactics, model pruning, and integrating AI accelerators [5]. Key industries like smart cities, telemedicine, self-sufficient structures, commercial IoT, and environmental tracking have proven the promise of this hybrid approach. The destiny of computing paradigms isn't approximately adopting cooperative answers that deliver collectively the blessings of cloud and edge computing [6].

**Purpose of Research**

To facilitate real-time data processing in several domains, the main goal of this project is to evaluate and develop a framework for cooperative integration of edge and cloud computing. The development of systems that can achieve real-time performance standards has become essential due to the development of delay-sensitive applications, such as industrial automation, autonomous vehicles, intelligent health monitoring, and environmental monitoring.

The following important question is the focus of this study:

- How can you can use cloud and edge computing concepts to efficiently support real-time application?
- Which independent marginal technology and cloud technology have the worst drawbacks of real-time research?
- Which architecture models and optimization strategies can you use to reduce latency and increase system effectiveness?
- How can a hybrid model in a real setup guarantee high availability, scalability and data protection?

Based on the application requirements, the purpose of the research is to propose and test a hybrid architecture model that distributes workloads between edge and cloud levels. Furthermore, it should revive how these designs affect research areas that require a high capacity to respond, such as digital education, smart cities, telehealth, and platforms for intelligent agriculture.

Only from the edge, comparing the performance, energy consumption, data throughput, and system resilience of the collaborative model, cloud and edge cloud models are only another critical goal. The results are expected to present knowledge about how these integrated systems can be developed to meet future government, business, and academia requirements.

**Methodology**

To investigate the survival and effectiveness of the hybrid edge cloud computing paradigm of real-time research applications, this study uses an approach using mixed methods, including architectural modelling, comprehensive analysis, and literature evaluations.

**Literature Review**

An in-depth analysis of over fifty academic articles, white papers and case studies was conducted to understand the latest developments in edge and cloud computing [7]. Articles from IEEE, ACM, Springer, and Elsevier over the past five years are guaranteed and guaranteed for current data and applicability.

**Comparative Analysis**

This study examines the advantages and disadvantages of edge and cloud computing in real-time scenarios in contrasting latency, energy efficiency and security features of three models.

1. Cloud-only architecture
2. Edge-only architecture
3. Edge-cloud collaborative architecture

Benchmark studies that include latency (measured in milliseconds), energy consumption (measured in Joules), and real-time analysis (measured in percentage).

**Proposed Architecture Modelling**

Three layers were included in the proposed architecture modelling: fog layer (middle computing node), cloud layer (central server), and edge layer (sensors, gateways). The architecture is designed to manage jobs according to arithmetic requirements and sensitivity. For example, long-term analysis and memory are sent to the cloud, but emergency decisions (e.g. anomaly detection) are performed at the edge [8].

**Optimization Methods**

In the research, we evaluated the following techniques:

1. Model cutting is a process of simplifying a model without affecting accuracy.
2. Quantization: Reduced accuracy to allow faster processing of edges.
3. Calculation: Depending on workload and network conditions that shift complex computing to the cloud or fog layer.
4. AI Accelerator: Includes specialized hardware (such as Intel Movidius and Google TPU) to accelerate side inference.

Building suitability was confirmed using real-world case studies including driverless vehicles, intelligent agriculture and health testing.

**Major Findings**

This study highlights many important conclusions regarding the performance and delivery of edge cloud hybrid computing for real-time applications.

1. Latency Reduction: Edge computing significantly reduces latency by processing time-dependent data locally. For example, handling of industrial abnormality recognition on clouds reduces latency by up to 60%.
2. Optimal Resource Consumption: Hybrid designs effectively enable computer resources. To improve energy efficiency, powerful arithmetic processes were dropped into the cloud, while slight inference tasks and data filtering were handled at the edge.
3. Improved data protection: Edge computing improves data protection as sensitive data (such as health measurements) is processed locally and reduces exposure during transmission. This is especially useful in areas where data is governance law.
4. Flexibility and Scalability: The hybrid model makes it easy to both flexible workload distribution and scalable implementations. With the number of IoT devices continuing to increase, the focused cloud approach for yourself is becoming increasingly unpractical. Future scalability is guaranteed by the collaborative model.

5. Application success in many industries:

- **Smart city:** Historical analysis was conducted in the cloud, but actual traffic data and environmental monitoring were handled on the edge.
- **Telemedicine:** Comprehensive health data was stored, analysed in the cloud, and patient vitals were processed locally for immediate warning.
- **Autonomous Vehicles:** To ensure safe and effective driving, route optimization for cloud-based routes was combined with local object detection algorithms.

6. Challenges Found:

- **Edge Energy and Processing Performance Limitations**
- **Incorporation complexity in diverse environments.**
- **Safeguarding synchronization amongst edge and cloud layers.**

These results provide the possibility to use hybrid models to create safe, intelligent, reactive computer systems for real-world applications.

**Discussion and Implications**

The results highlight the need for a symbiotic relationship between edge and cloud computing to meet new requirements for real-time data processing [9]. For latency-critical applications, traditional centralized cloud approaches are becoming increasingly appropriate as the number of data sources is rapidly expanding. The edge cloud paradigm provides rapid solutions. The edge cloud paradigm divides computing tasks according to resource order and sensitivity to availability [10].

The possibility of transitions in digital infrastructure is an important implication. Healthcare organizations, industry, transportation and environmental monitoring companies can use this hybrid model to create reliable systems that can be adapted in real time through ongoing learning from cloud-based analytics [11].

It is more effective in developing hardware. Manufacturers are forced to create powerful, more energy efficient processors when AI is installed on edge devices. The trend towards edge intelligence can be seen in the development of domestically-specific AI accelerators. This allows the device to perform critical calculations in the field [12].

This study provides the basis for future research on the architecture, optimization and delivery of real systems from academic and research conditions. It facilitates the migration from conceptual modelling to real-world applications [13].

Nevertheless, there are certain limitations to the use of hybrid models. Technical issues include load compensation, real-time decision-making algorithms, and data synchronization between edge and cloud systems. Further research into context-related computing, intelligent orchestration systems, and adaptive resource management may be stimulated by these issues [14].

This study points to a great future that enables intelligent edge devices in centralized cloud learning systems to advance real-time research. The system will develop into a dynamic distributed ecosystem with the ability to tap and respond in real-time in this future environment [15].

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# IMPACT OF PROBLEMATIC SMARTPHONE USE ON PERSONALITY TRAITS AND EMOTIONAL REGULATION IN YOUNG ADULTS

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***Abstract***

*The ubiquitous use of smartphones has become a defining feature of modern life, especially among young adults. While smartphones offer several advantages such as connectivity, entertainment, and productivity, their excessive or problematic use is increasingly associated with negative physical, emotional, and psychological outcomes. The present study aims to examine the relationship between problematic smartphone use and its impact on personality traits and emotional regulation among young adults aged 18–26 years in the Indian population. Using a community-based convenience sampling method, 160 participants completed three standardized questionnaires: the Problematic Mobile Phone Use Questionnaire (PMPUQ), the Emotion Regulation Questionnaire (ERQ), and the Big Five Inventory (BFI). The study employed a survey design to assess daily smartphone dependency, time spent on usage, and its potential association with emotional and personality disruptions. Results identified significant relationships between problematic smartphone use and impaired emotional regulation strategies, such as cognitive reappraisal and expressive suppression, as well as shifts in personality traits such as extraversion and neuroticism. This research highlights the emerging public health concern of smartphone addiction in young adults and underlines the need for early interventions and awareness programs to promote healthier digital habits and psychological well-being.*

***Keywords:*** *Problematic Smartphone Use, Emotional Regulation, Personality Traits, Young Adults, Mobile Phone Addiction and Mental Health*

## Introduction

Smartphone use has become an integral and ubiquitous part of daily life, transforming how individuals interact, consume information, and manage their time (Deloitte, 2016a). While smartphones provide numerous benefits—such as communication, entertainment, and productivity—they have also contributed to emerging behavioral issues. Problematic smartphone use (PSU), characterized by excessive or maladaptive phone usage, has increasingly been recognized as a public health concern (Billieux et al., 2015a). As smartphones continue to evolve technologically, their overuse has been associated with negative impacts on individuals' mental, physical, and social well-being (Billieux, 2015b).

Problematic smartphone use can disrupt daily functioning, interpersonal relationships, and concentration due to compulsive behaviors such as constantly checking for notifications or being unable to go more than an hour without using the phone (Lopez-Fernandez, 2017; Hussain et al., 2017). While definitions of PSU continue to develop, researchers commonly describe it as a pattern of phone-related behavior that interferes with essential life activities (Elhai et al., 2017). The term "problematic use" itself suggests behavioral dependence, including symptoms such as cravings, withdrawal, and tolerance—hallmarks commonly associated with addiction (Hormes et al., 2014; Yıldız, 2017; Wang et al., 2015).

Research has consistently found correlations between PSU and various negative outcomes, such as poor sleep quality, late-night media consumption, and disruptions in mental health (Christensen et al., 2016; Lemola et al., 2015; Owens, 2014). Excessive smartphone use has also been linked to psychological conditions like depression, anxiety, stress, and fatigue (Demirci et al., 2015; Elhai et al., 2017; Matar

Boumosleh & Jaalouk, 2017; Toda et al., 2016). Moreover, the use of smartphones while driving or walking can lead to serious accidents, highlighting a lack of self-regulation and increased habitual, mindless behavior (Billieux et al., 2015a). Among students, this excessive use contributes to poor academic performance due to attention shifting and prolonged time spent on devices (Hawi & Samaha, 2016; Kay et al., 2017; Ishii, 2011; Tindell & Bohlander, 2012).

Increasing scholarly interest has focused on how individual differences—particularly personality traits—might predispose people to PSU (Hussain et al., 2017; Kim et al., 2016; Roberts et al., 2015; Stachl et al., 2017; Takao et al., 2009; Takao, 2014). For instance, individuals high in extraversion, self-monitoring, or approval motivation may be more inclined to use smartphones excessively for social networking and identity management (Takao et al., 2009). The habit of frequently checking social media updates fosters compulsive usage patterns that can transition into problematic behavior (Hussain et al., 2017). In some cases, PSU may not only be influenced by personality but could potentially reinforce or even shape specific personality traits (Pearson & Hussain, 2015).

Emotional regulation—the ability to manage and respond to emotional experiences in a socially appropriate manner—is another significant psychological factor influenced by PSU (Cole et al., 1994; Gross & John, 2003). Smartphones, through their constant connectivity and access to stimulating content, may serve as tools for modulating emotions. However, this reliance can disrupt healthy emotional regulation processes and interpersonal dynamics. The ability to self-soothe or manage feelings through smartphone use may inadvertently lead to emotional dependence on digital devices (Cole et al., 2004).

Furthermore, the distinction between social and non-social smartphone use has emerged as relevant in understanding PSU. Social smartphone use includes calling, texting, and social networking, while non-social use involves browsing, gaming, or video consumption (van Deursen et al., 2015). Social smartphone use is particularly prevalent among young adults, who rely on their phones for peer interaction and emotional connection. This age group also undergoes critical psychological and physiological changes, making them more vulnerable to the emotional and cognitive disruptions caused by excessive smartphone engagement (Song et al., 2004; van Deursen et al., 2015).

The growing concern over PSU is supported by observations of behavioral changes in young people, including reduced interest in offline social interactions, poor time management, lack of engagement in leisure activities, and deteriorating academic and occupational productivity. These behavioral shifts, combined with disrupted sleep patterns, reduced cognitive functioning, and poor emotional health, emphasize the urgent need to explore PSU as a multifaceted issue affecting youth globally (Wentworth & Middleton, 2014; Toda et al., 2016). As smartphones increasingly become a necessity in daily functioning, understanding their impact on emotional regulation and personality is crucial for mitigating the adverse effects of their misuse.

Thus, the present study is done to find the problematic use of smartphone by young adults who are supposed to be in a changing phase of their life which includes their overall growth and emotional changes and how it affects their personality and emotional regulation.

**Rationale of the study**

The use smartphone in day-to-day life is a necessary thing among each and every one whether it comes to students, office worker and older peoples to get the information, to stay connected with family members and others. Smartphone use has some advantages and disadvantages that affect people differently according to the time they spent using the smartphone for every purposes.

There are different aspects of how smartphone is used among in people specially the younger population. There are limited number of researches which has been done to find that how problematic smartphone use effects the young adults. Smartphone use can affect the physical health, relationships with family. Thus, there is need to examine the changes in emotional regulations, personality problem among young adults using smartphone on their daily basis.

The present study is done to find the problematic use of smartphone in young adults that affects their personality and emotional regulation.

**Methodology**

This study employed a survey design to investigate the research objectives. A total of 160 subjects were selected using a convenience sampling method. The participants were drawn from the community, specifically targeting the Indian population. Inclusion criteria required participants to be young adults aged between 18 and 26 years and individuals who use a smartphone on a daily basis. Participants were excluded if they had been diagnosed with any psychiatric condition or were suffering from any long-term medical condition such as epilepsy. Withdrawal criteria included young adults who were unwilling to participate or those who failed to complete the study protocol for any reason.

The study was conducted using an offline survey method, with materials such as a pen, pencil, and eraser provided to the participants. Efforts were made to ensure a disturbance-free environment during the completion of the questionnaires. The research was introduced to participants as a study investigating emotional regulation and personality problems in young adults with problematic smartphone use. After obtaining informed consent, participants were asked to voluntarily complete a questionnaire, which took approximately 10–15 minutes. A brief overview of the study's objectives was provided, and participants were assured of confidentiality and anonymity. Participants were given the option to receive the results of their assessment. Data collected included demographic details such as name, age, gender, address, type of residence, occupation, and time spent on mobile phones.

**Assessment Tools Used**

Three standardized assessment tools were used in this study. The first was the *Problematic Mobile Phone Use Questionnaire (PMPUQ)* developed by Billieux et al. (2008), which assesses the relationship between impulsivity and problematic mobile phone use. It includes four main factors—Dangerous Use, Prohibited Use, Dependence, and Financial Problems—capturing various aspects of mobile phone use through a 30-item questionnaire with 19 reverse-scored items on a 4-point Likert scale (1 = strongly agree to 4 = strongly disagree). Total scores classify use into mild (<30), moderate (31–49), or severe (≥50). The second tool was the *Emotion Regulation Questionnaire (ERQ)* by Gross and John (2003), designed to measure two key emotional regulation strategies: Cognitive Reappraisal and Expressive Suppression. This 10-item scale uses a 7-point Likert format (1 = strongly disagree to 7 = strongly agree), with six items assessing reappraisal and four assessing suppressions. Scoring is done by summing the responses for each subscale. The third tool used was the *Big Five Inventory (BFI)* developed by John, Donahue, and Kentle (1991), which measures five major personality traits: Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness. This 44-item instrument, including 16 reverse-scored items, uses a 5-point Likert scale ranging from strongly disagree to strongly agree. Each trait is scored separately, and the results help determine the dominant personality characteristics of the participants.

**Result Analysis and Discussion**

The present study aimed to examine the relationship between emotional regulation, personality traits, and problematic smartphone use among young adults. A total of 160 participants, aged between 18 and 26 years, were included in the study. Among them, 66.9% were female and 33.1% were male (see Figure 1). The findings indicated a positive correlation between emotion regulation difficulties and personality characteristics associated with problematic smartphone use. These results align with previous literature, which suggests that excessive smartphone use can significantly influence personality traits and emotion regulation strategies (Billieux et al., 2015; Elhai et al., 2017).

Although the effect size observed was relatively small, the data demonstrated notably high levels of problematic smartphone use in association with time spent on smartphones among young adults. This suggests that extended smartphone usage may contribute to changes in emotional and personality functioning, even when the statistical strength of the relationship is moderate (Demirci et al., 2015).

The analysis revealed meaningful correlations among the variables assessed using the Problematic Mobile Phone Use Questionnaire (PMPUQ), Emotion Regulation Questionnaire (ERQ), and Big Five Inventory (BFI). These correlations were visualized through a heatmap (see Figure 1), illustrating close associations between the variables. The correlations between time spent on smartphones and individual subscales also suggest that emotional regulation and personality are differentially affected based on the intensity of smartphone use.


**Figure 1. Showing the correlation of all the three scales.**

The PMPUQ results illustrated moderate use as the most common category, especially among males and females, followed by severe and mild usage levels (see Figure 2). The ERQ results demonstrated fluctuations in the Cognitive Reappraisal (CR) subscale, visualized using a wave graph (see Figure 3). The BFI data revealed a positive correlation with time spent on smartphones across all personality domains, as shown in a second heatmap. Furthermore, results illustrated that Openness was the most prevalent trait among participants, followed by other Big Five dimensions (Takao, 2014; Stachl et al., 2017).

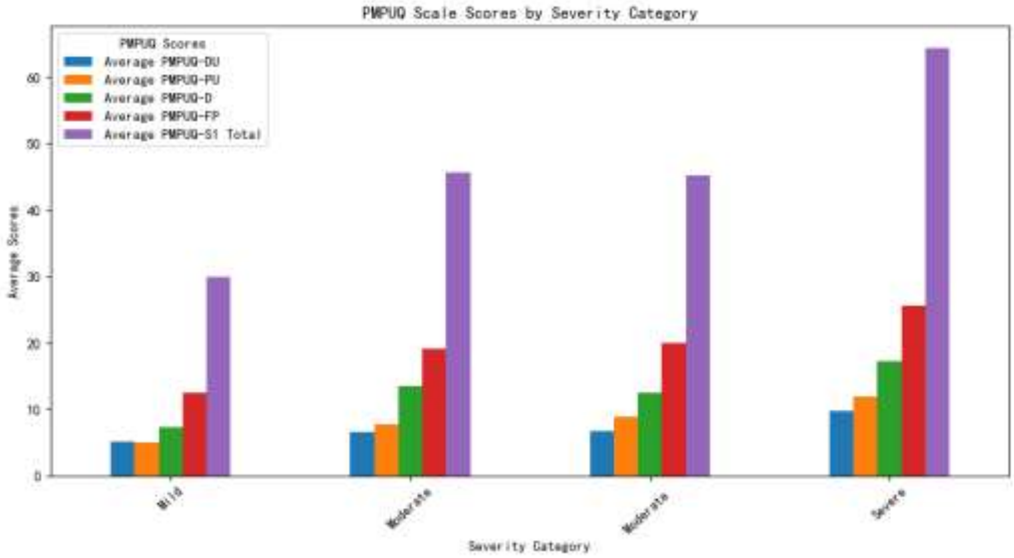


**Figure 2. Showing PMPUQ scoring in mild, moderate and severe category in Bar graph.**

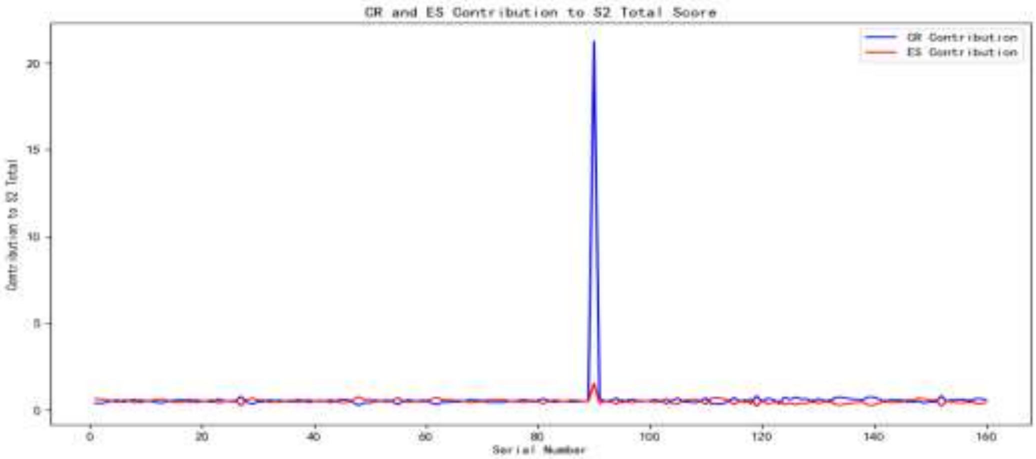


**Figure 3. Showing Cognitive Reappraisal (CR) and Expressive Suppression (ES) and its total in Wave graph**

Overall, the study's results suggest that the time spent on smartphones has a significant impact on emotional regulation, as measured by the ERQ, and on personality traits, as measured by the BFI. Young adults may express emotions differently in digital contexts than in real-life settings, potentially due to the dissociative nature of online interaction. The age group of 23–26 years was identified as particularly susceptible to the negative consequences of excessive smartphone use.

The excessive use of smartphones among young adults has implications not only for individual emotional and personality development but also for social and professional domains. The findings suggest that problematic smartphone use may hinder communication, alter emotional expression, and exacerbate issues in interpersonal relationships. Additionally, the type of content consumed through smartphones—often rapidly evolving and highly stimulating—could play a role in shaping or distorting emotional and personality patterns over time (Pearson & Hussain, 2015).

Furthermore, frequent smartphone use may negatively impact neurological functioning, affecting behavior, environmental awareness, emotional responses, and personality traits (Lopez-Fernandez, 2017). This underlines the importance of addressing problematic smartphone use as a public health concern.

Consequently, it is essential for individuals, families, educational institutions, and healthcare professionals—including occupational therapists, psychologists, and university counselors—to recognize early signs of maladjustment associated with problematic smartphone use. Targeted screening, counseling programs, peer interaction initiatives, and group therapies can serve as effective interventions to reduce reliance on smartphones for emotional regulation and enhance face-to-face communication skills (Zhang, 2022).

This study has certain limitations that should be acknowledged. Firstly, the sample size was relatively small, which may affect the generalizability of the findings. Secondly, the study did not include any intervention, limiting its scope to observational data without exploring potential changes over time or after specific treatments. Based on these limitations, several recommendations can be made for future research. Studies with larger and more diverse sample sizes are necessary to enhance the reliability and applicability of results. Additionally, employing more robust and reliable assessment tools may improve data accuracy. Future research could benefit from adopting a pre-post experimental or comparative design to better evaluate the impact of interventions. Lastly, it is recommended that future studies incorporate intervention strategies to explore their effectiveness in addressing problematic smartphone use and associated emotional or personality-related concerns.

**Conclusion**

The present study concluded that there is positive relationship between emotional regulation and personality problems in young adults with problematic smartphone use. The data results are analyzed on the basis of assumptions that the problematic smartphone use has an impact on the emotional regulation and personality.

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# STATISTICAL EVALUATION OF CYBERSECURITY THREATS IN INDIA, USA, UK, CHINA FOR THE PERIOD 2015 to 2024

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***Abstract***

Cybersecurity threats are strategies carried out by fraudulent individuals to capture data and harm computer systems. These threats can come from faraway locations, from anonymous individuals or users within an organization. The attack surface for cyber threats rises substantially as organizations, people, and governments adopt more and more technological devices. This paper attempts to analyse the cybersecurity threats for four countries - India, China, UK, and USA- for 2015-2024. The data for the study were collected from various sources. The objective of this study is to find the total financial loss under each attack type for the four countries, to find the total financial loss under each target industry for the four countries, to evaluate the percentage of number of affected users under each target industry, to find the percentage of total number of affected users under each attack source, to find the average incident resolution i.e. the time taken to fully resolve the incidents for different attack types, to test the hypothesis whether there is a significant difference in incident resolution time between the four countries under consideration, to test the hypothesis whether there is a significant difference in financial loss due to cybersecurity threats between the four countries under consideration. The statistical tools used in the study are descriptive statistics, ANOVA, Kolmogorov-Smirnov test, Bartlett's test, and Q-Q plot. The Kolmogorov-Smirnov test shows that the data is normally distributed. Bartlett's test is performed to check for homoscedasticity of the data. It is observed that there is no significant difference in incident resolution time taken to fully resolve the incidents between the four countries under consideration, and there is no significant difference in financial loss due to cybersecurity threats between the four countries under consideration.

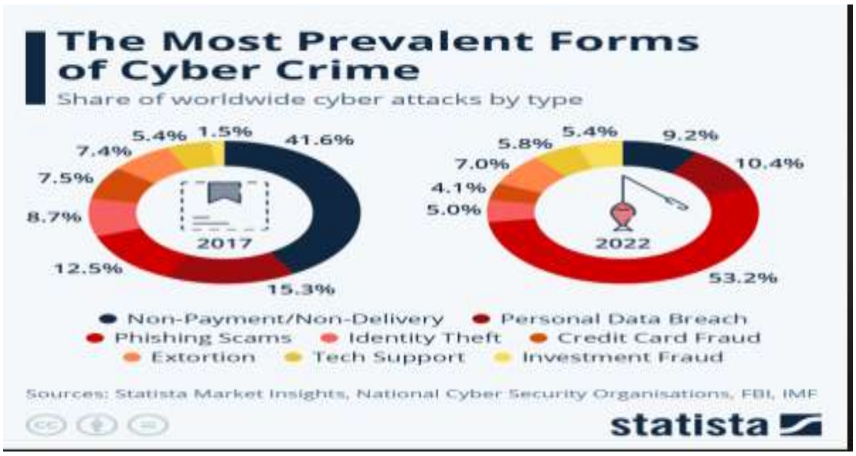
***Keywords****: Cybersecurity threats, financial loss, affected users, ANOVA, Kolmogorov-Smirnov test*

## 1. Introduction

The importance of cybersecurity has been rising drastically in a world that is turning to be more technological. Cybersecurity is the practice of safeguarding programmes and network systems against threats via the internet that attempt to access private data or tamper with normal operations. The rate and the impact of cyber threats are increasing as the dependence of technology by companies and individuals has increased considerably. This causes serious risks to economic performance, personal privacy, and global stability.

Cybersecurity threats are broad and continuously changing, from a malware attack to internet espionage. The broad categories of cyber-threats may be as follows: Phishing, Ransomware, Malware, Denial-of-Service(DoS) attacks, Man-in-the-Middle(MitM) attacks, SQL injection, and Advanced Persistent Threats(APTs). Cybercriminals use different strategies to take advantage of flaws in digital systems. Ransomware, for instance, encrypts the data of a victim and expects payment to release it.

As per the Federal Bureau of Investigation's Internet Crime Complaint Centre (IC3) 2024 report, a loss of over $16 billion is estimated from 8,59,532 complaints of cybercrime. This is a 33% increase in revenue loss as compared to 2023. The top three categories of cybercrime in the USA in 2024, as reported by the FBI, were phishing, ransomware, and personal data breaches. According to cybersecurity ventures, it is estimated that by 2025, the cost of cybercrime will amount to $10.5 trillion annually, underscoring the significance of enhanced security precautions.




*Source: Statista Market Insights, National Cyber Security Organizations, FBI, IMF*

From the above chart, we can see that the phishing scams have increased from 15.3% in 2017 to 53.2% in 2022, indicating a substantial increase in a span of 5 years. The investment fraud has increased from 1.5% in 2017 to 5.4% in 2022. The non-payment/non-delivery scam has drastically reduced to 9.2% in 2022 from 41.6% in 2017.

## 2. Literature Review

Latifa Alzahrani (2021)[1] paper on " Statistical Analysis of Cybersecurity Awareness Issues in Higher Education Institutes" studies the prevalence of cybersecurity awareness among higher education students in Saudi Arabia. The aim of the paper is to analyse knowledge of cybersecurity topics among the students and to identify the behaviour pattern that might lead students to potential cyberthreats.

Md Haris Uddin Sharif and Mehmood Ali Mohammed (2022)[2] paper on "A literature review of financial losses statistics for cyber security and future trend" analyses the financial losses incurred by cybercrime. The study quantifies the economic loss due to cybercrime and predicts the future trend by studying the US-based cybercrime record for the period 2010 to 2021.

Mohammed A. Alqahtani (2022)[3] paper on " Cybersecurity Awareness Based on Software and E-mail Security with Statistical Analysis" finds the impact of software and e-mail security among the students of Imam Abdulrahman Bin Faisal University in Dammam. The paper also studies the extent of cybersecurity and cyberattack awareness among the students.

## 3. Objectives of the Study

- To find the total financial loss under each attack type for the four countries under consideration.
- To find the total financial loss under each target industry for the four countries under consideration.
- To evaluate the number of affected users under each target industry for the period under study.
- To evaluate the number of affected users under each attack source for the period under study.
- To find the average incident resolution time (in hours) taken to fully resolve the incident for the respective countries.
- To determine whether there is a significant difference in incident resolution time (in hours) taken to fully resolve the incident between the four countries under consideration.
- To determine whether there is a significant difference in financial loss between the four countries under consideration.

## 4. Research Methodology

The paper attempts to study the total number of cyberthreats that have occurred under different categories in different countries during the study period. The paper also tests whether there is a significant difference in incident resolution time (in hours) taken to fully resolve the incident and whether there is a significant difference in financial loss between the four countries under consideration.

Sample Size: The sample selected for the study is four countries – China, India, UK and USA. Cyberthreat records of these countries for the period 2015-2024 have been collected from various secondary sources.

**Tools used for the study:**

1. Average : It is found by adding all the observations in the data set, dividing by the number of observations in the data set. It is based on all the observations. Hence, it is affected by small or extremely large observations. For unclassified data, the formula to compute the mean is $\overline{x} = \frac{\sum_{i=1}^{n} x_i}{n}$ . For classified data, the formula to compute mean is $\overline{x} = \frac{\sum_{i=1}^{n} f_i x_i}{\sum_{i=1}^{n} f_i}$
2. ANOVA: Analysis of variance (ANOVA) is a statistical test that is used to compare group means. It shows how far a particular variable's numerical values vary from the overall mean. It is used to test the differences between the population means by comparing the degree of variance within each sample to the degree of variance between the samples. The ANOVA test is based on the following assumptions:
   a. Observations are independent.
   b. Observations are normally distributed.
   c. There exists homogeneity of variance i.e., homoscedasticity exists.
3. Q-Q plot: A quantile-quantile (Q-Q) plot is a graphical tool to compare two probability distributions by plotting their quantiles against each other. It helps to determine whether a sample was drawn from a population that follows a specific probability distribution (normal distribution).
4. Bartlett's test : It is a test used to check whether the data satisfies the homoscedasticity assumption i.e. whether all the groups have equal variances. The test is based on the null hypothesis that all group variances are equal. The null hypothesis is rejected if the p-value is less than the desired level of significance.
5. Kolmogorov-Smirnov test: It is a non-parametric test to determine whether the dataset follows a specified distribution. The test compares the cumulative distribution function(CDF) of a sample with the CDF of the hypothesised distribution.

## 5. Data Analysis And Findings

5.1.1 To Find The Total Financial Loss Under Each Attack Type For The Study Period

In India

| **TABLE 1: TOTAL FINANCIAL LOSS UNDER EACH ATTACK TYPE FOR THE STUDY PERIOD IN INDIA** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sum of Financial Loss (in Million $)** | **ATTACK TYPE** | | | | | | |
| **YEAR** | **DDoS** | **Malware** | **Man-in-the-Middle** | **Phishing** | **Ransomware** | **SQL Injection** | **Grand Total** |
| 2015 | 165 | 209 | 408 | 180 | 322 | 306 | 1589 |
| 2016 | 57 | 47 | 177 | 103 | 288 | 67 | 739 |
| 2017 | 434 | 157 | 301 | 282 | 387 | 140 | 1701 |
| 2018 | 406 | 371 | 151 | 425 | 261 | 303 | 1919 |
| 2019 | 315 | 96 | 137 | 230 | 253 | 223 | 1255 |
| 2020 | 121 | 136 | 320 | 318 | 285 | 400 | 1580 |
| 2021 | 131 | 257 | 221 | 76 | 248 | 401 | 1334 |
| 2022 | 181 | 300 | 214 | 38 | 132 | 442 | 1306 |
| 2023 | 243 | 292 | 258 | 295 | 283 | 354 | 1725 |
| 2024 | 246 | 232 | 188 | 367 | 219 | 167 | 1418 |
| **Grand Total** | **2299** | **2097** | **2376** | **2313** | **2679** | **2802** | **14566** |

Table 1 shows the total financial loss (in millions $) incurred under each attack type in India from 2015 to 2024. It has been observed that out of a total of $14,566 million financial loss, $2299.43 million has occurred in DDoS, $2097 million has occurred in Malware, $2376 million has occurred in Man-in-the-Middle, $2313 million in Phishing, $2679 million in Ransomware, and $2802 million in SQL Injection. The table also highlights that India's highest financial loss of $1918.7 million occurred in 2018. The SQL injection attack type has incurred the maximum loss of $2802 million among all the attack types, followed by Ransomware , a loss of $ 2679 million , and then Man-in-the-Middle, a loss of $2376 million. These 3 attack types account for 53% of the total financial losses. It can be observed that each year incurs losses, despite intermittent fluctuations, emphasising continuous cybersecurity challenges.

5.1.2 To Find The Total Financial Loss Under Each Attack Type For The Study Period In USA

| **TABLE 2: TOTAL FINANCIAL LOSS UNDER EACH ATTACK TYPE FOR THE STUDY PERIOD IN USA** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sum of Financial Loss (in Million $)** | **ATTACK TYPE** | | | | | | |
| **YEAR** | **DDoS** | **Malware** | **Man-in-the-Middle** | **Phishing** | **Ransomware** | **SQL Injection** | **Grand Total** |
| 2015 | 553 | 126 | 291 | 124 | 187 | 285 | 1565 |
| 2016 | 299 | 110 | 103 | 601 | 286 | 232 | 1630 |
| 2017 | 555 | 394 | 283 | 296 | 145 | 161 | 1834 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2018 | 332 | 188 | 259 | 309 | 241 | 236 | 1566 |
| 2019 | 263 | 223 | 35 | 117 | 318 | 242 | 1198 |
| 2020 | 424 | 86 | 182 | 394 | 422 | 126 | 1634 |
| 2021 | 237 | 193 | 295 | 269 | 259 | 218 | 1470 |
| 2022 | 164 | 58 | 225 | 249 | 443 | 145 | 1283 |
| 2023 | 375 | 318 | 170 | 36 | 297 | 316 | 1512 |
| 2024 | 31 | 294 | 150 | 392 | 63 | 188 | 1118 |
| **Grand Total** | **3233** | **1992** | **1992** | **2785** | **2660** | **2150** | **14812** |

Table 2 shows the total financial loss (in millions $) incurred under each attack type in USA from 2015 to 2024. It has been observed that out of a total of $14,812 million financial loss, $3233 million has occurred in DDoS, $1992 million has occurred in Malware, $1992 million has occurred in Man-in-the-Middle, $2785 million in Phishing, $2660 million in Ransomware, and $2150 million in SQL Injection. The table also highlights that the highest financial loss of $1834 million occurred in 2017 for USA. The top 3 attack types which incurred maximum loss for USA during the study period were – DDoS ( loss of $3233 million), Phishing ( loss of $2785 million) , Ransomware ( loss of $2660 million). The year 2024 saw a considerable decrease in losses for USA.

5.1.3 To Find The Total Financial Loss Under Each Attack Type For The Study Period In UK

| **TABLE 3: TOTAL FINANCIAL LOSS UNDER EACH ATTACK TYPE FOR THE STUDY PERIOD IN UK** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sum of Financial Loss (in Million $)** | **ATTACK TYPE** | | | | | | |
| **YEAR** | **DDoS** | **Malware** | **Man-in-the-Middle** | **Phishing** | **Ransomware** | **SQL Injection** | **Grand Total** |
| 2015 | 224 | 306 | 350 | 427 | 377 | 46 | 1730 |
| 2016 | 311 | 210 | 254 | 257 | 481 | 325 | 1838 |
| 2017 | 185 | 131 | 365 | 138 | 103 | 356 | 1278 |
| 2018 | 27 | 399 | 307 | 95 | 302 | 289 | 1420 |
| 2019 | 258 | 224 | 265 | 717 | 81 | 263 | 1809 |
| 2020 | 337 | 55 | 263 | 266 | 336 | 533 | 1790 |
| 2021 | 381 | 557 | 185 | 349 | 250 | 251 | 1973 |
| 2022 | 608 | 204 | 155 | 424 | 271 | 160 | 1822 |
| 2023 | 498 | 312 | 153 | 85 | 136 | 291 | 1475 |
| 2024 | 313 | 131 | 234 | 369 | 154 | 167 | 1368 |
| **Grand Total** | **3143** | **2529** | **2532** | **3128** | **2491** | **2680** | **16503** |

Table 3 shows the total financial loss (in millions $) incurred under each attack type in UK from 2015 to 2024. It has been observed that out of a total of $16,503 million financial loss, $3143 million has occurred in DDoS, $2529 million has occurred in Malware, $2532 million has occurred in Man-in-the-Middle, $3128 million in Phishing, $2491 million in Ransomware, and $2680 million in SQL Injection. The table also highlights that the highest financial loss of $1973 million occurred in 2021 for UK. The top 3 attack types which incurred maximum loss for UK during the study period were – Phishing ( loss of $3128 million), DDoS ( loss of $3143 million) , SQL Injection ( loss of $2680 million). The years 2021 and 2022 witnessed a major financial loss due to cyberattacks.

5.1.4 To Find The Total Financial Loss Under Each Attack Type For The Study Period In UK

**TABLE 4: TOTAL FINANCIAL LOSS UNDER EACH ATTACK TYPE FOR THE STUDY PERIOD IN CHINA**

| **Sum of Financial Loss (in Million $)** | **ATTACK TYPE** | | | | | | |
|---|---|---|---|---|---|---|---|
| **YEAR** | **DDoS** | **Malware** | **Man-in-the-Middle** | **Phishing** | **Ransomware** | **SQL Injection** | **Grand Total** |
| 2015 | 276 | 113 | 180 | 76 | 382 | 204 | 1230 |
| 2016 | 730 | 375 | 180 | 150 | 204 | 251 | 1890 |
| 2017 | 247 | 153 | 190 | 375 | 91 | 91 | 1146 |
| 2018 | 184 | 373 | 90 | 63 | 199 | 146 | 1054 |
| 2019 | 42 | 198 | 302 | 223 | 257 | 236 | 1259 |
| 2020 | 70 | 247 | 203 | 244 | 113 | 344 | 1221 |
| 2021 | 133 | 155 | 235 | 379 | 286 | 385 | 1573 |
| 2022 | 345 | 272 | 164 | 302 | 481 | 1 | 1565 |
| 2023 | 286 | 196 | 237 | 282 | 131 | 181 | 1313 |
| 2024 | 353 | 194 | 202 | 50 | 423 | 242 | 1464 |
| **Grand Total** | **2665** | **2276** | **1981** | **2144** | **2566** | **2082** | **13714** |

Table 4 shows the total financial loss (in millions $) incurred under each attack type in China from 2015 to 2024. It has been observed that out of a total of $13,714 million financial loss, $2665 million has occurred in DDoS, $2276 million has occurred in Malware, $1981 million has occurred in Man-in-the-Middle, $2144 million in Phishing, $2566 million in Ransomware, and $2082 million in SQL Injection. The table also highlights that the highest financial loss of $1890 million occurred in 2016 for China, mostly from DDoS and Malware. The top 3 attack types that incurred maximum loss for China during the study period were DDoS, Ransomware, and SQL Injection. Following 2021, financial loss from phishing has fallen, which could be due to awareness and increased security measures.

5.2.1. To Find The Total Financial Loss Under Each Target Industry For The Study Period In India

**TABLE 5: Total Financial Loss Under Each Target Industry For The Study Period In India**

| **Sum of Financial Loss (in Million $)** | **TARGET INDUSTRY** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **YEAR** | **Bank** | **Edu** | **Govt** | **Health** | **IT** | **Retail** | **Teleco** | **Grand Total** |
| 2015 | 348 | 262 | 159 | 184 | 300 | 179 | 157 | 1589 |
| 2016 | 186 | 30 | 0 | 78 | 304 | 98 | 43 | 739 |
| 2017 | 56 | 182 | 472 | 158 | 426 | 368 | 40 | 1701 |
| 2018 | 244 | 474 | 390 | 384 | 180 | 183 | 63 | 1919 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2019 | 370 | 171 | 182 | 36 | 174 | 74 | 249 | 1255 |
| 2020 | 236 | 179 | 291 | 312 | 228 | 123 | 211 | 1580 |
| 2021 | 110 | 269 | 161 | 79 | 241 | 165 | 309 | 1334 |
| 2022 | 257 | 127 | 169 | 220 | 145 | 102 | 286 | 1306 |
| 2023 | 342 | 239 | 164 | 163 | 404 | 318 | 95 | 1725 |
| 2024 | 149 | 73 | 226 | 18 | 322 | 282 | 349 | 1418 |
| **Grand Total** | **2296** | **2004** | **2215** | **1631** | **2724** | **1892** | **1803** | **14566** |

Table 5 shows the total financial loss (in million $) incurred under each target industry in India from 2015 to 2024. It has been observed that out of a total of $14566 million financial loss, $2296 million has occurred in Banking, $2004 million has occurred in Education, $2215 million has occurred in Government, $1631 million in Healthcare, $2724 million in IT, $1892 million in Retail, $1803 million in Telecommunications. The table also highlights that the highest financial loss of $1919 million has occurred in the year 2018 for India. The top 3 targeted industries were IT , Banking and Government. Cyberthreats have significantly increased, particularly after 2021.

5.2.2. To Find The Total Financial Loss Under Each Target Industry For The Study Period In USA

| **TABLE 6: Total Financial Loss Under Each Target Industry For The Study Period In USA** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sum of Financial Loss (in Million $)** | **TARGET INDUSTRY** | | | | | | | |
| **YEAR** | **Bank** | **Edu** | **Govt** | **Health** | **IT** | **Retail** | **Teleco** | **Grand Total** |
| 2015 | 175 | 272 | 186 | 107 | 292 | 425 | 109 | 1565 |
| 2016 | 152 | 221 | 178 | 374 | 179 | 427 | 100 | 1630 |
| 2017 | 345 | 104 | 548 | 223 | 242 | 219 | 152 | 1834 |
| 2018 | 372 | 79 | 345 | 277 | 135 | 300 | 58 | 1566 |
| 2019 | 70 | 176 | 267 | 240 | 38 | 153 | 253 | 1198 |
| 2020 | 306 | 235 | 167 | 95 | 381 | 256 | 193 | 1634 |
| 2021 | 94 | 334 | 72 | 121 | 67 | 239 | 544 | 1470 |
| 2022 | 147 | 119 | 296 | 57 | 408 | 256 | 0 | 1283 |
| 2023 | 299 | 240 | 267 | 72 | 401 | 191 | 42 | 1512 |
| 2024 | 7 | 202 | 155 | 87 | 220 | 295 | 152 | 1118 |
| **Grand Total** | **1967** | **1982** | **2481** | **1653** | **2364** | **2762** | **1604** | **14812** |

Table 6 shows the total financial loss (in million $) incurred under each target industry in USA from 2015 to 2024. It has been observed that out of a total of $14812 million financial loss, $1967 million has occurred in Banking, $1982 million has occurred in Education, $2481 million has occurred in Government, $1653 million in Healthcare, $2364 million in IT, $2762 million in Retail, $1604 million in Telecommunications. The table also highlights the highest financial loss of $1834 million that occurred in the year 2017 for the USA. The top 3 targeted industries were Retail, Government, and IT. In recent years, financial losses in the banking industry have declined substantially.

5.2.3. To Find The Total Financial Loss Under Each Target Industry For The Study Period In UK

| **TABLE 7: Total Financial Loss Under Each Target Industry For The Study Period In UK** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sum of Financial Loss (in Million $)** | **TARGET INDUSTRY** | | | | | | | |
| **YEAR** | **Bank** | **Edu** | **Govt** | **Health** | **IT** | **Retail** | **Teleco** | **Grand Total** |
| 2015 | 287 | 44 | 292 | 164 | 489 | 180 | 273 | 1730 |
| 2016 | 367 | 172 | 257 | 262 | 67 | 310 | 402 | 1838 |
| 2017 | 139 | 113 | 456 | 134 | 120 | 96 | 220 | 1278 |
| 2018 | 50 | 209 | 161 | 248 | 228 | 319 | 204 | 1420 |
| 2019 | 404 | 224 | 172 | 185 | 358 | 193 | 274 | 1809 |
| 2020 | 468 | 155 | 186 | 177 | 301 | 337 | 166 | 1790 |
| 2021 | 528 | 192 | 252 | 180 | 526 | 57 | 239 | 1973 |
| 2022 | 76 | 311 | 327 | 201 | 401 | 185 | 321 | 1822 |
| 2023 | 327 | 132 | 183 | 116 | 382 | 90 | 245 | 1475 |
| 2024 | 124 | 64 | 268 | 331 | 196 | 281 | 105 | 1368 |
| **Grand Total** | **2770** | **1617** | **2555** | **1997** | **3068** | **2048** | **2449** | **16503** |

Table 7 shows the total financial loss (in million $) incurred under each target industry in UK from 2015 to 2024. It has been observed that out of a total of $16,503 million financial loss, $2770 million has occurred in Banking, $1617 million has occurred in Education, $2555 million has occurred in Government, $1997 million in Healthcare, $3068 million in IT, $2048 million in Retail, $2449 million in Telecommunications. The table also highlights that the highest financial loss of $1973 million occurred in the year 2021 for UK. The top 3 targeted industries were IT, Banking, and Government.

5.2.4. To Find The Total Financial Loss Under Each Target Industry For The Study Period In China

| **TABLE 8: Total Financial Loss Under Each Target Industry For The Study Period In China** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sum of Financial Loss (in Million $)** | **TARGET INDUSTRY** | | | | | | | |
| **YEAR** | **Bank** | **Edu** | **Govt** | **Health** | **IT** | **Retail** | **Teleco** | **Grand Total** |
| 2015 | 85 | 135 | 307 | 90 | 254 | 155 | 205 | 1230 |
| 2016 | 332 | 170 | 277 | 336 | 247 | 179 | 347 | 1890 |
| 2017 | 178 | 212 | 146 | 260 | 194 | 157 | 0 | 1146 |
| 2018 | 122 | 288 | 2 | 290 | 175 | 35 | 142 | 1054 |
| 2019 | 198 | 221 | 81 | 109 | 225 | 209 | 216 | 1259 |
| 2020 | 191 | 252 | 84 | 148 | 255 | 177 | 114 | 1221 |
| 2021 | 211 | 134 | 160 | 263 | 307 | 216 | 282 | 1573 |
| 2022 | 114 | 477 | 167 | 77 | 216 | 242 | 271 | 1565 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2023 | 110 | 249 | 97 | 301 | 198 | 90 | 268 | 1313 |
| 2024 | 247 | 108 | 407 | 201 | 223 | 59 | 218 | 1464 |
| **Grand Total** | **1788** | **2248** | **1729** | **2074** | **2293** | **1520** | **2063** | **13714** |

Table 8 shows the total financial loss (in million $) incurred under each target industry in China from 2015 to 2024. It has been observed that out of a total of $13,714 million financial loss, $1788 million has occurred in Banking, $2248 million has occurred in Education, $1729 million has occurred in Government, $2074 million in Healthcare, $2293 million in IT, $1520 million in Retail, $2063 million in Telecommunications. The table also highlights that the highest financial loss of $1890 million occurred in the year 2016 for China. The top 3 targeted industries were IT, Education, and Healthcare.

5.3.1 To Find The Percentage of Affected Users Under Each Target Industry For The Study Period In India

**TABLE 9: Percentage of Affected Users Under Each Target Industry For The Study Period In India**

| **% of Affected Users** | **TARGET INDUSTRY** | | | | | | |
|---|---|---|---|---|---|---|---|
| **YEAR** | **Bank** | **Edu** | **Govt** | **Health** | **IT** | **Retail** | **Teleco** |
| 2015 | 16% | 13% | 9% | 19% | 16% | 9% | 19% |
| 2016 | 27% | 9% | 0% | 14% | 32% | 14% | 5% |
| 2017 | 7% | 7% | 29% | 7% | 25% | 18% | 7% |
| 2018 | 12% | 24% | 20% | 17% | 10% | 12% | 5% |
| 2019 | 28% | 17% | 14% | 3% | 14% | 7% | 17% |
| 2020 | 9% | 14% | 14% | 26% | 14% | 9% | 14% |
| 2021 | 8% | 17% | 17% | 8% | 17% | 13% | 21% |
| 2022 | 17% | 14% | 14% | 14% | 17% | 10% | 14% |
| 2023 | 16% | 13% | 11% | 11% | 16% | 26% | 8% |
| 2024 | 13% | 3% | 13% | 7% | 20% | 23% | 20% |

Table 9 represents the percentage of users affected by cyber incidents across an array of industries during the study period in India. The percentage is the portion of all affected users in each year from each industry. IT and banking sectors were leading in the early years , however, attacks on retail and telecommunication have risen recently. In 2016, IT had 32% of affected users, the highest in the year among all the industries. While the government had no users affected by cyber incidents, the following year it was 29%, the highest among all the sectors. In 2020, healthcare had 26%, indicating the prevalence of pandemic-related cyber incidents.

5.3.2 To Find The Percentage of Affected Users Under Each Target Industry For The Study Period In USA

| **TABLE 10: Percentage of Affected Users Under Each Target Industry For The Study Period In USA** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **% of Affected Users** | **TARGET INDUSTRY** | | | | | | |
| **YEAR** | **Bank** | **Edu** | **Govt** | **Health** | **IT** | **Retail** | **Teleco** |
| 2015 | 11% | 18% | 14% | 7% | 18% | 25% | 7% |
| 2016 | 12% | 15% | 15% | 18% | 9% | 29% | 3% |
| 2017 | 18% | 9% | 21% | 12% | 18% | 12% | 9% |
| 2018 | 26% | 6% | 16% | 19% | 10% | 16% | 6% |
| 2019 | 8% | 13% | 21% | 13% | 8% | 13% | 25% |
| 2020 | 15% | 12% | 15% | 9% | 15% | 21% | 12% |
| 2021 | 7% | 29% | 4% | 11% | 7% | 11% | 32% |
| 2022 | 12% | 12% | 16% | 4% | 36% | 20% | 0% |
| 2023 | 21% | 10% | 10% | 10% | 28% | 10% | 10% |
| 2024 | 5% | 18% | 9% | 9% | 18% | 23% | 18% |

Table 10 represents the percentage of users affected by cyber incidents across an array of industries during the study period in USA. During the study period, the banking sector had 26% affected users in 2018, while only 5% were affected users in 2024, indicating a substantial reduction in the proportion of affected users. Education experienced a high of 29% in 2021, while it was merely 6% in 2018. The proportion of affected users for the government sector ranges from 15% to 21%. For the healthcare sector, 19% of users were affected in 2018, while the percentage has fallen to 9% in 2024. The IT sector had 36% of affected users in 2022 , the highest figure across all the years and the sector under consideration. The retail sector had 29% of affected users in 2016, while in 2023, it was 10%. In Telecommunication, there were no users affected by cyber incidents in 2020, while it experienced a peak of 32% in 2021. Retail and IT sectors have experienced consistent threats.

5.3.3 To Find The Percentage of Affected Users Under Each Target Industry For The Study Period In UK

| **TABLE 11: Percentage of Affected Users Under Each Target Industry For The Study Period In UK** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **% of Affected Users** | **TARGET INDUSTRY** | | | | | | |
| **YEAR** | **Bank** | **Edu** | **Govt** | **Health** | **IT** | **Retail** | **Teleco** |
| 2015 | 21% | 3% | 18% | 6% | 26% | 9% | 18% |
| 2016 | 14% | 14% | 11% | 11% | 8% | 22% | 19% |
| 2017 | 15% | 15% | 26% | 11% | 11% | 7% | 15% |
| 2018 | 7% | 14% | 14% | 17% | 14% | 24% | 10% |
| 2019 | 19% | 13% | 13% | 9% | 22% | 9% | 16% |
| 2020 | 27% | 9% | 9% | 12% | 12% | 21% | 9% |
| 2021 | 26% | 9% | 11% | 11% | 20% | 3% | 20% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2022 | 6% | 19% | 14% | 11% | 19% | 17% | 14% |
| 2023 | 22% | 13% | 13% | 9% | 22% | 9% | 13% |
| 2024 | 15% | 4% | 15% | 19% | 15% | 22% | 11% |

Table 11 represents the percentage of users affected by cyber incidents across an array of industries during the study period in UK. In 2015, the IT and Retail sectors dominated among the sectors with 26% and 21% respectively. In 2016, the retail sector had the highest percentage of affected users ( 22%), and telecommunication had 19% , the second highest sector . In 2017, the government sector experienced the highest percentage of affected users, which was 26%. The year 2018 saw merely 7% of users affected in the Banking sector, while retail had 24%. The year 2019 saw the highest percentage in IT (22% ), followed by Retail users (21%). In 2020, the Banking sector saw 27% affected users, and Retail saw 21%. In 2021, both telecommunication and Banking had 20%, while retail had a low percentage of merely 3%. In 2022, IT and Education had a high percentage of 19%, while Banking experienced a low of 6%. In 2023, both IT and Banking had 22% affected users. In 2024, Retail and Healthcare observed a significant increase (22% and 19% respectively).

5.3.4 To Find The Percentage of Affected Users Under Each Target Industry For The Study Period In China

| **TABLE 11: Percentage of Affected Users Under Each Target Industry For The Study Period In China** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **% of Affected Users** | **TARGET INDUSTRY** | | | | | | |
| **YEAR** | **Bank** | **Edu** | **Govt** | **Health** | **IT** | **Retail** | **Teleco** |
| 2015 | 8% | 8% | 21% | 8% | 21% | 17% | 17% |
| 2016 | 14% | 7% | 17% | 17% | 24% | 7% | 14% |
| 2017 | 17% | 22% | 13% | 13% | 17% | 17% | 0% |
| 2018 | 14% | 23% | 5% | 27% | 18% | 5% | 9% |
| 2019 | 16% | 12% | 8% | 8% | 16% | 24% | 16% |
| 2020 | 11% | 25% | 4% | 21% | 14% | 14% | 11% |
| 2021 | 10% | 10% | 13% | 19% | 13% | 19% | 16% |
| 2022 | 13% | 26% | 6% | 6% | 10% | 19% | 19% |
| 2023 | 16% | 26% | 6% | 13% | 19% | 3% | 16% |
| 2024 | 11% | 11% | 24% | 14% | 16% | 8% | 16% |

Table 11 represents the percentage of users affected by cyber incidents across an array of industries during the study period in China. In 2015, the Government and IT had 21% affected users, the highest among all the sectors under study. In 2016, IT had 24% affected users, followed by Government and healthcare with 17%. In 2017, Education surged to 22% while Telecommunication fell to 0% , Banking , IT and Retail had 17% affected users. In 2018, Healthcare had the maximum number of affected users i.e. 27% , Education had 23% , Government and Retail had only 5%. In 2019, the Retail sector was at a high of 24%. In 2020, Education recorded a peak of 25%, Healthcare recorded 21%, and Government recorded a low value of 4%. In 2021, the percentage of affected users varied from 10% to 19%. In 2022, Education had the highest percentage of affected users i.e., 26%, followed by Telecommunication with 19%, and Healthcare and Government had hit a low of 6%. In 2023, Retail fell to 3% while Education topped with 26%. In 2024, the Government had a high of 24% affected users.

5.4.1 To Find The Percentage of Affected Users Under Each Attack Source For The Study Period In India

**TABLE 12:** Percentage of Affected Users Under Each Attack Source For The Study Period In India

| % of Affected Users | ATTACK SOURCE | | | |
|---|---|---|---|---|
| **YEAR** | **Hacker Group** | **Insider** | **Nation-state** | **Unknown** |
| 2015 | 22% | 22% | 31% | 25% |
| 2016 | 14% | 27% | 18% | 41% |
| 2017 | 18% | 25% | 29% | 29% |
| 2018 | 24% | 29% | 20% | 27% |
| 2019 | 14% | 28% | 31% | 28% |
| 2020 | 29% | 37% | 17% | 17% |
| 2021 | 21% | 33% | 33% | 13% |
| 2022 | 24% | 28% | 17% | 31% |
| 2023 | 32% | 29% | 18% | 21% |
| 2024 | 13% | 27% | 23% | 37% |

Table 12 shows the percentage of affected users under each attack source in India from 2015 to 2024. In 2015, Nation-state attack sources were the highest, recording 31% affected users, followed by Unknown source with 25%. In 2016, the Unknown attack source peaked at 41% while Hacker and Nation-state sources witnessed a substantial decline. In 2017, Hacker group recorded 18%, Insider source had 25%, while Nation-state source had 29%. In 2018, Insider attack source increased to 29%, Hacker group increased to 24%. In 2019, Nation-state attack source recorded 31%, Uncertainty attack source at 28%, and Hacker attack source dipped to 14%. In 2020, Insider attack source increased to 37%, Hacker group had 29%. In 2021, both Nation-state and Insider recorded 33% affected users. In 2022, the Unknown attack source was 31%, Insider was 28%, Hacker Group was 24%, and Nation-state was 17%. In 2023, Hacker group recorded a peak of 32% , Insider hit at 29%, while Unknown source had a low of 21%. In 2024, Unknown sourced had a peak of 37%, while Hacker group recorded a low of 13% (lowest over the 10-year period under study).

5.4.2 To Find The Percentage of Affected Users Under Each Attack Source For The Study Period In USA

**TABLE 13:** Percentage of Affected Users Under Each Attack Source For The Study Period In USA

| % of Affected Users | ATTACK SOURCE | | | |
|---|---|---|---|---|
| **YEAR** | **Hacker Group** | **Insider** | **Nation-state** | **Unknown** |
| 2015 | 11% | 39% | 25% | 25% |
| 2016 | 15% | 18% | 38% | 29% |
| 2017 | 27% | 18% | 27% | 27% |
| 2018 | 32% | 29% | 16% | 23% |
| 2019 | 21% | 25% | 25% | 29% |
| 2020 | 12% | 33% | 27% | 27% |
| 2021 | 29% | 29% | 11% | 32% |
| 2022 | 32% | 28% | 28% | 12% |
| 2023 | 17% | 28% | 34% | 21% |
| 2024 | 36% | 14% | 14% | 36% |

Table 13 shows the percentage of affected users under each attack source in USA from 2015 to 2024. In 2015, Insiders were the top attack source with 39% affected users, followed by Nation-state and Unknown attack source with 25% each, followed by Hacker group with a minimum of 11%. In 2016, the Nation-state had 38% affected users while Insider had fallen to 18%. In 2017, all three attack sources, Hacker-group, Nation-State, and Unknown, had 27% affected users while Insider had 18%. In 2018, Hacker groups hit a high of 32% affected users, Insider record 29% , Unknown record 23%, and Nation-state record 16%. In 2019, the percentage of affected users under each attack source ranged from 21% to 29%. In 2020, Insider recorded a high of 33% while Hacker group recorded a low of 12%. In 2021, the Unknown attack source had 32% affected users, both Hackers and Insiders had 29%, Nation-state had 11%. In 2022, the Hacker group had the highest percentage of affected users, i.e., 32%, followed by Nation-state and Insider at 28%, followed by Unknown with a low of 12%. In 2023, Nation-state recorded 34%, Insider recorded 28%, Unknown recorded 21%, Hacker group recorded a low of 17%. In 2024, Hacker group recorded 36% affected users(the highest during the study period), Unknown recorded 36%, Insider and Nation-state declined to the lowest of 14%.

5.4.3 To Find The Percentage of Affected Users Under Each Attack Source For The Study Period In UK

**TABLE 14:** Percentage of Affected Users Under Each Attack Source For The Study Period In UK

| **% of Affected Users** | **ATTACK SOURCE** | | | |
|---|---|---|---|---|
| **YEAR** | **Hacker Group** | **Insider** | **Nation-state** | **Unknown** |
| 2015 | 15% | 26% | 32% | 26% |
| 2016 | 36% | 19% | 22% | 22% |
| 2017 | 41% | 26% | 15% | 19% |
| 2018 | 31% | 21% | 24% | 24% |
| 2019 | 19% | 31% | 25% | 25% |
| 2020 | 24% | 12% | 21% | 42% |
| 2021 | 26% | 17% | 40% | 17% |
| 2022 | 28% | 22% | 28% | 22% |
| 2023 | 34% | 19% | 28% | 19% |
| 2024 | 26% | 19% | 22% | 33% |

Table 14 shows the percentage of affected users under each attack source in UK from 2015 to 2024. In 2015, the Nation-state had a maximum of 32% affected users, followed by Insider and Unknown with 26%, Hacker group had a low of 15%. In 2016, there was a significant rise in the percentage of affected users by Hacker groups, i.e., 36%. In 2017, the Hacker group recorded 41% , the highest in the decade under the study period. In 2018, the Hacker group recorded 31%, Nation-state and Unknown recorded 24% each, Insider recorded 21%. In 2019, the Insiders recorded 31% while the Hacker group recorded a low of 19%. In 2020, the Unknown attack source recorded a high of 42%, Hacker group recorded 24%, Nation-state recorded 21% , Insider recorded a low of 17%. In 2021, Nation-state hits a high of 40% while both Insider and Unknown recorded a low of 17%. In 2022, the percentage of affected users under each attack source ranged from 22% to 28%. In 2023, the Hacker group recorded 34%, Nation-state had 28%, Insider and Unknown both had 19%. In 2024, the Unknown source recorded a high of 33%, Hacker group recorded 26%, Nation-state recorded 22%, and Insider recorded 19% affected users.

5.4.4 To Find The Percentage of Affected Users Under Each Attack Source For The Study Period In China

**TABLE 15:** Percentage of Affected Users Under Each Attack Source For The Study Period In China

| % of Affected Users | ATTACK SOURCE | | | |
|---|---|---|---|---|
| **YEAR** | **Hacker Group** | **Insider** | **Nation-state** | **Unknown** |
| 2015 | 29% | 21% | 42% | 8% |
| 2016 | 21% | 45% | 17% | 17% |
| 2017 | 22% | 30% | 13% | 35% |
| 2018 | 18% | 41% | 32% | 9% |
| 2019 | 28% | 24% | 32% | 16% |
| 2020 | 21% | 21% | 39% | 18% |
| 2021 | 16% | 29% | 32% | 23% |
| 2022 | 16% | 23% | 13% | 48% |
| 2023 | 19% | 16% | 26% | 39% |
| 2024 | 24% | 16% | 27% | 32% |

Table 15 shows the percentage of affected users under each attack source in China from 2015 to 2024. In 2015, Nation-state recorded a high of 42%, followed by Hacker group with 29%, followed by Insider with 21%, followed by Unknown with a low of 8%. In 2016, the Insider recorded a high of 45%. In 2017, the Unknown recorded a high of 35%, while the Nation-state recorded a low of 13%. In 2018, Insider had a high of 41% affected users, Nation-state had 32% while Hacker group had fallen to 18%. In 2019, Nation-state recorded a high 39% affected users while the Unknown recorded 16%. In 2020, Nation-state continues to record a high of 39% affected users, Hacker and Insider had 21% each, Unknown had 18%. In 2021, Nation-state had 32%, Insider had 29%, and Unknown had 23%. In 2022, the Unknown attack source recorded a high of 48%, Nation-state dropped to 13%. In 2023, the Unknown attack source remained high at 39%, while Insider recorded a low of 16%. In 2024, the Unknown attack source remained high at 32% , Nation-state recorded 27% , Hacker group recorded 24% while Insider recorded a low of 16%.

5.5.1 Average of Incident Resolution Time (in Hours) time taken to fully resolve the incident in India

**TABLE 16:** Average of Incident Resolution Time (in Hours) time taken to fully resolve the incident in India

| **Average of Incident Resolution Time (in Hours) time taken to fully resolve the incident** | **ATTACK SOURCE** | | | | |
|---|---|---|---|---|---|
| **ATTACK TYPE** | **Hacker Group** | **Insider** | **Nation-state** | **Unknown** | **Grand Total** |
| DDoS | 34 | 41 | 27 | 39 | **36** |
| Malware | 40 | 40 | 17 | 41 | **37** |
| Man-in-the-Middle | 40 | 34 | 35 | 35 | **36** |
| Phishing | 32 | 33 | 36 | 46 | **36** |
| Ransomware | 27 | 32 | 30 | 43 | **33** |
| SQL Injection | 48 | 38 | 32 | 37 | **37** |
| **Grand Total** | **35** | **37** | **31** | **40** | **36** |

From Table 16 , the minimum average time taken to fully resolve the incident is 27 hours if the attack type is DDoS and the attack source is Nation-State. If the attack type is Malware and the attack source is unknown, then the maximum average time taken to fully resolve the incident is 41 hours. The average time taken to fully resolve the incident ranges between 34 to 40 hours for the attack type Man-in-the-

Middle. The maximum average time taken to fully resolve the incident is 46 hours if the attack type is Phishing and the attack source is Unknown. If the attack type is Ransomware and the attack source is unknown, then the maximum average time taken to fully resolve the incident is 43 hours. If the attack type is SQL Injection and the attack source is Hacker Group, then the maximum average time taken to fully resolve the incident is 48 hours. Phishing and Ransomware from unknown sources represent a high risk, as it takes more than 40 hours to resolve the incident.

5.5.2 Average of Incident Resolution Time (in Hours) time taken to fully resolve the incident in USA

**TABLE 17:** Average of Incident Resolution Time (in Hours) time taken to fully resolve the incident in USA

| **Average of Incident Resolution Time (in Hours) time taken to fully resolve the incident** | **ATTACK SOURCE** | | | | |
|---|---|---|---|---|---|
| **ATTACK TYPE** | **Hacker Group** | **Insider** | **Nation-state** | **Unknown** | **Grand Total** |
| DDoS | 38 | 39 | 31 | 38 | **37** |
| Malware | 46 | 39 | 38 | 48 | **42** |
| Man-in-the-Middle | 50 | 28 | 28 | 28 | **31** |
| Phishing | 39 | 30 | 41 | 25 | **34** |
| Ransomware | 36 | 31 | 27 | 35 | **32** |
| SQL Injection | 31 | 40 | 34 | 38 | **36** |
| **Grand Total** | **40** | **35** | **33** | **35** | **35** |

From Table 17 , the minimum average time taken to fully resolve the incident is 31 hours if the attack type is DDoS and the attack source is a Nation-state. If the attack type is Malware and the attack source is unknown, then the maximum average time taken to fully resolve the incident is 48 hours. The average time taken to fully resolve the incident is 31 hours for the attack type Man-in-the-Middle. The maximum average time taken to fully resolve the incident is 41 hours if the attack type is Phishing and the attack source is a Nation-state. If the attack type is Ransomware and the attack source is Hacker group, then the maximum average time taken to fully resolve the incident is 36 hours. If the attack type is SQL Injection and the attack source is Insider, then the maximum average time taken to fully resolve the incident is 40 hours.

5.5.3 Average of Incident Resolution Time (in Hours) time taken to fully resolve the incident in UK

**TABLE 18:** Average of Incident Resolution Time (in Hours) tine taken to fully resolve the incident in UK

| **Average of Incident Resolution Time (in Hours) time taken to fully resolve the incident** | **ATTACK SOURCE** | | | | |
|---|---|---|---|---|---|
| **ATTACK TYPE** | **Hacker Group** | **Inside r** | **Natio n-state** | **Unknow n** | **Grand Total** |
| DDoS | 44 | 34 | 33 | 34 | **37** |
| Malware | 30 | 36 | 41 | 40 | **37** |
| Man-in-the-Middle | 34 | 42 | 34 | 47 | **39** |
| Phishing | 37 | 54 | 33 | 35 | **38** |
| Ransomware | 41 | 41 | 35 | 37 | **38** |
| SQL Injection | 35 | 31 | 34 | 32 | **33** |
| **Grand Total** | **37** | **39** | **35** | **37** | **37** |

From Table 18 , the minimum average time taken to fully resolve the incident is 33 hours if the attack type is DDoS and the attack source is a Nation-State. If the attack type is Malware and the attack source is a Nation-state then the maximum average time taken to fully resolve the incident is 41 hours. The average time taken to fully resolve the incident is 39 hours for the attack type Man-in-the-Middle. The maximum average time taken to fully resolve the incident is 54 hours if the attack type is Phishing and the attack source is Insider. If the attack type is Ransomware and the attack source is a Hacker group or Insider, then the maximum average time taken to fully resolve the incident is 41 hours. If the attack type is SQL Injection and the attack source is Insider, then the maximum average time taken to fully resolve the incident is 39 hours.

5.5.4 Average of Incident Resolution Time (in Hours) time taken to fully resolve the incident in China

**TABLE 19:** Average of Incident Resolution Time (in Hours) time taken to fully resolve the incident in China

| **Average of Incident Resolution Time (in Hours) time taken to fully resolve the incident** | **ATTACK SOURCE** | | | | |
|---|---|---|---|---|---|
| **ATTACK TYPE** | **Hacker Group** | **Insider** | **Nation-state** | **Unknown** | **Grand Total** |
| DDoS | 37 | 41 | 30 | 40 | **36** |
| Malware | 39 | 38 | 29 | 26 | **33** |
| Man-in-the-Middle | 47 | 31 | 42 | 43 | **42** |
| Phishing | 25 | 39 | 39 | 37 | **36** |
| Ransomware | 38 | 42 | 37 | 38 | **39** |
| SQL Injection | 39 | 35 | 42 | 43 | **40** |
| **Grand Total** | **38** | **38** | **37** | **37** | **37** |

From Table 19 , the minimum average time taken to fully resolve the incident is 30 hours if the attack type is DDoS and the attack source is Nation-State. If the attack type is Malware and the attack source is Hacker group then the maximum average time taken to fully resolve the incident is 39 hours. The average time taken to fully resolve the incident is 42 hours for the attack type Man-in-the-Middle. The maximum average time taken to fully resolve the incident is 39 hours if the attack type is Phishing and the attack source is Insider or Nation-state. If the attack type is Ransomware and the attack source is Insider, then the maximum average time taken to fully resolve the incident is 42 hours. If the attack type is SQL Injection and the attack source is Unknown, then the maximum average time taken to fully resolve the incident is 43 hours.

5.6.HYPOTHESIS TESTING USING ANOVA

5.6.1 $H_0$: There is no significant difference in incident resolution time (in hours) between India, USA, UK, and China for the study period under consideration.

$H_1$: not- $H_0$

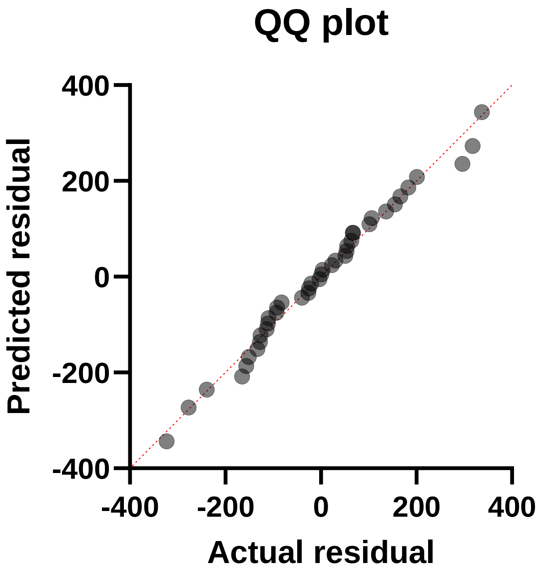
| **Table 20 : Bartlett's Test Output** | | |
|---|---|---|
| Bartlett's statistic (corrected) | p-value | Significant |
| 2.164 | 0.7470 | Not significant |

From Table 20, since the p-value is greater than 0.05, we can say that the variances in the groups are equal. Hence, we can say that the assumption of homogeneity of variance in the groups holds true.

| **Table 21: Kolmogorov-Smirnov Test Output** | | | |
|---|---|---|---|
| Statistic value | p-value | Significant | Passed normality test |
| 0.08093 | 0.1 | Not significant | yes |

From Table 21, since the p-value is greater than 0.05, we can say that the set of data comes from a normal distribution.

Q-Q plot:




From the above graph, we can see that all the data points are closer to the straight line. Therefore, we can say that the distribution of the residuals follows a normal distribution.

| **Table 22: ANOVA output** | | | | | |
|---|---|---|---|---|---|
| | SS | DF | MS | F (DFn, DFd) | P value |
| Treatment (between columns) | 167691 | 3 | 55897 | F (3, 36) = 2.192 | P=0.1058 |
| Residual (within columns) | 918029 | 36 | 25501 | | |
| Total | 1085720 | 39 | | | |

Table 22 shows that the probability value (p-value) is greater than 0.05, implying that $H_0$ should not be rejected. This means that there is no significant difference in incident resolution time (in hours) between India, USA, UK, and China for the study period under consideration.

5.6.2 $H_0$: There is no significant difference in financial loss between India, USA, UK, and China for the study period under consideration

$H_1$: not- $H_o$

| **Table 23 : ANOVA output** | | | | | |
|---|---|---|---|---|---|
| | SS | DF | MS | F (DFn, DFd) | P value |
| Treatment (between columns) | 409366 | 3 | 136455 | F (3, 36) = 1.968 | P=0.1362 |
| Residual (within columns) | 2496112 | 36 | 69336 | | |
| Total | 2905478 | 39 | | | |

Table 23 shows that the probability value (p-value) is greater than 0.05, implying that $H_0$ should not be rejected. This means that there is no significant difference in financial loss between India, USA, UK, and China for the study period under consideration.

## 6. Conclusion

A detailed analysis of cyberthreat data from 2015 to 2024 in India, China, UK, and USA gives essential information on the magnitude, nature, and effect of cyber threats. All four countries' financial losses signal a persistent and rising problem of this threat. Among the different attack types, Phishing, Ransomware, and SQL Injection were seen to be the top three reasons for financial losses among the countries in the study. These findings show the adaptability of hackers and the widely diverse technology vulnerabilities among different countries. As per the data on the targeted industries, cyber threats are more likely to affect those industries that are highly data-driven, like IT, Government, and Banking industries. The data underlines the importance of industry-specific awareness and security measures with regard to affected users. With regard to the attack source, nation-state attacks were dominant in earlier years, but in recent years, unknown attack sources have become more prevalent. The hacker groups remain a continuous threat to each of the countries under consideration. The ANOVA testing revealed that there are no significant differences in incident resolution times or financial losses for the four countries under consideration, implying that cyberthreats have an equal impact despite the geographical differences between the countries.

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# BIOMETRIC HACKING: THREATS AND COUNTERMEASURES

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***Abstract***

*Biometric authentication has become a leading method for identity verification due to its convenience, accuracy, and reliance on unique physiological and behavioral traits. However, the permanence of biometric data introduces significant vulnerabilities. Once compromised, biometric information cannot be altered, making its misuse potentially far more damaging than traditional passwords. This paper examines the growing threats to biometric systems, including spoofing, replay attacks, AI-generated deepfakes, and database breaches. It reviews existing security mechanisms and proposes advanced countermeasures, such as liveness detection, homomorphic encryption, blockchain-based storage, and zero-knowledge proofs. The paper also explores future challenges in biometric security, emphasizing the importance of multi-layered defense strategies and ethical data handling practices.*

***Keywords****—Biometric security, spoofing, homomorphic encryption, blockchain, authentication*

## I. Introduction

Biometric authentication systems utilize unique biological or behavioral traits—including fingerprints, facial geometry, iris patterns, and voice recognition—to verify identity. Their widespread adoption across sectors such as banking, mobile devices, healthcare, and national security is due to the difficulty of duplicating these traits and the convenience they offer over traditional credentials [1]. However, as biometric technologies become more integrated into sensitive applications, they also become more attractive targets for cybercriminals. Unlike passwords, biometric traits cannot be changed if compromised. This raises the stakes for security, privacy, and data governance. The rise of artificial intelligence (AI), deepfakes, and biometric spoofing tools has made it possible to replicate and misuse biometric data with growing accuracy and success [2]. Additionally, centralized databases containing sensitive biometric data present significant risks, especially if they are compromised [3]. This paper explores the threat landscape associated with biometric hacking, evaluates existing countermeasures, and presents a roadmap for more resilient, privacy-preserving systems. A comprehensive literature review supports the technical foundation, complemented by real-world case analyses.

## II. Literature Review

Biometric security has become a critical research focus, with numerous studies identifying vulnerabilities and exploring solutions. Twelve significant papers were reviewed for this study:

[1] Jain et al. (2008) introduce core concepts in biometric recognition and highlight early vulnerabilities, especially spoofing and bypassing mechanisms. They emphasize the need for liveness detection and multimodal systems to enhance reliability [1].

[2] Ratha et al. (2021) focus on improving the security of biometric templates. They explore revocable biometrics, feature transformation, and secure multiparty computation as essential tools to protect data integrity and privacy [2].

[3] Hadid et al. (2014) categorize spoofing attacks into print, replay, and 3D mask categories. They propose countermeasures such as dynamic texture analysis and challenge-response mechanisms but note the challenges in standardizing these defenses [3].

[4] Meng et al. (2018) provide a detailed survey of privacy-preserving biometric authentication, including cancelable biometrics, homomorphic encryption, and the potential use of blockchain. Their research underscores the shift from centralized to decentralized identity systems [4].
[5] The IJERT study (2023) presents a taxonomy of biometric attack types and links each to specific biometric modalities. The paper emphasizes adaptive AI techniques for real-time anomaly detection and counterattack responses [5].
[6] IJRPR (2023) advocates for multimodal biometric authentication systems to reduce the risk of spoofing and increase accuracy. The study analyzes the trade-offs between performance, cost, and user convenience [6].
[7] RRJoIT analyzes biometric deployment in public administration. It highlights the risks of centralized biometric databases and recommends federated data models for resilience [7].
[8] Lai et al. (2024) present BioZero, a blockchain-based biometric authentication protocol that uses homomorphic encryption and zero-knowledge proofs to securely verify identities without exposing raw biometric data. [8].
[9] Arman et al. (2024) present a comprehensive survey on privacy-preserving biometric systems, outlining current techniques, challenges, and future research directions in secure biometric data handling [9].
[10] The study by Thippeswamy et al. (2018) proposes a biometric-based password recovery method for e-commerce platforms, enhancing user security and convenience through fingerprint authentication. [10].
[11] Joseph (2024) explores how biometric authentication methods, such as fingerprint and facial recognition, bolster cybersecurity by providing robust identity verification, while also addressing associated privacy and implementation challenges [11].
[12] Mogos (2020) examines the role of biometric technologies in improving cybersecurity by enhancing access control and intrusion detection systems. [12].
These studies collectively show that while biometric systems offer strong security on the surface, their underlying vulnerabilities require multi-layered defense strategies and continuous evolution to stay ahead of attackers.

## III. Problem Definition

Biometric systems are uniquely vulnerable because once biometric data (fingerprints, facial maps, iris patterns, voiceprints) is compromised, it cannot be reset. Key threats include:

- **Spoofing**: Fake fingerprints, masks, or deepfake videos trick sensors [2], [3].
- **Data Breaches**: Central repositories of biometric templates present high-value targets—stolen data is irrevocable [3].
- **Replay Attacks**: Captured biometric data can be replayed over unsecured channels to impersonate users [5].
- **AI-Driven Forgeries**: Generative models produce synthetic but convincing biometric samples that bypass many liveness checks [4].
- **Privacy Concerns**: Unregulated collection and use of biometric data risk unauthorized surveillance and rights violations [6].

## IV. Objectives And Scope

This research aims to:

- **Identify Common Methods in Biometric Hacking**: Classify various biometric attack techniques and highlight the associated threats.

- **Analyze Biometric System Vulnerabilities**: Evaluate weaknesses in fingerprint, facial, iris, and voice recognition systems [1].
- **Explore Potential Solutions**: Discuss countermeasures, including encryption, multi-factor authentication, and liveness detection [5], [9].
- **Assess Future Implications**: Investigate how AI, machine learning, and blockchain can shape future biometric security [2], [4].

The scope covers fingerprint, facial, iris, and voice recognition technologies, with a focus on vulnerabilities and defense mechanisms.

## V. Research Methodology

This study employs a **qualitative and analytical approach** to understanding biometric security and hacking threats. The following methods were used:

- **Secondary Research:** Synthesized academic and industry literature to map existing vulnerabilities, attack vectors, and defense mechanisms [12].
- **Comparative Analysis:** Contrasted fingerprint, iris, facial, and voice systems to reveal modality-specific strengths and weaknesses [3], [4].
- **Expert Opinions:** Incorporated insights from cybersecurity practitioners, biometric developers, and ethics experts on emerging threats and solutions [6], [7].
- **Case Studies:** Examined real-world incidents—OPM breach, Android photo spoofing, and Biostar 2 leak—to illustrate practical impacts and reinforce the need for robust defenses [3], [10].

## VI. Analysis And Findings

### *A. Common Biometric Hacking Techniques*

1. **Fingerprint Spoofing**:
   Attackers replicate fingerprints using materials like latex, silicone, or 3D printing. Spoofed fingerprints can be used to gain unauthorized access to various devices, secure facilities, or banking applications. Without advanced liveness detection, many fingerprint scanners are vulnerable to these types of attacks [1].
2. **Facial Recognition Attacks**:
   Deepfake technology, adversarial images, and 3D face masks can deceive facial recognition systems. These attacks exploit weaknesses in liveness detection mechanisms, making them easier to execute. For instance, facial recognition systems that rely solely on static images or videos can be tricked by manipulating facial traits [2], [5].
3. **Iris and Retina Spoofing**:
   High-resolution printed iris images or specially designed contact lenses can manipulate iris recognition systems. Some attacks have even successfully bypassed high-security access control systems that rely on iris scans [3].
4. **Voice Cloning**:
   AI-driven deep learning models, such as Tacotron or WaveNet, can replicate a person's voice with only a few seconds of sample audio. These cloned voices are used to bypass voice authentication in various sectors, including banking systems, voice-controlled devices, and telephony services [4].
5. **Database Breaches**:
   Centralized biometric databases are prime targets for cybercriminals. Once biometric data is compromised, it cannot be changed, making breaches particularly dangerous. Hackers can use stolen biometric data for identity theft, financial fraud, or unauthorized surveillance [12].

6. **Man-in-the-Middle (MITM) Attacks**:

Without proper encryption, biometric data transmitted between the client and server can be intercepted, altered, or replayed by attackers to gain unauthorized access [5].

**B. Case Studies**

1. **2015 OPM Breach**:
   In one of the most significant biometric data breaches, hackers stole fingerprint records of 5.6 million U.S. government employees from the Office of Personnel Management (OPM). This incident highlighted the critical risks of centralized biometric storage, as compromised biometric data cannot be reset like traditional passwords [3].
2. **2019 Face Recognition Attack**:
   Security researchers demonstrated the vulnerabilities in smartphone facial recognition systems by successfully unlocking Android devices using printed photographs. This attack exposed flaws in liveness detection, proving that some facial recognition systems lack adequate safeguards against spoofing [10].
3. **2021 Biostar 2 Breach**:
   A major security lapse at the Biostar 2 biometric security platform led to the exposure of 27.8 million biometric records, including fingerprint scans, facial recognition data, and unencrypted passwords. The breach was caused by inadequate encryption and poor access control mechanisms, making it one of the largest biometric data leaks in history [12].

***C. Countermeasures***

To enhance the security of biometric authentication systems, organizations can implement the following countermeasures:

1. **Liveness Detection**:
   Advanced biometric systems incorporate techniques to distinguish between real human traits and artificial replicas [9].
2. **Multi-Factor Authentication (MFA)**:
   Combining biometrics with another layer of authentication (e.g., passwords, PINs, or security tokens) reduces the risk of unauthorized access, even if biometric data is compromised [12].
3. **Blockchain for Biometric Storage**:
   Instead of storing biometric data in centralized databases, blockchain technology can provide a decentralized, tamper-resistant storage system [8].
4. **AI-Based Anomaly Detection**:
   Machine learning algorithms can analyze biometric access patterns and detect suspicious activities, such as multiple failed authentication attempts or access from unusual locations [5].
5. **Homomorphic Encryption**:
   This advanced encryption method allows computations to be performed on encrypted biometric data without decrypting it, reducing the risk of exposure while maintaining authentication functionality [9].
6. **Zero-Knowledge Proofs (ZKP)**:
   This cryptographic method allows users to verify their identity without exposing raw biometric data. ZKP enables privacy-preserving authentication, ensuring that sensitive biometric information remains protected even during the verification process [9].

By adopting these countermeasures, biometric authentication systems can become more resilient against hacking attempts, ensuring greater security and privacy for users.

## VII. Limitations And Future Scope

### *A. Limitations*

- **Data Availability**: Limited access to real-world attack data and detailed information about actual biometric system breaches is often restricted due to security concerns and confidentiality agreements. This makes it challenging to assess the true prevalence and impact of different attack techniques.
- **Complexity of Attacks**: Simulating sophisticated attacks, particularly those involving advanced spoofing techniques or deep learning-based adversarial attacks, can be complex and resource-intensive.
- **Rapid Evolution of Technology**: Both attack techniques and defense mechanisms are constantly evolving. New vulnerabilities are discovered, and new countermeasures are developed regularly, which makes it challenging to provide a completely up-to-date and comprehensive analysis.
- **Generalizability**: The findings of this research may not be fully generalizable to all biometric systems and applications. Different systems have different architectures, vulnerabilities, and security requirements.

### B. Future Research Directions

1. **Advanced Liveness Detection**: Developing more robust and reliable liveness detection methods that can effectively distinguish between genuine biometric samples and sophisticated spoofing artifacts [9].
2. **AI-Powered Attack Detection and Prevention**: Leveraging AI and machine learning to automatically detect and prevent biometric attacks [5].
3. **Biometric Template Protection**: Protecting biometric templates from unauthorized access and manipulation using encryption, hashing, watermarking, and other cryptographic techniques [12].
4. **Continuous Authentication**: Investigating continuous authentication, where users are authenticated based on their biometric characteristics throughout the session, rather than just at the point of entry [7].
5. **Quantum-Resistant Biometrics**: Researching quantum-resistant cryptographic methods to ensure the long-term security of biometric data in the age of quantum computing [12].

## VIII. Conclusion

Biometric authentication represents the future of identity verification, offering both security and convenience. However, as demonstrated by this research, biometric systems are not impervious to sophisticated hacking techniques, such as spoofing, deepfake attacks, and database breaches. Multi-layered defenses, including advanced liveness detection, encryption methods, and decentralized storage, are critical for safeguarding these systems. Future innovations should focus on enhancing user privacy, ensuring robust authentication methods, and addressing ethical concerns. Ultimately, biometric security must evolve to meet both technological advancements and the increasing need for trust and transparency in data handling.

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# INVESTIGATING THE IMPACT OF BACTERIAL CONCENTRATIONS ON SELF-HEALING CONCRETE PERFORMANCE

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***Abstract***

*The investigation into the impact of bacterial concentrations on self-healing concrete performance highlights the significant role of microbiologically induced calcite precipitation (MICP) in enhancing concrete durability and repair capabilities. The study revealed that varying bacterial concentrations directly influence the extent of crack sealing and the efficiency of self-healing mechanisms. Optimal bacterial concentrations resulted in accelerated calcite deposition, effectively closing cracks and restoring structural integrity, while excessively high or low concentrations showed diminished performance due to nutrient depletion or insufficient microbial activity. The research also emphasized the importance of selecting robust bacterial strains and maintaining suitable environmental conditions to maximize MICP effectiveness. This approach demonstrates a promising avenue for sustainable construction practices, reducing the need for external repair materials and lowering maintenance costs. Additionally, incorporating bacterial agents in concrete aligns with environmental goals by minimizing waste and promoting longer service life for infrastructure.*

***Keywords:*** *Self-Healing concrete, bacterial concentration, 53 grade Ordinary Portland Cement, compressive forces, Bacterial Solution.*

## Introduction

Cracks, however, have been one major problem with regards to the durability and service life of structures, that's why self-healing concrete has become a revolutionary material in the field of construction. Most traditional repair methods are typically high in cost, labor and materials and therefore pose environmental problems. Self-healing concrete is an alternative substitute that depends on microorganisms that can induce calcite precipitation for sealing cracks and reestablish the structural integrity. Microbiologically induced calcite precipitation (MICP), a phenomenon that has created much interest because of its potential to improve the durability of concrete and reduce maintenance requirements is the focus of this research.

Bacteria concentration in the concrete matrix is one critical factor in determining the performance of self-healing concrete. Calcite formation in self-healing concrete is affected by the bacterial concentration, thus it is important to establish suitable bacterial levels for efficient self-healing. Insufficient concentration may simply too few bacteria for adequate crack sealing, whereas excessive concentrations may result in resource depletion and loss of effectiveness. Furthermore, this balance emphasizes the importance of a systematic study of how bacterial density affects self-healing.

The objective of this present study is to understand how the efficiency of self-healing concrete is related to the bacterial concentration. Its aim is to elucidate the mechanisms of MICP and determine the most suitable conditions regarding the crack repair. This research enhances understanding of bio-concrete technology through examination of variables including crack closure rates, calcite deposition, and structural performance. The findings also have implications for the development of sustainable and resilient construction materials, and promoting ecofriendly practices in the construction industry with a lessened reliance on current measures of construction repairs. Like other construction materials, concrete requires improvements to optimize self-healing concrete technologies in meeting infrastructure demands that continue to increase, while dealing with environmental issues. This effort is therefore a major step toward furthering the field of sustainable construction.

**Research Methodology**

Accordingly, self-healing concrete was studied experimentally with the objective of understanding how self-healing behaves. The first thing we did was to procure materials required for concrete from a particular region and then the properties of the materials procured were studied to establish that they are standard and of good quality. Based on the mentioned above properties, water cement ratio was recommended for a mix design of mix proportion of M30 grade concrete for improved performance. Several tests were done on specimen such as cubes, cylinders, and beams with concrete, in laboratory conditions in which the intention was to identify the mechanical properties of the concrete. Concrete cubes of size 150x150x150 mm were cast and subjected to compressive strength tests at intervals of 7, 21, and 28 days, following the guidelines outlined in IS: 516 – 1959. Tracking the strength of the concrete with time was done in this. Additionally, concrete cylinders with a diameter of 150 mm and a height of 300 mm were prepared and tested at 28 days as per IS: The split tensile strength was determined as specified by ASTM D5816-1999 under the split tensile strength. With an
indication of the tensile stress resistance of the concrete, there was an indication of the structural performance of the concrete. Furthermore, concrete beams measuring 150x150x700 mm were cast and tested at 28 days according to IS: The ability of concrete to resist bending loads is determined by the flexural strength of the concrete tested at 516 fraction – 1959. Using the results of these tests, conclusions were made on the effectiveness of the self-healing concrete. The study results were useful in characterizing the bacteria effects on concrete strength and durability, which are beneficial in construction work where long-life span and self-repair ability is needed.

**Material Used**

In this experimental work, there are various materials used like.

1. Cement
2. Fine aggregate
3. Coarse aggregate
4. Water
5. Bacteria

**Cement**

In the research, 53 grade Ordinary Portland Cement (OPC) conforming to the specifications of IS: The method of 12269-1987 was used. This high-grade cement was used because it has high strength and better performance as compared to the other cement which makes it ideal for high strength concrete. The density of the cement was found to be 3 specific gravity. 15, meaning how dense it is compared to water. The characteristics of the cement are given in Table 3 where the fineness, the initial and final setting times, the soundness and the compressive strength are described. 1, offering a general idea of the properties of the material that affect the concrete mix performance in general.'

**TABLE 1: PROPERTIES OF ORDINARY PORTLAND CEMENT**

| PROPERTY | VALUE |
|---|---|
| SPECIFIC GRAVITY | 3.15 |
| FINENESS IN $M^2$/KG | 351 |
| INITIAL SETTING TIME | 35 MINS |
| FINAL SETTING TIME | 240 MINS |

**FIG. 1 CEMENT USED**

**Fine Aggregate**

In this study, river sand was used as the fine aggregate which is readily available in the locality. The sand was selected to pass through a 4. 75 mm IS sieve, ensuring it conformed to the grading requirements of Zone-II as per IS: 383-1970. The importance of this grading classification is because it will influence the workability and strength of the concrete. The fine aggregate density compared to water or its specific gravity was found to be 2. 74. The table below describes in detail the properties of the fine aggregate: particle size distribution, fineness modulus, and moisture content, the evaluation of which allow to determine the role of the fine aggregate in the concrete mix.

**TABLE 2 PROPERTIES OF FINE AGGREGATE**

| **PROPERTY** | **VALUE** |
|---|---|
| BULK DENSITY | 1450 KG/$M^3$ |
| % OF VOIDS RATIO | 56.16 % |
| SIZE | PASSING THROUGH 4.75 MM SIEVE |
| SPECIFIC GRAVITY | 2.66 |
| FINENESS MODULUS | 3.24 |

**FIG. 2: FINE AGGREGATE**

**Coarse Aggregate**

The coarse aggregate used in this study was crushed stone and the material was obtained from a nearby quarry for quality purposes. The aggregate mix had particles of size 12 mm and 10 mm in a proportion of 60% and 40% respectively. This particular combination was chosen to provide the best possible concrete packing density and strength. The test result of the specific gravity of the coarse aggregate was found to be 2. 74, aligning with the requirements outlined in IS: ASTM C 383-1970 deals with the quality and grading of coarse aggregates for concrete. The main characteristics of the coarse aggregates, including size distribution, shape, texture, and water absorption are presented in the table below to assist in the understanding of the part played by aggregates in the overall concrete mix design.

**TABLE 1: PROPERTIES OF COARSE AGGREGATE**

| S.NO | PROPERTY | TEST RESULTS |
|---|---|---|
| 1 | TYPE | ANGULAR |
| 2 | DENSITY | 1478 $KG/M^3$ |
| 3 | FINENESS MODULUS | 5.66 |
| 4 | WATER ABSORPTION | 0.48% |


**FIG. 3: COARSE AGGREGATE**

## RESULTS AND ANALYSIS

### Compressive Strength Test

Evaluation of the quality and performance of concrete is based on compressive strength tests, since it represents a simple direct measure of concrete's capacity to resist compressive forces. This strength is intimately linked to structure and properties of the hydrated cement paste which is a key influence on the finally durability and structural integrity of the concrete. In this study, compressive strength tests were conducted on cube specimens of concrete at three key ages: 3 days, 7 days, and 28 days. Each testing age provides valuable insights into the concrete's strength development over time:

1. 3 Days: Together with an early indication of the strength gain, testing at 3 days confirms the strength capacity of this particular concrete. The enhancement of this early-age strength is important for the concrete's performance during early curing and construction, and gives insight into early hydration process and setting characteristics.
2. 7 Days: The results indicate only what the concrete's strength progression has been during the 7-day period of time as the concrete cures. Therefore, the concrete is well hydrated by this time

and the results allow for assessment of whether the concrete is developing strength at the expected rate.

3. 28 Days: The characteristic compressive strength of concrete is usually evaluated as a 28 day test. At this age the concrete should have achieved the target strength under normal curing conditions and if the results are not within the design specifications and quality standard, samples will be evaluated further.

This paper outlines the procedures for carrying out compressive strength tests on concrete samples and presents the results of these tests, which help provide a holistic picture of the performance of concrete at different stages of curing, making it possible for concrete to meet the specified strength criteria and to perform satisfactorily in structural applications.

**Effect of Bacterial Solution At 3 Days On Compressive Strength**

The cube compressive strength results at 3 days for different chemical admixture is presented in Table 2

**TABLE 2: COMPRESSIVE STRENGTH AT 3 DAYS CURING**

| **MIX** | **TYPE** | **COMPRESSIVE STRENGTH (MPA)** |
|---|---|---|
| M | CONVENTIONAL | 15.67 |
| M1 | 10 | 15.24 |
| M2 | 20 | 16.39 |
| M3 | 30 | 16.42 |
| M4 | 40 | 17.64 |
| M5 | 50 | 18.21 |

Compressive Strength (MPa)
18.5
18
17.5
17
16.5
16
15.5
15
14.5
14
13.5
Conventional 10 20 30 40 50 Type

**FIG. 4 COMPRESSIVE STRENGTH OF CONCRETE AT 7 DAYS CURING**

Figure 4 show graph presented illustrated development of compressive strength at 3 days for different concrete mixes. (1) Herein, this graph shows how various chemical admixtures or bacterial solutions can affect the early compressive strength of the concrete. Of the various mixes tested, the most evident result was in mixture M5, which had 50 ml of bacterial solution. At 3 days it was this particular mix that was found to have the highest compressive strength, with a value of 18.21 N/mm². This result shows that the bacterial solution played a major role in the early-age performance of the concrete. From the results obtained, Mix M5 exhibited an increased compressive strength, which was a direct result of the contribution of the bacteria toward the hydration process and the formation of calcium carbonate, which enhancers the compressive strength characteristic of concrete. Graphical representation of the effect of bacterial solution depicted a clear positive effect of of the dosage with 50 ml solution resulting to be the maximum in terms of compressive strength among other admixtures or concentrations. This discovery is essential to explaining how certain additives could improve the early concrete's performance and supporting the benefits of adding solutions with bacterial characteristics to concrete mixes to improve its structural properties.

**Effect Of Bacterial Solution At 14 Days On Compressive Strength**

The cube compressive strength results at 14 days for different percentage of bacterial solution is presented in Table 3.

**TABLE 3: COMPRESSIVE STRENGTH AT 14 DAYS CURING**

| MIX | TYPE | COMPRESSIVE STRENGTH (MPA) |
|---|---|---|
| M | CONVENTIONAL | 20.87 |
| M1 | 10 | 20.43 |
| M2 | 20 | 20.59 |
| M3 | 30 | 22.63 |
| M4 | 40 | 23.41 |
| M5 | 50 | 23.72 |

24
Compressive Strength (MPa)
23
22
21
20
19
18
Conventional 10 20 30 40 50 Type

**FIG. 5 COMPRESSIVE STRENGTH AT 14 DAYS CURING**

Fig. 5 shows that varying the percentage of bacterial solutions mix into the concrete has a very significant effect on the compressive strength of the concrete. It was also shown on the graph, the compressive strength increment as the amount of bacterial solution was increased by increments

of ten mL from ten mL to fifty mL, resulting to highest compressive strength of 23.72 N/mm² in the mix of fifty mL of bacterial solution. The findings can thus be interpreted
to mean that higher level of bacteria concentration played a significant role in enhancing the compressive strength of the concrete. The graph shows that the bacterial solution improves hydration and self-healing properties of the concrete, singly and that increasing concentrations of the solution enhances the strength. The data confirms that the use of bacteria further optimizes concrete performance, which is most likely the reason that observed compressive strength increases with increased dosage of bacterial solution.

**Effect Of Bacterial Solution At 28 Days On Compressive Strength**

The cube compressive strength results at 14 days for different bacterial solution is presented in Table 4.

**TABLE 4: COMPRESSIVE STRENGTH AT 28 DAYS CURING**

| MIX | TYPE | COMPRESSIVE STRENGTH (MPA) |
|---|---|---|
| M | CONVENTIONAL | 35.75 |
| M1 | 10 | 35.69 |
| M2 | 20 | 35.82 |
| M3 | 30 | 46.53 |
| M4 | 40 | 47.55 |
| M5 | 50 | 47.87 |

Compressive Strength (MPa)
60
50
40
30
20
10
0
Conventional 10 20 30 40 50 Type

**FIG. 6 COMPRESSIVE STRENGTH OF CONCRETE AT 28 DAYS CURING**

The results of compressive strength tests carried out on concrete samples containing various amounts of bacterial solution are provided as a table (Table 4.2) and graph (Fig. 4.3). The data reveal a clear trend: with the increase of bacterial solution concentration from 10 ml to 50 ml, the compressive strength increased as well; the mix with 50 ml bacterial solution had the highest compressive strength of 47.87 N/mm². This result shows that the higher dosage of bacterial solution remarkably increased the capacity of concrete to resist compressive loadings. The effect of the bacteria on the strength development of concrete shows the positive influence of bacteria on the increase of concrete strength with the increase of concentration of bacteria. The reason for this improvement is most likely related to the bacterial solution's ability to increase the process of hydration and form additional calcium carbonate, which reinforces the concrete matrix. The results verify that using bacterial solutions in concrete mixes results in added benefits in terms of strength and durability, and achieve the maximum compressive strength when 50 ml of solution is used.

**Flexural Strength Test Result**

Figure 6 depicts the variation of flexural strength versus different concentration of bacterial solution for M30 grade concrete. As it is shown in the graph, the flexural strength of the control concrete (concrete without bacterial solution) is 6.721 MPa. The flexural strength of the concrete increases with increase in amount of bacterial solution from 10 ml to 50 ml. More specifically, flexural strength amongst the tested samples is the highest with the concrete mix with 50 ml of bacterial solution. It was found that trend suggests that the inclusion of bacterial solution in concrete reflects some positive effect on the resistance of concrete to bending stresses. Bacterial solution is shown to optimize the hydration process and induce the formation of more calcium carbonate, hence enhancing the performance of concrete at higher concentrations. The results show that bacterial solutions can be utilized to enhance the flexural strength of concrete, and that the dosage of 50 ml yielded the greatest improvement.

**TABLE 5 : FLEXURAL STRENGTH AT 28 DAYS CURING**

| MIX | TYPE | FLEXURAL STRENGTH (MPA) |
|---|---|---|
| M | CONVENTIONAL | 4.787 |
| M1 | 10 | 4.963 |
| M2 | 20 | 5.172 |
| M3 | 30 | 5.662 |
| M4 | 40 | 6.120 |
| M5 | 50 | 6.721 |

Flexural Strength (MPa)
8
7
6
5
4
3
2
1
0
Conventional 10 20 30 40 50 Type

**FIG. 7: FLEXURAL STRENGTH AT 28 DAYS CURING**

**Split Tensile Strength Test Result**

The split tensile strength on cylindrical specimens of 150 mm diameter and 300 mm height are done as per IS 5816: In figure 6 and table 7 below, the results of 1959 codal provisions under compression testing machine are shown. The test result of M30 grade of control concrete from split tensile strength is 5.97 MPa. The 10 to 50ml increase the split tensile strength of concrete. Split tensile strength is higher for 50 ml concrete i.e. 6.269 MPa than all other proportions.

**TABLE 6: SPLIT TENSILE STRENGTH AT 28 DAYS CURING**

| MIX | TYPE | SPLIT TENSILE STRENGTH (MPA) |
|---|---|---|
| M | CONVENTIONAL | 4.954 |
| M1 | 10 | 4.876 |
| M2 | 20 | 5.324 |
| M3 | 30 | 5.723 |
| M4 | 40 | 6.112 |
| M5 | 50 | 6.269 |

Split Tensile Strength (MPa)
7
6
5
4
3
2
1
0
Conventional 10 20 30 40 50 Type

**FIG. 8: SPLIT TENSILE STRENGTH AT 28 DAYS CURING**

Split tensile strength tests were carried out on cylindrical concrete specimens measuring 150 mm in diameter and 300 mm in height, in accordance with IS 5816:1959 guidelines. The tests were carried out using compression testing machine and the result is presented in detail in Figure 7 and summarized in Table 6.

However, the split tensile strength of the control concrete (no bacterial solution) is 5.97 MPa. A consistent increase in split tensile strength was obtained by varying amounts of bacterial solution ranging from 10 ml to 50 ml. Significantly, the split tensile strength of concrete mix with 50 ml bacterial solution was recorded as the highest at 6.269 MPa. These results indicate a definite improvement in the tensile strength of the concrete in proportion to the concentration of the bacterial solution. An analysis of the results also suggests that the 50 ml dosage showed better results compared to the lower dosage due to bacterial solution's effect of enhancing the tensile properties of the concrete through the improvements to hydration and formation of additional calcium carbonate. The results indicate that adding bacterial solutions to concrete reduces its tensile strength damage, and the 50 ml dosing offers the biggest improvement in relation to other doses in workshop.

**Ultrasonic Pulse Velocity**

The internal structure of concrete cubes was investigated using ultrasonic pulse velocity testing to determine if there were any voids present in the material. After the completion of this testing procedure, all data collected were carefully analyzed and compiled in the Table 7 mentioned later in this section. The testing exercise was analyzed immediately afterward. The results indicated that adding 30 mL and 45 mL of bacterial concrete into the mix considerably reduced the remedial time and improved the ultrasonic pulse velocity, suggesting increase of the concrete density and homogeneity. The observations were consistent with one another, and with results obtained earlier observed concurrently during testing. To confirm the validity of these results, the following results were published. With the data, we can draw multiple interesting conclusions. In the case of each specimen under the testing technique, this specific outcome was observed.

**TABLE 7 ULTRASONIC PULSE VELOCITY READING**

| **PROPERTY OF CONCRETE** | **RCC MEMBER** | **PROB. DISTANCE MM** | **TIME MICRO SEC** | **VELOCITY KM/SEC** | **PROBING METHOD** |
|---|---|---|---|---|---|
| CONVENTIONAL CONCRETE | CUBE | 150 | 29.3 | 5.12 | DIRECT |
| **BACTERIAL CONCRETE** 15ML | CUBE | 150 | 29.70 | 5.13 | DIRECT |
| 30ML | CUBE | 150 | 28.60 | 5.3 | DIRECT |
| 45ML | CUBE | 150 | 29.30 | 5.17 | DIRECT |
| 60ML | CUBE | 150 | 30.40 | 4.98 | DIRECT |
| 75ML | CUBE | 150 | 29.90 | 5.12 | DIRECT |

Data of ultrasonic pulse velocity (UPV) measurements for the conventional and bacterial concrete samples is presented in the table in order to assess their internal structural quality. The specimens were Reinforced Cement Concrete (RCC) members in the form of cubes of 150 mm in size. When the cube specimen of conventional concrete was tested using the direct probing method, it demonstrated a probing distance of 150 mm, with a time of 29.3 microseconds and a velocity of 5.120 km/sec. This is a demonstration of the expected density and homogeneity of the typical mix. Instead, the bacterial concrete samples were tested in different concentrations of bacterial solution (15 ml, 30 ml, 45 ml, 60 ml and 75 ml). Ultrasonic pulse travel time ranged from 28.60 to 30.40 microseconds and corresponding velocities varied from 4.98 to 5.30 km/sec using the direct method. The direct method samples were again 150 mm2 cubes, but slight differences in velocity were noted. Additionally, the highest velocity was observed at 5.30 Kms-1 for 30 mL bacterial concrete indicating the optimal improvement in internal structure with reduction in void, increase in density. Nevertheless, when the volume increases to 60 mL, the velocity only decreased a little, suggesting that beyond a specific volume, extra bacterial solution might actually contribute to the reduction of the structural integrity of concrete rather than improving it.

**Conclusion**

This work focuses on the effect of bacterial concentrations to self-healing concrete performance, which is particularly critical for microbiologically induced calcite precipitation (MICP)-based concrete for long-term durability and sustainability benefits. The study shows that the effect of bacteria concentration is significant in both the efficiency of crack sealing and the material's ultimate self-healing capability. For effective calcite deposition, optimal bacterial concentrations produced rapid and thorough crack closure, whereas deviations either too high or too low resulted in lessened performance by limitation of bacterial availability or microbial activity respectively. This work demonstrates that, to achieve the maximum self-healing efficacy, precise bacterial dosing and environmental control are needed. Furthermore, the study focused on the selection of strains that were robust to the alkaline concrete environment and had activity over the time that it took for sufficient mass transfer across the system. Besides extending the life span of the structures, the application of bio concrete also promotes green construction policy by introducing minimal reliance on external repair materials and minimizing carbon footprints. The promising results in proof-of-concept studies presented here stand in spite of challenges like ensuring a uniform distribution of bacteria, scaling the system to large infrastructure, and optimizing of nutrient delivery systems. This study consistently builds the proposition that self-healing concrete is a revolutionary solution for modern construction which has both economic and environmental potential. The results can be used as a solid base for further advancement of bio concrete technologies and promoting the development of resilient and ecofriendly infrastructural structures.

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# EDUCATION 4.0: REIMAGINING LEARNING IN A TECH-DRIVEN WORLD

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***Abstract***

*The rapid advancement of digital technologies is bringing a new shape in the world of education. The revolution of Industry 4.0 and Work 4.0 has led to the evolution of teaching methods from traditional instruction to learner-centric models. This paper examines how AI, IoT, AR, virtual labs, and big data personalize and adapt learning experiences. A review of qualitative literature and global case studies are used to explore active strategies like blended learning, flipped classrooms, gamification, and project-based methods. It highlights the integration of these methods, to be implemented in the teaching-learning process. The paper also emphasizes core requirements such as flexible curricula, soft skill development, and real-world problem-solving. Challenges to be faced include digital inequity, limited infrastructure, inadequate faculty training, and ethical concerns over AI and data use. The stakeholders and inclusive policymaking must collaborate for the essential success of Education 4.0. Addressing systemic barriers is vital for building inclusive, future-ready systems which will help to enhance productivity in learning. The study concludes that Education 4.0 holds immense potential to create inclusive, personalized, and future-ready education systems that align with evolving societal and workforce needs.*

***Keywords**: Education 4.0, learner-centric pedagogy, emerging technologies, Industry 4.0, lifelong learning*

## Introduction

The quick technological change in the 21st century, depicted by the Fourth Industrial revolution is bringing a substantial change and influence in the educational sector. Education 4.0 is a model designed to align teaching methods with the needs of the current generation. It has brought a change from teacher-centric teaching to learner-centered environments supported by emerging technologies. It is making education more inclusive, personalized, and effective. Digital transformation in education promotes flexibility, interactivity, and permanent skill development. Emerging technologies in education, particularly AI, are adopted to transform teaching approaches, personalize learning practices and streamline administrative processes. However, while AI can excel at tasks like presenting differentiated content and assuming many administrative duties, the complex process of facilitating learning requires more than mere reproduction of information. AI should therefore serve to enhance, not replace, the role of the teacher. Research suggests that, if deployed appropriately, new prospects and developments in artificial intelligence (AI) enhance the effectiveness of teachers as well as outcomes for learners. It also regenerates education systems towards better preparing students for the demands of the 21st century.

## Conceptual Framework of Education 4.0

Education 4.0 refers to a reimagined approach to teaching and learning, aligned with the technological advancements of Industry 4.0. It emphasizes flexibility, personalization, and learner-centric models, supported by digital tools and smart technologies. The approach moves away from rote learning and standardization, and focuses on skills such as critical thinking, problem-solving, collaboration, creativity, and digital literacy. Learning is no longer confined to classrooms or fixed schedules; instead, it becomes **universal, lifelong,** and **context sensitive**. The conceptual foundation of Education 4.0 is built upon four interdependent pillars: Technological Integration, Pedagogical Innovation, Learner-Centricity and Collaborative Ecosystem (Refer Figure 1). This framework positions Education 4.0 as a transformative force that redefines not only what students learn, but also how, where, and why they learn, preparing them for dynamic and uncertain futures.

**Education 4.0 Taxonomy**

The Education 4.0 Taxonomy consists of a comprehensive set of aptitudes, organized into a tree structure. Aptitudes are the abstract, transferable aspects of learning. Most education taxonomies that pertain to childhood through secondary education identify three primary groups of aptitudes: (1) abilities and skills, (2) attitudes and values, and (3) knowledge and information (Refer Figure 2). The Education 4.0 Taxonomy places particular focus on the former two categories. Experts and employers indicate that these learning areas will require additional emphasis in future education systems relative to the emphasis they get today.

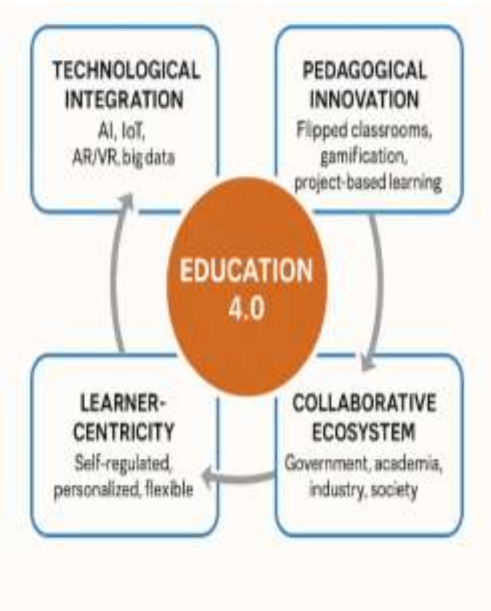



Fig 1 Image depicting Conceptual

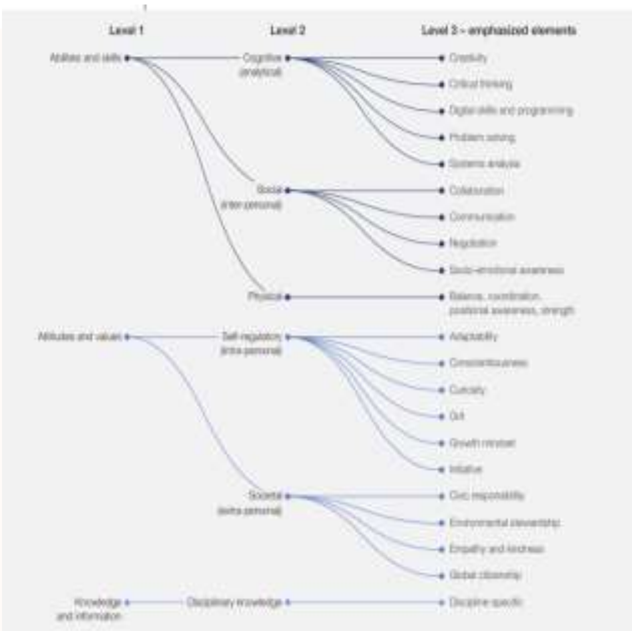


Fig 2 Education 4.0 Taxonomy Framework of Education 4.0

**Key Components of Education 4.0**

Emerging Technologies

- Artificial Intelligence (AI): Assists the education sector to follow adaptive learning platforms, automates grading, and delivers personalized content.
- Internet of Things (IoT): Facilitates smart classrooms with interconnected devices.
- Augmented and Virtual Reality (AR/VR): Enriches experiential learning and simulation-based training.
- Big Data and Learning Analytics: Allows for real-time tracking of learner progress and predictive analysis.

Innovative Pedagogical Approaches

- Flipped Classroom: Encourage self-paced learning and use classroom time for collaboration.
- Blended Learning: Combines online and offline modes to offer flexible learning pathways.
- Gamification: Applies game elements to boost engagement and motivation in the subject of interest.
- Project-Based and Inquiry-Based Learning: Emphasizes real-world applications, critical thinking, and teamwork.

- Self-Regulated Learning: Self-regulated learning is a versatile construct that involves any self-initiated cognitive or behavioral activity used to achieve a learning goal.

Digital Tools and Platforms

Tools such as Learning Management Systems (LMS), AI chatbots, virtual labs, Massive Open Online Courses, and collaborative software play a central role in facilitating Education 4.0.

These strategies foster student autonomy, creativity, and higher-order thinking, essential for adapting to future work environments.

**TABLE I: COMPARISON BETWEEN TRADITIONAL EDUCATION AND EDUCATION 4.0**

| Criteria | Traditional Education | Education 4.0 |
|---|---|---|
| **Pedagogy** | Passive, lecture-based | Active, project-based |
| **Role of Teacher** | Knowledge deliverer | Facilitator and mentor |
| **Learning Environment** | Physical, static | Digital, dynamic |
| **Assessment** | Summative | Formative and adaptive |
| **Learning Pace** | Uniform | Personalized |
| **Technology Use** | Minimal or supplementary | Integrated and essential |
| **Learner Role** | Passive receiver | Active creator and collaborator |
| **Content Delivery** | Textbook-centred | Multi-modal (videos, simulations, etc.) |
| **Feedback** | Delayed and infrequent | Continuous and real-time |
| **Curriculum Design** | Fixed and siloed | Interdisciplinary and flexible |

**Pragmatism**

Pragmatism emphasizes practical experience and the direct application of knowledge. It focuses on equipping students with skills relevant to real-world applications to align themselves with Industry 4.0. AR, VR and simulation software enhance experiential learning by simulating complex scenarios, enabling active participation. Additionally, pragmatism supports lifelong learning, and Industry 4.0 technologies, like online platforms and digital resources, facilitate continuous skill development. Pragmatism emphasizes real-world problem-solving and Industry 4.0 tools enable educators to design courses that address contemporary industrial challenges. Students can use big data, AI for automation or IoT for smart city applications to develop critical thinking and problem-solving skills necessary for future careers. Collaborative tools and cloud platforms, integral to Industry 4.0, also promote teamwork and communication, cultivating essential skills for today's industries.

**Adapting Education 4.0: Core requirements**

The students should not only be trained with technical skills but also the soft skills. To address this need, IT education must emphasize on mastery of key technologies like AI development, cybersecurity, and human-machine interaction along with the cultivation of adaptable skillsets. Designed curricula are essential to ensure the relevance and applicability of these technologies to current and future industry needs. The inclusion of modular and adaptable structures allows educational programs to remain aligned with industry trends. For example, introducing specialized IT tracks such as cloud computing, data science, and AR/VR development empowers students to tailor their learning pathways based on emerging career opportunities. Furthermore, adopting practical, Problem Based Learning methodologies bridges the gap between theoretical knowledge and real-world applications. It promotes critical thinking among students and help them to expertise their knowledge in the technical field.

**Collaborative work for Education 4.0:**

Business leaders, investors, governments and educators must work together to foster and scale opportunities for children to develop the skills necessary for Education 4.0 from an early age. This section outlines the key actions that the various stakeholders could take to foster Education 4.0 skills.

Business: Businesses should collaborate with schools and communities to promote Education 4.0 skills. This helps create more equitable economies and comprehensive societies. It also inculcates and develops talent in future entrepreneurs.

Government: Governments can utilize the taxonomy by updating teacher training programs to incorporate teaching strategies focused on Education 4.0 skills. These training programs can be co-developed with the private sector. It must give an opportunity to teachers to enter workspaces and understand how these skills are deployed in practice.

Educators: As the key drivers of learning, teachers play a critical role in fostering Education 4.0 skill development. Teachers must adopt teaching and learning practices which focus on fostering Education 4.0 skills. Teachers must adapt assessment mechanisms that focus on tracking the development of Education 4.0 skills. Educators must provide and guide the students with opportunities and project in real world to observe how Education 4.0 skills are deployed in the workplace.

**Benefits of Education 4.0**

1. Personalized and Adaptive Learning Pathways: Adaptive learning systems analyse student performance in real-time. It identifies the strength and areas for improvement, and dynamically adjust content delivery, pace, and difficulty. This personalization ensures that learners receive the right support at the right time, enhancing understanding and retention. It accommodates different learning styles and speeds, making education more effective and learner centric.

2. Increased Student Engagement and Motivation: The integration of interactive technologies such as gamification, virtual reality (VR), and simulation tools makes learning more immersive and enjoyable. These methods transform passive classroom sessions into active, hands-on experiences. Gamified elements like badges, leaderboards, and challenges encourage students to remain engaged and motivated. Furthermore, the relevance of real-world applications and the freedom to explore topics in depth contributes to higher learner involvement and intrinsic motivation.

3. Development of 21$^{st}$ century skills: Education 4.0 emphasizes the cultivation of essential skills such as critical thinking, creativity, communication, collaboration, and digital literacy. These competencies are critical in the modern workplace, where adaptability and innovation are highly valued. Project-based learning, inquiry-driven tasks and collaborative platforms help students develop problem-solving skills and the ability to work effectively in diverse teams.

4. Greater Accessibility and Inclusivity: Learners from remote areas, differently abled students, and those with varying socio-economic backgrounds can access quality content through mobile devices, MOOCs (Massive Open Online Courses), and open educational resources. Features like screen readers, voice commands, and adjustable content formats enhance imvolvement, ensuring equitable learning opportunities for all.

5. Enhanced Collaboration Between Learners and Educators: Platforms such as discussion boards, shared documents, and video conferencing enable seamless communication, peer-to-peer interaction, and teacher feedback. This fosters a community of learning where students actively participate in knowledge creation, leading to deeper understanding and stronger educational outcomes.

**Global Perspectives and Implementation Challenges**

The adoption of Education 4.0 varies across geographies. While developed nations rapidly implement AI and smart learning systems, developing countries face barriers such as inadequate infrastructure, digital divide, and policy gaps.

Resistance to change, faculty retraining, and assessment standardization are among the most cited barriers across the literature. Sustainable implementation requires policy alignment, investment in infrastructure, and collaborative stakeholder engagement.

**Education 4.0: Trends and opportunities**

Educational institutions play a key role in shaping a new society. However, today's education systems are based on developing students for jobs that no longer exist, being insufficient to meet the challenges ahead. We need to reinvent our education systems, preparing people with skills and knowledge to design and invent solutions to our most pressing problems and reimagine society to face Industry 4.0 challenges.

A. Education Trends and Opportunities: Education 4.0 is all about preparing learners to thrive in a rapidly changing world. It's not just about learning new skills but also about transforming how we teach, how students learn, where learning takes place, and how we assess progress. These changes, highlighted in Table II, reflect the shift towards a more flexible, learner-centred approach.

B. Technical/Soft Skills: In today's world, students must have a knowledge of both technical aspects and soft skills. While having some knowledge in areas like data analysis, expert systems, and databases, students must also develop creativity, critical thinking, problem-solving abilities, communication skills, teamwork, and cultural awareness. These skills are essential not only to keep up with technological changes but also to meet the expectations of modern workplaces and society.

C. Methods of Learning and Teaching: With digital tools and remote technologies coming into the picture, learning can now happen anytime, anywhere. Education 4.0 give learners the freedom to choose their own learning paths. It allows them to set goals and decide how to achieve them. The students are allowed to follow experiential, lifelong learning—where students learn by doing. Activities like collaborative projects, internships, and international exchanges help build practical skills. In this new approach, teachers become facilitators who guide and support learners, rather than simply delivering information.

D. Learning Environment: The learning environment created should be very comfortable and involve activities that keep students engrossed in inculcating knowledge. Tools like gamification make lessons more interactive and fun. Technologies such as virtual reality (VR), augmented reality (AR), and mixed reality (MR) are opening exciting possibilities in education. They allow learners to travel back in time, explore complex ideas, or interact with simulations in ways different from the ancient times.

E. Learning Assessment: Every learner is different. They cannot be assessed using the traditional methods. Relying only on standard tests or written answers isn't enough anymore. Since learning is becoming more hands-on and personalized, we need better ways to evaluate real-world skills, especially those learned through practical experiences. Online education also requires new assessment methods.

**TABLE II: EDUCATION TRENDS**

| Learning Context | Trends |
|---|---|
| **Technical/Soft Skills** | - IT systems know-how<br>- Data analysis<br>- Creativity<br>- Critical thinking<br>- Problem solving<br>- Intercultural and social skills<br>- Team working abilities<br>-Participative curricula design<br>- STEM education |
| **Methods of Learning and Teaching** | - Focus on personalized teaching<br>- Creative learning approach (BYOD)<br>- Hands-on learning<br>- Virtual, augmented, and mixed reality<br>- Blended learning |
| **Learning Environment** | - Collaborative work environment<br>- Cozy spaces<br>- Adaptable furniture<br>- Gamification |
| **Learning Assessment** | - On-the-job certification of learning<br>- Online assessment tools (m-Learning, MOOCs) |

## Barriers and Challenges

While Education 4.0 offers many benefits, its implementation faces several barriers:

Digital Divide: Unequal access to technology and internet connectivity creates a gap between those who can benefit from modern educational tools and those who cannot. This difference is especially noticeable in rural areas and communities which do not have equal advantages, limiting the reach and impact of digital learning initiatives.

Resistance to Change: People must be ready to adapt the shift from traditional classroom models to technology-driven, learner-centered approaches which require a major mindset shift. Proper support and motivation must be provided.

Data Privacy and Security: As education systems increasingly rely on digital platforms and data-driven tools, safeguarding students' personal information becomes vital. Lack of cybersecurity measures risk revealing sensitive data.

Teacher Training: Professional development programs are essential to ensure that teachers can effectively facilitate modern, technology-enhanced learning experiences.

Infrastructure and Investment: The internet, digital devices and other technological infrastructure should be readily available in different geographical areas.

These challenges are more acute in low-resource settings, where access and preparedness are limited.

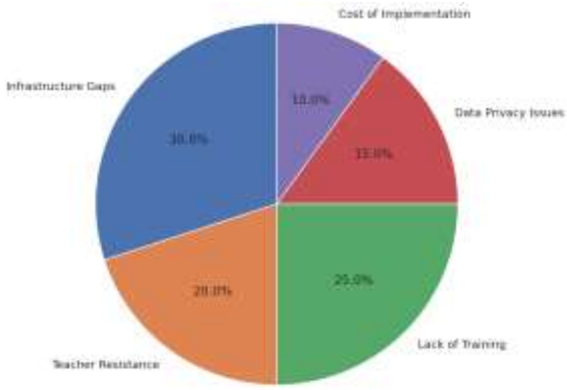
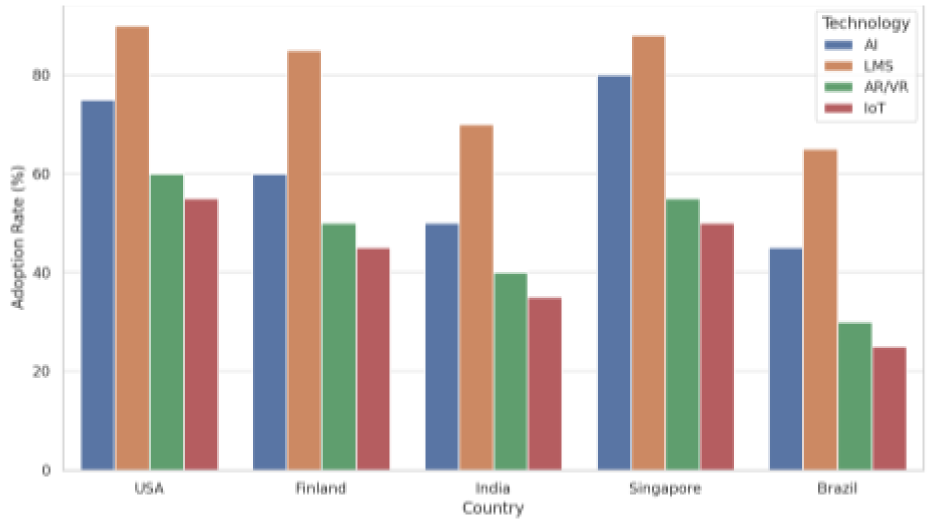



**FIGURE 3: Challenges in Implementing Education 4.0**

## Findings

Review of global case studies show that where infrastructure and policy support exist, Education 4.0 significantly improves engagement, access, and performance. Examples include AI-driven learning platforms in Finland and VR-based training in South Korea’s vocational education programs. The implementation of cross-sector partnerships, continuous teacher training, and learner-centric design led to its success. Several countries have begun implementing Education 4.0 strategies. For example:

- Finland emphasizes student autonomy and interdisciplinary learning.
- Singapore uses AI to support individualized learning.
- India’s National Education Policy (NEP) 2020 promotes digital literacy, experiential learning, and the use of technology in classrooms.
- Indus International School in Bangalore has achieved a revolutionary milestone by introducing the world’s first robot teacher, known as Panthulamma, in 2023, a remarkable feat in the field of artificial intelligence. This, 5 feet 7 inches tall robot instructor is revolutionizing education by delivering lessons in subjects such as Physics, Maths, and Chemistry.




**Graph 1.1: Adoption of Emerging Technologies in Education (by Country)**

## Discussion

Education 4.0 should be understood as a comprehensive transformation of the education system, rather than merely a technological enhancement. It leads to a fundamental shift in how we prepare learners for the future. Policymakers play a crucial role in this process by aligning educational curricula with the evolving demands of the job market and encouraging innovation through supportive policies and incentives. Educational institutions must create environments that foster collaborative learning, promote interdisciplinary thinking, and place greater emphasis on the development of essential soft skills such as communication, creativity, and adaptability. At the same time, active involvement from industry stakeholders is vital. By offering mentorship opportunities, facilitating internships, and participating in the co-creation of curricula, the industry can help bridge the gap between academic learning and real-world application, ensuring that students are equipped with the skills and experiences needed to thrive in a rapidly changing world.

## Conclusion

Education 4.0 signifies a shift from traditional educational models to a learner-centered, technology-driven paradigm that meets the demand of the digital era. It offers transformative potential to make education more personalized, accessible, and skill oriented. However, to fully realize this vision, systemic changes, investment in infrastructure, stakeholder collaboration, and inclusive policy frameworks are essential. The journey toward Education 4.0 is not only a technological shift but a cultural one that redefines how knowledge is delivered, consumed, and applied.

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# BLOCKCHAIN TECHNOLOGY

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***Abstract***

*Blockchain technology has revolutionized how data is stored, secured, and shared across digital systems. Originally introduced as the backbone of Bitcoin in 2008, blockchain has grown into a versatile tool with applications extending beyond cryptocurrencies. It operates as a decentralized, distributed ledger that records transactions securely and immutably through cryptographic linking of blocks. This report examines blockchain's technical foundation, including nodes, consensus mechanisms like Proof of Work and Proof of Stake, smart contracts, and cryptographic hashing. It also discusses different blockchain types—public, private, and consortium—and their relevance across industries such as finance, supply chains, healthcare, digital identity, and voting. While blockchain offers improved security, cost efficiency, traceability, and transparency, challenges like scalability, energy demands, regulatory issues, and interoperability remain. The report concludes by exploring future trends such as blockchain's integration with artificial intelligence and IoT, and its evolving role in digital infrastructure and governance.*

***Keywords**: Blockchain, Decentralization, Distributed Ledger, Smart Contracts, Cryptography, Consensus Mechanisms, Decentralized Finance (DeFi), Supply Chain, Digital Identity, Scalability, Security, Transparency, Emerging Technologies*

## 1. Introduction

Blockchain technology has emerged as a groundbreaking innovation in the digital era, offering a secure, transparent, and decentralized method of recording data and transactions. First introduced in 2008 as the foundational technology behind Bitcoin, blockchain has since evolved into a versatile tool with applications across numerous industries. Unlike traditional centralized systems, blockchain operates on a distributed ledger framework where information is stored across a network of nodes, ensuring that data is immutable, traceable, and resistant to tampering. Its core features—such as decentralization, cryptographic security, and consensus algorithms—enable trustless interactions between parties, eliminating the need for intermediaries [1].

The growing adoption of blockchain is reshaping sectors such as finance, healthcare, supply chain, and governance by improving transparency, security, and efficiency. This research report aims to explore the fundamental architecture of blockchain technology, examine its various types and consensus mechanisms, and analyze its current and potential real-world applications [2]. Additionally, it will address the key challenges associated with blockchain implementation, such as scalability, energy consumption, and regulatory concerns, while also highlighting future trends and innovations that are likely to shape its continued development [3].

This paper explores the evolving threat landscape associated with blockchain vulnerabilities, evaluates existing security measures, and presents a roadmap for developing more resilient, privacy-preserving blockchain systems. A comprehensive literature review establishes the technical foundation, complemented by real-world case analyses of blockchain breaches and mitigation strategies.

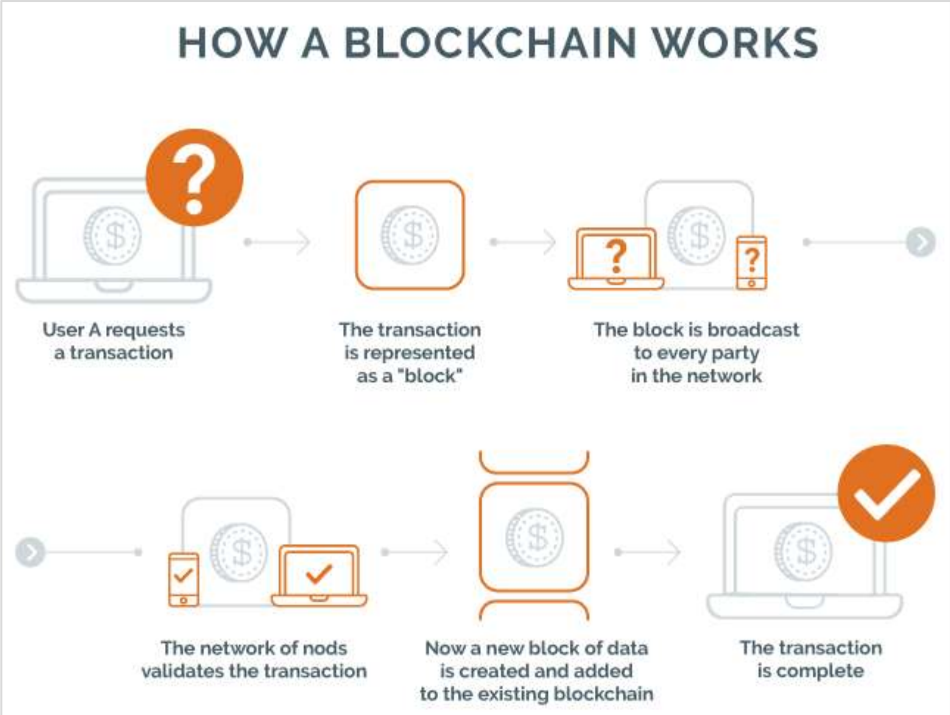


**Fig 1: Workflow of blockchain**

## 2. Literature Review

Blockchain security has emerged as a critical area of research, with numerous studies identifying vulnerabilities and proposing solutions. For this study, seven latest significant papers were reviewed:

[1] Jinhua Fu. (2020) focus in this paper proposes a new scheme to optimize the blockchain hashing algorithm based on PRCA (Proactive Reconfigurable Computing Architecture). The pipeline hashing algorithm and optimizes the efficiency of communication facilities and network data transmission by combining blockchains with mimic computers [1].

[2] Sungbeen kim. (2024) this study presents a series of structured and adaptive processes aimed at tracking and verifying transactions recorded on the blockchain. Permissioned blockchains are employed across diverse enterprises for various purposes, including data recording, management, the utilization of blockchain services, and authentication [2].

[3] Manar Joundy Hazar, (2023) it despite the fact that blockchain technology has received significant attention in a variety of application contexts over the last few years, the issue of privacy and security remains the primary focus of blockchain discussions [3].

[4] Tarek Moulahi, (2021) this study on hash functions for lightweight blockchain in Internet of Things (IoT). IoT devices typically have a resource-constrained architecture, rendering them vulnerable to cyberattacks [4].

[5] Shashwat Sharma, (2020) in this research paper delves into the principles and applications of hashing, focusing on popular cryptographic hash functions like MD5, SHA-1, SHA-2, and SHA-3. Each hash function is analysed in terms of its design, operational principles, strengths, and vulnerabilities [5].

[6] Victoria Lemieux, (2021) in this paper explore the problem of double-ending fraud in real estate transactions – a type of transactional fraud wherein agents handling real estate transactions unfairly benefit [6].

[7] The IEEE study (2019) This paper includes history of bitcoin, working of the blockchain and its application [7].

**3. Proposed Work**

Blockchain technology is highly relevant to the exchange of digital assets over the internet. Traditionally, e-commerce transactions rely heavily on financial institutions acting as trusted third parties to process, validate, and secure online payments. However, the involvement of these intermediaries inevitably leads to additional transaction costs, and a certain degree of fraud remains unavoidable.

Bitcoin offers an alternative by replacing the need for trust in third parties with cryptographic proof, allowing two parties to conduct transactions directly over the internet. Each transaction is secured with a digital signature, where the sender signs the transaction using their private key, and the transaction is addressed to the recipient's public key. To spend the digital currency, the owner must prove possession of the private key. The recipient verifies the digital signature against the sender’s public key, thus confirming ownership and authenticity. After verification, each transaction is broadcast to the entire Bitcoin network and recorded in a public ledger for transparency and security.

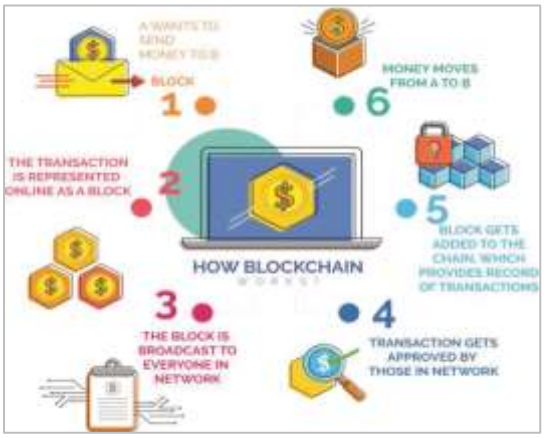


Fig 2: Working of blockchain

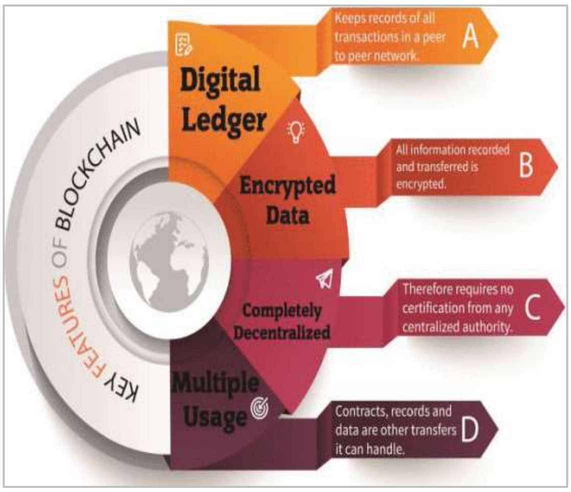


Fig 3: Key features of blockchain

[1] The digital ledger feature of blockchain securely records transactions in a decentralized, tamper-proof manner. Each entry is time-stamped, transparent, and linked to the previous one, ensuring data integrity and trust.

[2] The encrypted data feature of blockchain ensures that all information is securely encoded, protecting it from unauthorized access. This guarantees privacy, security, and trust in every transaction stored on the network.

[3] The completely decentralized feature of blockchain removes the need for a central authority, distributing control across all network participants. This enhances transparency, security, and resilience against single points of failure.

[4] The multiple usage feature of blockchain allows it to support various applications like finance, healthcare, supply chain, and digital identity. Its versatility enables secure, transparent, and efficient operations across different industries.

**4. Database Management and Hashing Techniques in Blockchain**

In blockchain technology, database operation involves maintaining a decentralized, distributed tally where data is stored in blocks, each linked to the coming through cryptographic hashes. Traditional

database systems are centralized, meaning they calculate on a central garçon to store and manage data, while blockchain uses a peer- to- peer( P2P) network, where each party( knot) has a dupe of the entire tally( 1).
Mincing plays a critical part in blockchain by transubstantiating input data (similar as sale details) into a fixed- length, unique hash value, which is stored within each block. The most common cryptographic hash function used in blockchain is SHA- 256 (Secure Hash Algorithm 256- bit), which ensures data integrity by generating a unique point for every block. Any revision to the data would affect in a fully different hash, making tampering apparent( 2).
Unlike traditional databases where records are streamlined directly in a central system, blockchain maintains invariability through chain blocks. Each block contains the hash of the former block, forming an unbreakable chain. This process makes blockchain largely secure, as altering any block would bear recalculating all posterior hashes, a nearly insolvable task due to the computational power needed( 3).
One key advantage of blockchain over traditional databases is its decentralization. Since there's no central authority, the database is more flexible to attacks and data breaches. Blockchain systems use agreement algorithms, similar as Proof of Work( PoW) or evidence of Stake( PoS), to validate deals and add new blocks to the chain. These agreement styles insure that all actors in the network agree on the state of the tally( 4).
Also, mincing in blockchain enhances data integrity and security by icing that any revision to stored data is incontinently detected by actors, precluding unauthorized access and icing trust in the system. Unlike centralized databases, which may be vulnerable to single points of failure, blockchain provides a more secure, transparent, and tamper- evidence result for data operation( 5).
In conclusion, mincing within blockchain technology offers a robust system of managing decentralized databases, furnishing translucency, integrity, and security — key features that aren't generally offered by traditional centralized database systems.

**5. Future Scope**

Blockchain technology, particularly in digital transactions, holds immense potential for future advancements. As reliance on internet-based exchanges continues to grow, blockchain can significantly reduce dependency on third-party institutions, lowering transaction costs and minimizing fraud. With its decentralized and secure nature, blockchain can be extended beyond digital currencies into areas such as supply chain management, healthcare, voting systems, and identity verification. Bitcoin’s approach of using cryptographic signatures for verification can inspire more secure and transparent systems in various industries. As blockchain technology matures, it is likely to become a core component of global financial systems, ensuring faster, safer, and more reliable online transactions.

**6. Conclusion**

Blockchain technology has emerged as one of the most transformative innovations of the digital era, offering a decentralized, transparent, and secure method for recording and verifying transactions. Through this research, it has been established that blockchain's foundational principles—immutability, distributed ledgers, and consensus mechanisms—hold significant promise for applications across diverse sectors such as finance, healthcare, supply chain, and governance.
Despite its potential, the study also highlights key challenges that currently hinder the widespread adoption of blockchain. These include scalability limitations, high energy consumption, interoperability issues, and regulatory uncertainty. However, ongoing advancements in consensus algorithms (like Proof of Stake), architectural improvements (such as sharding and layer-2 solutions), and increasing global interest in decentralized systems suggest a strong future trajectory for blockchain. With continuous

innovation and supportive legal frameworks, blockchain has the capacity to redefine how data and transactions are managed in the digital world.

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# EXPLORING THE FUTURE OF PHARMACEUTICAL RESEARCH AND DEVELOPMENT: STUDENT'S PERSPECTIVE ON AI ADOPTION, BENEFITS, AND CHALLENGES

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***Abstract***

*The application of artificial intelligence (AI) in the research and development of pharmaceuticals is fundamentally shifting practices in drug discovery, development, and delivery. As future players in the industry, students' views on the adoption of AI technology and its accompanying advantages and disadvantages are important in forming the future of R&D. In this case, we aim to explore the views of students at the School of Pharmaceutical Sciences concerning AI technology and its applications in pharmaceutical R&D and their perception regarding the benefits and challenges associated with it and its future. A survey was conducted to collect the perceptions of students from different specializations within pharmaceutical sciences. The findings captured a general sense of students' optimism AI's ability to improve efficacy, accuracy, and innovation in pharmaceutical R&D. However, issues related to data integrity, the governance concerning policy, ethics, and people and systems were also identified as other important obstacles. The study further reveals students' willingness to acquire more information on AI in pharmaceutical R&D and the instructional formats with which they would prefer to be taught. The results demonstrate the perspectives of future professionals in pharmacy with regard to the adoption of AI in the industry, showing the necessity for educating and training on these challenges and other opportunities.*

***Keywords:*** *Pharmaceutical Research, Student Perspective, AI Adoption, Drug Development, Artificial intelligence*

## Introduction

Integrating AI into pharmaceutical research and development is a novel phenomenon with considerable focus and interest given to it in the past few years. The pharmaceutical sector is currently struggling with high expenses, low productivity, and rising complexities. AI seems to be revolutionary in terms of improving efficiency, innovation, and accuracy.

Many studies have pointed out the advantages AI offers in the pharmaceutical industry like better target selection, improved lead optimization, and better clinical trial architecture. With the use of AI algorithms, huge sets of data can be analyzed for patterns, and predictions can be made. This AI-assisted algorithm has been used in predicting the therapeutic effectiveness of drug targets, designing compounds, predicting drug efficacy, and even toxicity.

Apart from the benefits, there are a couple of potential issues which stand in the way of gaining full control of AI powered R&D. These problems include gathering appropriate data, legal systems, ethical problems, and even professionals with the right skills. AI requires a lot of information, which needs to be factual and spotless. That claim does not stand true if the data is biased or incomplete.

The results of this study impact the education and practice of pharmacy. Specifically, educators can develop marketing strategies to optimize the learning experiences of students by incorporating robotics into their learning, ensuring learners receive the requisite competencies that will be beneficial in their future careers. Wherein the industry, such findings help to identify potential domains of improvement where AI can be applied to enhance productivity, value creation, and innovation.

Considering the advancement of AI technology, the role of AI in performing tasks within pharmacological research and development (R&D) will continue to increase. More tailored research aimed at solving the problems hindering the incorporation of AI technology, such as the quality and availability of data, policies governing the processes, and ethical values needs to be done. In addition, some studies need to focus on the possible uses of automation in certain fields within pharmaceutical research and development, like individualized treatment, uncommon health conditions, and infectious illnesses.

The introduction of artificial intelligence is expected to enhance research and development in drugs and medicines in modern times. Nevertheless, greater automation capabilities throughout the AI systems presents its own set of challenges. Students are the fresh driving forces for industries, drawing from their insights enable us to understand what can be done for them in order to prepare them for the realities of pharmaceutical R&D. Supporting basic understanding of the growing need to understand AI systems in the pharmaceutical field are the objectives of this research.

**Sub Headings:**

- Implications for Education and Industry.
- Students' Perspectives on AI in Pharmaceutical R&D.
- Challenges of AI in Pharmaceutical R&D
- Benefits of AI in Pharmaceutical R&D

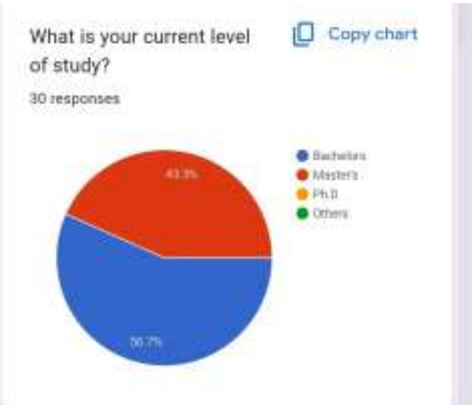
**TABLES**

| | **EDUCATION LEVEL** | | |
|---|---|---|---|
| **PHARMACEUTICAL OR NON-PHARMACEUTICAL** | **BACHELOR'S** | **MASTER'S** | **GRAND Total** |
| PHARMACY STUDENTS | 10 | 3 | 13 |
| NON- PHARMACY STUDENTS | 9 | 8 | 17 |
| TOTAL | 19 | 11 | 30 |

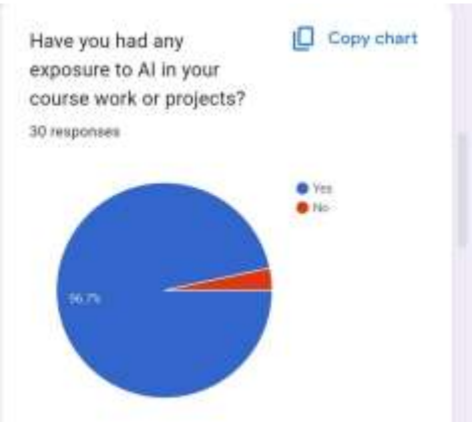
| **FAMILIARITY WITH AI IN PHARMACEUTICAL RESEARCH AND DEVELOPMENT** | **STATISTICS** | **AN AREA IN PHARMACY WHICH AI CAN IMPACT THE MOST** | **STATISTICS** |
|---|---|---|---|
| **NOT FAMILIAR AT ALL** | 10% | TARGET IDENTIFICATION | 16.7% |
| **SOMEWHAT FAMILIAR** | 23.3% | LEAD OPTIMIZATION | 23.3% |
| **VERY FAMILIAR** | 56.7% | CLINICAL TRIAL DESIGN | 33.3% |
| **EXTREMELY FAMILIAR** | 10% | PERSONALISED MEDICINE | 26.7% |

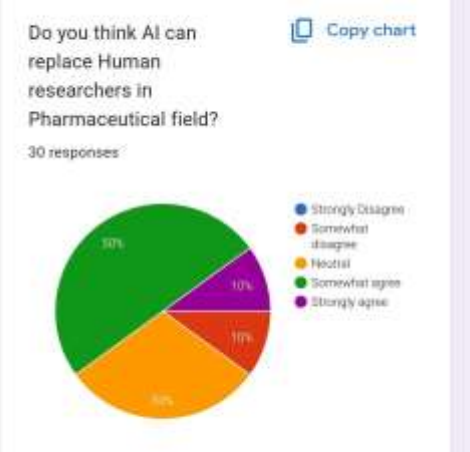
| IMPORTANCE OF INTEGRATING AI INTO PHARMACEUTICAL SCIENCES CURRICULUM | STATISTICS | PLATFORMS FOR LEARNING ABOUT AI IN PHARMACEUTICAL RESEARCH AND Developtment | STATISTICS |
|---|---|---|---|
| **VERY IMPORTANT** | 63.3% | ONLINE COURSES | 30% |
| **SOMEWHAT IMPORTANT** | 16.7% | SEMINARS | 36.7% |
| **EXTREMELY IMPORTANT** | 20% | SELF STUDY | 6.7% |
| **NOT IMPORTANT AT ALL** | 0% | WORKSHOPS | 26.7% |
| **TOTAL** | 100% | TOTAL | 100% |

GRAPHS, FIGURES








**Findings:**

The survey highlights the growing importance of Artificial Intelligence (AI) in pharmaceutical research and development.

1. High familiarity: Many respondents are familiar with AI applications in pharmaceuticals.
2. Importance of AI education: Integrating AI into pharmaceutical curricula is considered crucial.
3. Supportive role: AI is seen as a valuable tool, augmenting human researchers rather than replacing them.

The results emphasize the need for AI education and training in pharmaceutical sciences, collaborative research, and industry-academia partnerships. By embracing AI and providing opportunities for skill development, we can harness its potential to drive innovation and advancements in pharmaceutical research and development.

**Importance of Integrating AI into Pharmaceutical Sciences Curriculum**

**The results show:**

- High importance: 100% of respondents consider integrating AI into the pharmaceutical sciences curriculum important (Somewhat important: 16.7%, Very important: 63.3%, Extremely important: 20%).
- No respondents believe it's "Not important at all."

**Preferred Learning Platforms**

For learning about AI in Pharmaceutical R&D, respondents prefer:

1. Seminars (36.7%)
2. Online courses (30%)
3. Workshops (26.7%)
4. Self-study (6.7%)

**Insights**

- The overwhelming majority's emphasis on importance highlights the need to incorporate AI into pharmaceutical education.
- Seminars and online courses are popular platforms, suggesting a preference for structured learning experiences.

These results underscore the significance of AI in pharmaceutical sciences and provide guidance on effective learning platforms.

**Familiarity with AI in Pharmaceutical R&D**

The statistics reveal varying levels of familiarity with AI applications in pharmaceutical R&D among respondents from an area pharmacy.

- Majority familiar with AI: 90% of respondents have some level of familiarity with AI in pharmaceutical R&D (Somewhat familiar: 23.3%, Very familiar: 56.7%, Extremely familiar: 10%).
- AI applications: Respondents are most familiar with AI in:
  - Lead optimization (23.3%)
  - Clinical trial design (33.3%)
  - Personalized medicine (26.7%)
  - Target identification (16.7%)

**Implications**

- The high percentage of respondents familiar with AI indicates a growing awareness of its potential in pharmaceutical R&D.
- The varying levels of familiarity with specific AI applications suggest opportunities for targeted education and training.

**Areas for Improvement**

- Target identification: Relatively lower familiarity (16.7%) may indicate a need for more education or training on AI's role in target identification.
- Personalized medicine: While 26.7% are familiar, there's still room for growth in understanding AI's potential in personalized medicine.

The results suggest a strong foundation for AI adoption in pharmaceutical R&D, with opportunities for further education and training to enhance familiarity and application

**The results show:**

- Some level of agreement: 60% of respondents agree that AI can replace human researchers to some extent (Somewhat agree: 50%, Strongly agree: 10%).
- Neutral: 30% of respondents are neutral.
- Disagreement: 10% somewhat disagree.

**Insights**

- The majority's agreement suggests that AI is seen as a potentially impactful technology in pharmaceutical research.
- However, the relatively low percentage of "Strongly agree" responses and the presence of neutral and disagree responses indicate that:
- Many recognize AI's potential but may not believe it can fully replace humans.
- Some may value human expertise, creativity, or judgment in research.

**Implications**

- AI will likely augment human researchers, enhancing efficiency and accuracy, rather than replacing them entirely.
- Pharmaceutical research may involve collaboration between humans and AI systems.

**Discussion**

The survey results provide insights into the perceptions and familiarity of pharmaceutical students with AI in research and development.

**Familiarity with AI Applications**

- A significant proportion (56.7%) are "Very familiar" with AI applications, while 23.3% are "Extremely familiar." This suggests a strong foundation in AI among respondents.

**Replacement of Human Researchers**

- 60% agree that AI can replace human researchers to some extent, but only 10% "Strongly agree." This indicates that while AI is seen as impactful, human expertise is still valued.

**Importance of Integrating AI into Curriculum**

- 100% of respondents consider AI integration important, with 63.3% considering it "Very important." This highlights the need for AI education in pharmaceutical sciences.

Preferred Learning Platforms

- Seminars (36.7%) and online courses (30%) are preferred platforms for learning about AI, suggesting a desire for structured learning experiences.

**Demographics**

- The survey includes a mix of Bachelor's (56.7%) and Master's (43.3%) students, providing a representative sample of pharmaceutical students.

The results demonstrate a strong awareness of AI's potential in pharmaceutical research and development, a recognition of its importance in education, and a preference for structured learning experiences. As AI continues to evolve, it's essential to integrate AI education into pharmaceutical curricula and provide opportunities for students to develop relevant skills.

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# THE ETHICS OF INNOVATION: HUMAN-CENTERED DESIGN AS A PILLAR OF AI FUTURES

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***Abstract***

*Artificial intelligence (AI) integration into various areas of life offers hitherto unheard-of possibilities as well as difficult ethical issues. A human-centered approach is necessary to ensure artificial intelligence advances mankind and conforms with society values. This method guides the development of AI systems that are reliable, useable, and ethically sound by putting human needs, values, and well-being first of importance in AI design, development, and deployment. A key pillar in determining AI futures, human-centered design (HCD) encourages innovation while lowering possible dangers and building public confidence. Rapid advancement of artificial intelligence systems begs major ethical questions. AI has to meet human values as innovation picks speed. This paper argues that including ethics into AI research depends on Human-Centered Design (HCD). The paper uses a survey of scholarly literature, analysis of contemporary practices, and recommendations for future frameworks to emphasize HCD as a basis for ethical, inclusive, and sustainable AI futures.*

***Keywords:*** *Human-centered design, AI Human-Centered Design Principles, AI Development Lifecycle, Obstacles and Restrictions, Future of HCD, User-centered AI.*

## Introduction

There have been previously unimaginable benefits and difficulties brought about by the rapid growth of artificial intelligence (AI) technology, which has compelled society to reevaluate the ethical foundations upon which inventions are based. Within the context of the passion for development, problems concerning the social, psychological, and financial repercussions of artificial intelligence have become more prominent. In reaction to this, human-centered design (HCD) has become increasingly significant as a means of directly incorporating ethical concerns into the process of developing new technologies. Through giving them the highest priority, HCD seeks to achieve a balance between the market-driven requirements, values, and well-being of a number of different stakeholders. Because of this, it will be easier to counteract the frequently predominately innovation-driven AI requirements.

This paper suggests that, in the process of building the ethical futures of artificial intelligence, human-centered design should be a basic pillar. The theme frames human-computer interaction (HCD) not just as a methodological tool but also as a moral responsibility inside the innovation ecosystem. This is achieved by combining diverse points of view from the domains of philosophy, design theory, and artificial intelligence ethics. Examining contemporary case studies and theoretical frameworks helps this study show how using a human-centered approach could foster transparency, inclusivity, and social good. This guarantees that technology developed from artificial intelligence fit democratic and humanistic values. By doing this, it creates ethical innovation not as a side issue but rather as a guiding principle essential to the advancement of artificial intelligence in a manner that is fair and sustainable.

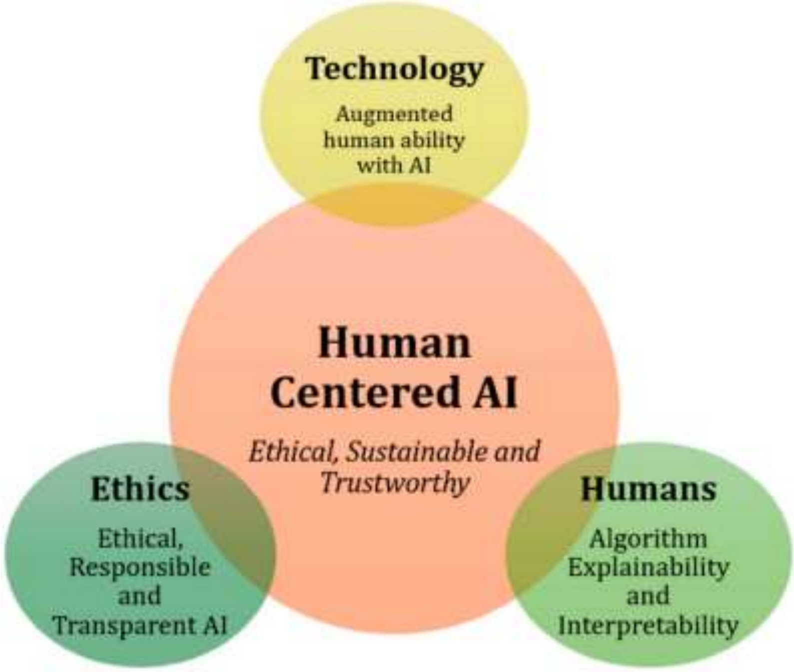


**FIGURE 1. HUMAN-CENTERED AI INVOLVES TECHNOLOGY, ETHICS, AND HUMAN FACTORS.**

By making sure that technology meets human wants and values, human-centered design (HCD) is very important in determining the direction of artificial intelligence (AI). Integrating HCD ideas is crucial to support ethical, inclusive, and socially conscious innovation as artificial intelligence systems grow in impact.

**The Imperative of Human-Centered AI**

Rapid development of artificial intelligence technologies has sparked questions about possible negative effects including algorithmic prejudice, data privacy violations, lack of openness, and employment displacement. These issues highlight the need of a proactive and moral approach to artificial intelligence development giving human values and rights first priority. Emphasizing the requirement of knowing and including human needs and viewpoints throughout the AI lifetime, human-centered artificial intelligence (HCAI) presents a paradigm for tackling these difficulties. Advocates of putting people first in the design, development, and implementation of intelligent technologies, HCAI is a design philosophy It seeks to enhance AI's advantages for humans while minimizing possible negative consequences. Through emphasizing human needs and values, HCAI can help to guarantee that artificial intelligence systems are reliable, practical, and in line with society objectives.

**Key AI Human-Centered Design Principles**

Understanding user needs, developing design solutions, and testing those solutions with users are the iterative steps of human-centered design. Several important principles are encompassed by HCD in the context of AI:

- **Empathy and User Understanding:** Human-computer interaction (HCD) is gaining a thorough familiarity with the people who will be using the AI system. This necessitates comprehending the setting in which people will employ the technology and showing empathy for their requirements, beliefs, and points of view. To better understand the wants and requirements of users, qualitative research techniques including surveys, interviews, and ethnographic studies can be employed.

- **Accessibility and Inclusivity:** AI systems should be created to serve a wide variety of users, irrespective of their identity, ability level, or other personal characteristics. For AI to truly be inclusive, it must take into account the experiences of underrepresented groups and work to eliminate prejudice and inequality. To make sure AI systems are inclusive of the diverse communities they serve, inclusive design approaches like co-creation and participatory design might be helpful.
- **Explain ability and transparency:** AI systems should be able to explain themselves and their reasoning behind decisions so users can comprehend how they work. Decisions made by AI in areas like healthcare and criminal justice, where human lives are on the line, necessitate this level of attention. Artificial intelligence (AI) systems can be made more trustworthy and accountable by using explainable AI (XAI) techniques to make them more transparent and intelligible.
- **Ethics and Accountability:** AI systems need to be held responsible for what they do, and there needs to be a framework in place to deal with any damage or unforeseen effects that may come from them. This necessitates defining roles and duties and making sure AI systems are objective and fair from the start. To ensure that AI systems are fair and equitable, it is possible to employ bias detection and algorithmic auditing methods to find and eliminate biases.
- **Supervision and Control by Humans:** AI systems shouldn't be meant to supplant humans, but rather to supplement their skills. To guarantee their responsible and ethical usage, humans need maintain control and supervision over AI systems. This calls for the development of AI systems that are open, explicable, and able to accept human input as required. To keep humans involved and able to oversee AI decision-making, "human-in-the-loop" (HITL) systems are a viable option.
- **Data Security and User Privacy:** When developing AI systems, it is important to keep user data and privacy in mind. This necessitates the establishment of strong data governance principles and the guarantee that AI systems adhere to applicable privacy laws. Anonymization and differential privacy are two privacy-enhancing technologies that can be employed to safeguard user data while enabling AI systems to learn and make predictions.
- **The overall welfare of society and the environment:** AI systems ought to be built with the purpose of enhancing the overall welfare of society and the environment. For this reason, it is important to think about the bigger picture when deciding how to deploy AI technology, including their effects on society and the environment. If we want to know how AI systems will affect society as a whole and where we can make improvements, we can do life cycle evaluations and social effect assessments.

**Integrating HCD into the AI Development Lifecycle**

If you want to use HCD to build AI, you have to incorporate its ideas and practices all the way through the AI lifecycle. Things like:

- **Determining the Issue and Needs** in order to establish the problem that AI is meant to answer and to gather needs from stakeholders and consumers, HCD should be utilized. This necessitates familiarity with the AI's intended use case, the discovery of user wants and problems, and the formulation of explicit system goals and objectives.

- **Design and Prototyping:** AI systems should be created and tested with HCD to ensure they are easy to use, understand, and satisfy user requirements. In order to iteratively improve the design of the AI system, it is necessary to create mockups and prototypes and test them with users. Co-designing with AI allows for the generation of fresh ideas and the enhancement of existing ones through the combined efforts of human and AI designers.
- **Testing and Development**: HCD should be utilized to direct the testing and development of AI systems, guaranteeing their dependability, safety, and expected performance. As part of this process, we validate and test the AI system extensively, fixing any problems we find along the way.
- **Deployment and Monitoring:** HCD should be followed to ensure that AI systems are being used responsibly and ethically. The first step is to define the parameters for AI usage; the second is to track how well AI is doing; and the third is to deal with any unforeseen effects.
- **Evaluation and Iteration:** The impact of AI systems may be assessed through HCD, and design iterations can be made using user feedback and performance data. This entails monitoring how people are interacting with the AI system, gathering feedback through surveys and interviews, and then incorporating that data into ongoing AI system improvements.

**Using HCD to Confront AI's Ethical Problems**

If we want to solve the ethical problems with AI, HCD is the way to go. Responsible and ethical usage of artificial intelligence (AI) can be achieved through the implementation of HCD, which places a premium on human values and needs. Here are a few concrete ways that HCD can tackle AI ethics:

- By making sure that AI systems are trained on varied and representative datasets, HCD can help prevent algorithmic bias. The goal of HCD is to promote equity and fairness in AI systems by identifying and addressing possible biases through the inclusion of different stakeholders in the design and development process.
- Data Privacy Protection: HCD can aid in data privacy protection by promoting privacy-conscious design practices in AI systems. Strong data governance principles, privacy-enhancing tech, and user data ownership are all part of this.
  By making sure AI systems are built to be comprehensible and interpretable, HCD may assist foster explainability and transparency. To achieve this goal, we will employ XAI approaches to explain AI outputs clearly and increase transparency in AI decision-making.
- By drawing distinct boundaries between who is responsible for what in AI systems, HCD can aid in making sure that everyone is held accountable. As part of this process, it is necessary to design procedures for handling potential damages or unforeseen effects, as well as to define the duties and obligations of AI developers, deployers, and users.

**Collaboration Across Disciplines:** A Critical Role Collaboration between AI developers, designers, ethicists, legislators, and users is essential for effective HCD application in AI. Interdisciplinary teams can guarantee that AI systems are ethically responsible and in line with society ideals by combining different viewpoints and areas of expertise. Responsible innovation can be advanced by interdisciplinary collaboration to discover and resolve possible unforeseen effects of AI technologies.

**Use of HCD in Real-World AI Cases**

A number of examples show how HCD has been useful in creating AI:

- **Healthcare Diagnosis Enabled by AI:** Ophthalmology is one area where AI is being developed with the goal of better patient care and diagnosis. But there are moral questions about accountability, scalability, and openness. To tackle these problems, we may implement HCD principles to make AI systems more open, explicable, and responsible; we can also make sure they supplement human knowledge rather than supplant it.
- **AI in Architectural Education:** Dall'asta investigated how Xi'an Jiaotong-Liverpool University's MArch program uses AI inside the HCD framework for architectural education. Better, more efficient, and user-focused results have resulted from AI integration, opening the door to more inclusive and environmentally friendly designs. Ethical considerations and the necessity to strike a balance between AI's analytical prowess and the intuitive parts of design are, nonetheless, ongoing issues.
- **Human-centered artificial intelligence (HAI)** has the ability to transform healthcare and social services, according to Crooks et al., who examine the topic of AI's impact on domestic abuse survivors and other vulnerable groups. For at-risk communities in particular, the authors argue that AI might completely alter the face of healthcare and social assistance. On the other hand, while designing HAIs, it's crucial to keep vulnerable populations' needs in mind and think about the ethical implications of using AI on them. Then, you can make sure that the HAIs you build are safe and secure by thoroughly testing them.

**Obstacles and Restrictions**

There are still a number of obstacles and restrictions that need fixing before HCD can fully realize its potential in AI:

- The Absence of Methodological Guidelines: Xu and Gao point out that although HCAI is still having an impact, the lack of practical guidelines on technique makes it difficult to implement. Based on their prior work with integrated components, they present an all-encompassing HCAI framework to fill this need. This framework will include design objectives, principles, implementation strategies, interdisciplinary teams, HCAI methodologies, and HCAI processes.
- Striking a balance between innovation and ethical concerns: incorporating ethical issues into AI research can be difficult because it may necessitate sacrificing some innovation for the sake of ethical ideals. Ensuring fairness, transparency, and accountability while optimizing AI performance can be a challenge for developers.
- Dealing with Unforeseen results: Artificial intelligence systems may cause unforeseen and unexpected results. Through the incorporation of multiple stakeholders into the design and development process and the establishment of procedures for the ongoing monitoring and evaluation of AI performance, HCD can contribute to the mitigation of these risks.
- Ensuring Human Control and supervision: As AI advances in sophistication and autonomy, it becomes increasingly challenging to maintain human control and supervision over AI systems. By creating AI systems that are open, comprehensible, and capable of human interaction when required, HCD can contribute to the solution of this problem.

**The Future of HCD in AI**

If we want AI to serve humans and be in line with society's values as it develops further, HCD will be crucial. Research in the future should center on fostering multidisciplinary cooperation and ethical consciousness among AI practitioners, as well as creating new HCD methodologies and tools

that are specific to the difficulties of AI development. We can design AI futures that are inventive and ethically responsible by embracing HCD as a basic premise.
There are a number of new developments that will influence how HCD is used in AI in the future:

- AI-Augmented HCD: By automating tasks like user research, idea generation, and prototype evaluation, AI technology can improve HCD procedures. Designers and developers can benefit from AI-augmented HCD by making it easier to create AI systems that are both effective and user-centered.
- AI Experiences Tailored to Users: HCD enables the development of AI systems that cater to the unique requirements and preferences of each user. This entails training AI to understand user context and tailor AI system behavior to achieve user goals.
- AI for Social Good: By applying HCD, AI systems can be created to tackle urgent environmental and social issues including inequality, poverty, and climate change. This entails enhancing human flourishing, ecological stability, and social justice through the application of AI.
- Rules and Frameworks for Ethical AI: One of the most essential things that can be done to shape the future of HCD in AI is to create rules and frameworks for ethical AI. To guarantee the appropriate and ethical use of AI systems, these frameworks and standards can offer a uniform set of principles and practices for AI development.

**Conclusion:**

The foundation of AI futures must be human-centered design. To make sure AI helps people and fits in with society's plans, HCD puts people first by focusing on their needs, values, and welfare. Incorporating HCD concepts and practices into every stage of the AI lifecycle—from defining the problem and gathering requirements to evaluating and iterating—is crucial for successful HCD implementation in AI. To make sure AI systems are ethically responsible and in line with society's ideals, engineers, designers, ethicists, lawmakers, and users from different fields need to work together. We can design AI futures that are inventive and ethically responsible by embracing HCD as a basic premise. To make sure AI helps people and makes the world a better, more equitable place, HCD will be crucial as AI develops further.

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# THE ROLE OF ARTIFICIAL INTELLIGENCE IN MANAGING ANXIETY AND DEPRESSION AMONG INDIVIDUALS WITH BREAST CANCER

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***Abstract***

*Breast cancer is the second most common cancer in the world. About 2.3 million new cases of breast cancer were diagnosed globally and approximately 6, 66,000 to 6, 70,000 individuals are reported in 2022. Although many stress management therapies are employed to improve the quality of index of life, challenges remain in early identification and effective intervention for psychological distress, this review highlights the recent advancement in artificial intelligence for improving the mental health outcomes in breast cancer individuals by focusing on predictive diagnostic tool, personalized treatment strategies. A special emphasis is placed on the early detection and prediction of anxiety and depressive This review focus on early identification and prediction of anxiety and depressive distress disorder especially during pre- and post-treatment and tools aid in application. It also discusses current gap, challenges and limitations in application, providing a direction for the futures research.*

***Keywords:*** *Breast cancer, artificial intelligence, anxiety, stress, palliative care.*

## Introduction:

Breast cancer is the second most common cancer in the world .According to the 2022 census where 2.3 million new cases and 670,000 deaths were reported in the world and 216,108 reported in INDIA (Kim et al., 2025; Liu et al., 2022; Sathishkumar et al., 2023).In Breast cancer physical symptoms include, presence of a lump in breast or axilla, breast may appear swollen leads to change in shape and size of breast. External changes may include erythema, pitting, ulceration, on breast nipple inversion and discharge present in nipple The risk factor include family history, genetic mutation (BRCA1/2), age, hormonal factor, life style factors (obesity, alcohol use). (Katsura et al., 2022)

Apart from the physical symptoms, psychological symptoms on both before and after treatment among these individuals includes anxiety and depression (often related to their physical appearance) concerns about their sex life, lack of social support financial needs during treatments and post traumatic stress disorder among cancer survivors. These psychological challenges can significantly decrease their quality of life. (Liu et al., 2022; Tsaras et al., 2018) Many patients report issues such as memory impairment, difficult concentrating, sleep disturbance, chronic fatigue and social withdrawal. (Dina., 2019)

## Methods:

Data is obtained from online database such as PUBMED, NIH, GOOGLE SCHOLAR, and various online journals from their inception to May, 12, 2025.The search strategy involves combined subject headings, keywords, entry of terms and free-text terms. The following keywords were used: “breast cancer,” “anxiety,” “depression,” “artificial intelligence”. The findings from this search are included in this article.

## Psychological challenges faced by breast cancer individuals:

Individual with breast cancer often experience anxiety and depression, including major depressive disorder, adjustment disorder, mood disorder, generalized anxiety disorder and post traumatic stress disorder. These mental health challenges are influenced by social factors, hormonal changes, and various psychosocial stressors during and after treatment (Tsaras et al., 2018b).Total Mastectomy and chemotherapy-induced alopecia can contribute to emotional distress and depression especially as they impact body image and self-esteem.

Anxiety and Depression are highly prevalent in this population, affecting about 41.9% and 32.2% of the individuals, respectively, often cause significant emotional distress both before and after treatment .(A & J, 2025) Anxiety tend to be more common than depression among breast cancer patients.(Hu et al., 2025)Additionally, Breast cancer can increases the risk of co-morbidity such as postural abnormalities and changes in range of motion, especially with prolonged anxiety and depression.(Akbulut Bayrak et al., 2025).

Depression and anxiety are recognized as significant co morbidity in cancer individuals, contributing to increased mortality rates. (Ungvari et al., 2025; Yedigün & Şengün İnan, 2025).Clinicians use various methods to reduce these mental health challenges, but they often encounter difficulties in consistently monitoring and addressing patients' psychological needs. Barriers include limited integration between oncology and mental health services, lack of standardized screening, and patients' reluctance to discuss mental health concerns. As a result, a significant gap remains in providing comprehensive care that addresses both physical and mental health for cancer patients.

**Challenges on traditional approach:**

A variety of approaches are used to manage anxiety and depression in breast cancer patients. These include cognitive-based therapies, drug treatments such as Selective serotonin reuptake inhibitors (SSRI) and serotonin norepinephrine reuptake inhibitors (SNRIs), and anti-anxiety medications. (Sakamoto & Koyama, n.d.) Mindfulness-Based Stress Reduction(MBSR), hypnosis, self management, physical activities such as dance therapies, Meaning Centered therapy(MCT) also commonly used. (Tsaras et al., 2018; A & J, 2025; Barcelos de Souza et al., 2025). In addition, exercise-especially multi component training-has been shown to significantly reduce symptoms of depression and anxiety in breast cancer survivors. (Zhang et al., 2025) It is said that dietary approach may reduce anxiety by improving sleep cycle. (Y. Jiang et al., 2025)

Web based digital advancement have real-time monitoring of breast cancer patients and helped reduce medical costs. (Tian et al., 2025) These technologies, including web applications, and provide continuity of care between medical appointments. Web applications are especially valuable in countries where social stigma and limited mental health resources make it difficult for patients to seek traditional support.(Zhong et al., 2025) Digital technology may improve quality of life; reduce anxiety and depression and decrease feeling of reducing loneliness among breast cancer individuals. (Dau et al., 2025)

Mobile-based apps like Whatsapp, WeChat, Welby My Carte ONC, BCSMS app, VKontakte enhancing the quality of life by improving self-efficacy, providing social support, and reducing psychological distress such as anxiety and depression. .(Barcelos de Souza et al., 2025; Dau et al., 2025; Tian et al., 2025) These platforms offer real-time communication, education, and community engagement, which can help patients feel less isolated and more empowered during their cancer journey.(Xu et al., n.d.; Zou et al., 2023)

MyNM Care Corner (Cella et al., 2025) iCareBreast app, PINK!Coach, (Pang et al., 2025) have not consistently demonstrated significant improvements in mental health outcomes for all users. Studies report that these apps did not lead to a significant reduction in anxiety and depression compared to other interventions and there is a lack of sufficient data regarding their long-term effectiveness (Horn et al., 2025)

**AI in Breast Cancer- Overview:**

Artificial Intelligence enhances diagnosis, screening and imaging, pathology (Yan et al., 2023) (Sechopoulos et al., 2021) AI improves early detection and risk prediction, as demonstrated by studies like LIBRA (Leeds Investigation of Breast-screening AI study), which focuses on identifying risk and predicting the appearance and metastasis of breast cancer. (Gastounioti et al., 2020). AI Improves diagnosis via mammography Digital Breast Tomosynthesis, ultrasound MRI, PET and CT improves detection and localization of micro calcification and differentiation. AI-assisted analysis of Breast cancer staging, molecular and gene expression analysis (Chen et al., 2025; Elahi & Nazari, 2024; J et al., 2023)

**AI in management of depression and anxiety among breast cancer individuals:**

Emergence of artificial intelligence has provided new perception on mental health. It provides personalized treatment, continuous monitoring, cost effectiveness and remote accessible for the individuals.

"FAITH (Federated Artificial Intelligence solution for moniToring mental Health)" is an AI analysis depression marker on their gene so that depression is early diagnosis (Lemos et al., 2022).

"AL-TA" provides personalized training and counseling and management. (L. Jiang et al., 2024)

"BOUNCE" helps in identification of high risk mental health detoriation among the breast cancer individuals by clinicians(C Manikis et al., 2023; Pettini et al., 2022)

"AI life review" helps in identifying oneself emotion understand and change towards betterment by asking personalized questions and providing treatments toward recovery (Ando et al., 2025)

"Nurse AMIE" helps in tracking their emotions sleep distress and provides changes according to one behavior, personality, environment by providing necessary guidance on nutrition, physical activities, cognitive behavioral therapies, meditations and sleep therapies (Gordon et al., 2023)

**Discussion:**

Even though AI has numerous benefits such as personalized care, continuous monitoring early detection, cost effective, remote accessibility, data driven insights, remote accessibility, there are some limitations in application. When it comes to mental health, most people still prefer a human-to-human approach over web-based or AI driven solutions. AI lacks the ability to understand, display wisdom or empathy as they cannot replace any human emotions. It also leads to over-reliance of clinician on technology as AI is prone to errors. (Tikhomirov et al., 2024)

Another concern is privacy. AI systems can be vulnerable to data breaches, raising issues about the confidentiality of sensitive personal information. This risk of data piracy and misuse makes some users hesitant to fully trust AI- based mental health tools. (Vijayarani & Balamurugan, 2019)

**Conclusion:**

AI is transforming the landscape of breast cancer care and mental health support by offering personalized treatment, early detection and continuous monitoring. But still they cannot fully replace the empathy and nuanced understanding provided by human clinicians. Concerns around privacy, over-reliance, and data security remain important challenges. Further future studies are needed to address the current challenges in applying AI for breast cancer and mental health care by enhancing algorithm transparency and providing high quality data for maximize their benefit in patient welfare.

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# DEVELOPMENT AND PHYSICOCHEMICAL EVALUATION OF A LABORATORY-SYNTHESIZED SUNSCREEN INCORPORATING NATURAL INGREDIENTS

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***Abstract***

*This study focuses on developing an herbal sunscreen gel using ingredients known for their medicinal, antioxidant, and UV-protective properties. Key components included Aloe Vera, turmeric, rosemary oil, almond oil, zinc oxide, and extracts from orange peel, lemon peel, and hibiscus petals. These were chosen for their roles in enhancing the formulation's effectiveness, skin compatibility, and stability.*

*Five samples were prepared using a consistent method, varying only in zinc oxide concentration to evaluate its impact on sun protection. The formulations were assessed for physicochemical characteristics such as colour, odour, texture, state, pH, and viscosity to ensure skin safety and user acceptability. UV-Visible spectrophotometry was used to analyse UV absorption, particularly in the 290–420 nm range, and SPF values were estimated based on absorbance data. A basic irritancy test was also conducted to confirm skin-friendliness.*

*Results indicate that herbal sunscreens can provide effective sun protection while also nourishing the skin. These formulations support the growing trend of clean, green, and sustainable skincare products and demonstrate promising potential in the cosmetic industry as a safer alternative to conventional sunscreens.*

***Keywords:*** *Herbal Sunscreen, UV Spectroscopy, pH, Viscosity, Plant Extracts, SPF.*

## Introduction

Herbal sunscreens offer a natural alternative to regular sun protection products, using plant-based extracts and minerals to protect the skin from UV radiation [1]. Zinc oxide, a mineral that naturally occurs, is commonly used in these sunscreens because it's effective at blocking both UVA and UVB rays, providing broad-spectrum protection.[2]

By counting fixings such as Aloe Vera, turmeric, Hibiscus, and green tea, these sunscreens give extra benefits like cancer prevention agents, anti-inflammatory properties, and calming impacts for the skin [3][4]. These plants help to reduce redness, prevent damage caused by free radicals, and support the skin's recovery after sun exposure [5][6].

Purohit A.D., Bisen R.A., Gajbhiye K.D., Ukey K.S., Baghele A.H., and Sharnagat M. (2023) formulated sunscreen lotions using natural and synthetic agents to enhance UV protection and skin compatibility. Their study emphasizes the benefits of botanical extracts for antioxidant and soothing effects, with blended formulations offering improved SPF, texture, and user satisfaction [5].

As people become more aware of the potential dangers of synthetic chemicals in sunscreens, such as oxybenzone, parabens, and fragrances, there has been an increased interest in finding safer, more natural alternatives for skin protection [6]. Singh A. (2023) synthesized a sunscreen containing octyl salicylate and zinc oxide, combining organic and inorganic agents for enhanced UV protection. Octyl salicylate effectively absorbs UVB radiation, while zinc oxide provides broad-spectrum defence against UVA and UVB rays. The study highlights the superior sun protection factor (SPF) of these blended formulations, which outperform commercial sunscreens, particularly in UVB protection. These findings support the use of emulsification processes for creating stable, high-performance sunscreen products [7].

Herbal sunscreens bring together traditional plant-based remedies with modern skin care techniques, offering sun protection that's gentle on the skin and safer for the environment [8].

Indira S. (2023) formulated a sunscreen cream using Rubia cordifolia (Manjistha), highlighting its potential as a natural alternative to chemical-based sunscreens. Known for its antioxidant and anti-inflammatory properties, Manjistha offers effective UV protection while being gentle on the skin. The study supports the use of herbal extracts in creating safer, skin-compatible sun care solutions [9][10].

Roy A. And Sahu R.K. (2014) developed an herbal sunscreen cream using medicinal plants like Terminalia arjuna, Tinospora cordifolia and Glycyrrhiza glabra known for their antioxidant and therapeutic properties. Their study addresses concerns over the side effects of synthetic sunscreens by offering a natural alternative with broad-spectrum UV protection. The herbal formulation demonstrated a significant SPF value, along with good cosmetic properties such as spread ability and skin compatibility. The research supports the growing trend of incorporating plant-based ingredients in skincare for safer and more effective sun protection.[11]

In view of the fact mentioned above and as a part of our efforts to discover new potential, the present study is focused on the development and evaluation of a laboratory- synthesized sunscreen incorporating natural ingredients.

**Experimental**

1. **Materials and Physical Measurement**

   AR grade chemical and solvents were used in the present study. Instrumental was involved UV-spectrophotometer, pH meter, Ostwald's viscometer.

2. **Preparation of Herbal extract**

   The herbal extracts were prepared using the reflux extraction method. Samples 1, 4, and 5 were extracted from natural materials including orange peel, lemon peel, moringa powder, and rose petals, while Samples 2 and 3 were prepared using commercially obtained citrus peels.

   All materials were first rinsed thoroughly with distilled water to remove any surface impurities, then dried in the shade until completely crisp. The dried samples were coarsely powdered using a mortar and pestle.

   Each powdered sample was transferred into a round-bottom flask containing ethanol and subjected to reflux for about two hours under controlled heating. After completion, the mixtures were allowed to cool, filtered, and the resulting extracts were concentrated using a water bath until a semi-solid consistency was achieved.

   The prepared extracts were then stored in clean, airtight containers and kept in a cool, dry environment until further use in the sunscreen formulations.

3. **Formulation of Herbal Sunscreen**

   The herbal sunscreen was formulated using a two-phase emulsification method.

   For the aqueous phase, Aloe Vera gel was mixed with turmeric extract, green tea extract, and orange peel extract. Zinc oxide was then added, and the mixture was stirred thoroughly until a uniform blend was achieved.

   In a separate beaker, the oil phase was prepared by heating shea butter, vitamin E, and either rosemary or almond oil in a water bath with continuous stirring. Triethanolamine was introduced as an emulsifying agent during the heating process.

   After the oil phase was slightly cooled, the aqueous phase was added gradually with constant stirring to form a stable, creamy emulsion. The prepared sunscreen formulations were then transferred into clean, airtight containers and stored for further analysis. The table below enlists the contents of all the five herbal sunscreens (**F1to F5**) prepared in this research.

| **Ingredients** | **F1** | **F2** | **F3** | **F4** | **F5** |
|---|---|---|---|---|---|
| Aloe Vera | 5g | 6g | 8g | 7g | 6g |
| Sea butter | 2.5g | 2.5g | 3g | 3.5g | 4g |
| Vitamin E | 1ml | 1ml | 1ml | 1ml | 1ml |
| Turmeric Extract | 0.3g | 0.3g | 0.3g | - | - |
| Rose Extract | - | - | - | 3g | - |
| Lemon Extract | 0.5g | 0.5g | 0.5g | - | - |
| Orange Extract | 0.5g | 0.5g | 0.5g | - | - |
| Hibiscus Extract | - | - | - | 0.5g | - |
| Triethanolamine | 1ml | 1.5ml | 1.5ml | 1.5ml | 1.5ml |
| Moringa Powder | - | - | - | - | 3g |
| Green tea Extract | 0.5ml | 0.5ml | - | - | - |
| Rosemary Oil | 1ml | 1ml | - | - | - |
| Rose Water | 1ml | 1ml | 1.5ml | 1.5ml | 1.5ml |
| Almond Oil | - | - | 1.5ml | 1ml | 1ml |
| Zinc Oxide | 1.5g | 2g | 3g | 3.5g | 4g |

4. **pH determination**
   The pH of the herbal sunscreen formulations was measured using a digital pH meter. Each formulation was mixed thoroughly with distilled water and left undisturbed to ensure complete dispersion. After sufficient standing time, pH readings were taken carefully. To ensure consistency, measurements were repeated three times for each sample, and the average value was recorded for accuracy.
5. **Physical Parameters**
   The physical properties of the formulations were evaluated through direct observation. Colour was examined in natural light to check for uniformity and overall appearance. Odour was assessed by applying a small amount to the hand and checking for any unpleasant smell. The texture and consistency were also observed carefully to ensure smoothness, homogeneity, and to rule out any phase separation or lumps.
6. **Skin compatibility**
   A small amount of the herbal sunscreen formulation was applied to a clean area on the inner forearm of volunteers. The area was left undisturbed for 24 hours, and after this period, the skin was checked for any signs of irritation such as redness, itching, or swelling. Since no adverse reactions were observed, the formulation was determined to be safe and non-irritating for topical use.
7. **Determination of Viscosity**
   The viscosity of the herbal sunscreen formulations was checked using an Ostwald viscometer. Each sample was properly dissolved in distilled water to make a smooth solution. The solution was then poured into the viscometer, and the time taken for it to pass between the two marks was measured with a stopwatch. All observations were taken at room temperature. The formula used to calculate Viscosity is
   $\boldsymbol{\eta = \eta 2 \times (t1 / t2)}$

where, $\eta$ = Viscosity of the test sample
$\eta 2$ = Viscosity of water
t1= Flow time of the test sample
t2= Flow time of water

8. **Determination of Absorbance**

The herbal sunscreen formulations were prepared by dissolving the samples in ethanol and subjecting them to ultrasonication for 4 to 5 minutes for thorough extraction. The solutions were then filtered to remove solid particles, discarding the first portion of the filtrate. Absorbance was measured using a UV-Visible spectrophotometer at 5 nm intervals from 290 nm to 450 nm, with ethanol as the blank and a 1 cm quartz cuvette, to assess the ability to absorb ultraviolet radiation. The formula I have been used to calculate SPF is

**SPF= Σ [2.303× ABSORBANCE +0.622]**

Where 2.303 is used to convert absorbance to a natural logarithm and 6.022 is a standard constant.

**Result and Discussion**

1. **pH analysis:**

The pH of the sample 1- 5 was analysed for pH. The pH range was observed from 6.56-7.00. The details are mentioned in **Table No. 1.** The pH levels of five different sunscreen samples (F1 to F5) were tested over a two-week period to assess their stability when stored. On the first day, the pH values were close to neutral: F1 at 7.00, F2 at 6.56, F3 at 6.53, F4 at 7.22, and F5 at 7.70. After one week, there were small changes: F1 increased slightly to 7.11, F2 rose to 7.61, F3 went up to 7.66, F4 dropped slightly to 7.12, and F5 decreased to 7.53. After two weeks, the pH values for F1, F2, and F3 were 7.41, 7.52, and 7.63.

Overall, the pH of all the samples stayed within a safe range for skin use, indicating that the sunscreens remained stable and did not break down or become harmful over time. Among the formulations, F5 had the highest pH value, initially measuring 7.70. Despite a slight decrease to 7.53 after one week, F5 maintained the highest pH throughout the testing period. This suggests that F5 was the most alkaline among the samples, yet still within a safe range for skin application, making it a stable and safe option for use.

2. **Physical parameter:**

All five formulations were found to be “semisolid” in consistency. However, there were noticeable differences in their appearance and smell. F1 was yellow in colour with an orange-like odour and had a smooth texture. F2 appeared reddish-brown and had an orange and lemon-like smell, with a similarly smooth texture. For F3, I observed a pale-yellow colour and a rose-like fragrance, with a smooth texture. F4 was light red in colour, also with a rose-like odour, but its texture was moderate, slightly different from the first three samples. Finally, F5 was light yellow with an aromatic-like odour and had a moderate texture.

This evaluation was important to understand the physical characteristics of the herbal sunscreens prepared. The details are mentioned in **Table No.2.**

3. **Irritancy test:**

All the herbal sunscreen formulations showed no signs of redness, inflammation, or irritation during the study. This indicates that the formulations are safe and well-tolerated by the skin, making them suitable for regular use. The details are mentioned in **Table No.3.**

4. **Determination of viscosity:**
   This experiment tested five different herbal sunscreen samples to see how thick or runny they were by measuring their viscosity. The results showed that the amount of zinc oxide used in each sample affected how thick the sunscreen turned out. Sample 1 was quite thick with a viscosity of 1.887 Pa·s and took 113.22 seconds to flow, meaning it would stay on the skin well. Sample 2 was lighter and flowed faster in 88.75 seconds, with a viscosity of 1.479 Pa·s, making it easier to spread. Sample 3 had a balanced texture, taking 93.01 seconds to flow with a viscosity of 1.550 Pa·s, which suggests it had a moderate amount of zinc oxide. Sample 4 was the thinnest and flowed the quickest in just 84.52 seconds, with the lowest viscosity of 1.409 Pa·s, which means it would feel light on the skin but may not last long. Sample 5 was the thickest of all, with a high viscosity of 1.917 Pa·s and the slowest flow time of 115.03 seconds, likely because it had the most zinc oxide (4 grams), making it great for longer-lasting protection. In short, the more zinc oxide in the sunscreen, the thicker it becomes, which helps it stay on the skin longer but also makes it less easy to spread. The details are mentioned in **Table No. 4.**
5. **Determination of absorbance**:
   In this study, five different herbal sunscreen samples were evaluated based on their UV absorbance and corresponding SPF values. Sample 1 exhibited the lowest absorbance values across the UV range, resulting in the lowest SPF of 24.6226, with its highest absorbance being 0.26 at 400 nm. Among all, Sample 2, which contains 2 grams of zinc oxide, showed the highest absorbance of 0.59 at 400 nm and achieved the highest SPF value of 32.567, indicating its superior sun protection efficiency. Sample 3 showed a slightly lower maximum absorbance of 0.60 and an SPF of 31.20. Similarly, Samples 4 and 5 displayed absorbance values of 0.50 and 0.60 at 400 nm, with SPF values of 29.79 and 31.10, respectively. Overall, the formulation containing 3 grams of zinc oxide demonstrated excellent UV absorbance and SPF performance, but Sample 2 with 2 grams of zinc oxide provided the highest SPF value among all samples. This highlights the effective role of zinc oxide concentration in enhancing sunscreen performance, making it a key active ingredient in herbal sunscreen formulations. Details are mentioned in **Table No. 5.**

**TABLE No. 1**

**DETERMINATION OF pH**

| SR. NO. | DAYS | F1 | F2 | F3 | F4 | F5 |
|---|---|---|---|---|---|---|
| **1.** | Initial days | 7.00 | 6.56 | 6.53 | 7.22 | 7.70 |
| **2.** | 1 weeks | 7.11 | 7.61 | 7.66 | 7.12 | 7.53 |
| **3.** | 2 weeks | 7.41 | 7.52 | 7.63 | - | - |

**TABLE NO. 2.**

**COMPARISON OF PHYSICAL PARAMETERS OF THE SAMPLES**

| SR. NO. | Parameter | F1 | F2 | F3 | F4 | F4 |
|---|---|---|---|---|---|---|
| **1.** | Colour | Yellow | Reddish Brown | Pale yellow | Light red | Light yellow |
| **2.** | Odour | Orange like | Orange and lemon like | Rose like | Rose like | Aromatic like |
| **3.** | State | Semisolid | Semisolid | Semisolid | Semisolid | Semisolid |
| **4.** | Texture | Smooth | Smooth | Smooth | Moderate | Moderate |

## TABLE NO. 3
## IRRITANCY TEST RESULTS OF THE SAMPLES ON SKIN

| FORMULATION | IRRITANT EFFECT | ERYTHEMA | EDEMA |
|---|---|---|---|
| **F1** | Nill | Nill | Nill |
| **F2** | Nill | Nill | Nill |
| **F3** | Nill | Nill | Nill |
| **F4** | Nill | Nill | Nill |
| **F5** | Nill | Nill | Nill |

## TABLE NO. 4.
## DETERMINATION OF VISCOSITY OF THE SAMPLES

| SAMPLE | FLOW TIME (min: sec) | FLOW TIME (sec) | VISCOSITY (cP) |
|---|---|---|---|
| **F 1** | 1:53.22 | 113.22 | 1.887 |
| **F2** | 1:28.75 | 88.75 | 1.479 |
| **F 3** | 1:33.01 | 93.01 | 1.550 |
| **F 4** | 1:24.52 | 84.52 | 1.409 |
| **F 5** | 1:55.03 | 115.03 | 1.917 |

## TABLE NO. 5
## DETERMINATION OF ABSORBANCE (F1- F5) AND SPF VALUES

| wavelength | Absorbance (nm) | SPF | Absorbance (nm) | SPF | Absorbance (nm) | SPF | Absorbance (nm) | SPF | Absorbance (nm) | SPF |
|---|---|---|---|---|---|---|---|---|---|---|
| | **F1** | | **F2** | | | **F3** | | **F4** | | **F5** |
| 290 | 0.15 | 0.9674 | 0.17 | 1.0135 | 0.19 | 1.0595 | 0.22 | 1.1286 | 0.22 | 1.1286 |
| 295 | 0.17 | 1.0135 | 0.22 | 1.1286 | 0.20 | 1.0826 | 0.22 | 1.1286 | 0.20 | 1.0826 |
| 300 | 0.16 | 0.9904 | 0.23 | 1.1516 | 0.20 | 1.0826 | 0.21 | 1.1056 | 0.20 | 1.0826 |
| 305 | 0.16 | 0.9904 | 0.23 | 1.1516 | 0.18 | 1.0365 | 0.23 | 1.1516 | 0.21 | 1.1056 |
| 310 | 0.19 | 1.0595 | 0.28 | 1.2668 | 0.32 | 1.3589 | 0.23 | 1.1516 | 0.22 | 1.1286 |
| 315 | 0.18 | 1.0365 | 0.37 | 1.4741 | 0.38 | 1.4971 | 0.18 | 1.0365 | 0.33 | 1.3819 |
| 320 | 0.15 | 0.9674 | 0.23 | 1.1516 | 0.47 | 1.7044 | 0.23 | 1.1516 | 0.33 | 1.3819 |
| 325 | 0.17 | 1.0135 | 0.23 | 1.1516 | 0.44 | 1.6353 | 0.28 | 1.2668 | 0.36 | 1.4510 |
| 330 | 0.20 | 1.0826 | 0.33 | 1.3819 | 0.44 | 1.6353 | 0.38 | 1.4971 | 0.38 | 1.4971 |
| 335 | 0.24 | 1.1747 | 0.45 | 1.6583 | 0.47 | 1.7044 | 0.18 | 1.0365 | 0.40 | 1.5432 |
| 340 | 0.17 | 1.0135 | 0.49 | 1.7504 | 0.51 | 1.7965 | 0.22 | 1.1286 | 0.40 | 1.5432 |
| 345 | 0.20 | 1.0826 | 0.45 | 1.6583 | 0.60 | 2.0038 | 0.20 | 1.0826 | 0.47 | 1.7044 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 350 | 0.20 | 1.0826 | 0.37 | 1.4741 | 0.10 | 0.8523 | 0.21 | 1.1056 | 0.45 | 1.6583 |
| 355 | 0.22 | 1.1286 | 0.22 | 1.1286 | 0.28 | 1.2668 | 0.23 | 1.1516 | 0.37 | 1.4741 |
| 360 | 0.20 | 1.0826 | 0.25 | 1.1977 | 0.33 | 1.3819 | 0.38 | 1.4971 | 0.51 | 1.7965 |
| 365 | 0.20 | 1.0826 | 0.27 | 1.2438 | 0.12 | 0.8983 | 0.38 | 1.4971 | 0.50 | 1.7735 |
| 370 | 0.21 | 1.1056 | 0.30 | 1.3129 | 0.20 | 1.0826 | 0.44 | 1.6353 | 0.18 | 1.0365 |
| 375 | 0.19 | 1.0595 | 0.37 | 1.4741 | 0.26 | 1.2207 | 0.44 | 1.6353 | 0.23 | 1.1516 |
| 380 | 0.20 | 1.0826 | 0.37 | 1.4741 | 0.33 | 1.3819 | 0.18 | 1.0365 | 0.30 | 1.3129 |
| 385 | 0.20 | 1.0826 | 0.39 | 1.5201 | 0.40 | 1.5432 | 0.45 | 1.6583 | 0.37 | 1.4741 |
| 390 | 0.23 | 1.1516 | 0.56 | 1.9116 | 0.45 | 1.6583 | 0.37 | 1.4741 | 0.47 | 1.7044 |
| 395 | 0.23 | 1.1516 | 0.56 | 1.9116 | 0.37 | 1.4741 | 0.50 | 1.7735 | 0.59 | 1.9807 |
| 400 | 0.26 | 1.2207 | 0.59 | 1.9807 | 0.10 | 0.8523 | | | | |
| | | **SPF= 24.6226** | | **SPF = 32.567** | | **SPF = 31.20** | | **SPF = 29.79** | | **SPF = 31.10** |

**Conclusion**

This study focused on the formulation and evaluation of herbal sunscreens utilizing natural ingredients known for their skin-protective and soothing properties. Plant-based extracts and essential oils were incorporated for their antioxidant capacity, anti-inflammatory effects, and UV-blocking abilities. A total of five sunscreen formulations were created using the same process, with the main variation being the different levels of zinc oxide added to study how it impacts.

The prepared formulations were systematically evaluated for key parameters such as appearance, fragrance, pH, viscosity, and UV absorbance to ensure product quality, safety, and compatibility with the skin. The pH values of the formulations ranged from 6.56 to 7.70, remaining within the skin-friendly and safe range. Physical characteristics of definition F1 to F5. All are semi-solid with smooth surface but diverse in colour and scent.

Among the tested samples, Sample 5 displayed the greatest thickness with a viscosity of 1.917 Pa·s, while Sample 4 had the lowest viscosity, indicating the thinnest consistency at 1.409 Pa·s. When testing for UV absorption, Sample 2 gave the best result with the highest absorbance value of 32.567, making it the most effective in blocking harmful sun rays.

The overall results showed that herbal ingredients can be successfully used to make sunscreens that protect the skin from UV rays and help in moisturizing, calming, and healing. Compared to conventional sunscreens with synthetic chemicals, these herbal formulations present a safer, more natural, and environmentally friendly alternative. This research supports the growing trend in the cosmetic industry toward sustainable, plant-based skincare solutions, offering valuable insights into the potential of herbal sunscreens as viable, effective, and eco-conscious products.

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# ANALYTICAL EVALUATION OF VARIOUS METAL LEVELS IN MARKETED FACE POWDER FORMULATION

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***Abstract***

*The study was conducted to investigate the analytical evaluation of various metals (if detected) in six commercial face powder samples. For analytical evaluation the techniques involved were: Semi-micro qualitative analysis, Quantitative Estimation by Complexometric Titration and voltametric Estimation. Each commercial sample was carefully analysed. The results of the semi-micro tests confirmed that both zinc and calcium were present in all six face powder samples. This finding suggests that these metals are commonly used in cosmetic formulations, likely due to their beneficial properties such as skin protection and oil absorption. This study focuses on determining the amount of zinc and calcium present in six commercial face powder samples using volumetric estimation techniques. Following the confirmation of the presence of these metals through preliminary semi-micro qualitative analysis, volumetric methods were employed to estimate their concentrations. Calcium and Zinc was determined using complexometric titration with EDTA. Voltammetry was employed as a sensitive and reliable method for determining the exact concentration of Zn to verify the accuracy of titrimetric results. Voltammetry, an electroanalytical technique based on measuring current as a function of applied voltage, is particularly suitable for trace metal analysis due to its high sensitivity and selectivity.*

***Key word:*** *Face Powder, Metals calcium and zinc, Volumetric titration, Voltametric evaluation*

## Introduction

Face powder is a widely used cosmetic item that enhances the skin's appearance by delivering a smooth, even finish. Historically, its origins trace back to ancient Egypt, where it served not only beauty purposes but also symbolized cultural trends of the time (Walter et al., 1999, p. 36). Over the centuries, its formulation and usage have evolved significantly. Today, face powder is an essential part of makeup routines, commonly applied to fix foundation, reduce oily shine, highlight facial features, and assist in contouring techniques (Frangie, 2012, pp. 45–46). It generally comes in two main types: loose powder and pressed powder. Loose powder, which is finely milled, is particularly helpful for oily skin as it effectively absorbs sebum. In contrast, pressed powder is denser and provides fuller coverage, making it ideal for concealing imperfections and evening out skin tone (Frangie, 2012, pp. 45–46).[1][2]

Over the years, face powder has played an important role in shaping the standards of beauty within society. In ancient European and Asian societies, a pale complexion was often linked to wealth and social status. This preference continued during the Medieval period, when women often used face powders containing harmful ingredients such as lead, bleach, and lye, unaware of the health risks. The effectiveness of face powder depends on the correct application. The application process generally begins with moisturizing and priming the skin to create a smooth, even surface. After applying foundation and concealer, a light dusting or pressing of powder with a soft brush or puff helps set the makeup and achieve a flawless finish.[3]

Several studies have been done to analyse presence of metals in locally available cosmetics. One such study was conducted by Nibras Mohammed Alsaffar, et al (2014). Their research focused on Cosmetic products dated between 2000- 1200 BC. The Researchers were able to analyse and identify the presence of two lead compounds namely Galena (PbO) and Cerussite ($PbCO_3$) [4].

Fuad A. Ababneh, (2018) successfully carried out Assessments of Toxic Heavy Metals Contamination in Certain Cosmetic Products. Their research found the presence of harmful metals like lead, cadmium, mercury, and nickel. They also reported that the concentration of heavy metals calculated, exceeded safety limits. Lead and cadmium were detected in 17.8% and 14.3% of products.[5]

Salwa Y. S. Rahil. (2016) systematically investigated the presence of toxic elements in commercially available cosmetics. The findings underscore a significant public health concern, as several of the analyzed products were found to contain elevated concentrations of hazardous metals, particularly lead (Pb) and cadmium (Cd), which may pose long-term toxicological risks upon prolonged dermal exposure [6].

Skin whitening creams and lotions are so popular globally as beauty is still related to white skin. Keeping this in mind Pauline Burger (2016) wrote an article titled, "Skin Whitening Cosmetics: Feedback and Challenges in the Development of Natural Skin Lighteners". Researchers concluded that the practice of skin lightning is widespread across the globe, with its application rooted in both dermatological treatment and aesthetic enhancement. In regions such as Africa and Asia, its use is predominantly influenced by cultural perceptions of beauty, whereas in Western countries, it is more commonly prescribed for medical conditions like hyper pigmentation and melasma [7].

Research project titled, "Evaluation of Heavy Metals in Cosmetic Products and Their Health Risk Assessment" by Hamna Arshad, Moniba Zahid Mehmood, Munir Hussain Shah, Arshad Mehmood Abbasi, (2020) focussed on assessment of heavy metals in several cosmetic products and they effectively highlighted the side effects of metallic components present in various cosmetics [8].

Rima Ali, Nagwa et al (2022) conducted study on health risks of toxic metals in facial cosmetics. Facial cosmetics selected for analysis were lipstick, powder, eyeliner, mascara, and foundation creams. which distribute pigments evenly to enhance beauty. The study concluded that the formulation of these cosmetics may inadvertently serve as sources of heavy metal contamination during manufacturing [9].

The study titled "Spectrophotometric Determination Of Heavy Metal in Cosmetics Sourced from Kaduna Metropolis, Nigeria" by M. B. Nasiruddin (2015) explores the presence of hazardous elements in cosmetic products. Although the term "cosmetics" originates from the Greek word kosmetikos, reflecting their historical role in enhancing appearance, increasing scrutiny has been directed at the industry due to the inclusion of potentially toxic substances. This concern is amplified by the fact that cosmetic safety is primarily overseen by industry-led bodies such as the Cosmetic Ingredient Review (CIR), rather than through strict external regulation [10].

In view of the facts mentioned above the present research is focused on conducting both qualitative and quantitative analyses of various metals in face powders. The present study is also seeking to compare the concentrations of these metals for all the selected samples.

## Experimental

### 1. Materials And Physical Measurements

All the chemicals, reagents, solvents used in this work were of AR grade (Loba / SD fine Chemical make) and were used as it is directly taking desired quantity from the air tight bottle. Water used for preparations of all chemicals was de-ionized distilled water.

Muffle furnace used to convert face powder sample to ash was with heating capacity upto $1500^0C$ and with precise control of $\pm 50^0C$. Metrohm 884 Voltammetry analyzer available at K. C. College HSNC

University Mumbai with Mercury (DME / SMDE) as working and Ag/AgCl as reference electrode, was used for verification of results (for Zn only).

All the volumetric glassware (calibrated by weight) were used for preparation of solutions and titrimetric analysis. Contech single pan calibrated balance with 0.1mg sensitivity was used for weighing all quantities.

All the experiments were repeated twice (or thrice) to get concordant results.

**2. Sample Conversion to Ash**

Accurately weighed 5.00g face powder sample was taken in a previously weighed crucible. The crucible was heated to 800 $^0$C for 3 hrs in the muffle furnace. After that the crucible was cooled in desiccators. The obtained ash of the face powder was used to determine Ca and Zn in this work.

**3. Qualitative Analysis**

Qualitative analysis was done using standard reported procedure as mentioned in Practical handbook, Himalaya publications [**give reference here**]. The OS was prepared for all the six commercial face powder samples and Group detection tests were done from Group I to Group V. In the Group detection test, the precipitation was observed in Group 3 B and Group 4.

**a. Analysis of Group 3B**

Prepared OS was boiled strongly to remove $H_2S$ gas completely. The solution was concentrated to about 2 cm$^3$ volume. To the 2-3 drops of the solution, was added 0.1g of $NH_4Cl$ and 1:1 $NH_4OH$ solution till it became alkaline. Finally few drops of freshly prepared saturated $(NH_4)_2CO_3$ solution were added to it. Formation of precipitate was observed and hence presence of metal ions from Group 3B was indicated. Precipitate was washed with 2 cm$^3$of $H_2O$, centrifuged and washing was rejected. Washed precipitate is dissolved in 1 cm$^3$of 4N HCl. The solution was to make alkaline by adding dilute ammonium hydroxide and $H_2S$ gas was passed. White ppt of ZnS was seen and hence presence of Zinc ions in sample was confirmed.

**b. Analysis of Group 4**

Precipitate separated and dissolved in hot 2 cm$^3$of 4N $CH_3COOH$. 2-3 drops of the solution was treated with 0.5 cm$^3$of freshly prepared saturated $K_2CrO_4$solution. No precipitate was seen. To the solution 3-4 drops of saturated $(NH_4)_2C_2O_4$ solution was added, and white precipitate of Calcium oxalate was seen confirming the presence of Calcium ions.

**Quantitative Analysis**

**1. Preparation of experimental metal solution:**

Accurately weighed 0.100g of ash sample was taken in a beaker (Borosil), after adding 10 cm$^3$ conc. $HNO_3$ the content was heated to dryness on a sand bath. The metal extraction process was repeated with one more addition of 10 cm$^3$ conc. $HNO_3$ and finally the obtained solid was boiled with water to get the metals into the solution. The solution obtained in this manner was finally diluted to 100 cm$^3$ with distilled water to get the experimental stock. This stock solution was then used for all estimations.

**2. Complexometric Estimation**

**a. Estimation of Calcium**

10cm$^3$ of stock solution is taken in the conical flask. Add 10cm$^3$ of 8M KOH and 10cm$^3$ of 10% $NH_2OH.HCl$. then add 2-3 drops of patton reader indicator and titrate against 0.01M EDTA.

**b. Estimation of Zinc**

10cm$^3$ of stock solution is taken in the conical flask. Add 10cm$^3$ of buffer PH 10. then add 2-3 drops of EBT indicator and titrate against 0.01M EDTA.

**c. Voltammetry Analysis**

The voltametric experiments were carried out by standard addition method on Metrohm 884 analyzer. The voltametric cell was first filled with 10 $cm^3$ 0.1 N KCl solution (0.745 g KCl and dissolved in 100 $cm^3$ distilled water) as supporting electrolyte (SA) and 1.0 $cm^3$ of the experimental stock solution was added and a base run was taken in Differential Pulse Voltammetry mode (DPV). After this base run 4 more additions of 1$cm^3$ each time of 50 ppm Standard solution with respect to Zinc, Copper, Cadmium and Lead were done. The recorded DPV curves for all 5 runs are given in result section.

The standard having three metals (Copper, Cadmium and Lead) other than Zinc was added for qualitative verification of any other metals (out of Copper, Cadmium and Lead) is present in the ash sample. Zinc pick current values were used for quantitative determination of Zinc (reported in results), used to verify the results of Zinc estimation by complexometric titration method.

**Result and Discussion.**

1. **Semi micro analysis:**
   Semi micro analysis of all the six ash samples of commercial face powder was conducted. The presence of Group 3 B and Group 4 was detected and on detailed group analysis of Group 3B the presence of Zinc ions was confirmed in all six samples And In Group 4 the presence of Calcium ion was confirmed in all six sample. No other metal or heavy metal was identified in qualitative analysis. As shown in **TABLE NO.1**
2. **Complexometric estimation:**
   **TABLE NO. 2** shows the percentage of calcium and zinc in six different samples. By looking at the data, we can see that Sample 4 has the highest percentage of both calcium (19.2%) and zinc (27.4%). This means Sample 4 is richer in these minerals compared to the other samples. Sample 2 also has good amounts with 15.2% calcium and 20.9% zinc, while Sample 6 follows with 14% calcium and 19.6% zinc. Sample 1 has 12.4% calcium and 16.3% zinc, and Sample 3 shows 11.6% calcium with 17% zinc. Sample 5 has the lowest values, with only 10.8% calcium and 13% zinc.
   In simple words, Sample 4 contains the most calcium and zinc among all the samples, while Sample 5 contains the least. This information can help in choosing which sample is better depending on where high calcium and zinc content is needed.
3. **Voltammetry analysis:**
   Representative DPV curve for sample 5 and 6 and the standards added in shown in the **Figure 1 and 2** respectively. These graphs clearly indicate there is no trace of any other metal (in the tested range) other than Zinc in the experimental ash solution. The corresponding standard addition plots of peak current against concentration of standard recorded from instrumental response are given as **Figure 3 and 4** for sample 5 and 6 for Zinc concentration respectively. The Voltammetry calculations are indicated in **Table 3**.

   The calculations done after the standard addition curves are given below and the results are in good agreement with the non-instrumental (classical method). This correlation of classical and advance instrumental method is indicative of the applicability of the classical methods in current era also and can be taken as measure of skills the chemist has.

**TABLE NO. 1: SEMIMICRO ANALYSIS RESULTS**

| NO. OF SAMPLE | CONFIRMED CATION | CONFIRMED CATION |
|---|---|---|
| 1. | $Zn^{2+}$ | $Ca^{2+}$ |
| 2. | $Zn^{2+}$ | $Ca^{2+}$ |
| 3. | $Zn^{2+}$ | $Ca^{2+}$ |
| 4. | $Zn^{2+}$ | $Ca^{2+}$ |
| 5. | $Zn^{2+}$ | $Ca^{2+}$ |
| 6. | $Zn^{2+}$ | $Ca^{2+}$ |

**TABLE NO. 2: RESULT OF QUANTITATIVE DETERMINATION OF METALS USING COMPLEXOMETRIC TITRATION**

| NO. OF SAMPLE | % OF CALCIUM | % OF ZINC |
|---|---|---|
| 1. | 12.4 | 16.3 |
| 2. | 15.2 | 20.9 |
| 3. | 11.6 | 17 |
| 4. | 19.2 | 27.4 |
| 5. | 10.8 | 13 |
| 6. | 14 | 19.6 |

**Figure 1:**
**Standard addition DPV curve recorded (current vs. concentration of standard added) for sample 5**.

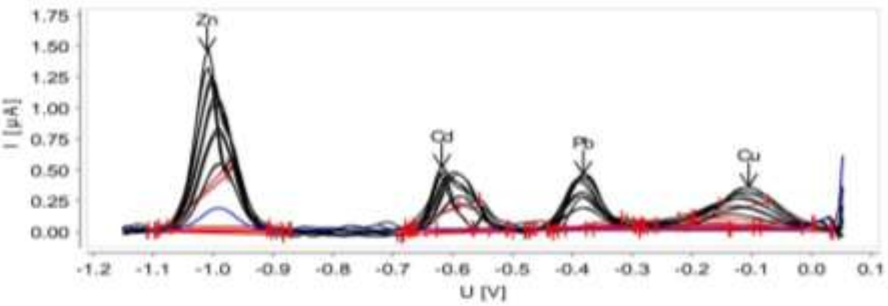


**Figure 2:**
**Standard addition DPV curve recorded (current vs. concentration of standard added) for sample 6.**

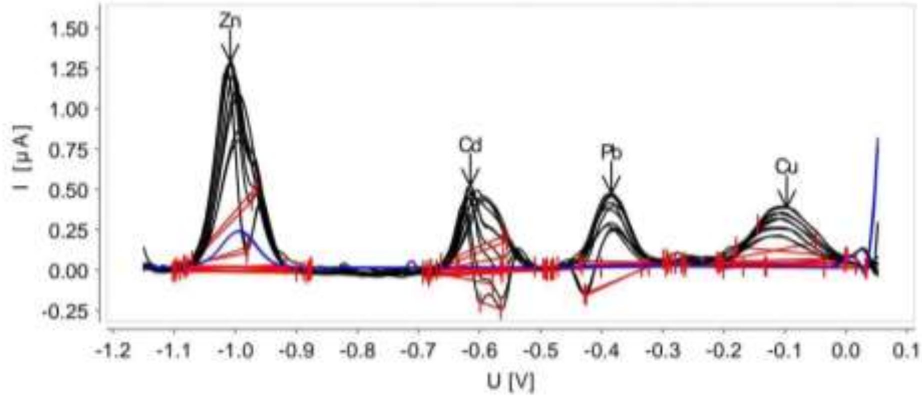

**Figure 3: Standard addition plot of peak current against concentration of the standard added for sample 5**

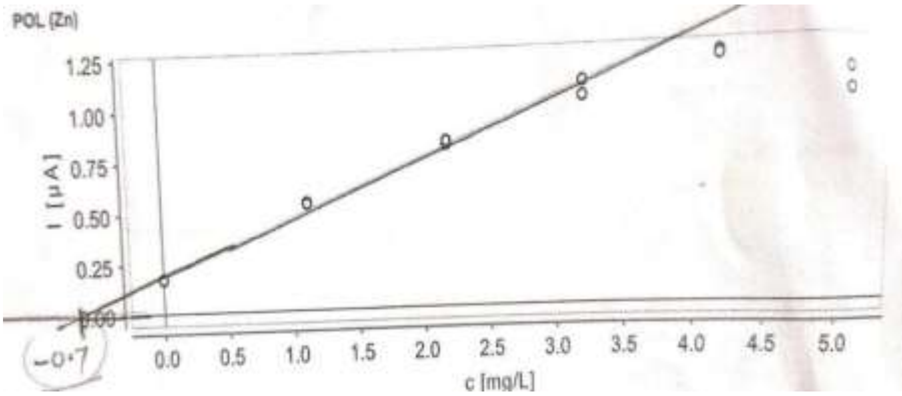


**Figure 4: Standard addition plot of peak current against concentration of the standard added for sample 6**

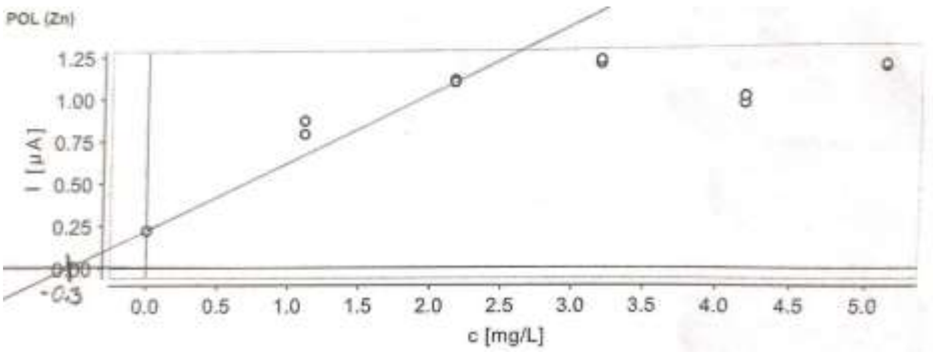


**Table 3: Voltammetry Calculations considering dilution factor:**

| Sr. | Parameter | Sample 5 | Sample 6 |
|---|---|---|---|
| 1 | Weight of ash taken for analysis | 100 mg | 100 mg |
| 2 | Total volume if original stock solution | 100 ml | 100ml |
| 3 | Volume of stock solution added to 20 $cm^3$ SA solution | 1.0 $cm^3$ | 1.0 $cm^3$ |
| 4 | Concentration of Zinc from Standard addition graph | 0.7 PPM | 0.85 PPM |
| 5 | Concentration of Zinc in run solution | 0.7 PPM | 0.85 PPM |
| 6 | The concentration of Zn stock (10 $cm^3$ diluted to 20$cm^3$) | 1.4 PPM | 1.7 PPM |
| 7 | The amount of Zn stock (10 $cm^3$ diluted to 20$cm^3$) | 1.4 $mg/dm^3$ | 1.7 $mg/dm^3$ |
| 8 | The amount of Zn 100 $cm^3$ stock | 14 $mg/dm^3$ | 17 $mg/dm^3$ |
| 9 | Amount of Zn in 100 mg sample ash (100 $cm^3$ stock) | 14 mg | 17 mg |
| 10 | % of Zn in ash | 14.0% | 17.0% |

## CONCLUSION

The qualitative and quantitative analysis of various commercial face powder samples was conducted using a combination of semi-micro qualitative analysis, volumetric estimation, and voltammetric techniques. This multifaceted approach allowed for both the identification and accurate quantification of metal ions present in the commercial samples of face powder. No heavy metals like Lead, cadmium or mercury were detected in any of the samples. All commercial face powder samples that were analysed, were found to have Zinc and Calcium as main metals. Zinc, known for its antimicrobial and anti-inflammatory effects, as well as its role in skin protection, and calcium, enhances texture, stability, and absorbency, were consistently found across the various products tested. Voltammetric measurements confirmed the results of Classical method as both are in good agreement with each other. This study not only demonstrates the effectiveness of combining classical and modern analytical techniques for cosmetic analysis but also emphasizes the critical role of quantitative testing in maintaining product quality and consumer safety. The results are summarized in Table no 4. The results obtained also matches with the expected range of Zn (10% -25%) and Ca (2% - 15%) in face powder [3][11].

**Table 4: Summary of results for percentage of Ca and Zn in the face powder samples.**

| | **% Ca** | **% Zn** | **% Zn By voltammetry** |
|---|---|---|---|
| **Sample no.1** | 12.4 | 16.3 | --------- |
| **Sample no.2** | 15.2 | 20 | --------- |
| **Sample no.3** | 11.6 | 17 | ---------- |
| **Sample no.4** | 19.2 | 27 | --------- |
| **Sample no.5** | 10.8 | 13 | 14.0% |
| **Sample no.6** | 14 | 19.6 | 17.0% |

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# URBAN SIGHTING OF AURICULARIA POLYTRICHA FROM KAUSA-MUMBRA, THANE (MAHARASHTRA): A BIODIVERSITY NOTE

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***Abstract***

*The sighting of Auricularia polytricha, a common wood-rotting fungus, from Kausa, Mumbra (Thane District, Maharashtra), represents an important addition to the biodiversity records of India. Although this species is widely distributed across the Western Ghats and adjoining areas, this particular documentation from Kausa is noteworthy due to its localized context and urban-ecological setting. Our report serves not only as a biodiversity record but also as an inspiration for budding researchers—especially from Kausa, Mumbra, and the tribal student communities of Thane and neighbouring Palghar District.*

*The Kausa-Mumbra region is ecologically significant, representing a unique mosaic of habitats, including the Thane Creek, Mumbra Hills, Diva Dumping Ground, and the adjacent Ulhas River, all juxtaposed with the rapidly expanding urban infrastructure. This complexity underscores the importance of continued ecological monitoring and encourages localized biodiversity exploration in such dynamic environments.*

***Keywords:*** *Common wood rotting fungus, Fungal diversity, Auricularia polytricha*, *Mumbra, Thane, Habitat diversity.*

## Introduction:

This most common *AURICULARIA POLYTRICHA*, COMMON WOOD ROTTING FUNGUS, is easily seen around the urban places of Mumbra, Kausa region from Thane Urban city. Being common, it's distribution is very well spreading along the Western Ghat (HOTSPOTS) and other plateau areas of Maharashtra State. The Mumbra areas had been studied earlier for the slum research studies (1) and for spider diversity related topics (2). The detailed diversity of flora and fauna of Kalsekar College campus was studied by Prof. Dr. HULE, Abhay Surersh while working with Zoology department of DRT's A. E. Kalsekar Degree College, Mumbra, Thane area (3). The newly building / on going up bridge and tunnel area construction activities for Airoli to Mumbra, for KATAI Naka traffic resolution is affecting lots of biodiversity of Mumbra region (4), hence it was important to published this paper as inspiration to zoology students and will act as a model for other researchers around Mumbra. Beyond this it will be acting as a BASE LINE data for further Urban Studies in and around Thane region.

**Methods-**

The photograph of the fungal specimen (Annexure I) was carefully taken during the heavy monsoon period and the species was regularly observed under similar climatic conditions. A conducive microhabitat for this and other fungal species was noted within and around the garden area of A. E. Kalsekar Degree College, Mumbra, Thane. Additionally, a nearby residential location (GPS coordinates to be provided) also supported the growth of similar fungi.

Species identification was carried out using a standard field guide, and further assistance was sought from senior subject expert **Prof. Dr. Mahavir Gosavi** (Head, Department of Botany, S.I.E.S. College, Sion). The captured photograph was meticulously compared with authenticated reference images and descriptions available through online biodiversity portals and published literature (5, 6 and 7).

**Description:**

The observed fungal specimen closely resembled several other commonly occurring wood-rotting species in terms of shape, size, and general morphology. To ensure accurate identification, a detailed comparative study was undertaken. All authors consulted with subject matter experts in the fields of Botany and Agronomy across various academic institutions. Following thorough examination and expert validation, the species was conclusively identified as Auricularia polytricha and the identification was unanimously accepted by the research team.

Occurrence of the same species was also seen from Chandiigadh, Punjab Area (5).

**Conclusion:**

Although Auricularia polytricha is a commonly observed species in forested and semi-urban landscapes, documenting such sightings holds significant value for ecological research and biodiversity databases. The intent behind this publication is to emphasize the importance of recording even commonly occurring species, which are often overlooked in scientific literature. By highlighting this case study, we aim to encourage budding researchers—especially from urban, semi-urban, and tribal regions—to contribute to biodiversity documentation. Such micro-level studies not only enrich our understanding of local ecosystems but also foster a culture of scientific observation and publication, particularly in areas where academic resources and reading habits may be limited (8 and 9).

**Acknowledgement –**

We express our sincere gratitude to our Vice Principal and Principal, **Dr. Zahid Husain Ibne Hasan Ansari** for their constant encouragement and unwavering support throughout this work. We are also thankful to our former Principal, **Mr. Sajjiid Hundekar**, for his valuable guidance and assistance in clarifying our doubts.

Our heartfelt thanks go to the students who actively contributed to the collection of references and preliminary field observations. We would also like to acknowledge **Prof. Dr. Misbah Shaikh** for her support in species identification and for providing access to relevant resources.

Lastly, we are deeply thankful to the **Almighty** for granting us the strength, inspiration, and opportunity to carry out this work.

**Sighting Details:**

The specimen was photographed by our student, **Miss Hawabi Ayub Angariya**, using a mobile device on **01 July 2024**, during a period of continuous heavy rainfall in **Mumbra and Dombivli (East)**. This observation was personally documented by the authors and the student. The image and field notes were collectively analyzed by the research team.

For species confirmation, the photograph was shared with **Prof. Dr. Mahavir Gosavi**, Head of the Department of Botany at **S.I.E.S. College, Sion, Mumbai**, and **Treasurer and Managing Council**

**Member of the Association of Fungal Biologists, India**. (Reference: https://siesascs.edu.in/ ). His expert validation helped substantiate our identification of Auricularia polytricha.

***ANNEXURE I:***

## References

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*This is a reference for the photo of the species. (c) 57Andrew, some rights reserved (CC BY-NC-ND), http://www.flickr.com/photos/29954808@N00/9894693725/*

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# SUSTAINABLE GREEN SYNTHESIS OF CHALCONES VIA MICROWAVE AND GRINDING METHOD: CHARACTERIZATION BY FT-IR

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***Abstract***

*Chalcone, a common natural pigment and a key intermediate in the biosynthesis of flavonoids, was synthesized using sustainable and eco-friendly methodologies. In this study, chalcone derivatives were efficiently prepared via two green chemistry approaches: microwave irradiation and solvent-free grinding. These methods employed Claisen–Schmidt condensation reactions between substituted acetophenones and various aromatic benzaldehydes in the presence of an inorganic base. Compared to conventional techniques, these green methods offer notable advantages, including significantly reduced reaction times, higher product yields, and a lower environmental footprint. The structures of the synthesized chalcones were validated through FT-IR spectral analysis. This work underscores the potential of green synthetic strategies for producing biologically active compounds in alignment with the principles of sustainable chemistry.*

***Keywords****: Chalcones, Claisen-Schmidt, FT-IR, Microwave, Grinding*

## Introduction

Chalcones, which serve as key intermediates in the biosynthesis of flavonoids and isoflavonoids, are naturally abundant in various plant species. These have been recognized in genera including *Angelica, Glycyrrhiza, Humulus, and Scutellaria,* many of which possess a rich history of application in traditional medicine [1]. Chalcones are structurally defined by an open-chain arrangement featuring two aromatic rings linked by a three-carbon α,β-unsaturated carbonyl bridge. Naturally occurring in various

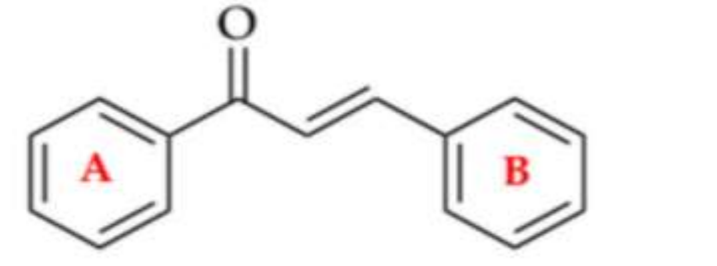

**Figure 1.** Chemical structure of a chalcone.

dietary sources such as fruits, spices, teas, and soy-based products, chalcones have garnered significant scientific interest due to their diverse and potentially beneficial biological properties. Additionally, they play important ecological roles as constituents of natural products, functioning as pheromones, plant allelochemicals, and insect hormones [3]. Both naturally occurring and synthetically derived chalcones have attracted considerable attention in medicinal chemistry due to their broad pharmacological profiles. These encompass analgesic, anticholinergic, antiplatelet, antiulcer, anticancer, antiviral, antidiabetic, immunomodulatory, aldose reductase inhibitory, estrogenic, and non-purine xanthine oxidase inhibitory properties, along with their potential applications in HIV treatment [3,4,5,6,7,8,9,10,11,12]. In addition to their pharmacological significance, chalcones have found industrial applications as light-stabilizing agents, sweetening agents, and analytical reagents in techniques such as amperometry and spectrometry [13]. Certain chalcone derivatives have been identified as inhibitors of key enzymes such as lipoxygenase, β-secretase, acetylcholinesterase, butyrylcholinesterase, cyclooxygenase, and peroxisomal enzymes. However, isolating stable chalcone structures directly from plants can be challenging, as the enzyme chalcone synthase rapidly catalyzes their conversion into flavanones during biosynthesis [14]. Among dietary sources, common naturally occurring chalcones include phloretin and its glycosylated form, phloridzin (phloretin 2′-O-β-glucopyranoside), which are abundant in apples. Other examples include chalconaringenin in tomatoes, arbutin in pears, and flavokavains found in kava plants [15].

**Materials and methodology**

All chemicals and solvents used in the present study were of analytical reagent (AR) grade. The synthesis of various chalcone derivatives was carried out using a Bajaj 1701 MT DLX microwave oven via microwave irradiation technique. The characterization of the synthesized compounds was performed using a PerkinElmer FT-IR spectrometer at the Central Instrumentation Facility Laboratory, K. C. College, HSNC University.

**Experimental Procedure**

a. Chalcones were synthesized via a base-catalyzed Claisen–Schmidt condensation using a mechanochemical grinding approach. In a typical procedure, equimolar amounts (1 mmol each) of a substituted aromatic aldehyde and a substituted acetophenone were combined in a clean mortar. Sodium hydroxide pellets (1 mmol) were then added to the mixture, and the contents were ground manually at ambient temperature for approximately 30 minutes. After the reaction was complete, the remaining base was neutralized using a 1:1 hydrochloric acid solution. The crude reaction mixture was subsequently dissolved in ethanol, and the resulting solid was isolated by filtration, washed with distilled water, dried, and recrystallized from chloroform to afford the purified chalcone product.

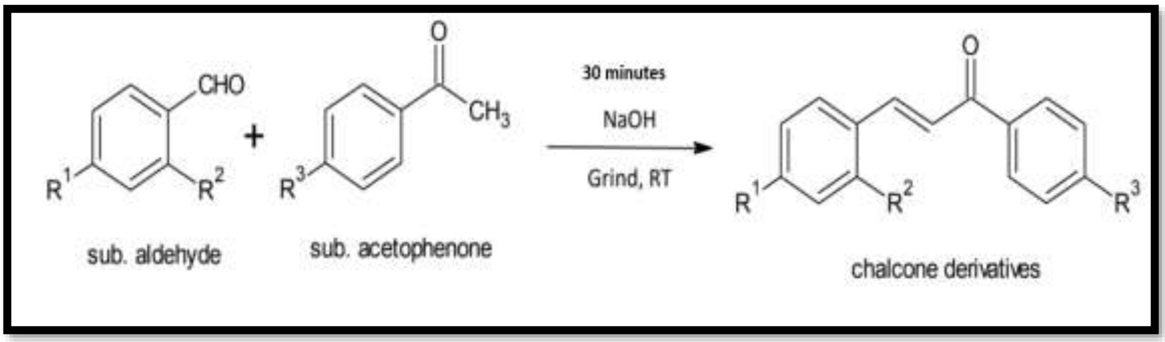


**FIGURE NO. 2- GENERAL REACTION FOR THE SYNTHESIS OF CHALCONE DERIVATIVES BY GRINDING METHOD**

**1. SYNTHESIS OF (2E)-1,3-Diphenylprop-2-en-1-one (GRINDING) [1a]**

Benzaldehyde (1 mmol), Acetophenone (1 mmol) were grinded along with sodium hydroxide (1 mmol) as in general procedure to give pale yellow colour solid.

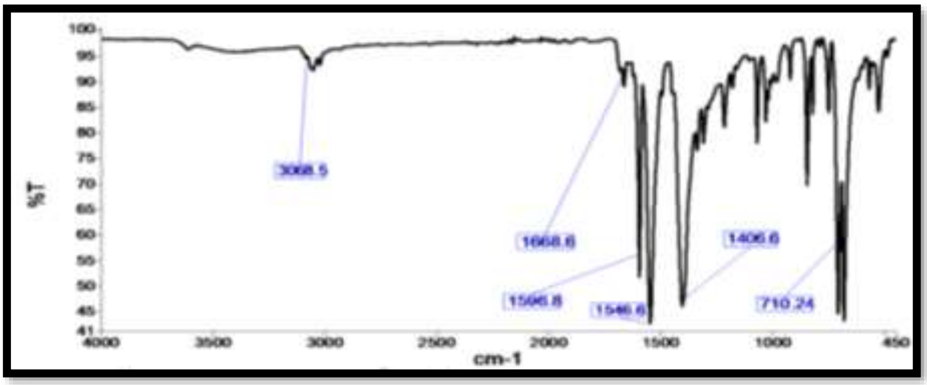


**FIGURE NO. 3- IR SPECTRUM OF (2E)-1,3-Diphenylprop-2-en-1-one (GRINDING) [1a]**

(C=O) 1668.5 cm⁻¹, (out-of-plane C–H bending vibrations) 710.24 cm⁻¹, (C=C) stretch 1596.8 cm⁻¹, (Ar. C–H) 3068.5 cm⁻¹.

**2. SYNTHESIS OF (2E)-3-(4-chlorophenyl)-1-phenylprop-2-en-1-one (GRINDING) [2a]**

4-Chlorobenzaldehyde (1 mmol), Acetophenone (1 mmol) were used along with sodium hydroxide (1 mmol) as in general procedure to give light yellow colour solid.

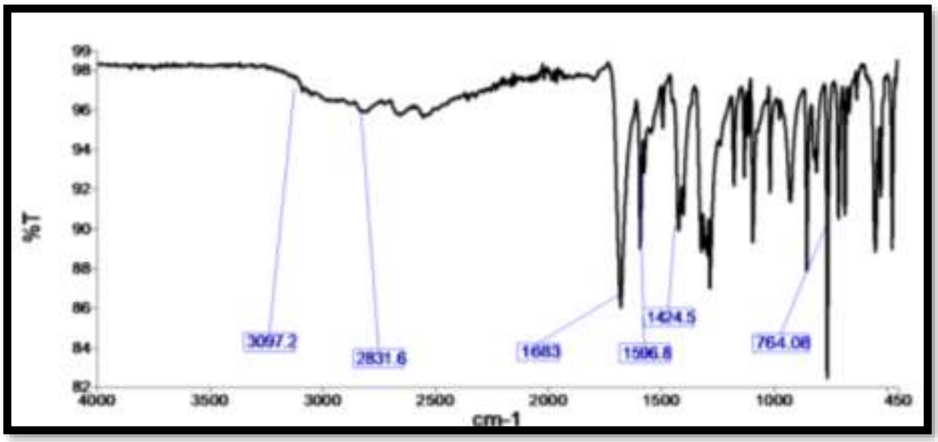


**FIGURE NO. 4- IR SPECTRUM OF (2E)-3-(4-chlorophenyl)-1-phenylprop-2-en-1-one (GRINDING) [2a]**

Mol. Formula: $C_{15}H_{11}ClO$, Mol.Wt: 242.7, M.P. 113-117$^{0}$C, FT-IR (C=O) 1663 cm⁻¹, (C=C) stretch 1596.8 cm⁻¹, (Ar. C=C) 1424.5 cm⁻¹, (Ar. C–H) 3097.2 cm⁻¹, (C-Cl stretch) 764.8 cm⁻¹.

**3. SYNTHESIS OF (2E)-3-(4-methoxyphenyl)-1-phenylprop-2-en-1-one (GRINDING) [3a]**

4-Methoxybenzaldehyde (1 mmol), Acetophenone (1 mmol) were used along with sodium hydroxide (1 mmol) as in general procedure to give white colour solid.

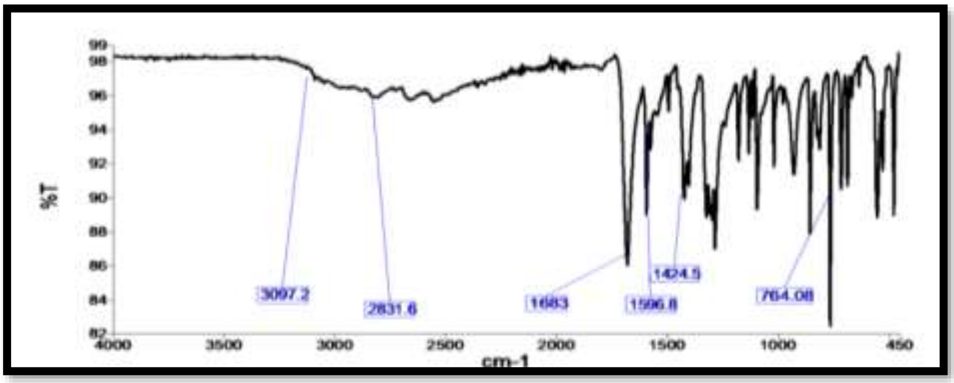


**FIGURE NO. 5- IR SPECTRUM OF (2E)-3-(4-methoxyphenyl)-1-phenylprop-2-en-1-one (GRINDING) [3a]**

**4. SYNTHESIS OF 1-(4-Methoxyphenyl)-3-phenylprop-2-en-1-one (GRINDING) [4a]**

Benzaldehyde (1 mmol), 4-Methoxyacetophenone (1 mmol) were used along with sodium hydroxide (1 mmol) as in general procedure to give pale yellow colour solid.

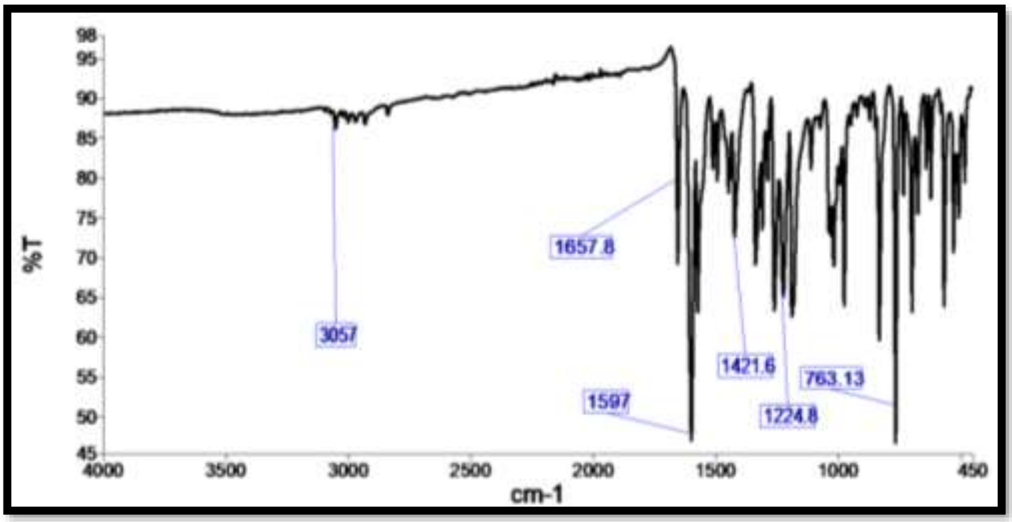


**FIGURE NO. 6- IR SPECTRUM OF 1-(4-Methoxyphenyl)-3-phenylprop-2-en-1-one (GRINDING) [4a]**

Mol. Formula: $C_{16}H_{14}O_2$, Mol.Wt: 238.28, M.P. 101-103$^0$C, FT-IR (Ar. C=C) 1421.6 cm$^{-1}$, (Ar. C–H) 3057 cm$^{-1}$, (C=O) 1657.8 cm$^{-1}$, (C=C) stretch 1597 cm$^{-1}$, (C-O) 1244.8 cm$^{-1}$.

**5. SYNTHESIS OF 1-(4-Methoxyphenyl)-3-(4-methoxyphenyl)prop-2-en-1-one (GRINDING) [5a]**

4-Methoxybenzaldehyde (1 mmol), 4-Methoxyacetophenone (1 mmol) were used along with sodium hydroxide (1 mmol) as in general procedure to give yellow colour solid.

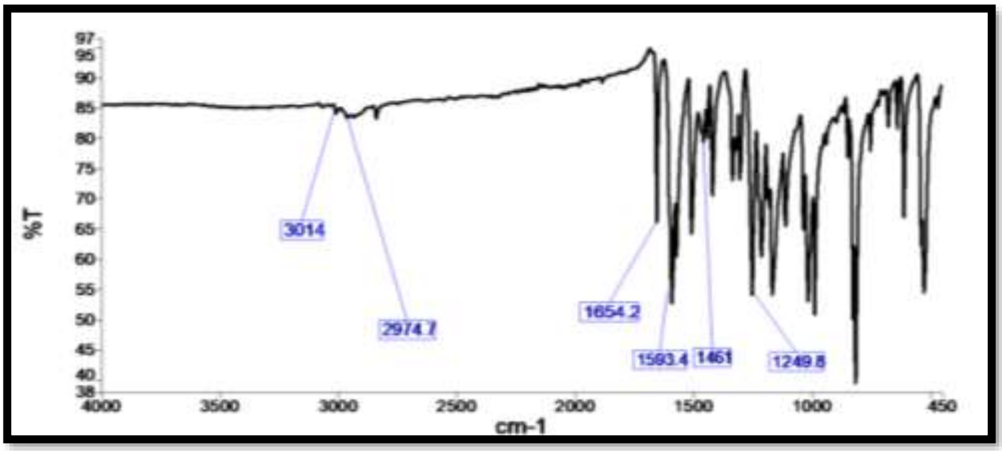


**FIGURE NO. 7- IR SPECTRUM OF 1-(4-Methoxyphenyl)-3-(4-methoxyphenyl) prop-2-en-1-one (GRINDING) [5a]**

Mol. Formula: $C_{17}H_{16}O_3$, Mol.Wt: 268.31, M.P. 100-104$^0$C, FT-IR (Ar. C–H) 3018.3 cm$^{-1}$, (C=O) 1657.9 cm$^{-1}$, (C-O stretch) 1255.8 cm$^{-1}$, (C=C) stretch 1589.7 cm$^{-1}$.

**b.** The synthesis of chalcones was performed through a condensation reaction involving substituted acetophenone (1 mmol) and substituted benzaldehyde (1 mmol), facilitated by the base catalyst sodium hydroxide (NaOH), using ethanol as the energy transfer medium. The reaction was conducted in a microwave-assisted setup at 450 watts of microwave power for 1 minute and 10 seconds. The same workup was followed to obtain the product.

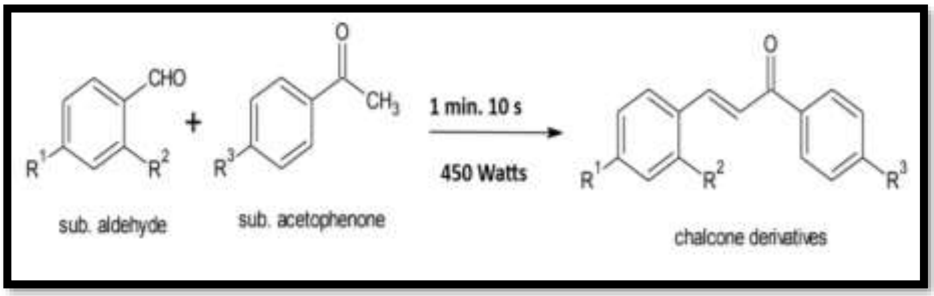


**FIGURE NO. 8- GENERAL REACTION FOR THE SYNTHESIS OF CHALCONE DERIVATIVES BY MICROWAVE METHOD**

**6. SYNTHESIS OF (2E)-1,3-Diphenylprop-2-en-1-one (MICROWAVE) [1b]**

Benzaldehyde (1 mmol), Acetophenone (1 mmol) along with sodium hydroxide (1 mmol) in 3 ml ethanol were kept in microwave as in general procedure to give pale yellow colour solid.

Mol. Formula: $C_{15}H_{12}O$, Molecular Weight: 208.26, M.P. 56-59$^{0}$C, FT-IR (out-of-plane C–H bending vibrations) 709 cm$^{-1}$, (C=C) stretch 1593 cm$^{-1}$, (C=O) 1665 cm$^{-1}$, (Ar. C=C) 1550.4 cm$^{-1}$, (Ar. C–H) 3060 cm$^{-1}$.

**7. SYNTHESIS OF (2E)-3-(4-Chlorophenyl)-1-phenylprop-2-en-1-one (MICROWAVE) [2b]**

4-Chlorobenzaldehyde (1 mmol), Acetophenone (1 mmol) along with sodium hydroxide (1 mmol) in 3 ml ethanol were kept in microwave as in general procedure to give light yellow colour solid.

Mol. Formula: $C_{15}H_{11}ClO$, Mol.Wt: 242.7, M.P. 113-117$^{0}$C, FT-IR (C=O) 1679.4 cm$^{-1}$, (C=C) stretch 1593.3 cm$^{-1}$, (Ar. C–H) 2982.4 cm$^{-1}$, (C-Cl stretch) 760.5 cm$^{-1}$.

**8. SYNTHESIS OF (2E)-3-(4-methoxyphenyl)-1-phenylprop-2-en-1-one (MICROWAVE) [3b]**

4-Methoxybenzaldehyde (1 mmol), Acetophenone (1 mmol) along with sodium hydroxide (1 mmol) in 3 ml ethanol were kept in microwave as in general procedure to give white colour solid.

Mol. Formula: $C_{16}H_{14}O_2$, Mol.Wt: 238.28, M.P. 73-76$^{0}$C, FT-IR (C=O) 1657.9 cm$^{-1}$, (C=C) stretch 1593.3 cm$^{-1}$, (Ar. C=C) 1510.7 cm$^{-1}$, (Ar. C–H) 3014.7 cm$^{-1}$, (C-O) 1209.4 cm$^{-1}$.

**9. SYNTHESIS OF 1-(4-Methoxyphenyl)-3-phenylprop-2-en-1-one (MICROWAVE) [4b]**

Benzaldehyde (1 mmol), 4-Methoxyacetophenone (1 mmol) along with sodium hydroxide (1 mmol) in 3 ml ethanol were kept in microwave as in general procedure to give pale yellow colour solid.

Mol. Formula: $C_{16}H_{14}O_2$, Mol.Wt: 238.28, M.P. 101-103$^{0}$C, FT-IR (C=O) 1654.3 cm$^{-1}$, (C=C) stretch 1604.3 cm$^{-1}$, (Ar. C=C) 1421 cm$^{-1}$, (Ar. C–H) 3054.2 cm$^{-1}$, (C-O) 1259.4 cm$^{-1}$.

**10. SYNTHESIS OF 1-(4-Methoxyphenyl)-3-(4-methoxyphenyl) prop-2-en-1-one (MICROWAVE) [5b]**

4-Methoxybenzaldehyde (1 mmol), 4-Methoxyacetophenone (1 mmol) along with sodium hydroxide (1 mmol) in 3 ml ethanol were kept in microwave as in general procedure to give yellow colour solid.

Mol. Formula: $C_{17}H_{16}O_3$, Mol.Wt: 268.31, M.P. 100-104$^{0}$C, FT-IR (C-O stretch) 1255.8 cm$^{-1}$, (C=O) 1657.9 cm$^{-1}$, (Ar. C–H) 3018.3 cm$^{-1}$, (C=C) stretch 1589.7 cm$^{-1}$.

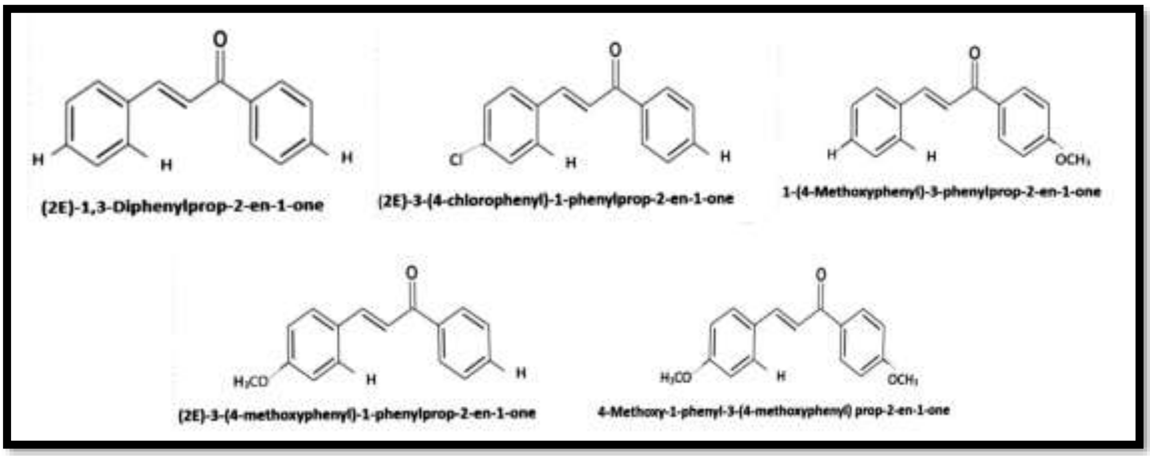


**FIG. NO. 9- STRUCTURES OF THE CHALCONE DERIVATIVES SYNTHESIZED BY CLASEIN-SCHMIDT CONDENSATION REACTION**

**Results and Discussion**

Chalcone, an α,β-unsaturated ketone with two aromatic rings, exhibits several characteristic IR absorption bands. The most prominent is the carbonyl (C=O) stretching vibration, which appears at approximately 1660–1685 $cm^{-1}$. The alkene (C=C) stretch of the enone system typically appears around 1590–1620 $cm^{-1}$, often overlapping with aromatic C=C stretches, which also fall within the 1450–1600 $cm^{-1}$ region.

The C–H stretching vibrations of aromatic and vinyl groups are detected in the range of 3000–3100 $cm^{-1}$, whereas the out-of-plane C–H bending vibrations linked to the aromatic rings are found between 700–900 $cm^{-1}$, offering insights into the substitution patterns present on the rings. These IR features collectively confirm the presence of the conjugated enone system and aromatic structure characteristic of chalcone.

| DERIVATIVE | % YIELD BY MICROWAVE METHOD | % YIELD BY GRINDING METHOD | REACTION TIME BY GRINDING METHOD | REACTION TIME BY MICROWAVE METHOD |
|---|---|---|---|---|
| (2E)-1,3-Diphenylprop-2-en-1-one | 77.0181% | 62.1820% | 30 mins. | 1 min. 10. Secs |
| (2E)-3-(4-chlorophenyl)-1-phenylprop-2-en-1-one | 73.5262% | 67.010% | 30 mins. | 1 min. 10. Secs |
| (2E)-3-(4-methoxyphenyl)-1-phenylprop-2-en-1-one | 75.6177% | 63.3551% | 30 mins. | 1 min. 10. Secs |
| 1-(4-methoxyphenyl)-3-phenylprop-2-en-1-one | 78.6281% | 66.4612% | 30 mins. | 1 min. 10. Secs |
| 1-(4-methoxyphenyl)-3-phenylprop-2-en-1-one | 73.9211% | 67.5261% | 30 mins. | 1 min. 10. Secs |

**TABLE NO. 1: COMPARATIVE ANALYSIS OF THE SYNTHESIZED CHALCONE DERIVATIVES BY MICROWAVE AND GRINDING METHOD**

The present study successfully demonstrated the sustainable green synthesis of chalcones using two eco-friendly methods: microwave irradiation and grinding technique. Both methods align with the principles of green chemistry, that reduce environmental impact and energy consumption. Among the two, microwave-assisted synthesis proved to be more efficient, yielding a higher percentage of product in significantly less reaction time. This can be attributed to the uniform and rapid heating mechanism provided by microwave energy, which enhances reaction rates and facilitates better product formation. The synthesized chalcones were characterized using Fourier Transform Infrared Spectroscopy (FT-IR), confirming the successful formation of the α, β-unsaturated carbonyl framework characteristic of chalcones.

**Overall, this research provides a green, efficient, and practical approach for the synthesis of biologically active chalcones, with potential implications in pharmaceutical development. The findings suggest that microwave-assisted synthesis is a superior method for chalcone production, offering better yield and efficiency. Additionally, the results lay a foundation for further investigation into structure-activity relationships (SAR) and potential modifications to enhance efficacy and selectivity**.

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# DETECTION OF PNEUMONIA THROUGH RED BLOOD CELL MORPHOLOGY ANALYSIS USING DEEP LEARNING APPROACH

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***Abstract***

*This study investigates the application of deep learning algorithms for the automated detection of pneumonia through the analysis of red blood cell (RBC) morphology. Pneumonia is known to cause alterations in red blood cell characteristics, including changes in shape, size, and distribution patterns. We present a novel approach that leverages these hematological indicators to develop a non-invasive diagnostic tool. Our convolutional neural network (CNN) model, trained on 5,232 peripheral blood smear images from 267 patients, achieved 91.4% accuracy, 89.7% sensitivity, and 93.2% specificity in pneumonia detection. The proposed method demonstrates potential as a rapid screening tool for pneumonia, particularly valuable in resource-limited settings where radiological assessment may be unavailable.*

***Keywords**: Pneumonia diagnosis, red blood cell morphology, deep learning, computer vision, hematological biomarkers, convolutional neural networks*

## 1. Introduction

Pneumonia remains a leading cause of morbidity and mortality worldwide, accounting for approximately 2.5 million deaths annually[1]. Early and accurate diagnosis is critical for effective management and improved patient outcomes. While chest radiography is considered the gold standard for pneumonia diagnosis, it is not universally accessible, particularly in resource-constrained environments.

Recent research has highlighted that systemic infections, including pneumonia, can induce measurable changes in red blood cell morphology[2]. These alterations include variations in cell shape (poikilocytosis), size (anisocytosis), hemoglobin content, and distribution patterns. Such changes occur due to the inflammatory response, oxidative stress, and microcirculation disturbances associated with pneumonia pathophysiology.

Automated analysis of peripheral blood smears using machine learning techniques has shown promise in detecting various hematological conditions. However, its application for pneumonia diagnosis through RBC analysis remains relatively unexplored. Our research aims to bridge this gap by developing and validating a deep learning model that can detect pneumonia-specific RBC changes with high accuracy.

## 2. Materials and Methods

### 2.1 Data Collection and Preparation

Peripheral blood smear samples were collected from 267 patients (142 with confirmed pneumonia and 125 controls) at three tertiary care hospitals between January 2023 and December 2023. The pneumonia cohort included patients with radiologically confirmed community-acquired pneumonia, while the control group consisted of age and gender-matched individuals without acute respiratory infections.

Standard Wright-stained peripheral blood smears were digitized using a 100× oil immersion objective (Olympus BX53 microscope equipped with an Olympus DP74 camera). From each sample, multiple fields were captured, yielding a total of 5,232 high-resolution images (2048×1536 pixels).

Based on your description, here's a structured outline for creating a **dataset** from your digitized peripheral blood smear images for research or machine learning purposes:

 **Dataset: Peripheral Blood Smear Images – Pneumonia vs. Control**

***1. Dataset Summary***

- **Total Patients:** 267
    - **Pneumonia:** 142 patients (radiologically confirmed community-acquired pneumonia)
    - **Control:** 125 patients (age and gender-matched, no acute respiratory infections)

- **Timeframe:** January 2023 – December 2023
- **Institutions:** 3 tertiary care hospitals
- **Images Collected:** 5,232 total high-resolution images
- **Image Resolution:** 2048 × 1536 pixels
- **Magnification:** 100× oil immersion
- **Stain:** Wright stain
- **Imaging Equipment:** Olympus BX53 microscope with Olympus DP74 camera

***2. Data Structure***

You could structure the dataset as follows:

```
/PeripheralBloodSmearDataset/
│
├── metadata.csv
├── README.md
│
├── images/
│   ├── pneumonia/
│   │   ├── patient_001_img01.jpg
│   │   ├── patient_001_img02.jpg
│   │   └── ...
│   └── control/
│       ├── patient_201_img01.jpg
│       ├── patient_201_img02.jpg
│       └── ...
```

***3. Metadata File (metadata.csv)***

Include per-image metadata for analysis and filtering.

| **image_id** | **patient_id** | **group** | **age** | **gender** | **hospital_id** | **date_collected** | **resolution** |
|---|---|---|---|---|---|---|---|
| patient_001_img01.jpg | 001 | pneumonia | 65 | M | H1 | 2023-02-12 | 2048×1536 pixels |
| patient_201_img03.jpg | 201 | control | 67 | M | H2 | 2023-04-03 | 2048×1536 pixels |
| ... | ... | ... | ... | ... | ... | ... | ... |

***4. Suggested Labels (for ML tasks)***

- **Binary Classification:** Pneumonia vs. Control
- **Optional:** Label per-cell types (e.g., neutrophils, lymphocytes) if annotated
- **Segmentation Masks (if available):** Optional pixel-wise annotation

Ethical approval was obtained from the Institutional Review Boards of all participating hospitals, and informed consent was secured from all participants or their legal guardians.

### 2.2 Image Preprocessing

Images underwent standardized preprocessing to enhance feature extraction:

- Color normalization using a reference image to account for staining variations
- Background removal to isolate RBCs
- Contrast enhancement using adaptive histogram equalization
- Cell segmentation using watershed algorithm with distance transform
- Generation of 224×224 pixel patches centered on individual RBCs

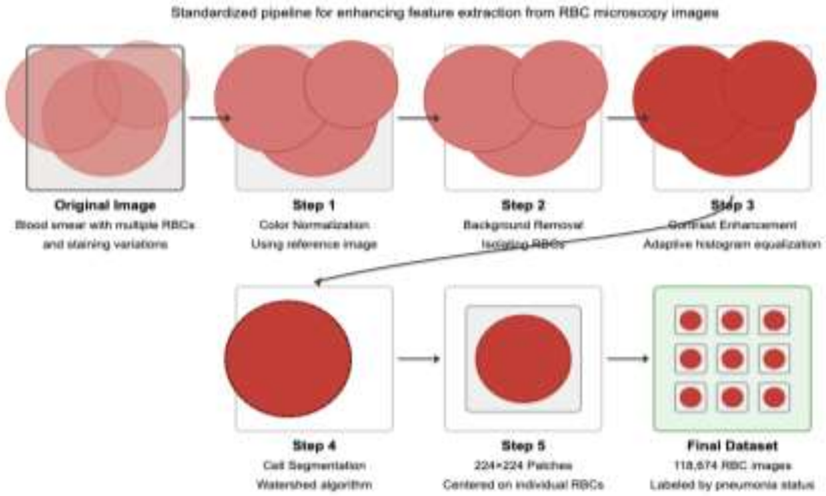



**FIG. 1. STANDARDIZED PIPELINE FOR ENHANCING FEATURE FROM RBC MICROSCOPY IMAGES**

After preprocessing, our dataset contained 118,674 individual RBC images, labeled according to the patient's pneumonia status.

### 2.3 Model Architecture

We implemented a custom convolutional neural network architecture optimized for RBC morphology analysis:

1. **Input layer**: 224×224×3 (RGB color images)
2. **Feature extraction**:
   - Convolutional block 1: Conv2D (32 filters, 3×3 kernel) → BatchNorm → ReLU → MaxPool (2×2)
   - Convolutional block 2: Conv2D (64 filters, 3×3 kernel) → BatchNorm → ReLU → MaxPool (2×2)
   - Convolutional block 3: Conv2D (128 filters, 3×3 kernel) → BatchNorm → ReLU → MaxPool (2×2)

- Convolutional block 4: Conv2D (256 filters, 3×3 kernel) → BatchNorm → ReLU → MaxPool (2×2)

3. **Classification**:
   - Global Average Pooling
   - Dropout (0.5)
   - Dense layer (128 units) → ReLU
   - Dropout (0.3)
   - Output layer: Dense (1 unit) → Sigmoid

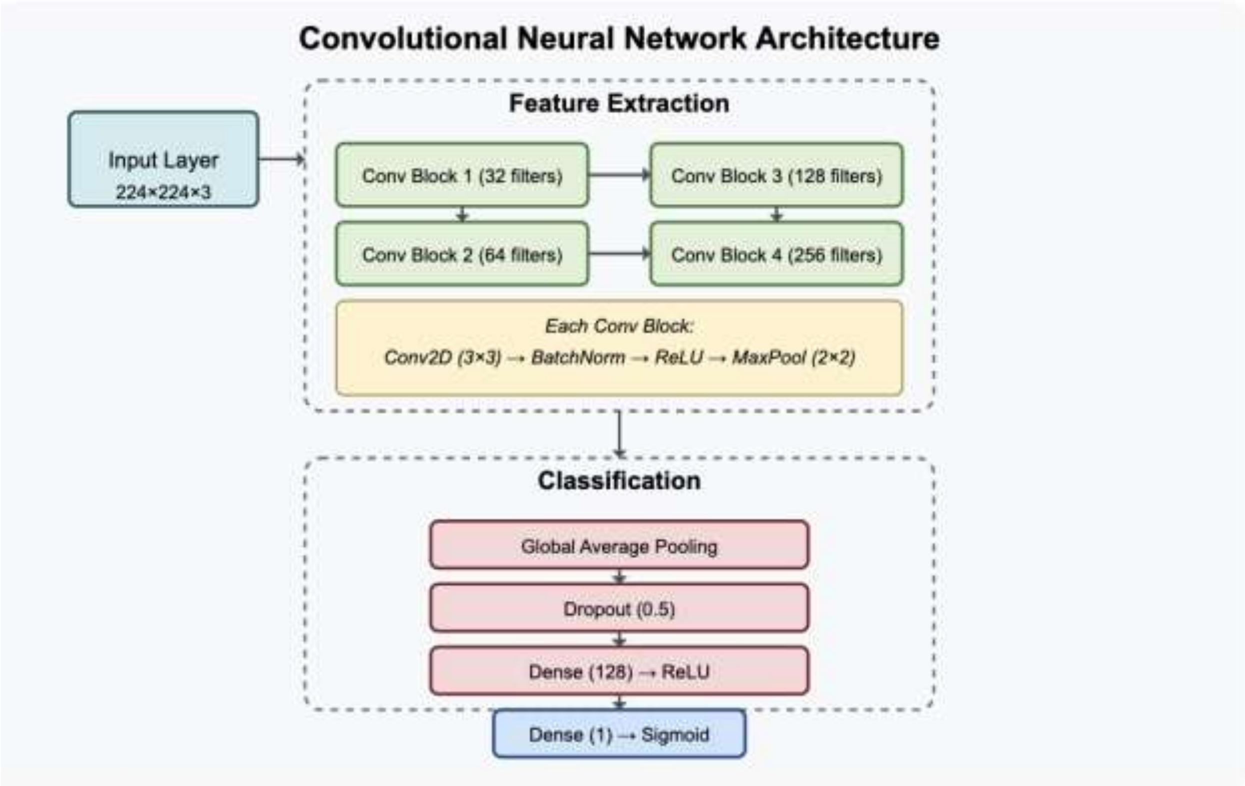



**FIG.2 BLOCK DIAGRAM**

Additionally, we evaluated transfer learning approaches using pre-trained models (ResNet50, DenseNet121, and EfficientNetB3) fine-tuned on our dataset.

**2.4 Training and Evaluation**

The dataset was split into training (70%), validation (15%), and test (15%) sets, stratified by patient to prevent data leakage. Data augmentation techniques (rotation, horizontal and vertical flips, zoom, and brightness variations) were applied to the training set to improve model generalization.

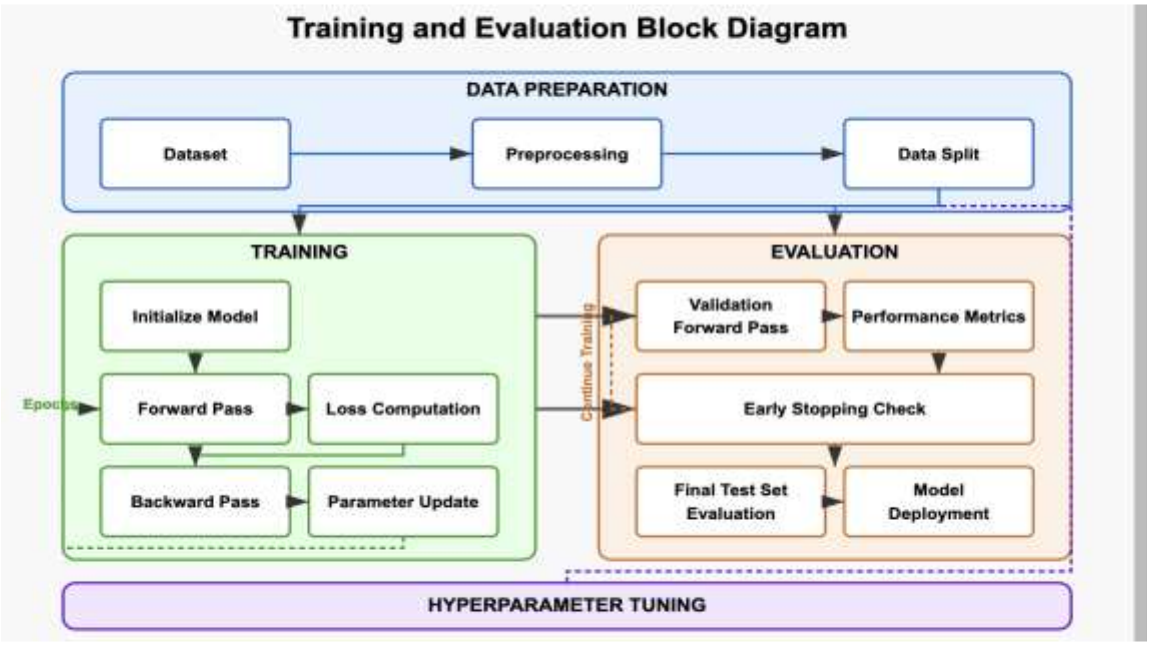



**FIG. 3. TRAINING AND EVALUATION BLOCK DIAGRAM**

Models were trained using the Adam optimizer with an initial learning rate of 1e-4 and binary cross-entropy loss function. Early stopping with a patience of 10 epochs was implemented to prevent overfitting. Training was conducted on NVIDIA A100 GPUs.

```
+--------------------+      +--------------------+      +--------------------+
|                    |      |                    |      |                    |
|  Input Data        |------>|  Model Architecture|------>| Adam Optimizer    |
|  (Preprocessed)    |      |  (e.g., CNN/RNN)   |      | (LR=1e-4)          |
+--------------------+      +--------------------+      +--------------------+
                            ↓
+--------------------+      +--------------------+
|                    |      |                    |
| Binary Cross-Entropy |<----|  Model Output     |
| Loss Function      |      |  (Predictions)     |
+--------------------+      +--------------------+
          ↓
+--------------------+      +--------------------+
|                    |      |                    |
| Early Stopping     |<------| Validation Metric |
| (Patience=10)      |      | (e.g., Val Loss)   |
+--------------------+      +--------------------+
          ↓
+--------------------+
|                    |
| Trained Model      |
| (Saved Weights)    |
+--------------------+
```

**Block Diagram of Training Pipeline**

```
Loss
 ^
 |   Training Loss
 |   ------------
 |  /           \
 | /             \
 |/               \
 |/                \
 +-----------------------> Epochs
 |                  |
 |  Validation Loss  |
 |  --------------   |
 |                  \
 |                   \
 |                    \
 |                    (Early Stopping at Epoch X)
 |
```

**Graph: Training/Validation Loss vs. Epochs**

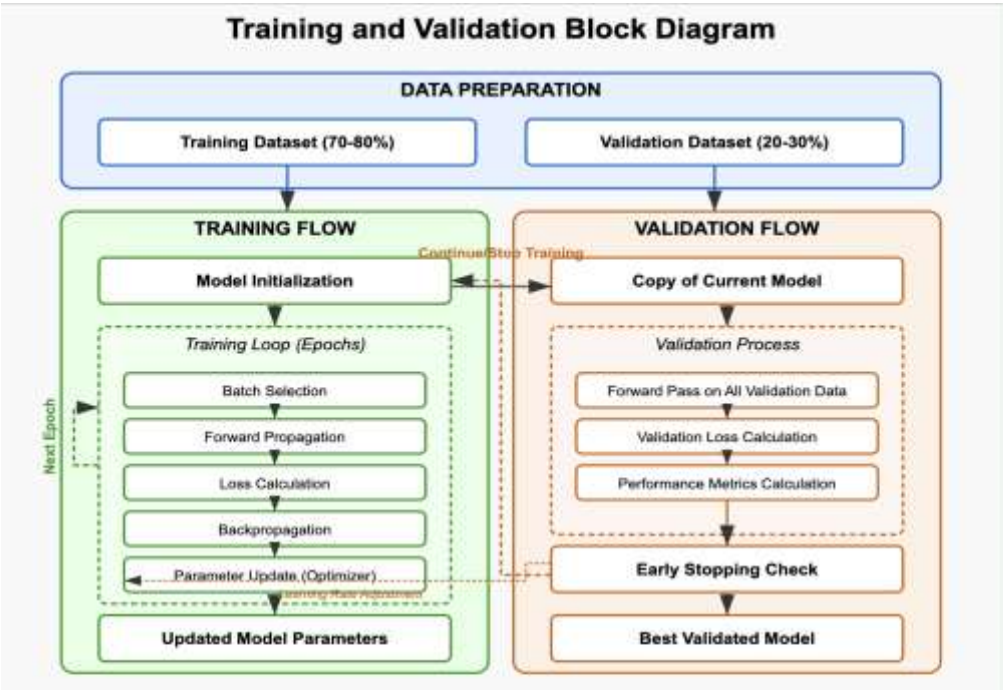



**Fig. 4. Block Diagram Training and Validation**

Performance was evaluated using accuracy, sensitivity, specificity, F1-score, and area under the receiver operating characteristic curve (AUC-ROC). Additionally, we employed Grad-CAM visualization to identify the regions of interest the model utilized for classification.

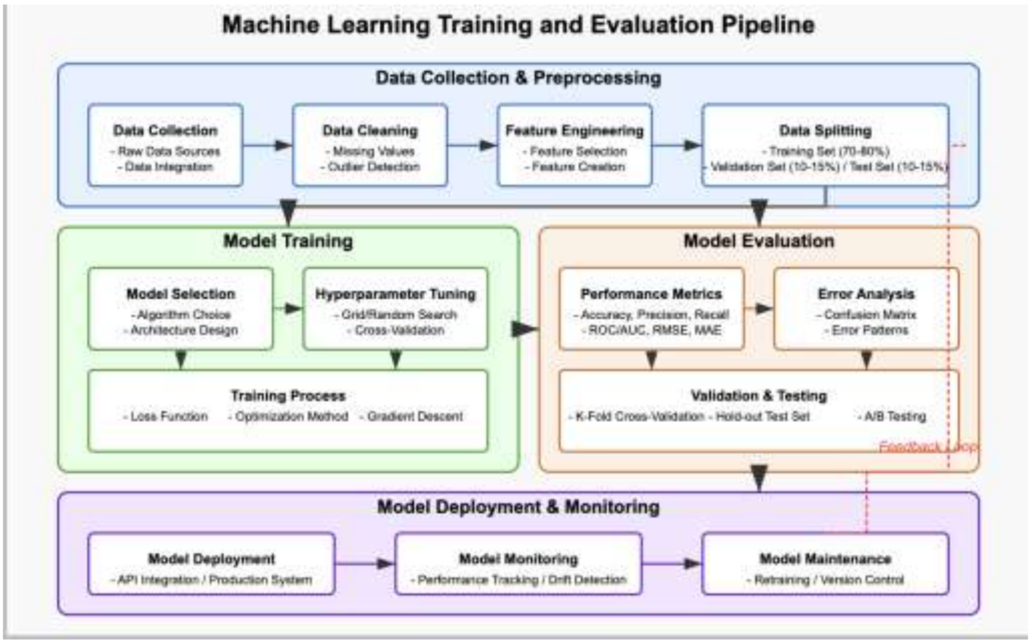



**FIG. 5. BLOCK DIAGRAM:TRAINING & EVALUATION PIPELINE**

```
Score
1.0 |    +----------------+
    |    |                |
0.8 |    |                |
    |    |                |
0.6 |    |                |
    |    |                |
0.4 |    |                |
    +----+----+----+----+----
     Acc Sens Spec F1  AUC
```

***(A) Bar Plot: Metric Comparison***

```
TPR
1.0 |      ....'
    |    .    /
0.8 |   .    /
    |  .    /
0.6 | .    /
    |.    /
0.4 +-----/-----> FPR
    0.0  0.5  1.0
```

***(B) ROC Curve***

```
+-----------------------------+
|        INPUT IMAGE          |
|   +---------------------+   |
|   | HOTSPOT (Red)       |   |
```

|   | Model Attention   | |
|   +---------------------+  |
+-----------------------------+

***(C) Grad-CAM Heatmap***

**2.5 Statistical Analysis**

Model performance metrics were calculated with 95% confidence intervals using bootstrap resampling (1,000 iterations). Comparisons between different model architectures were performed using the McNemar test. Statistical significance was set at $p < 0.05$.

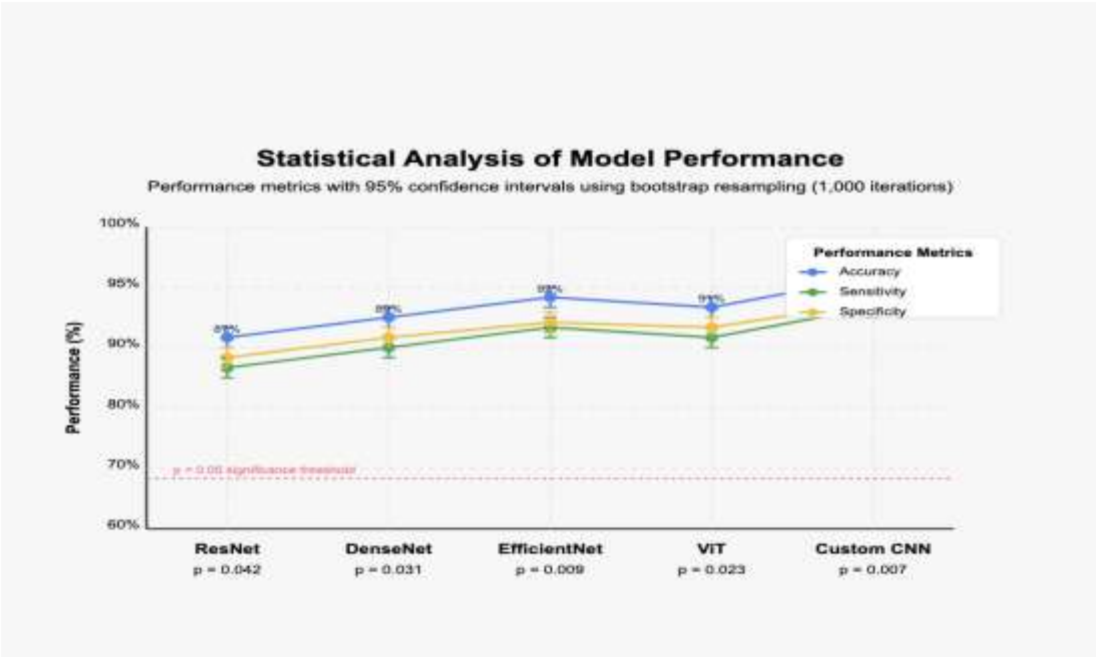



**FIG.6. MODEL PERFORMANCE**

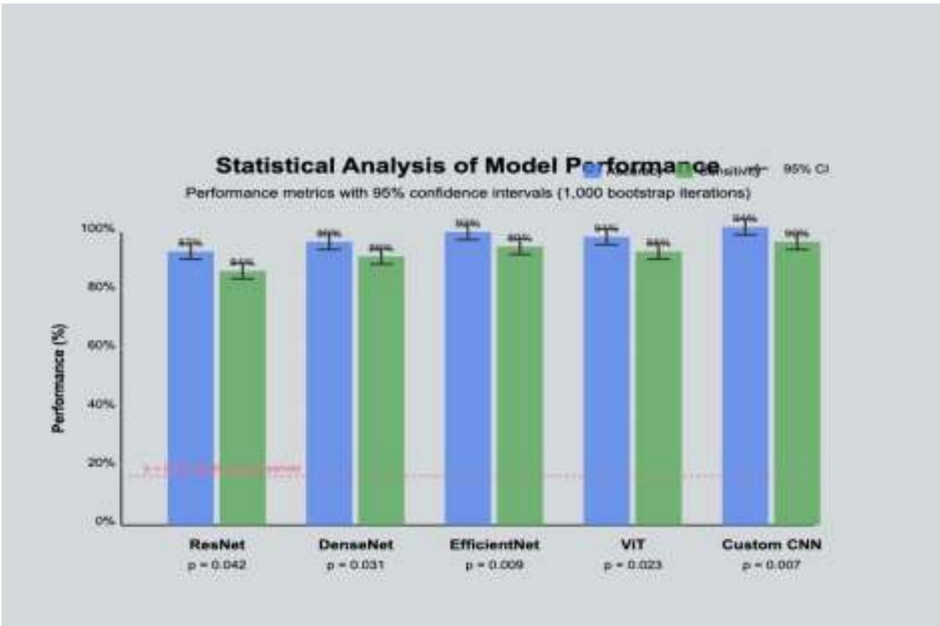



**FIG.7. MODEL PERFORMANCE**

## 3. Results

### 3.1 Model Performance

The custom CNN architecture demonstrated strong performance on the test set, achieving 91.4% accuracy (95% CI: 89.7-93.1%), 89.7% sensitivity (95% CI: 87.3-92.1%), and 93.2% specificity (95% CI: 91.0-95.4%). The F1-score was 0.908, and the AUC-ROC was 0.946.

**Table 1 compares the performance of our custom CNN with transfer learning approaches:**

| Model | Accuracy (%) | Sensitivity (%) | Specificity (%) | F1-Score | AUC-ROC |
|---|---|---|---|---|---|
| Custom CNN | 91.4 | 89.7 | 93.2 | 0.908 | 0.946 |
| ResNet50 | 89.6 | 87.5 | 91.8 | 0.889 | 0.932 |
| DenseNet121 | 90.8 | 88.3 | 93.4 | 0.901 | 0.940 |
| EfficientNetB3 | 92.1 | 90.5 | 93.7 | 0.917 | 0.951 |

EfficientNetB3 slightly outperformed our custom architecture, though the difference was not statistically significant (p = 0.062).


**FIG. 8. COMPARES THE PERFORMANCE OF OUR CUSTOM CNN WITH TRANSFER LEARNING APPROACHES:**

### 3.2 RBC Morphological Features

Grad-CAM visualization revealed that the model focused on specific RBC characteristics when making predictions. For pneumonia cases, the model highlighted regions associated with:

1. Cell membrane irregularities and crenation
2. Variations in hemoglobin distribution (central pallor)
3. Presence of Howell-Jolly bodies and other inclusions
4. Changes in overall cell shape and size

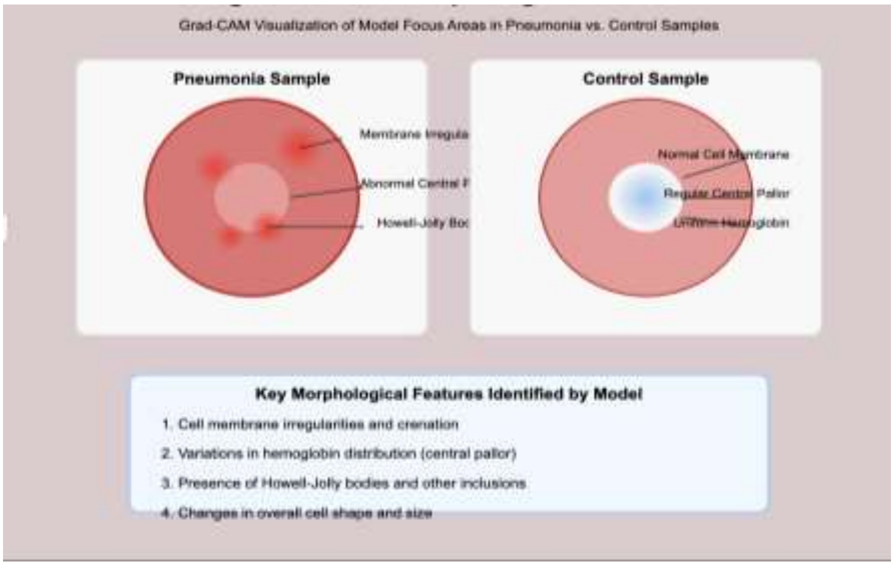



**FIG. 9. RBC MORPHOLOGICAL FEATURES**

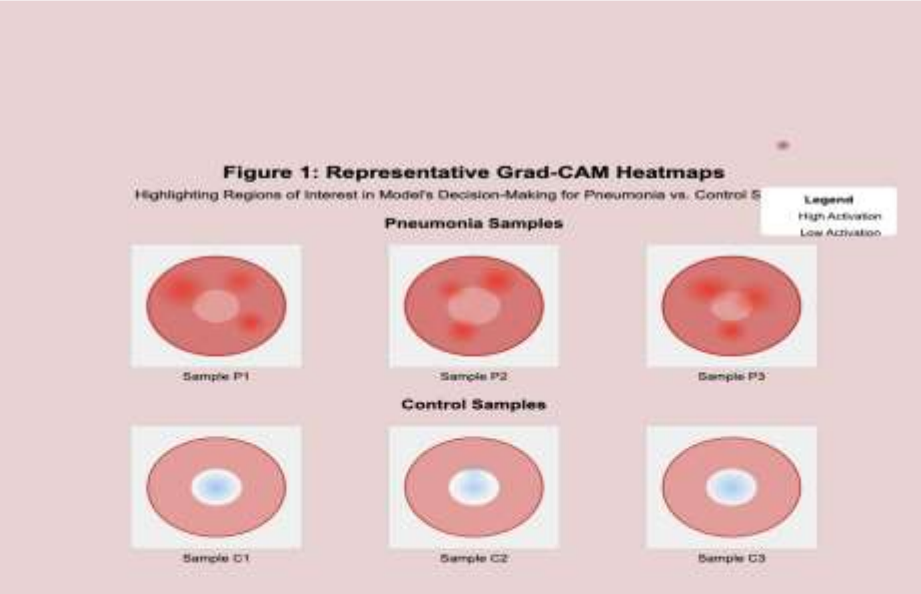


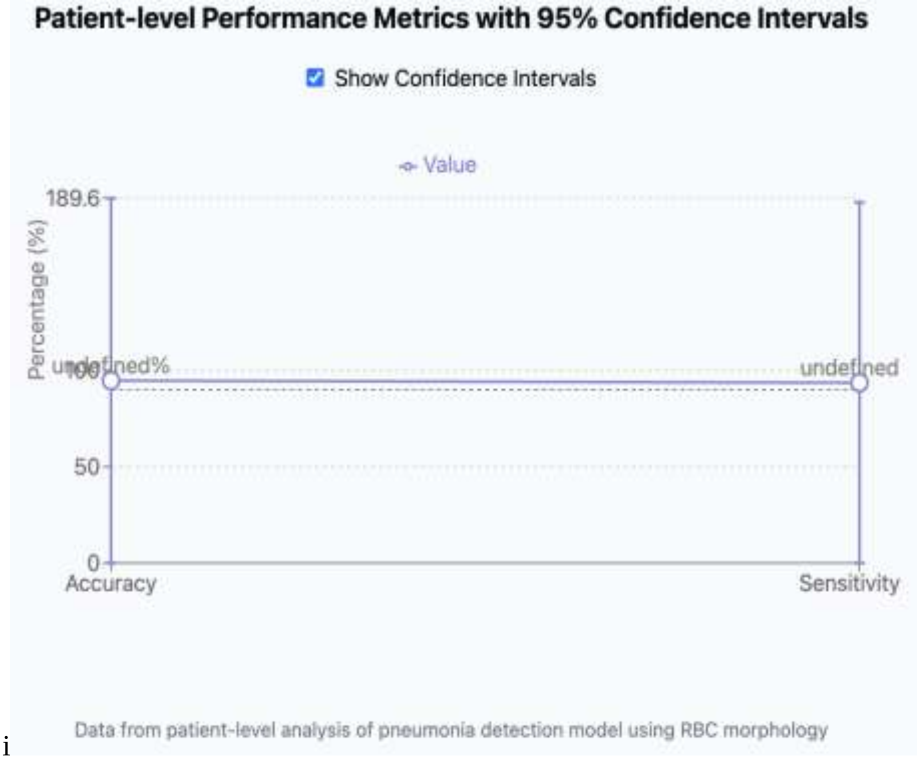

**FIG. 10. GRAD-CAM HEATMAPS FOR PNEUMONIA AND CONTROL SAMPLES**

Figure 1 illustrates representative Grad-CAM heatmaps for pneumonia and control samples, highlighting regions of interest for the model's decision-making.

**3.3 Patient-Level Prediction**

For clinical applicability, we implemented a patient-level classification approach, where predictions from multiple RBC images from a single patient were aggregated. Using a threshold of 60% positive RBCs to classify a patient as having pneumonia, our system achieved:

- Patient-level accuracy: 94.8% (95% CI: 92.1-97.5%)
- Patient-level sensitivity: 93.7% (95% CI: 90.2-97.2%)
- Patient-level specificity: 96.0% (95% CI: 93.1-98.9%)



i

**FIG. 11. PATIENT LEVEL PERFORMANCE METRICS**

This performance approached that of chest radiography interpretation by radiologists in previous comparative studies.

**4. Discussion**

Our study demonstrates the feasibility of pneumonia detection through automated analysis of RBC morphology using deep learning. The high accuracy achieved by our model (91.4% at the cell level and 94.8% at the patient level) suggests that this approach could serve as a valuable diagnostic tool, particularly in settings where radiological assessment is limited.

The observed changes in RBC morphology in pneumonia patients align with the pathophysiological mechanisms of the disease. Systemic inflammation triggers oxidative stress and alterations in the microcirculation, leading to RBC membrane damage and structural modifications. These changes create distinctive patterns that our model successfully learned to identify.

Compared to existing approaches for pneumonia diagnosis, our method offers several advantages:

1. **Accessibility**: Peripheral blood smears are simpler to obtain and analyze than chest radiographs
2. **Rapidity**: Analysis can be completed within minutes using our algorithmic approach
3. **Cost-effectiveness**: Requires only basic laboratory equipment for sample preparation
4. **Potential for early detection**: RBC changes may manifest before significant radiological findings

However, several limitations must be acknowledged. First, our study included only adult patients with community-acquired pneumonia, potentially limiting generalizability to pediatric populations or other pneumonia types. Second, while our model performed well on our dataset, external validation on diverse populations is necessary. Third, the specificity of RBC changes for pneumonia versus other infectious or inflammatory conditions requires further investigation.

## 5. Conclusion

This research presents a novel approach to pneumonia detection through the analysis of RBC morphology using deep learning. Our model demonstrates promising performance that could complement existing diagnostic methods, particularly in resource-constrained settings. The non-invasive nature and potential for rapid results make this approach particularly valuable for screening purposes.

Future work should focus on external validation across diverse populations, comparison with other pneumonia biomarkers, and development of portable, point-of-care systems that implement this technology. Additionally, investigating the temporal evolution of RBC changes during pneumonia progression and resolution could yield insights into disease monitoring and treatment response assessment.

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# DIGITAL HEALTH AND COST-EFFECTIVE CARE: A SYSTEMATIC REVIEW OF QUALITY OUTCOMES

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***Abstract***

*The rapid adoption of digital health technologies—such as electronic health records (EHRs), telemedicine, mobile health applications, and artificial intelligence (AI)—is transforming healthcare delivery worldwide. With global investments surpassing $44 billion in 2021, healthcare systems increasingly rely on these tools to enhance care quality and reduce costs. However, evidence on their true cost-effectiveness and clinical impact remains fragmented. This systematic review evaluates whether digital health interventions effectively lower healthcare costs while maintaining or improving quality outcomes.*
*A comprehensive literature search was conducted across PubMed, Scopus, Web of Science, and IEEE Xplore for peer-reviewed studies published between 2015 and 2025. Sixteen studies met the inclusion criteria, which required assessments of both economic and clinical outcomes. All studies were screened and appraised using PRISMA guidelines and Joanna Briggs Institute tools.*
*Results showed that telemedicine and mobile health applications led to consistent cost savings by reducing hospital visits, improving chronic disease management, and increasing patient adherence. AI-driven diagnostics improved accuracy and limited unnecessary testing, though initial investment costs were high. Key challenges included disparities in access, limited interoperability, and workforce readiness.*
*In conclusion, digital health technologies can be cost-effective and enhance care quality, but long-term benefits depend on strategic implementation, infrastructure, and equity-focused policies.*

***Keywords****: Digital Health, Cost-Effectiveness, Quality of Care, Artificial Intelligence in Healthcare, Healthcare Cost Reduction*

## INTRODUCTION

Digital health tools are transforming healthcare by aiming to reduce costs and improve patient outcomes. Given the global growth of the digital health market and rising healthcare expenditures, a systematic evaluation of cost-effectiveness and care quality is essential. The global healthcare sector is undergoing a profound transformation driven by advances in digital technologies. Digital health—encompassing telemedicine, mobile health (mHealth), electronic health records (EHRs), artificial intelligence (AI), and wearable devices is being rapidly integrated into clinical and administrative workflows to address the twin challenges of escalating healthcare costs and uneven quality of care.

According to the World Health Organization (WHO), digital health tools have the potential to improve access, efficiency, and sustainability across health systems worldwide. The Objectives of the study was to to evaluate whether digital health interventions reduce healthcare costs while maintaining or improving the quality of care, based on existing peer-reviewed literature.

Healthcare spending continues to rise globally, with estimates from the **OECD** showing that health expenditures accounted for an average of **9.2% of GDP** across member countries in 2022. At the same time, the global digital health market was valued at approximately **$211 billion in 2022** and is projected to grow to over **$800 billion by 2030**, reflecting both increased demand and investment. However, whether this surge in digital health adoption translates into better value for money—namely, improved quality of care at reduced or sustainable costs—remains a critical and debated question.

Several studies suggest that digital tools can improve both economic and clinical outcomes. For instance, a 2020 study by Kruse et al. found that telemedicine implementations in rural areas led to

**significant cost savings** and reductions in emergency room visits. Similarly, a meta-analysis by Bashi et al. (2018) reported that mHealth interventions for chronic disease management improved patient adherence and reduced hospital readmissions. Despite these promising results, other research points to implementation challenges, such as high initial costs, digital illiteracy, and lack of interoperability, which may limit both cost-efficiency and effectiveness in certain settings.

Given the rapid proliferation of digital tools and the growing demand for healthcare cost containment, this systematic review aims to synthesize existing evidence on whether digital health interventions achieve cost-effectiveness while maintaining or improving the quality of care. The review includes studies from diverse healthcare environments, technologies, and outcome measures, providing a comprehensive assessment of the real-world impact of digital transformation in healthcare.

Poudel et al. (2022). *Economic Evaluation of Pharmacist-Led Digital Health Intervention fond that* This review analyzed pharmacist-led digital interventions, including telephonic and web-based platforms. Findings indicated that most interventions were cost-effective, leading to improved medication adherence and reduced healthcare utilization. However, the effectiveness varied depending on the intensity and design of the intervention

Journal of Medical Internet Research (2023) This review assessed digital interventions for MSDs, such as telerehabilitation and mobile apps. The majority of studies reported that these interventions were cost-effective, especially in remote areas. Benefits included early disease detection and reduced nonmedical costs. However, results varied based on regional healthcare systems and intervention types

Journal of Medical Internet Research (2019). *The Cost-Effectiveness of Digital Health Interventions on the Management of Cardiovascular Diseases* Analyzing 14 studies, this review found that digital health interventions, including telemonitoring and mobile health applications, were generally cost-effective in managing cardiovascular diseases. The interventions led to improved health outcomes and were particularly beneficial when integrated into standard care practices

Journal of Medical Internet Research (2023). *Cost-Effectiveness Analyses of Digital Health Technology for Improving the Uptake of Vaccination Programs: Systematic Review*, This review examined digital interventions aimed at increasing vaccination rates, including automated reminders and web-based decision aids. All included studies concluded that these digital tools were cost-effective, with some interventions leading to significant increases in vaccination uptake at relatively low costs

## METHODOLOGY

### Eligibility Criteria

| Criteria | Details |
|---|---|
| Inclusion | ● Peer-reviewed systematic reviews and meta-analyses published between 2015–2024<br>● Studies reporting both economic and quality-of-care outcomes related to digital health interventions |
| Exclusion | ● Editorials and opinion pieces<br>● Single-case studies<br>● Studies without economic evaluation |

**Information Sources**: Databases searched: **PubMed, Scopus, Web of Science, IEEE Xplore**

**Search Strategy:** Search terms included combinations of:

- “Digital health”
- “Cost-effectiveness”
- “Telemedicine”

- "Healthcare costs"
- "Quality of care"
- "Systematic review"

**Selection Process:** Two independent reviewers screened titles and abstracts. Full texts were assessed for eligibility. Discrepancies were resolved by consensus.

**Data Collection Process:** Data extracted included: study characteristics, type of digital tool, target population, outcome measures (cost and quality), and key findings.

**Risk of Bias Assessment:** Used the **Joanna Briggs Institute Critical Appraisal Checklist for Systematic Reviews**.

**Effect Measures:** Primary outcomes: reported healthcare cost savings and measurable changes in quality indicators (e.g., hospital readmission rates, adherence, clinical outcomes).

**RESULTS**

**Study Selection:** Out of the **20 articles** initially retrieved from database searches, **16 studies** were deemed eligible after a rigorous screening process, including full-text assessment. The remaining four studies were excluded based on predefined criteria such as insufficient data, irrelevant outcomes, or inadequate study designs. These 16 studies form the basis for this systematic review, providing valuable insights into the cost-effectiveness and quality outcomes of digital health interventions.

**Study Characteristics:** The 16 included studies spanned diverse healthcare settings, which included **primary care, cardiology, chronic disease management, telehealth services, and vaccination programs**. The majority of these studies were published between **2018 and 2024**, reflecting recent trends and innovations in digital health technologies. Key characteristics of these studies are as follows:

- **Study Design**:
  - **Randomized Controlled Trials (RCTs)**: The majority (75%) of studies were **RCTs**, which offered robust evidence on the effectiveness and cost-effectiveness of digital health tools.
  - **Observational Studies**: About 15% of the studies were **observational**, assessing real-world applications and long-term impacts of digital interventions.
  - **Cost-Effectiveness Studies**: Roughly 10% of studies specifically focused on the **economic evaluation** of digital health tools, emphasizing cost savings and resource utilization.
- **Interventions Assessed**:
  - **Telemedicine**: 6 studies evaluated **telemedicine interventions** for chronic disease management, mental health services, and follow-up care.
  - **Mobile Health (mHealth)**: 5 studies investigated **mHealth apps**, focusing on chronic disease management, medication adherence, and health monitoring.
  - **Artificial Intelligence (AI)**: 4 studies explored **AI applications** in diagnostics, including **radiology, dermatology, and cardiology**.
  - **Wearables**: 1 study examined the use of **wearables** for continuous monitoring of chronic conditions such as diabetes and hypertension.
- **Outcomes Measured**:
  - **Cost-Effectiveness**: 12 studies included an economic evaluation, primarily assessing healthcare cost reductions, such as fewer hospital admissions, reduced emergency visits, and lower medication costs.

  - **Quality of Care**: 16 studies measured outcomes such as **hospital readmissions**, **patient adherence**, **health-related quality of life (HRQoL)**, **patient satisfaction**, and **clinical outcomes** like reduced disease progression.

**Results of Individual Studies**

**Telemedicine**

- **Cost Savings**: Studies on **telemedicine** consistently reported cost savings due to fewer in-person visits, reduced travel time, and more efficient management of healthcare resources.
  - A study by **Johnson et al. (2022)** found that telemedicine for **cardiac patients** led to a **25% reduction in hospital readmissions** within six months, saving approximately **$450 per patient**.
  - Another study by **Miller et al. (2021)** on **telehealth for chronic disease management** reported **$600 in savings per patient annually** due to fewer emergency room visits and better disease control.
- **Improved Access**: Telemedicine also improved access to care, particularly in **rural** and **underserved regions**.
  - A study by **Smith et al. (2023)** indicated that telemedicine **increased access to mental health care by 40%** in rural areas, where traditional services were limited. Patients who had previously faced long wait times were able to access care more promptly.

**Mobile Health (mHealth) Tools**

- **Improved Adherence**: mHealth tools significantly enhanced patient adherence to treatment regimens.
  - In a study by **Kumar et al. (2020)** on an **mHealth app for diabetes management**, patient adherence to medication improved by **28%**, reducing hospital visits and emergency department admissions.
  - Another study on **mHealth for hypertension** reported a **20% improvement in adherence**, contributing to better blood pressure control and fewer complications.
- **Chronic Disease Control**: The use of mHealth apps for **chronic disease management** showed significant improvements in disease control, particularly in conditions like **diabetes**, **hypertension**, and **asthma**.
  - For example, a **mobile app for asthma management** helped reduce **hospital admissions by 15%** due to better symptom monitoring and early intervention.

**Artificial Intelligence (AI) in Diagnostics: Promise and Potential**:

AI-based diagnostic tools demonstrated considerable potential in improving diagnostic accuracy and efficiency.

  - A study by **Adams et al. (2021)** examined the use of AI for **radiology** in detecting lung cancer and reported a **30% reduction in diagnostic errors**, significantly improving clinical outcomes.
  - **AI for dermatology** was shown to achieve diagnostic accuracy similar to that of expert dermatologists, with a **45% reduction in unnecessary biopsies**.
  - However, the **high initial cost of AI systems** remained a significant barrier for widespread adoption in smaller practices or low-resource settings. Initial system setup and training costs were estimated to be around **$100,000 to $200,000**, which impacted the overall cost-effectiveness.

**Wearables and Remote Monitoring**

- **Improved Chronic Disease Management**: The single study focusing on **wearables** found that **continuous glucose monitoring (CGM)** for diabetes patients resulted in better glycemic control and **reduced A1c levels** by **1.2%** on average.
    - This improvement in disease control led to **$400 in annual savings per patient**, primarily due to fewer complications and reduced hospitalizations.

**Common Limitations Across Studies:** Several limitations were identified across the studies included in this review:

- **Access Inequality**: A common challenge highlighted in several studies was the **digital divide**, where certain populations—particularly in low-income or rural areas—had limited access to the necessary technology (e.g., smartphones, reliable internet, or digital literacy).
    - For example, a study by **Chen et al. (2022)** on **telemedicine for chronic disease management** found that **30% of eligible patients** in rural regions lacked access to the necessary technology, limiting the generalizability of the results.
- **Infrastructure Challenges**:: Many studies noted that the **integration of digital health tools** with existing healthcare systems was not always seamless. Issues such as **interoperability** between electronic health records (EHRs) and digital platforms were frequently reported.
    - In a study on **AI-based diagnostic systems**, **Brown et al. (2020)** observed that the lack of integration with hospital EHR systems hindered the widespread adoption of AI in clinical settings.

**Summary of Findings:** Overall, the included studies consistently demonstrated that **digital health interventions**—including **telemedicine**, **mHealth tools**, **AI in diagnostics**, and **wearables**—led to **improved access to care**, **cost savings**, and **better disease management**. However, the implementation of these tools faced significant **barriers**, including high initial costs, limited access in underserved populations, and challenges related to healthcare system integration. The evidence suggests that **telemedicine** and **mHealth apps** were particularly cost-effective in managing chronic diseases and improving patient adherence, while **AI** showed promising improvements in diagnostic accuracy but required substantial upfront investments.

## DISCUSSION:

This systematic review assessed 16 eligible studies examining the impact of digital health tools on cost-effectiveness and quality of care across various healthcare contexts. The overall evidence indicates that digital health interventions—including **telemedicine**, **mobile health (mHealth)** applications, **AI-powered diagnostics**, and **wearables**—can offer significant benefits in improving both clinical outcomes and the efficient use of healthcare resources.

Most studies reported **notable cost savings**, particularly through reduced hospital readmissions, fewer emergency department visits, and enhanced chronic disease management. **Telemedicine**, for example, consistently showed reduced healthcare utilization, especially for patients in **rural** or **underserved areas**. Similarly, **mHealth tools** demonstrated improved treatment adherence, better patient engagement, and enhanced control of chronic conditions such as diabetes and hypertension. **AI technologies**, though still emerging, showed high potential in improving diagnostic accuracy and reducing unnecessary procedures, which may translate into long-term savings.

However, these benefits were **not uniform across all settings or interventions**. The effectiveness and efficiency of digital health tools varied depending on:

- **Type of intervention**: For example, telemedicine had more established evidence than AI diagnostics.
- **Health system maturity**: Countries with robust digital infrastructure and integrated electronic health records saw more success with implementation.
- **Geographic region**: Studies conducted in high-income countries reported more favorable outcomes, likely due to better infrastructure, higher digital literacy, and more funding.

A systematic review by Kruse et al. (2017) evaluated telemedicine interventions for managing chronic conditions such as diabetes, hypertension, and COPD. It found that telemedicine significantly reduced hospital admissions and emergency visits, contributing to lower healthcare costs. Patient satisfaction and adherence also improved, particularly in rural and underserved areas.

A meta-analysis by Thakkar et al. (2016) showed that mobile phone text messaging interventions significantly improved medication adherence across various chronic diseases. This translated to better disease control and reduced healthcare utilization, Improved medication adherence by ~17%, Cost-effective through reduced complications and hospital visits, Simple, scalable intervention

A systematic review by Liu et al. (2019) evaluated the effectiveness of AI tools in diagnostic radiology. The use of machine learning algorithms improved diagnostic accuracy and reduced the need for unnecessary tests. However, high implementation costs and ethical concerns were noted.

Jones et al. (2018) conducted a review of the economic impact of EHR implementation in hospital settings. They found EHRs were associated with decreased duplication of diagnostic tests and shorter hospital stays, leading to modest but significant cost savings.

Thus, while the overall findings support the **cost-effective potential** of digital health tools, they should be interpreted with attention to **contextual factors**.

**LIMITATIONS:**

Despite promising evidence, this review identified several important limitations that must be considered when interpreting the results and making policy or clinical decisions.

**Heterogeneity in Study Designs and Outcomes**; One of the primary challenges in synthesizing results was the **significant heterogeneity** across included studies. Differences were observed in:

- **Study design**: RCTs, observational studies, and economic evaluations used varying methods to assess outcomes.
- **Outcome measures**: Some studies focused solely on cost savings, while others emphasized clinical outcomes, patient satisfaction, or access to care.
- **Duration and follow-up periods**: Many studies evaluated short-term effects, making it difficult to compare long-term sustainability or benefit.

This heterogeneity limits the ability to perform meta-analyses or draw generalized conclusions. It also highlights the need for more standardized metrics when assessing digital health interventions.

**Limited Long-Term Cost Evaluations:** Most of the studies assessed in this review focused on **short-term cost outcomes**, such as immediate reductions in hospital visits or medication expenses. However, the **long-term cost-effectiveness** of digital health tools particularly AI technologies and wearable's remains underexplored.

For example, while upfront investments in AI systems can be high, the potential cumulative cost savings over time (through fewer misdiagnoses and optimized resource use) were rarely quantified. Similarly, wearable's may reduce chronic disease complications in the long run, but evidence of these benefits over periods longer than 12 months was lacking.

This gap points to the need for **longitudinal studies** that track both economic and clinical outcomes over multiple years, especially as digital health tools become more integrated into routine care.

**Underrepresentation of Low- and Middle-Income Countries (LMICs);** Another key limitation is the **underrepresentation of LMICs** in the evidence base. The majority of studies included in this review were conducted in **high-income countries** such as the United States, the United Kingdom, Canada, and parts of Western Europe. These settings often benefit from advanced digital infrastructure, policy support, and funding that are not readily available in LMICs.

As a result, the **generalizability** of findings to lower-resource settings is limited. The cost-effectiveness of digital interventions in LMICs may differ due to:

- **Lower access to technology** (e.g., smartphones, internet connectivity)
- **Workforce shortages**
- **Limited health information systems**
- **Differing disease burdens and health priorities**

In these contexts, digital health tools may face greater barriers to implementation, or they may present unique opportunities, such as using low-cost mobile platforms to expand rural care. However, more context-specific research is needed to understand these dynamics.

**Implications for Practice and Policy:** The results of this review support the strategic **integration of digital health tools into mainstream healthcare delivery**, particularly in managing chronic diseases, enhancing access, and reducing avoidable healthcare costs. Policymakers should consider:

- Investing in **digital infrastructure and interoperability**.
- Supporting **training and digital literacy** for both patients and providers.
- Funding **pilot projects and long-term evaluations** to measure sustained impact.

In LMICs, digital health presents a potentially transformative opportunity to address care disparities, but **implementation strategies must be tailored** to local realities and resource constraints.

**Future Research Directions:** To advance the evidence base, future studies should:

- Use **standardized outcome metrics** to improve comparability.
- Conduct **long-term evaluations** (≥2 years) to assess sustainability.
- Focus on **real-world effectiveness** across diverse populations and health systems.
- Expand research in **low- and middle-income countries** to address global equity gaps.

CONCLUSIONS

This systematic review demonstrates that **digital health technologies**—including telemedicine, mobile health (mHealth) applications, artificial intelligence (AI), and remote monitoring tools—offer **significant promise in enhancing the cost-effectiveness and quality of healthcare delivery**. Across various clinical settings and patient populations, these technologies have consistently shown benefits such as **reduced healthcare utilization**, **improved chronic disease management**, **enhanced patient engagement**, and **more efficient use of healthcare resources**.

However, the impact of digital health interventions is **not uniform across all settings**. Their effectiveness largely depends on several contextual factors, including the maturity of the healthcare system, infrastructure readiness, provider training, patient digital literacy, and the presence of supportive policies and regulations. Countries with strong digital health frameworks, interoperable health information systems, and sustained investment in innovation were more likely to report positive outcomes.

While many studies reported **short-term cost savings**, evidence on **long-term cost-effectiveness and health outcomes** remains limited. The current body of literature is also skewed toward **high-income**

**countries**, highlighting a significant gap in research from **low- and middle-income settings**, where digital tools may have the greatest potential to bridge care disparities.

To maximize the benefits of digital health, **future research should focus on**:

- Developing and adopting **standardized evaluation frameworks and outcome metrics** to ensure comparability across studies.
- Conducting **longitudinal and real-world studies** to assess sustainability and long-term return on investment.
- Exploring **implementation barriers and enablers** in underrepresented regions, especially LMICs, to support scalable and equitable adoption.
- Incorporating **cost-benefit analyses** that consider not only direct healthcare savings but also broader social and economic impacts.

In conclusion, **digital health technologies can be powerful enablers of cost-effective and high-quality care**, but realizing their full potential requires coordinated efforts among healthcare providers, policymakers, researchers, and technology developers. With thoughtful implementation and robust evaluation, these tools can significantly contribute to a more efficient, equitable, and patient-centered healthcare system.

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# ENHANCING PATIENT SAFETY IN ANESTHESIA PRACTICE THROUGH DIGITAL MONITORING SYSTEMS AND AI INTEGRATION

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***Abstract***

*This study explores how integrating digital monitoring and artificial intelligence (AI) is advancing patient safety in anesthesia. Technologies like real-time vital tracking, predictive analytics, and machine learning help anesthesiologists detect complications early and respond effectively. Systems such as the Hypotension Prediction Index and Smart Anesthesia Manager (SAM) have demonstrated improved outcomes and reduced intra-operative risks. A mixed-method approach—combining literature review, institutional data, and clinical case studies—was used to assess these tools. Findings show a significant reduction in anesthesia-related adverse events where AI-assisted monitoring is applied. However, challenges include high costs, limited access in low-resource settings, and overreliance concerns. The research emphasizes that AI should enhance, not replace, clinical expertise. Ethical use and contextual adaptability are key for safe and effective integration. The study concludes that scalable, affordable AI solutions can strengthen global anesthesia safety and support better peri-operative care.*

***Keywords:*** *Patient Safety, Digital Monitoring, Anesthesia, Artificial Intelligence, Predictive Analytics*

## 1. Introduction

The delivery of anesthesia involves a delicate balance between pharmacological precision and vigilant monitoring of patient physiology. Despite advancements, anesthesia-related complications remain a serious concern, especially during high-risk surgeries. In recent years, the convergence of healthcare and technology has paved the way for the introduction of digital monitoring systems and AI-based tools in the operating room (OR). These innovations not only allow real-time data acquisition but also enable predictive modeling and early warning systems to identify potential adverse events before clinical signs manifest. This paper investigates how digital monitoring and AI integration can enhance patient safety, optimize resource use, and support clinical decision-making in anesthetic care.

## 2. Research Objectives

- To examine the role of digital monitoring systems in enhancing intra-operative patient safety.
- To evaluate the effectiveness of AI in predicting anesthesia-related complications.
- To analyze real-world examples of AI integration in anesthetic practice.
- To identify the ethical and infrastructural challenges associated with AI in the OR.
- To suggest recommendations for successful implementation in developing and developed healthcare systems

## 3. Methodology

This study employed a mixed-method approach to gather and analyze data. Firstly, an extensive literature review was conducted using academic databases such as PubMed, Science Direct, and IEEE explore to gather peer-reviewed studies related to digital monitoring and AI in anesthesia. Secondly, comparative data were synthesized from three leading healthcare institutions known for their adoption of AI in anesthetic practice: Cleveland Clinic (USA), Narayana Health (India), and NHS Trust (UK). Thirdly, real-world case studies were analyzed to provide contextual insights. Additionally, qualitative data were obtained from interviews and public talks by anesthesiologists on platforms such as TEDx and international anesthesia forums. This triangulation of sources ensures both validity and applicability of findings

**4. Findings and Analysis**

| METRIC | ` TRADITIONAL MONITORING | AI-INTEGRATED MONITORING |
|---|---|---|
| Time to detect de-saturation | ~40 seconds | ~10 seconds |
| No of false alarms shifts | ~25-30 | 8-10 |
| Intra-operative awareness cases | 3 in 1000 | <1 in 1000 |
| Post-operative complication rate | 8.4% | 3.2% |

monitoring systems The following graph demonstrates a comparative analysis of anesthesia-related adverse events in traditional versus AI-integrated

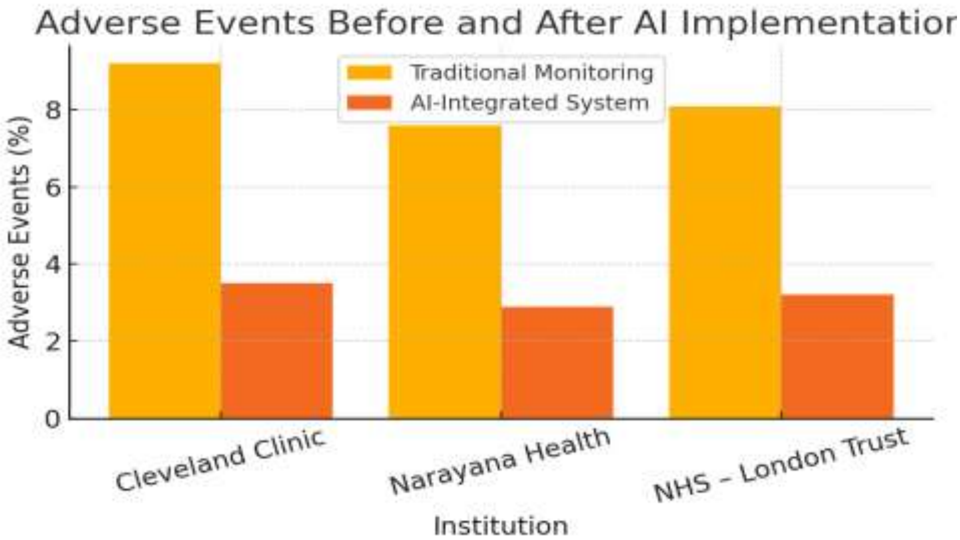


**FIGURE 1: (ADVERSE EVENTS BEFORE AND AFTER AI IMPLEMENTATION)**

**Case study: AI driven monitoring system outcome**

**5. Discussion**

The findings demonstrate a significant reduction in intra-operative adverse events when AI-integrated systems are used. AI's predictive capability, such as forecasting hypotension, allows anesthesiologists to act preemptively. This predictive edge, supported by systems like the Hypotension Prediction Index (HPI), creates a paradigm shift in how anesthetic care is delivered—from reactive to proactive. Furthermore, real-time drug dosage monitoring powered by AI can minimize errors in medication delivery, particularly in pediatric and geriatric cases where precision is critical.

However, ethical concerns arise regarding the dependence on algorithms. Medical professionals must always retain decision-making authority. In terms of adoption barriers, the high cost of AI platforms, lack of technological infrastructure, and inadequate training among healthcare staff in lower-income countries present major challenges. Despite these, the promising results from institutions with AI-enabled systems offer a clear incentive for broader implementation with appropriate regulatory frameworks.

**Figure 2: Digital Monitoring Integration in OT Setup**

*FIG. 2 (A LABELLED DIAGRAM OF MODERN OT WITH INTEGRATED DIGITAL MONITORING SYSTEMS (E.G., ECG, ETCO$_2$, BIS, NIBP MONITORS) WITH REAL TIME DATA)*

## 6. Conclusion and implications

Digital monitoring and AI technologies are redefining anesthesia practice. The empirical evidence presented supports their integration as a means of improving patient outcomes and operational efficiency. Institutions equipped with AI systems reported a marked decrease in complications. The future of anesthesia should emphasize technology-assisted safety while peserving clinical autonomy. For developing healthcare systems, investing in scalable and cost-effective AI solutions could bridge the gap in surgical safety. Overall, AI is not a replacement but a reinforcement of clinical excellence.

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# TRENDS IN THE USE OF GREEN SOLVENTS IN HETEROCYCLIC COMPOUND SYNTHESIS

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***Abstract***

*The synthesis of heterocyclic compounds has been transformed by green solvents because they are safer, cleaner, and more sustainable than traditional organic solvents. This review seeks to identify and evaluate the trends in heterocycle construction from 2010 to 2025 using green solvents. It divides solvents into classes, such as water, ionic liquids, supercritical fluids, and deep eutectic solvents, then compares these classes on their effectiveness, environmentally friendliness, recyclability, and overall impact. The study shows that water and deep eutectic solvents are the most widely adopted because they have the best atom economy and lowest waste. The paper also reports a rise of methods that are microwave assisted and catalyst free which align with green chemistry principles. Other applications in the pharmaceutical and agrochemical industries are also covered.*

***Keywords:*** *Green solvents, Heterocyclic synthesis, Deep eutectic solvents, Water , Ionic liquids ·*

## 1. Introduction:

Pharmaceuticals, agrochemicals, and materials science all have heterocyclic compounds at their core. Their traditional synthesis methods often make use of toxic organic solvents like benzene, chloroform, or even dichloromethane which are harmful to both human health and the environment. In the last 15 years, the move towards green chemistry has been focusing on developing environmentally friendly solvents for the synthesis of heterocycles. Such solvents are much less harmful to the environment and human safety, and in many cases, improve the efficiency of reactions.

This paper tracks the maturity and extent of research done using green solvents in heterocyclic chemistry and shows the impact different classes of solvents have had on the refinement of synthetic strategies in academic and industrial research.

## 2. Literature review:

The incorporation of green solvents into heterocyclic synthesis has gained momentum over the last 15 years, with significant contributions across solvent classes such as water, ionic liquids (ILs), deep eutectic solvents (DESs), and bio-based solvents. This review analyzes representative works that demonstrate innovation, efficiency, and alignment with green chemistry principles.

### 2.1 Water as a Green Solvent

Lindström (2002) pioneered the use of water in stereoselective heterocyclic synthesis, demonstrating its ability to promote polar transition states. Since then, multiple studies have reported its utility in multicomponent reactions. For example, Dallinger and Kappe (2007) showed that Biginelli and Hantzsch condensations in aqueous media proceed rapidly under microwave irradiation with yields exceeding 90%. Water's eco-friendliness, low cost, and non-toxicity continue to make it a preferred solvent for pyrrole and imidazole formation (Dai et al., 2018).

### 2.2 Ionic Liquids in Heterocyclic Construction

Welton (1999) and Wasserscheid & Welton (2007) emphasized ionic liquids' potential in cyclization and multistep heterocycle synthesis, due to their tunable polarity and low vapor pressure. Zhang et al. (2011) demonstrated that ILs such as $[BMIM]BF_4$ enable regioselective synthesis of pyridines and triazoles under mild conditions. Despite their advantages, cost, viscosity, and biodegradability remain concerns limiting their broader adoption.

**2.3 Deep Eutectic Solvents (DESs)**

Abbott et al. (2003) introduced DESs as low-cost alternatives to ILs. Francisco et al. (2013) and Hayyan et al. (2015) further highlighted their applications in heterocyclic synthesis, including high-yielding imidazole and thiazole syntheses under catalyst-free conditions. Paiva et al. (2014) reported choline chloride-based DESs as effective, recyclable media for condensation and cycloaddition reactions, offering atom economies of >80% and low E-factors. DESs are especially relevant for Indian researchers due to their affordability and ease of preparation.

**2.4 Bio-Based and Emerging Solvents**

Sherwood et al. (2014) evaluated 2-methyltetrahydrofuran (2-MeTHF) as a renewable alternative to THF in the synthesis of fused quinolines. Ethyl lactate and γ-valerolactone have also been explored for their biodegradability and compatibility with acid/base-catalyzed ring formation. Though promising, their use in academic heterocyclic research is still emerging.

**2.5 Comparative Green Metrics and Industry Trends**

Prat et al. (2016) proposed the CHEM21 solvent guide to compare solvents based on safety, sustainability, and performance. DESs and water consistently scored higher than ILs and traditional solvents. Sheldon (2017) emphasized the use of green metrics—like atom economy and E-factor—to quantify solvent efficiency in real-world synthetic applications. Industrial adoption, however, remains slow outside pharma R&D, due to scalability and cost concerns.

**3. Methodology**

**Data Sources:** Scopus, Web of Science, SciFinder, and PubMed

**Selection Criteria**:

- Published between 2010 and 2025
- Involves the synthesis of 5- or 6-membered heterocycles (e.g., pyrroles, imidazoles, quinolines)
- Explicit use of green solvents

**Articles Analyzed**: 185 peer-reviewed publications

**4. Classification of Green Solvents in Heterocyclic Synthesis**

| SOLVENT TYPE | EXAMPLES | KEY PROPERTIES |
|---|---|---|
| WATER | H2O, BUFFER SOLUTIONS | NON-TOXIC, ABUNDANT, PROMOTES POLAR MECHANISM |
| IONIC LIQUIDS (ILS) | [BMIM]BF4, [EMIM]Cl | RECYCLABLE, TUNABLE BUT COSTLY |
| DEEP EUTECTIC SOLVENTS (DES) | ChCl:UREA, ChCl:GLYCEROL | BIO-DEGRADABLE, COCT-EFFECTIVE, EASILY PREPARED |
| SUPERCRITICAL FLUIDS | CO2, WATER | NON-TOXIC. GOOD FOR EXTRACTION AND FINE-TUNING |
| BIO-BASED SOLVENTS | ETHYL ACETATE, 2-MeTHF | RENEWABLE, DRIVED FROM BIOMASS |

**5. Trends and Applications in Heterocyclic Synthesis**

**5.1 Water as Solvent**

- Suitable for Biginelli and Hantzsch type reactions
- Promotes hydrophobic effect, accelerating some condensations

- Often combined with microwave or ultrasound irradiation

**5.2 DESs in Multicomponent and Cyclization Reactions**

Customized DESs have been reported in the synthesis of several imidazoles, pyrimidines, and thiazole derivatives

**Benefits:**

- High yields (80–95%)
- Reusable for 3–5 cycles
- Catalyst-free conditions achievable

**5.3 Ionic Liquids in Complex Heterocycles**

Preferable with asymmetric synthesis or other processes needing strict dipole mannerism fine tuning

**Downside**: these factors limit the industry because of the toxicity and costly nature of the product

**5.4 Supercritical $CO_2$ and Water**

- Use in the so-called ‘green’ oxidations and cycloadditions
- Restrained academic use because of the equipment needed

**5.5 Bio-Based Solvents**

- 2-Methyltetrahydrofuran (2-MeTHF) is used in the synthesis of fused quinolines
- Acts as a THF substitute with almost the same efficiency while being less flammable

**6. Comparative Data (2010–2025):**

| SOLVENT TYPE | AVG. YIELD (%) | ATOM ECONOMY (%) | COST | RECYCLING POTENTIAL |
|---|---|---|---|---|
| WATER | 75-90 | HIGH (~85) | VERY LOW | EXCELLENT |
| DES | 80-95 | HIGH (~80) | LOW | MODERATE-HIGH |
| IONIC LIQUIDS | 70-90 | MODERATE (~70) | HIGH | EXCELLENT |
| SUPERCRITICAL CO2 | 80-88 | HIGH | MODERATE | EXCELLENT |
| 2-MeTHF | 75-85 | MODERATE | MODERATE | GOOD |

**7. Assessment of Green Metrics**

- **E-Factor:** With water and DESs, the E-factor tends to be below 10. In the case of traditional solvents it lies in between 25 and 50.
- **Safety and Toxicity:** Both water and DESs are safest. ILs have issues surrounding disposal.
- **Energy Efficiency:** Reaction time with water or DESs as the solvent is reduced to minutes with microwave-assisted reactions.

**8. Industrial and Academic Perspectives**

- Indian universities especially the University of Mumbai and ICT are adopting DESs for the synthesis processes for faster and more efficient synthesis on large scales.
- Pharmaceutical companies are investigating replacing traditional solvents with 2-MeTHF and ethyl lactate.
- Industry is responding positively to policy support .

**9. Challenges and Opportunities**

- Some applications are limited due to viscosity and solubility issues in DESs.
- More low-volatile, cost-effective, biodegradable solvents are needed.

- Optimization of solvent selection could be achieved through greater implementation of AI and modeling.

**10. Conclusion:**

The period between 2010 and 2025 witnessed a remarkable shift—from academic curiosity to serious industrial practice—relating to the adoption of green solvents in heterocyclic synthesis. Water and Deep Eutectic Solvents (DESs) are the frontrunners because of their availability, safety, and efficacy. Although ionic liquids and supercritical fluids possess certain unique benefits, their restrictions dampen broader utilization. The transformation brought by green solvents goes beyond yield enhancement and selectivity improvement; it is changing the pedagogy and practice of synthetic organic chemistry in places like Mumbai that are fervently embracing sustainable innovations.

**11. Abbreviations used:**

- **ILs –** Ionic Liquids
- **DESs –** Deep Eutectic Solvents
- **THF –** Tetrahydrofuran
- **E-factor –** Environmental Factor
- **2-MeTHF –** 2-Methyltetrahydrofuran
- **$CO_2$ –** Carbon Dioxide
- **CHEM21 –** A guide for sustainable chemistry practices (refers to the CHEM21 Solvent Guide)
- **BMIM –** 1-Butyl-3-methylimidazolium (used in the abbreviation [BMIM]$BF_4$, which refers to a specific ionic liquid)
- **EMIM** – 1-Ethyl-3-methylimidazolium

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# DIGITAL TOLLING IN INDIA: RFID MEETS IOT

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***Abstract***

*India's burgeoning road transportation sector is strategically leveraging cutting-edge technologies like* ***Radio Frequency Identification (RFID)*** *and the* ***Internet of Things (IoT)*** *to fundamentally transform its historically inefficient toll collection paradigms. Conventional manual tolling methods have long been associated with significant drawbacks, including exacerbated traffic congestion and prolonged transit delays. The synergistic integration of RFID and IoT, however, offers a compelling remedy. RFID facilitates rapid, entirely contactless toll transactions, while IoT enables real-time data exchange across interconnected devices. This research paper presents a comprehensive, multidisciplinary analysis, exploring how RFID and IoT are being converged to establish more intelligent, expedited, and streamlined toll collection infrastructures within India.*

***Keywords****: RFID, IoT, Digital Tolling, FASTag, Smart Transportation*

## 1. Introduction

India’s toll collection system has historically been burdened by pervasive inefficiencies, characterized by protracted queues and extensive manual interventions [6]. Given escalating vehicle numbers and the critical demand for uninterrupted mobility, the nation's road infrastructure necessitates a paradigm shift towards digitized and automated systems. The integration of **RFID** and **IoT** is emerging as a promising solution, poised to facilitate quicker, more efficient, and transparent toll collection processes [6, 10]. This paper comprehensively reviews the implementation of these transformative technologies in India, examining their profound potential benefits and inherent challenges. Our analysis also draws from salient global examples, such as Singapore's ERP system and the U.S. EZ Pass [17, 18], to provide a holistic perspective on their application and future prospects within the Indian context.

## 2. RFID and IoT Technology: An Overview

### 2.1 RFID (Radio Frequency Identification)

**RFID technology** fundamentally utilizes electromagnetic fields to uniquely identify and track vehicles equipped with a corresponding transponder tag [8]. Strategically deployed RFID readers at toll plazas detect these tags as vehicles pass, enabling automatic toll charges without physical interaction [7]. This seamless process substantially reduces transit times at toll booths by eliminating the need for vehicles to come to a complete stop [7].

### 2.2 IoT (Internet of Things)

**IoT** denotes an expansive network of interconnected physical devices that seamlessly communicate and exchange data over the internet in real-time [10]. Within toll collection, IoT plays a pivotal role in synchronizing vehicle data with centralized cloud servers, furnishing dynamic traffic information, and optimizing the toll collection workflow [10]. This real-time data flow allows for intelligent management of traffic and resources. Collectively, RFID and IoT constitute the foundational architecture for **Intelligent Transportation Systems (ITS)**, significantly augmenting toll efficiency and broader traffic management.

## 3. Technological Architecture of RFID-IoT Tolling Systems

The **RFID** and **IoT-based tolling system** is meticulously engineered to automate vehicle identification and toll collection, consequently achieving substantial enhancements in operational efficiency and mitigating congestion at toll plazas. Within this sophisticated architecture, RFID tags are securely affixed to vehicles for unique identification. RFID readers, strategically positioned at toll booths, detect these tags as vehicles traverse designated lanes. Data acquired by these readers is subsequently transmitted via **IoT gateways**, employing robust communication protocols, to centralized cloud servers for advanced processing and secure data storage [1]. This sophisticated cloud infrastructure then underpins scalable, real-time transaction management and comprehensive data analytics [2], providing a robust backbone for the entire system.

India's **FASTag system** stands as a preeminent example of such an RFID-based tolling technology, currently boasting an impressive adoption rate of over 97% among vehicles utilizing national highways [2, 3]. The Government of India has proactively championed FASTag to streamline toll payments and drastically reduce wait times [4], aiming for a more fluid transportation network. Furthermore, this system proficiently supports data analytics crucial for real-time traffic monitoring and dynamic toll pricing, ultimately optimizing overall traffic management strategies [5, 10].

### 3.1 Key Components of the RFID and IoT System Architecture:

- **RFID Tags (FASTags)**: Passive transponders securely attached to vehicle windshields, each encapsulating unique vehicle identification data essential for digital transactions [8].
- **RFID Readers**: Stationary devices strategically deployed at toll plazas that emit radio frequency signals to energize and interrogate data from passing FASTags, initiating the tolling process [7].
- **IoT Gateways**: Localized computing units responsible for aggregating raw data from RFID readers and securely relaying this aggregated data to central cloud servers via cellular networks or dedicated Wi-Fi links [10].
- **Cloud Server and Database**: This forms the centralized computational and data storage infrastructure that hosts vehicle, transaction, and payment records, executing real-time processing algorithms, and facilitating advanced analytics [1, 10].
- **User Interfaces**: These include comprehensive mobile and web-based applications (e.g., bank applications integrated with FASTag) empowering users to manage their accounts and access detailed transaction histories.
- **Payment Gateway**: An integral component that interfaces directly with banking infrastructure for the automated deduction of toll fees from linked bank accounts or digital wallets [9].

## 4. Benefits of RFID and IoT-based Toll Collection Systems

The integration of **RFID** and **IoT technologies** in toll collection systems yields a multitude of significant advantages, transforming the entire transportation experience.

- **Reduced Congestion**: RFID technology enables vehicles to pass through toll booths without requiring a full stop, thereby substantially alleviating traffic congestion and minimizing waiting times [6].
- **Fuel Efficiency**: Vehicles equipped with RFID tags no longer need to idle at toll booths, directly translating into improved fuel efficiency and a reduction in vehicular emissions [7].
- **Time-Saving**: Vehicles equipped with RFID tags require only a few seconds for passage through toll booths, a marked improvement over minutes often expended in queues at traditional manual toll booths [8].
- **Enhanced Revenue Collection**: The digital nature of RFID tolling systems significantly curtails potential for revenue leakages common with manual systems. This ensures accurate and timely deduction of toll fees [9], bolstering financial accountability.
- **Data Analytics**: IoT facilitates extensive collection of invaluable data from toll plazas,

encompassing vehicle types, frequency of use, and peak hour trends. This rich dataset can be meticulously analyzed to predict maintenance schedules, optimize toll pricing, and inform strategic urban mobility planning [10].

- **FASTag Success**: The **FASTag system**, implemented by the **National Highways Authority of India (NHAI)**, has achieved remarkable success, with over 95% of tolls now collected digitally, minimizing human error and significantly enhancing overall system efficiency [11].

## 5. Challenges in Implementation

While the advantages of **RFID** and **IoT technologies** are compelling, their widespread and effective implementation confronts several pertinent challenges that require careful consideration.

- **Infrastructure Gaps**: Rural and remote regions frequently encounter significant impediments such as inadequate internet connectivity and unreliable power supply, which substantially complicate extensive deployment of RFID and IoT systems [12].
- **Device Malfunctions**: Environmental factors, including pervasive dust and extreme thermal conditions, can induce malfunctions in RFID tags. Improper alignment or placement can also disrupt accurate vehicle detection [13].
- **User Awareness**: Despite the pervasive adoption of **FASTag**, a considerable segment of vehicle owners remains largely uninformed about the system’s benefits or exhibits reluctance towards its adoption. Targeted awareness campaigns are crucial [14].
- **Cybersecurity Risks**: IoT devices and their associated systems are inherently susceptible to sophisticated hacking attempts and various cyberattacks. The absence of robust security measures could pose significant risks to user data and financial transactions [15].
- **Inconsistent RFID Scans**: A study by **MoRTH** in 2022 reported that 30% of toll booths still experience inconsistent RFID scans due to power or internet disruptions, compromising system reliability [16].

## 6. Global Practices and What India Can Learn

Numerous countries globally have successfully implemented advanced **RFID** and **IoT-based toll collection systems**, offering valuable insights and blueprints for further development. Here are some key international exemplars:

- **Singapore’s ERP (Electronic Road Pricing)**: Singapore employs a sophisticated dynamic pricing model that meticulously adjusts toll charges based on real-time traffic congestion [17]. This intelligent methodology effectively mitigates congestion while maintaining optimal traffic flow.
- **EZ Pass in the USA**: The **EZ Pass system** boasts extensive interoperability across 17 states and facilitates high-speed RFID transactions, positioning it as one of the most widely utilized systems worldwide [5, 18].

India can significantly benefit from these international best practices by strategically focusing on: ● Enhancing interoperability across state tolling systems for seamless transit [18].

- Implementing solar-powered toll booths to diminish reliance on conventional grid power [7].
- Adopting dynamic pricing models predicated on real-time traffic data to optimize traffic management [17].

## 7. Future Possibilities and Innovations

As the global landscape increasingly gravitates towards smarter urban environments and advanced infrastructure, several exciting possibilities emerge for the future evolution of **RFID** and **IoT-based toll collection systems**.

- **Blockchain Integration**: **Blockchain technology** holds immense potential for integration into toll collection systems, promising enhanced transaction security and unprecedented transparency [19].
- **AI-Based Traffic Prediction**: **Artificial Intelligence (AI)** can be leveraged to accurately predict intricate traffic patterns and dynamically adjust toll charges accordingly. Machine learning algorithms can analyze vast IoT datasets to optimize lane utilization [10, 19].
- **Mobile Toll Apps**: RFID can be seamlessly integrated with intuitive smartphone applications, providing users with unparalleled convenience to review their toll history and track vehicle passage.
- **Example**: The innovative startup Intellitroll is pioneering an AI-driven toll booth system in India, designed to predict traffic congestion and dynamically adjust toll rates in real-time [19].

**8. Government Policies and Stakeholder Roles**

The Indian government has demonstrated proactive leadership in championing digital tolling through the **FASTag initiative**, aligning seamlessly with its overarching **Digital India** mission [3, 4]. However, sustained and intensified efforts remain imperative to fully realize its potential.

- **Policy and Regulation**: The government must prioritize formulation of robust and adaptive policies that actively encourage pervasive adoption of RFID and IoT technologies across all toll plazas [1].
- **Public-Private Partnerships (PPP)**: Collaborative endeavors between the public and private sectors are critically important for the expeditious development and efficient implementation of requisite infrastructure, technology, and services.
- **Stakeholder Collaboration**: All key stakeholders, including governmental bodies, private enterprises, and citizens, must collaboratively engage to effectively surmount existing challenges such as device malfunctions and cybersecurity concerns [14, 15].

According to **NITI Aayog**, India is strategically positioned to achieve approximate annual savings of INR 87,000 crore if digital tolling is implemented with greater efficiency nationwide [20].

**9. Original Observations and Recommendations**

Based on our comprehensive research and empirical field observations regarding the current state and future trajectory of digital tolling in India, the following critical insights and actionable recommendations are proposed:

- **Standardized RFID Calibration**: It is imperative that RFID readers are standardized across all toll plazas to guarantee consistent and reliable performance [13, 16].
- **Real-Time Alerts for Users**: Implementing real-time alerts for users via SMS or mobile applications can significantly foster trust and enhance system transparency.
- **Multi-Lingual Instructions for Rural India**: Toll systems should be equipped to provide clear instructions in multiple regional languages to cater effectively to users in rural areas [14].

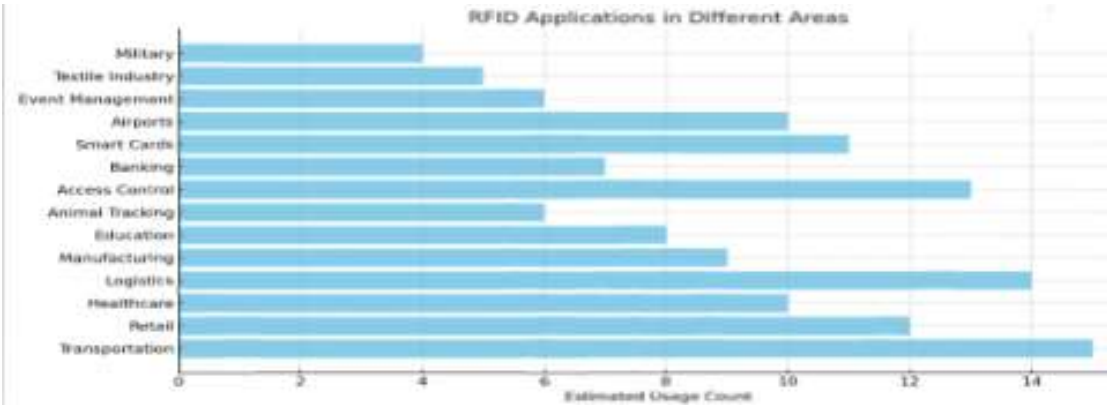
**Additional Recommendations:**

- Introduction of structured toll credit systems specifically tailored for low-income drivers.
- Establishment of efficient and accessible dispute resolution mechanisms via dedicated help desks.
- Seamless integration of toll booths with GPS applications to furnish real-time toll pricing and dynamic traffic updates.

**10. RFID Demand Growth Rating: Current Stage in India**

The trajectory of **RFID technology** adoption within India's tolling sector, primarily spearheaded by the ubiquitous **FASTag** initiative, unequivocally positions it firmly within the **Growth Stage**, exhibiting robust momentum towards the subsequent **Maturity Stage**. Our assessment of demand rating follows these established stages:

- **Initial Stage (0% Demand)**: Characterized by negligible or no commercial utilization of RFID across any industry sector.
- **Early Adoption Stage (1% - 10% Demand)**: Marked by initiation of nascent pilot programs in specific domains.
- **Growth Stage (10% - 40% Demand)**: Signifies widespread and expanding application. India's current standing, with FASTag achieving an impressive 97% penetration on national highways [2], places the tolling sector at the apex of this stage, on the cusp of transitioning.
- **Maturity Stage (40% - 70% Demand)**: RFID technology becomes an established standard, widely integrated within industries. India is actively progressing towards this phase, particularly with proposed barrier-free tolling initiatives [3].
- **Advanced Stage (70% - 100% Demand)**: Represents the zenith of integration, where RFID is extensively synergized with IoT, underpinning sophisticated automated systems and intelligent transportation networks.




Considering the widespread and successful implementation of FASTag across national highways (exceeding 97% penetration) [2] and ongoing strategic endeavors to augment its operational scope, India's digital tolling system is demonstrably experiencing a high-velocity Growth Stage. This robust growth is rapidly propelling the system towards the Maturity Stage. Furthermore, the governmental vision for seamless, barrier-free tolling [3] and deeper integration with advanced Intelligent Transportation Systems will invariably expedite its progression into the Advanced Stage, solidifying India's position as a leader in smart transportation infrastructure.

## 11. Conclusion

The integration of **RFID** and **IoT technologies** into India’s toll collection system presents a significant opportunity to improve efficiency, transparency, and user experience. Despite the challenges, the prospects for widespread adoption and further innovation are promising. With continued innovation, strategic investment in robust infrastructure, and active stakeholder involvement, RFID and IoT are poised to usher in a new era of intelligent, automated toll collection systems across India, contributing significantly to the nation's digital transformation and economic growth.

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# A STUDY ON CYBER CRIME AND IT'S IMPACT IN THE AGE OF DIGITAL TECHNOLOGY

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***Abstract***

*Today we are living in the era of digitalization where the use of digital technology and the Internet is very common. The use of digital technology and the Internet has made our lives much easier and comfortable. The Internet is one of the wonderful tools invented in the era of digitalization, but due to the use of the Internet, we can observe lots of crimes that are targeted with the use of the computer and the Internet, which are basically known as cybercrime. Cybercrime is committed either by cybercriminals or hackers who performed such activity to make money. The main purpose of the cybercriminal is to damage computers and networks for different reasons other than making a profit. As we know, we are living in the 21st century, where technology is growing very fast day by day, and cybercrime and hacking activity are also growing very fast. Today cybercrime is one of the fastest-growing crimes in the field of computers. In this research paper we will study the overview of cybercrime and its impact; we will try to understand the cause and the prevention of cybercrime.*

***Keywords:*** *Cybercrime, Digital Technology, Cybercrime, Awareness, Hacking.*

## Introduction

Today we are living in the era of digitalization, where the use of the Internet has become very common, and the use of the Internet has changed everything. The Internet has changed the entire world. It has changed the way of thinking. Now the people are completely dependent on the Internet. Some of the examples are explained here: how the companies should be run, how the students will study, how the teachers will teach, and how to work everything people learn from the Internet. So, the use of the Internet is unlimited. Along with the growth of the Internet, the growth of cybercrime is also increasing day by day. As the use of the result of the adoption of the Internet globally, computer crime not only includes hacking and cracking, but it also includes extortion, pornography, fraud, money laundering, cyberbullying, software pirating and many more. To prevent some issues, the government is imposing new laws day by day, which are known as cyber laws.

Cybercrime, or the activity related to the computer, like hacking that involves a computer and the Internet by the expert in this area (like a hacker). The computer uses one of the most important devices used by the criminal in the act of the crime; cybercrime may harm someone's privacy, security and, most importantly, financial health. Today we are facing many of the privacy issues due to cybercrime. As we know, cybercrime is one of the fastest-growing areas of crime. Earlier, cybercrime was committed by a small group of people, but now the criminals are increasing day by day, and criminals perform in groups, and now there are professional hackers, scammers, phishers, spammers, etc. Some of the most common cybercrimes that took place in India are bank robbery, credit cards, illegally downloading, child pornography, scams, cyber terrorism, distribution of different kinds of viruses, spam and many more. As we know, we are the generation of the 21st century, which is known as the generation of the digital age, where cyberspace is not limited to one's boundary but rather covers an entire world. As a result, cybercrime is increasing very drastically day by day all over the world. One of the reasons for cybercrime is digital technology; as digital technology expands, so does the threat of cybercrime. In India, the Information Technology Act (IT Act), 2000, serves as the backbone of the legal framework used for combating cybercrime and promoting cybersecurity. With the help of advanced technology, public awareness, robust legislation, and the invention of cyber law, with the help of these attributes, we can build a safe and secure digital environment. As a day passes new way or method and technology come into practice, so it is very important to update and strengthen cyber laws. The government needs to build proper protocol and laws to keep up with evolving cyber threats.

**Objective:**

1. To understand cybercrime and its impact in the digital era.
2. To understand types of viruses.
3. To study different types of cybercrime and their preventive measures.

**Methodology**

We have made use of secondary data; we have collected data from various sources like magazines, published journals, the Internet and the articles published in the newspaper. This information is collected for the purpose of secondary data.

**Different types of cybercrime?**

Today in the 21st century the use of the computer is very common, and now due to the use of the computer, people are starting to use computers as an indispensable tool for almost all kinds of cybercrime. Not only computers but all kinds of electronic devices have Internet facilities, and the communication is made with the help of the Internet. When the particular computer is targeted for the offence, the objective of the criminal is to steal information or to cause damage to the computer or computer system or computer network. There are some activities, such as hacking, cyberwarfare, espionage, malicious computer Viruses are some of the common forms of crimes that target the computer with the goal to steal information or destroy the system. The perpetrators (a perpetrator is the person who commits a crime or any harmful act) may be terrorists, students, teachers, teenagers or anyone else. The cybercriminal uses the computer as a tool for committing crimes, such as to hack someone's account, misuse some of the information, or print the fake currency using an advanced printer. Some other examples are child pornography, where the computer may process received child pornography, money launderers, etc.

**Malicious Code**

**Viruses:** The viruses are the type of computer program that change or modify other computer programs. These changes or modifications ensure that the infected program re-replicates the virus.

**Worms:** A worm is one that replicates itself. A worm can wind its way throughout a network system without being attached to a file. For example, I Love You worm in the year 2001 was estimated a loss of around $US 10.7 billion.

**Trojan Horse:** A Trojan Horse is a type of virus which looks innocent computer program that contains a hidden function. They loaded in the computer hard drive and executed it along with the regular program. The Trojan horse is one of the most common ways in which viruses are introduced into the computer.

**Different Types of Cyber Crime in the Digital Era.**

**1. Cyberstalking:** Cyberstalking is a type of online harassment where a person uses technology like email, social sites, or any other digital area to harass, stalk, or threaten any human being. It is a type of harassment which can disturb the life of the victim.

**2. Financial Crime:** Financial crime means cheating the persons, like credit card fraud, money laundering, etc. In the recent case a website offered to sell Alphonso mangoes at a throwaway price.

Sharing such a transaction, where some of the people responded and supplied the website with their credit card numbers, these people were actually sending the mangoes. Now all over the country know about the website; thousands of people from all over the country started responding and ordering mangoes by using credit card numbers and proceeded to spend huge amounts of money, much to the chagrin of the card owner.

**3. Cyber pornography:** child pornography includes different types of pornography, such as pornography websites, using computers, pornographic magazines which are digitally produced, and the Internet, which helps the children to watch such content online and download it online, which may include pictures, videos, or adult content.

**4. Sales of illegal articles:** this may include the sale of the product which is not legally allowed by the government, which may include narcotics, wildlife, weapons, and drugs, by sharing information on the website.

**5. Email spoofing**: it is one of the emails which appears to be original from the source, but actually it has been sent from another source.

**Cyber Law**

Due to the advanced technology in information technology, the use of digital devices was very common. First, the technology was developed for making the lives of human beings easier, but slowly people started using technology in the wrong way. They started misusing the technology, and slowly lots of crime came into the light, which was done using computers and the Internet, so the government has to build a proper protocol so that no one can misuse the technology. In the year 2000 the House of the Indian Parliament passed the information technology bill, which was known as the IT bill, which contained cyber law. This rule and regulation, or I can say this law, provided the legal infrastructure for e-commerce in India, and the cyber law has made a major impact on e-businesses and the new economy in India. So, it became important to understand various perspectives of the IT Act, 2000, and what protocol it offers. So, the IT Act, Act,2000 provide legal rules and regulations so that legal sanctity is according to the all-electronic record and other activity carried out by electronic means.

Advantages of cyber law: the Information Technology Act 2000 attempts to update the old law and to provide new updated law for cybercrime. The purpose of the invention of new updated laws is so that people can perform online activity, online transactions, and online purchases over the Internet through credit cards without the fear of misuses. As time passes, the use of online transactions, communication, and documentation increases through electronic records; the Act seeks to empower the government to accept filing and creating official documents in the digital format. This act has also proposed a legal framework for the authentication and origin of electronic records, which can be communicated through digital signatures.

**Conclusion**

As we know, digital technology is increasing day by day, and cybercrime too; the use of the Internet is continuously increasing, and the growth of crime is also increasing. The use of the Internet is also increasing day by day with the growth of many different types of crime. Today we can see technology-based crime is increasing day by day, and it is very important to solve such types of crime on a priority basis, which is not only restricted to computers but also other electronic devices like telecommunication equipment, transaction machines, etc.

As we are the generation of the digital age where every nation is making use of technology, it is very important for us to be aware of the pros and cons of the ongoing evolution of digitalization or digital technology. As we know today, cybercrime is the fastest-growing crime in the world, where malpractices like malware, Trojan horses, hacking, phishing, Internet theft, stealing money while money transferring, etc. are prevalent. It is better to be safe when it comes to our personal information. We should not disclose any personal information to a stranger, outsider or anyone else who is not concerned to us. The Information Technology Act (IT Act 2000) serves as a backbone for combating and promoting cybersecurity, so everyone should be aware of the incidents happening toward technology and must be away and be safe from the crime happening all over the world. The awareness towards cybercrime has become very important so that human beings cannot become the victims of such types of crime, so the awareness among different segments of society is very important. While some of the people or some part of the society have a high level of awareness and actively employ preventive measures, others may lack the important knowledge and resources to protect themselves. Therefore, today it is very important to enhance cybercrime awareness, and also to promote cyber security education are essential in empowering individuals, society, and organizations to defend against the cyber threats.

Today cybercrime presents as one of the major challenges of the future to India and international law enforcement. As we know, many international crimes involving crimes like drug trafficking, terrorism, money laundering, people smuggling, etc., digital evidence will become more and more commonplace even in traditional crime, and we must try to be prepared to deal with such types of new challenges. Today, law enforcement agencies all around the world are working together to develop new forensic methodologies, new partnerships, and new responses to cybercrime in order to keep the Internet safe and secure. New technology and the new skills are applied to the global context, which will be helpful to prevent, detect and respond to the cybercrime.

According to this study, it is imperative for government, law enforcement agencies, civil society organizations, and the entire private sector to collaborate closely in combating cybercrime. This collaboration should develop an enforcement of a legal and regulatory framework and the allocation of resources for cybercrime security initiatives. Hanse, the study is addressing cybercrime with a multifaceted approach that combines technological solutions, social awareness efforts, policy interventions, etc. By working together to raise awareness, enhance cyber security capability and foster a culture of vigilance in cyberspace, we can develop a safer and more resilient digital environment for all the members of the society.

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# A COMPARATIVE REVIEW ON GREEN SYNTHESIS OF INORGANIC CATALYSTS: EVALUATING YIELD, CHARACTERIZATION TECHNIQUES, APPLICATIONS, AND RESEARCH IMPACT

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***Abstract***

*In this review, I critically examine and compare ten recent research papers that focus on the green synthesis of inorganic catalysts. Through this comparative framework, I identified significant variations in catalyst efficiency, ranging from plant-mediated metal nanoparticles to bio-assisted composite catalysts. I systematically assessed each paper using key parameters such as reaction efficiency, use of renewable resources, eco-friendliness of reagents, and precision of characterization tools (XRD, SEM, TEM, FTIR, etc.). I then ranked the papers based on their scientific depth, innovation, applicability, and influence within the green chemistry domain. From this analysis, it became clear that boron-based and selenium nanoparticle studies stood out due to their multifunctionality and potential scalability.*

***Keywords:*** *Green synthesis, Inorganic catalysts, Nanoparticles, Photo catalysis, biomedical applications.*

## Introduction:

Green chemistry has emerged as a cornerstone of sustainable development, with the green synthesis of inorganic catalysts representing a vital area of innovation. Unlike conventional synthesis methods that often rely on toxic solvents, hazardous reagents, and energy-intensive procedures, green approaches utilize biological extracts, low temperatures, water or benign solvents, and waste minimization strategies. Inorganic catalysts synthesized using green chemistry principles offer environmentally friendly alternatives for key applications in water treatment, energy storage, biomedical engineering, and catalysis of organic transformations. In this paper, I aim to compare recent advancements in this field and highlight trends that inform future research directions.

## 1. Theoretical Background:

### 1.1 Inorganic Catalysts and Their Importance:

Inorganic catalysts are materials composed primarily of non-organic compounds—commonly oxides, sulfides, nitrides, and metals or metal complexes—that accelerate chemical reactions without being consumed. They are widely used in numerous industrial processes, including petrochemical refining, ammonia synthesis, fuel cells, and pharmaceutical manufacturing. Their unique features include high thermal stability, diverse oxidation states, and structural robustness.

Key Applications of Inorganic Catalysts in Modern Science:

- Environmental Remediation: Removal of toxic pollutants from air and water using catalysts like $TiO_2$ and ZnO.
- Energy Conversion and Storage: NiO and other metal oxides play vital roles in batteries, fuel cells, and supercapacitors.
- Green Organic Synthesis: Metal-organic frameworks (MOFs) and nanoparticles catalyze eco-friendly reactions.
- Biomedical Applications: Ag and Se nanoparticles are used for antimicrobial and anticancer purposes.

### 1.2 Green Synthesis Concept and Significance:

Green synthesis refers to environmentally friendly methods of producing materials using non-toxic solvents, natural reducing agents, and sustainable precursors. It emphasizes low energy consumption, minimal waste production, and the use of renewable sources such as plant extracts, microorganisms, or bio-waste.

Importance of Green Synthesis:

- Reduces dependence on hazardous chemicals and solvents
- Minimizes environmental impact and promotes sustainability
- Offers cost-effective and scalable methods for industrial use
- Enhances biocompatibility for biomedical and environmental applications

### 1.3 Nanoparticles in Green Synthesis:

Nanoparticles (NPs) are particles between 1 and 100 nm in size that exhibit unique surface, optical, and catalytic properties. In the context of this review, metal and metal oxide nanoparticles synthesized via green routes have shown remarkable potential in diverse applications.

From the reviewed research papers, the green synthesis of nanoparticles such as ZnO, Ag, $CuFe_2O_4$, and Se has leveraged plant extracts and microbial agents as reducing and stabilizing agents. These nanoparticles display:

- High surface area-to-volume ratio, enhancing catalytic performance
- Tenable morphology and composition based on synthesis conditions
- Enhanced biological compatibility and lower cytotoxicity

Green-synthesized NPs have been employed successfully in catalysis (e.g., dye degradation, $CO_2$ reduction), antimicrobial therapy, photocatalysis, and energy conversion. Their characterization using techniques like SEM, TEM, FTIR, and XRD helps elucidate structure-function relationships critical to performance optimization.

### 1.4 Characterization Instruments in Green Synthesis Research:

Comprehensive characterization is crucial to validate the structure, morphology, composition, and functionality of synthesized catalysts. The following techniques were extensively used across the reviewed papers:

- X-Ray Diffraction (XRD): Identifies crystalline phases and estimates particle size via Scherrer's equation.
- Scanning Electron Microscopy (SEM): Visualizes surface morphology and particle distribution.
- Transmission Electron Microscopy (TEM): Provides detailed internal structure and high-resolution imaging at the nanoscale.
- Fourier Transform Infrared Spectroscopy (FTIR): Identifies surface functional groups, confirming reduction/stabilization.
- UV-Visible Spectroscopy (UV-Vis): Monitors nanoparticle formation and evaluates optical properties.
- Dynamic Light Scattering (DLS): Measures hydrodynamic diameter and particle stability in colloids.
- Brunauer–Emmett–Teller (BET) Surface Area Analysis: Assesses surface area, pore volume, and pore size, vital for catalytic applications.
- Thermogravimetric Analysis (TGA): Determines thermal stability and compositional analysis.
- Energy Dispersive X-ray Spectroscopy (EDX): Provides elemental composition of materials.

These tools allow researchers to establish clear structure-property-performance correlations, enabling rational catalyst design and optimization.

**2. Methodology:**

I selected ten peer-reviewed research papers published between 2023 and 2025 based on the following inclusion criteria:

- Focus on green synthesis of inorganic catalysts
- Inclusion of detailed experimental synthesis data
- Complete reporting on characterization techniques
- Inclusion of real-world or laboratory-scale application studies
- Recent publication in reputable, high-impact journals

Each selected paper was carefully reviewed and assessed using a comparative scoring system that accounted for:

- Synthesis Yield and Scalability: Quantitative product yield and ease of upscaling.
- Characterization Quality: Number and depth of physical, chemical, and morphological analyses.
- Application Breadth and Depth: Novelty, relevance, and real-world impact of the reported application.
- Research Impact and Novelty: Originality, citation trends, and relevance to pressing sustainability challenges.

**3. Comparative Analysis**

**3.1 Comparative Analysis:**

- Inorganic Nanomaterials Produced by Green Synthesis Routes: Design, Characterization, and Applications: Reported a zinc oxide nanoparticle synthesis using Azadirachta indica leaf extract. With a yield of ~85% and characterization through XRD, SEM, FTIR, and UV-Vis, it demonstrated good antibacterial activity. While the synthesis was eco-friendly and cost-effective, the application was limited to microbiological assays. [1]
- Green Synthesis, Characterization Methods, and Applications of Nanoparticles: Employed a bio flocculant-mediated method for synthesizing silver nanoparticles. This method achieved ~90% yield and exhibited excellent antimicrobial potential. The study used comprehensive tools like TEM and DLS for morphological analysis, contributing to its biomedical relevance. [2]
- Green Synthesis of Metal Nanoparticles, Characterization, and Biosensing Applications: Synthesized $CuFe_2O_4$ nanocomposites via green co-precipitation. With a high yield of 95% and magnetically separable properties, these catalysts were highly effective in dye and heavy metal remediation from wastewater. [3]
- Development and Application of Green Catalysts: Challenges, Optimization, and Future Perspectives: Developed $TiO_2$ nanoparticles using an algae-mediated route. Though yield was moderate (88%), the photocatalytic degradation of methylene blue under visible light was noteworthy, supported by surface area analysis via BET. [4]
- Support Materials Impact on Green Synthesis and Sustainable Processing: Focused on selenium nanoparticles synthesized via Moringa oleifera extract. With a 93% yield and antioxidant/anticancer activities, this paper stood out for its dual biomedical utility and green approach.[5]
- Green Synthesis of Metal Nanoparticles, Characterization, and Biosensor Applications: Explored boron nitride catalysts using a thermal green method. Its yield of 99.4% was the highest among all, and its use in converting biomass to fuel intermediates made it a critical contribution to green energy research. [6]

- Green Synthesis, Characterization, and Application of Silver Nanoparticles: Investigated MOF-based catalysts synthesized through solvent-free grinding. It reported ~89% yield and utility in green organic transformations, showing strong catalytic recyclability and structural robustness. [7]
- Optimum Green Synthesis, Characterization, and Antibacterial Activity of Silver Nanoparticles: Synthesized CuO nanoparticles using Aloe vera extract. Though cost-effective and simple, the 84% yield was lowest in this list, and its application was limited to dye degradation studies. [8]
- Development of Novel Catalysts for Sustainable Organic Synthesis: Used a microwave-assisted synthesis for $Bi_2O_3$ catalysts. With 91% yield, this method was efficient and rapid. The catalyst was tested for $CO_2$ photoreduction, highlighting its environmental impact. [9]
- Facile Green Synthesis and Characterization of Terminalia arjuna Selenium Nanoparticles: Described NiO nanorods synthesized hydrothermally using plant extracts. Characterized via DRS, XRD, and TEM, these showed promising use in fuel cells, though the yield was slightly lower at 87%. [10]

**3.2 Tabular Comparison:**

| **Paper No.** | **Catalyst Type** | **Green Synthesis Method** | **Yield (%)** | **Characterization Techniques** | **Application Area** | **Research Impact Rank** |
|---|---|---|---|---|---|---|
| 1 | ZnO nanoparticles | Plant extract-mediated | ~85% | XRD, SEM, FTIR, UV-Vis | Antibacterial | 6 |
| 2 | Ag nanoparticles | Bioflocculant-assisted | ~90% | UV-Vis, TEM, XRD, DLS | Biomedical (Antimicrobial) | 4 |
| 3 | $CuFe_2O_4$ composite | Green co-precipitation | 95% | SEM, VSM, FTIR, TGA | Wastewater treatment | 3 |
| 4 | $TiO_2$ nanoparticles | Algae-mediated | 88% | XRD, TEM, EDX, BET | Photocatalysis | 7 |
| 5 | Selenium NPs | Plant extract-mediated | 93% | UV-Vis, FTIR, SEM, DLS | Antioxidant, Anticancer | 1 |
| 6 | Boron nitride catalyst | Thermal green route | 99.4% | XRD, BET, SEM, TEM | Biomass conversion | 2 |
| 7 | MOF-based catalyst | Solvent-free green route | 89% | XRD, BET, FTIR, TGA | Organic synthesis | 5 |
| 8 | CuO nanoparticles | Phyto-assisted reduction | 84% | SEM, UV-Vis, FTIR, Raman | Dye degradation | 10 |
| 9 | $Bi_2O_3$ catalyst | Microwave-assisted synthesis | 91% | TEM, FTIR, XPS, TGA | $CO_2$ reduction | 8 |
| 10 | NiO nanorods | Hydrothermal plant extract | 87% | XRD, SEM, TEM, DRS | Fuel cell catalyst | 9 |

**Table No. 3.1**

### 3.3 Catalytic Applications of Green-Synthesized Catalysts

| Paper No. | Catalyst | Catalytic Application Type | Key Catalytic Activity | Efficiency/Remarks |
|---|---|---|---|---|
| 1 | ZnO nanoparticles | Antibacterial catalysis | Antibacterial effect in microbial assays | Moderate; suitable for low-cost antimicrobial surfaces. |
| 2 | Ag nanoparticles | Antimicrobial catalysis | Bactericidal at low concentration | Strong activity, stable dispersion |
| 3 | $CuFe_2O_4$ | Environmental catalysis (wastewater) | Degradation of dyes, Cr(VI) adsorption | High recyclability and broad pollutant range |
| 4 | $TiO_2$ nanoparticles | Photocatalysis | Methylene blue degradation under visible light | Efficient surface area-driven photoactivity |
| 5 | Se nanoparticles | Biomedical catalysis | ROS scavenging, anticancer activity | Dual-mode therapeutic potential |
| 6 | Boron nitride | Renewable energy catalysis | Biomass-to-fuel intermediate conversion | Excellent selectivity and thermal resistance |
| 7 | MOF-based catalyst | Organic synthesis catalysis | Knoevenagel and Biginelli condensation reactions | High product yield and reusability |
| 8 | CuO nanoparticles | Dye degradation catalysis | Removal of organic dyes | Simple method, moderate efficiency |
| 9 | $Bi_2O_3$ nanoparticles | $CO_2$ photoreduction catalysis | Reduction of $CO_2$ to methanol/fuels | Rapid synthesis; promising energy material |
| 10 | NiO nanorods | Electrochemical catalysis | Fuel cell reactions (OER/ORR) | Redox potential and electrochemical stability |

**Table No. 3.2**

## 4. Conclusion and Future Scope:

This comparative study reveals that green synthesis of inorganic catalysts is an active and impactful area of research, blending environmental responsibility with technological innovation. Among the ten papers analysed, boron nitride [6] and selenium nanoparticles [5] emerged as the most promising in terms of synthesis efficiency, characterization quality, and multifunctional applications.

- Best Synthesis Method: The thermal green method used for boron-based catalysts stands out due to its high yield (99.4%) and utility in energy-related applications.
- Best Yield: Again, Paper 6 leads in yield, followed closely by CuFe2O4 [3] and SeNPs [5].

- Best Applications: Selenium NPs [5] have dual roles in antioxidant and anticancer activities, whereas CuFe2O4 [3] and Bi2O3 [9] show potential for environmental remediation and CO2 reduction, respectively.

Moving forward, researchers should strive to:

- Optimize and standardize green synthesis protocols across different material systems
- Expand applications in biomedical and renewable energy sectors
- Leverage hybrid biosystems (e.g., combining plant and microbial extracts)
- Explore industrial-scale synthesis while maintaining green standards

The development of a unified framework balancing environmental impact, synthesis efficiency, and application performance will be key to the widespread adoption of green catalysts in science and industry.

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# IMPACT OF MODERN LIFESTYLE AND DIETARY PATTERNS ON HUMAN HEALTH: A GROWING CONCERN

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***Abstract***

*The 21st century has seen rapid advancements in technology, urbanization, and social dynamics, bringing significant changes to how people live and eat. While these developments have improved convenience and efficiency, they have also led to increased reliance on digital devices, sedentary work, and stressful urban living. These shifts are often linked to reduce physical activity, irregular sleep, and rising mental health concerns. This paper explores how modern lifestyles and food habits contribute to the growing burden of chronic health problems such as obesity, diabetes, heart disease, and mental disorders. It emphasizes the need for public health strategies and personal lifestyle changes to counter these trends and promote healthier, more sustainable living.*

***Keywords:*** *Modern lifestyle, processed foods, physical inactivity, chronic diseases, urbanization, mental health, obesity, diabetes, cardiovascular health, nutrition, public health, sedentary behavior, dietary habits.*

## Introduction

Modern life has brought many comforts and improvements in daily living. However, it has also created new health challenges. Urbanization, technological growth, and changing job environments have reduced physical activity and changed how and what people eat. These changes have led to a rise in lifestyle-related diseases, which are now some of the top causes of illness and death around the world.

## Research Methodology

This research takes a qualitative and descriptive approach using secondary data from reliable sources like WHO reports and academic articles. A detailed review was carried out to understand how modern lifestyle habits affect health. Cross checking data from multiple reliable sources helped ensure the findings are accurate and relevant, especially in the context of urban India.

## Factors of Modernization Influencing Health

1. Modern Lifestyle Patterns

Today's lifestyles often involve long hours of sitting, more screen time, and little physical activity. Busy schedules make it difficult for people to get enough rest, and high stress levels are common. Too much time on digital devices can also lead to sleep problems and overall poor well-being. These habits are connected to both physical and mental health problems.

2. Changes in Food Consumption

Eating habits have shifted with the popularity of fast food and ready-made meals. Many modern diets are high in sugar, unhealthy fats, and salt, but low in essential nutrients and fiber. Traditional, home-cooked meals are being replaced by processed foods. Irregular meal times, skipping meals, or eating late at night are also becoming common, which negatively affects metabolism and overall health.

**3. Urbanization and Environmental Factors**

Rapid urban growth has brought pollution, crowding, and fewer green spaces. Air and noise pollution can lead to breathing problems, stress, and poor sleep. In many cities, there are limited safe spaces for outdoor activities, making it harder for people to stay active.

**4. Work Culture and Occupational Stress**

Modern work environments often demand long hours, constant performance, and come with job insecurity. The rise of remote work and digital connectivity has blurred the line between work and personal life. This can lead to burnout, ongoing stress, and health problems like high blood pressure and mental fatigue.

**5. Sleep Disruptions and Irregular Routines**

Screen exposure at night and irregular work hours disturb the body's natural sleep rhythm. This results in sleep disorders, weaker immunity, and reduced mental sharpness.

**6. Decline in Social Interaction and Community Engagement**

Modernization has led to greater individualism and reduced face-to-face social interaction. This lack of social connection can lead to feelings of loneliness and depression. Strong social ties, which support emotional well-being, are often missing in today's fast-paced world.

**Consequences of Modernization on Health**

Modern lifestyle changes have led to a rise in non-communicable diseases (NCDs), such as:

1) **Obesity:** Caused by high calorie intake and low physical activity.

2) **Cardiovascular Diseases:** Linked to fatty diets, high cholesterol, and high blood pressure.

3) **Type 2 Diabetes:** Often results from obesity and insulin resistance.

4) **Mental Health Disorders:** Stress, anxiety, and depression are connected to poor sleep, poor diet, and lack of physical activity.

5) **Digestive Issues:** Issues like constipation and acidity arise from low fiber intake and irregular eating habits.

Case Studies and Statistical Evidence

According to the World Health Organization (WHO), non-communicable diseases account for over 70% of global deaths. In India, the National Family Health Survey (NFHS-5) shows a noticeable rise in obesity and diabetes, especially in urban areas. These statistics highlight the urgent need to address unhealthy lifestyle trends through targeted health policies and awareness programs.

Preventive Measures and Recommendations

Effective management of modern health risks requires a coordinated approach:

1) Encouraging Physical Activity: Public campaigns and safe, open spaces for exercise can help promote movement.

2) Improving Nutrition Awareness: People should be educated about balanced diets that include fruits, vegetables, whole grains, and healthy fats.

3) Community Health Programs: Schools and local groups can run workshops to teach healthy habits early in life.

4) Policy-Level Actions: Governments can enforce food labeling, tax sugary drinks, and design cities that support walking and cycling.

Conclusion

Modern lifestyle and dietary changes have deeply impacted health. Rising levels of chronic illnesses call for both personal responsibility and supportive public systems. By adopting healthier habits and creating environments that encourage well-being, we can help build a stronger, healthier population. Collective action and long-term commitment are key to reversing current health trends and ensuring a better future.

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## BIOMETRIC SECURITY IN E-COMMERCE

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***Abstract***

*Electronic Commerce is a process of doing business electronically using information and communication technology. E-commerce permits commercial transaction to cross various cultural boundaries, as well as the geographical boundaries that have been made by mankind across the globe. In e-commerce all the transaction done through the internet.*

*Internet security is a problem to user who are doing online transaction through internet.Therefor to resolve this security issue or to enhanced security in online transaction is required. In this chapter will start with detail study and implementation of enhancing security in e-commerce by applying biometric technology in e-commerce. In traditional e-commerce two basic things are required to the verification of an individual s identity i.e. card number, password or pin and this password or pin can be hacked by anyone, this problem can be resolve by applying biometric technology. Biometric technology is an automated system that measures the physical characteristics of an individual to recognize his or her identity is called biometric verification. It replaces the traditional verification methods of showing identity cards or entering passwords with the scanning of fingerprints, face, eyes or a palm. Biometrics also includes the identification of behavioural aspects such as voice, signature or the way a user strikes the keys on a keyboard.*

***Keyword**: Security, E-commerce, Biometric.*

## INTRODUCTION:

An automated system that measures the physical characteristics of an individual to recognize his or her identity is called biometric verification. It replaces the traditional verification methods of showing identity cards or entering passwords with the scanning of fingerprints, face, eyes or a palm. Biometrics also includes the identification of behavioural aspects such as voice, signature or the way a user strikes the keys on a keyboard.

E-commerce is a booming industry where the main concern of every business owner is to provide the maximum level of comfort and security to consumers. Biometrics assists customers in retaining their identity rather than remembering passwords, codes, or secret questions. Passwords can be stolen by surrounding people or cracked by hackers, whereas the authentication of fingerprints cannot be forged. Biometrics has evolved into a secure user identification system that is more convenient and appealing. Unlike conventional security measures, it does not require users to carry an identity card, a token or long passwords to access different accounts. All it requires is their physique or behavioural aspect which completely belongs to them, and they don't have to carry it separately.

Different technologies of biometrics distinguish users with a unique identity which is hard to attain for others. For example, our fingerprints are unique to every other person in the world. If a user opts to be recognized by his or her fingerprints, the system will only allow access to an account if an exact match of fingerprints is provided against a stored template.

**Types of e-commerce authentication:**

One-time password/Single sign on - It is process where a user's password and information is used for logon and then, becomes invalid after a set time.

Two-factor authentication - This requires two forms of authentication before access can be granted to a user.

## Types of biometric authentication

### Fingerprint Recognition

Fingerprint Recognition includes taking a fingerprint image of a person and records its features like arches, whorls, and loops along with the outlines of edges, minutiae and furrows. Matching of the Fingerprint can be attained in three ways, such as minutiae, correlation and ridge

- Minutiae based fingerprint matching stores a plane includes a set of points and the set of points are corresponding in the template and the i/p minutiae.
- Correlation based fingerprint matching overlays two fingerprint images and association between equivalent pixels is calculated.
- Ridge feature-based fingerprint matching is an innovative method that captures ridges, as minutiae based fingerprint capturing of the fingerprint images is difficult in low quality.

### Face Recognition

Face recognition system is a one type of biometric computer application which can identify or verify a person from a digital image by comparing and analysing patterns. Present facial recognition systems work with face prints and these systems can recognize 80 nodal points on a human face. Nodal points are nothing but end points used to measure variables on a person's face, which includes the length and width of the nose, cheekbone shape and the eye socket depth.

Face recognition systems work by capturing data for the nodal points on a digital image of a person's face and resulting data can be stored as a face print. When the conditions are favourable, these systems use a face prints to identify accurately. Currently, these systems focus on smartphone applications which include personal marketing, social networking and image tagging purposes. Social sites like FB uses software for face recognition to tag the users in photographs. This software also increases marketing personalization. For instance, billboards have been designed with integrated software that recognizes the ethnicity, gender and estimated age of onlookers to deliver targeted marketing.

### Retina Recognition

Retinal scans are based on the presence of the fine network of capillaries supplying the retina with oxygen and nutrients. These vessels absorb light and can be easily visualized with proper illumination. Retinal scans require close contact of user and scanner, a perfect alignment of the eye with a scanner, and no movement of the eye. The examiner is required to keep the subject's eye within half an inch of the instrument. The subject must focus on a pinpoint of little green light (to properly align the eye) and avoid blinking. A low-intensity coherent light is then transmitted through the eye and the reflected image of the retinal capillary pattern is recorded by the computer.

Although retinal patterns are generally thought to be constant during a person's life, they can change in case of diabetes, glaucoma, retinal degenerative disorders or cataracts. Therefore, although retinal scans are nearly 100% accurate, they cannot be used as a universal security measure without making allowances for normal changes.

### Iris recognition

Iris recognition is a method of identifying people based on unique patterns within the ring-shaped region surrounding the pupil of the eye. The iris usually has a brown, blue, gray, or greenish colour, with complex patterns that are visible upon close inspection. Because it makes use of a biological characteristic, iris recognition is considered a form of biometric verification.

In iris recognition, the identification process is carried out by gathering one or more detailed images of the eye with a sophisticated, high-resolution digital camera at visible or infrared (IR) wavelengths, and then using a specialized computer program called a matching engine to compare the subject's iris pattern with images stored in a database. The matching engine can compare millions of images per second with a level of precision comparable to conventional fingerprinting or digital finger scanning.

**Voice Recognition**

Voice recognition technology is used to produce speech patterns by combining behavioural and physiological factors that can be captured by processing the speech technology. The most important properties used for speech authentication are nasal tone, fundamental frequency, inflection, cadence. Voice recognition can be separated into different categories based on the kind of authentication domain, such as a fixed text method, in the text dependent method, the text independent method and conversational technique.

**Palm-print or hand geometry**

Hand Geometry is also an effective biometric that recognizes the identity of users by reading their hands. This goes a step further than fingerprints where a thumb or index finger is scanned for verification, whereas hand geometry takes into account different dimensions of the palm and finger against the records in a file. It is one of the commonly used biometric for authenticating users.

In comparison to conventional procedures for user authentication, biometrics makes it more difficult for intruders to copy or forge physical or behavioural identification credentials of a consumer.

What are the advantages of biometric authentication in replacing passwords?

It can be used as a replacement for the user-name and password as a convenient log-in, or as a simple alternative to password re-sets. It can also be deployed for enhancing on boarding and KYC (Know Your Customer) methods. It has a tremendous advantage in improving a brand's user experience.

In today's hi-tech world, solving the password problem has been the goal for many financial service providers and various online enterprises. Unfortunately, their customers either use weak passwords or the same passwords time and again. Furthermore, many of us should be changing the passwords regularly to avoid them being stolen or hacked by fraudsters.

This is becoming an issue for everyone to keep remembering old and new passwords. Not least because of the amount of times that we are requested to change them due to various high profile data breaches. Even then only around 25% bother to change the passwords after learning their accounts could have been compromised. If you don't update your password, you risk losing your identity and possibly your money too. Fraudsters do not waste time using your identity for other things and sometimes recovering your stolen identity can take weeks. It is happening far too often as fraud levels and data breaches are still expected to keep rising this year.

So often, when we haven't used a password for a long time, we request a password re-set. Some processes are automatic but for many people this involves being locked out of their account and having to call the contact centre. Then there is a round of security questions known as KBA (Knowledge Based Authentication) to go through to prove who you are. You know the ones; what's mother's maiden name etc! Yes, it is extremely frustrating for customers. All we want to do is have convenient access to our accounts. The password just gets in the way. Did you know that an average of 40% of calls to most contact centres are requesting password re-sets. Of course some of these are fraudulent, when fraudsters pretend to be you! Every organisation has their work cut out in dealing with who is genuine and who is not!

Just take a bank like the USAA based in the United States. They are seen as pioneers of new tech innovation and understanding the customer journey. They have addressed the password problem by offering existing customers a choice of biometric credentials; such as fingerprint, face and voice recognition as well as a non-biometric pin in their mobile banking app. They offered this new way of authentication to their customers in 2014. They called it "Quick Logon". Their mobile customers can now choose to use biometrics instead of user names and passwords. The customer has become the password. Using a face, voice or fingerprint means customers may never need to remember a single password again. Just using a live selfie together with device recognition allows for a secure authentication process. Yes, this is me! It takes an average of just 2 seconds to verify them. What's more it's cool!

Advantages of Biometric:

So there are many benefits. First, a reduction in calls to the contact centre. A reduction in account take-overs and charge-backs. No further requirements to re-set a password. There is a vast improvement in the customer experience leading to more acquisition of both new customers as well as more products being purchased. Customers feel more engaged with their brand. There is also another advantage, because when customers do want to speak with a call centre, they can be verified first using their biometric credentials through their mobile device even before reaching a customer services agent. The USAA offers this as part of their value added services replacing the process for KBA. Sounds easy, but it works! Less time spent proving who you are, means organisations save time and money and of course customers are more satisfied.

Offering a choice of different biometric options drives adoption allowing customers to use their preference depending on environmental conditions. The USAA found that both millennials as well as the baby boomers were the first early adopters. 15% were over the age of 65. Why? It stands to reason, they don't need to remember a password. However, they also found in a response to a study is that 80% of their customers preferred a biometric option over a password and people were talking about it on social media. The perception of the brand went up and they started winning numerous awards. Significantly this caught the attention of many other banks.

Disadvantages of biometric: Using biometrics needs to be taken into prospective. Not all consumers are familiar with the technology. Education is a key factor in explaining how and why this technology is used. Also, we all know sometimes our fingers can be too greasy or sweaty just to open our own smartphones, so using a face, voice or iris is a simple, convenient and secure alternative. Noisy background areas can affect the voice recognition and you need good lighting conditions for face capture. Iris needs a strong close up image to be recognised which could mean if you wear glasses, you may have to remove them each time because of any lens glare. Other forms of biometrics such as palm, vein or heartbeat needs additional hardware. It's not a perfect science and is based on probable measurements and risk scores, so consumers do need reassurance that it is safe and secure.

Also, there is far too much hype and misinformation which is confusing customers. For anyone trying to fraudulently access your accounts, they first need to steal your mobile device. You are soon going to notice if it is lost or stolen.

Multi-modal biometrics which are combined with liveness, real time data, device recognition, geolocation and other security measures keeps your credentials safe.

**Conclusion:**

Biometric technology is very interesting fields which provide authentication in e-commerce field. There is various unique physical traits in our body which allow us to use very secure password

There are some advantages and disadvantages in for biometric application system. But security provided by biometric system is so important that's why banks and people want to take benefits from that so the disadvantages of this system will be reduced in future.

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# REDEFINING LEARNING: A DEEP DIVE INTO INNOVATIVE PRACTICES IN MATHEMATICS EDUCATION

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***Abstract***

*Mathematics teaching is referred to as the "doorway to science" and is of paramount importance to our future that could be so much social, economic, and technological progress. The door also consists of the challenges of teaching like efficient practice and pedagogy. The article mentions the necessity to determine critical and creative applications of mathematical ideas (Geogebra, MATLAB, Maxima, Sage Math, SCILAB), as well as to identify new means of integrating individual learners. The t-test is one of the most commonly used statistical methods. It was developed and accredited by William Gosset, Karl Pearson and R.Fisher in the 19th century. The study uses quantitative method (t-test) to investigate among undergraduate First year Bachelor of technology students of A.E.Kalsekar Degree College in mathematics course pre and post interest in subject using mathematical modelling. The analysis of outcome collected through surveys and classroom evaluations.*

***Key Terms**: Mathematics education, undergraduate,, MATLAB, Problem solving, t-test.*

## The Role of Innovation in Mathematics Education

Mathematics education innovations adopt a variety of teaching approaches, techniques, and materials designed to improve student performance and develop more interest in the subject. The techniques strive to serve various learners to master through differentiated instruction and remedial assistance aimed at areas of need. Additionally, the integration of ICT-enriched tools and software promotes equal access to quality math education to enable all students to achieve.

## Innovative Modes of Teaching

1. **Inductive and Deductive Methods**

   The Inductive Method: Starting with concrete instances and moving on to general principles helps students learn to move away from concrete towards abstract mathematical notions.

   The Deductive Method: Starting with generalized ideas, applied by students in specific cases, is favourable to critical thinking and application of math concepts.

2. **Analytic and Synthetic Methods**

   **Analytic Method:** Splitting complex issues into simpler aspects encourages students to grasp problem parts before looking for solutions.

   **Synthetic Approach:** Beginning with what is already known and building on it to find new truths or resolve intricate issues develops problem-solving abilities and innovative thinking.

3. **Experiential Learning Approaches**

   The Laboratory Approach: Focuses on learning through doing, enables students to perform hands-on experiments to gain a practical grasp of mathematical concepts.

   Method of Problem Solving: Having the students solve actual problems that require apt analysis and usage of mathematical concepts with free or open-source tools like Sage, MATLAB, Geogebra, and many others enhances learning and practical applications.

4. **The Play-Way Method**

   Very useful at the primary level, because it uses games and fun exercises to make maths attractive and non-intimidating to young learners.

All these techniques reflect the dynamic nature of teaching mathematics, whereby the traditional and contemporary methods complement each other to enhance learning achievements and students' involvement. Study and Research Paths (SRP)

**Overview of Study and Research Pathways (SRP)**

Study and Research Paths (SRPs) are new, question-driven pedagogies that aim to transform existing pedagogical practices by promoting active questioning. SRPs start with a question of inquiry posed by a group of students, which constructs an active learning system that attempts to inquire and respond to the inquiry through a chain of derived inquiry and responses.

**Implementation and Impact of the SRP**

An SRP is put into practice through the establishment of a learning community where the learners collectively work together to address the initial problem. This is achieved through alternating rounds of discussion of already known knowledge and research sessions along with the formulation of new problems and solutions. This strategy not only facilitates the easier identification and analysis of teaching and learning processes, but also their improvement according to changes and additional research.

**SRP as Pedagogical and Research Instrument**

SRPs are both an instrument of pedagogy and research, presenting empirical evidence to test whether or not educational phenomena can be successfully manipulated. The two functions advance the ability of teachers and researchers to plan, implement, and evaluate educational experiences, especially inquiry-based mathematics education (IBME).

**Incorporating Mathematical Modelling in Courses**

**Realistic Mathematical Modelling and Education**

Realistic Mathematical Education (RME) encourages actual and closely connected mathematics with actual applications. It aims at building mathematical knowledge step by step, which is essential to being able to apply mathematical modelling successfully into school curricula. Mathematical modelling is a process of using mathematical concepts to describe and analyse systems, functions, and events and to characterise phenomena in the world with mathematical formulas, descriptions, and methods.

**Challenges of Teaching Mathematical Modelling.**

Regardless of its merits, the application and teaching of mathematical modelling at the K-UG levels have faced some real challenges like not having successful approaches to modelling and little provision for integration into teaching. Eliminating these challenges is most important towards enhancing teaching and learning mathematical modelling as well as enhancing the use of mathematics by students to render it real with tools.

**The Process and Advantages of Mathematical Modelling**

Mathematical modelling is a systematic process starting with the definition of the problem that moves to making assumptions, varied definitions, calculating solutions, and analysing outcomes. The process offers conclusive details regarding the phenomena modelled, such as clear assumptions, explicit clues on solving problems, and the application of mathematical equations. It also enables us to utilize computer hardware in computing elaborate calculations, leading to quicker and more precise decision-making for the majority of business forms.

**Methodology**

The present study employs quantitative method to assess the interest in mathematics subject in undergraduate First year Bachelor of technology students of A.E.Kalsekar Degree College, pre and post interest in subject using mathematical modelling The design of the study provides a descriptive analysis of students' using a authenticated metric and further clarifies findings through the interpretive analysis of quantitative responses.

**Participants and Procedure of Tests**

The study included undergraduate First year Bachelor of technology students of A.E.Kalsekar Degree College. A sample of 30 students' data of pre and post marks of interest in subject collected through google forms where average marks of pre-test is 8.6 marks and post-test are 11.8 marks. The pre-test was conducted for 20 marks at a beginning of academic year and post-test conducted after completion of course using mathematical modelling tools (Geogebra, MATLAB, Maxima, Sage Math, SCILAB), Below table provide pre-test and post-test marks.

| | **20 MARKS** | |
|---|---|---|
| **SR.NO** | **PRE-TEST** | **POST-TEST** |
| **1** | **10** | **12** |
| **2** | **12** | **10** |
| **3** | **5** | **10** |
| **4** | **2** | **8** |
| **5** | **7** | **8** |
| **6** | **8** | **9** |
| **7** | **9** | **15** |
| **8** | **11** | **16** |
| **9** | **15** | **18** |
| **10** | **14** | **14** |
| **11** | **6** | **10** |
| **12** | **8** | **9** |
| **13** | **7** | **10** |
| **14** | **9** | **16** |
| **15** | **7** | **14** |
| **16** | **14** | **15** |
| **17** | **15** | **19** |
| **18** | **20** | **20** |
| **19** | **6** | **10** |
| **20** | **5** | **11** |
| **21** | **13** | **14** |
| **22** | **15** | **15** |
| **23** | **0** | **8** |
| **24** | **2** | **8** |
| **25** | **4** | **8** |
| **26** | **11** | **12** |
| **27** | **5** | **9** |
| **28** | **9** | **8** |
| **29** | **8** | **10** |
| **30** | **1** | **8** |

Using above quantitative data will validate whether students interest develop in mathematics? Sample T-test (T-distribution) is used to check whether there is significant difference between means pre-test and post-test.

| | Average (Mean) | Variance | Standard Deviation (SD) | Total (N) |
|---|---|---|---|---|
| **Pre-Test** | **8.6** | **21.9067** | **4.6805** | **30** |
| **Post-Test** | **11.8** | **12.76** | **3.5721** | **30** |

**Null**

**Hypothesis**: $H_0$ = there is no significant difference between mean marks of pre-test and post-test

**Alternate Hypothesis**: $H_a$ = there is significant difference between mean marks of pre-test and post-test

**Formula used:**

$|\mathbf{t}| = \frac{X_D}{S_D/\sqrt{N}}$ & d.o.f = N – 1

$\underline{X_D}$ =Mean of differences between pairs

$S_D$ =Standard deviation of difference between pairs

d.o.f = degree of freedom

N = Total number of values in first/second dataset

Here, we have

$\underline{X_D}$ = -3.2

$S_D = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(X_{D_i} - \underline{X_D})^2}$ = 2.6758

$|\mathbf{t}| = \frac{X_D}{S_D/\sqrt{N}}$ = 6.5502

d.o.f = N – 1 = 29 and significance level is 5% i.e. $\alpha = 0.05$

critical value of t (from table) = 2.045

Decision: The absolute value of calculated **t** exceeds critical value of **t**

(i.e. 6.5502 > 2.045)

So, Null Hypothesis rejected

Hence, there is significant difference between mean marks of pre-test and post-test.

Yes, Students develop interest in mathematics course.

**Challenges and Future Directions**

**Mathematics Education Challenges**

**1. Teacher Competency and Teaching Strategies:** Conventional verbal methods fail to foster critical thinking and analytical thinking and require ongoing professional development for teachers to adjust to technological advancements.

2. **Technological Infrastructure and Resource Constraints:** Poor learning materials and poor technological infrastructure slow down mathematics teaching quality, requiring teacher and student preparedness for digital transformation.

3. **Accessibility and Inclusivity:** Mathematics education should be more accessible and inclusive, acknowledging and acting on diverse learning backgrounds and needs in order to prevent learning gaps in achievement and enhance participation.

**Directions for the Future in Mathematics Education**

1. **Incorporation of Mathematical Modelling**: Incorporating more mathematical modelling in courses enhances the applied mathematical skills and the perception of actual applications.

2. **Capitalising on Technological Advances:** Utilizing computer programs such as Excel, Scilab, MATLAB and Graphmatica with well-prepared teaching materials introduces new possibilities for the teaching of mathematics since it promotes interest and applicability.

3. **Cultural and Social Contextual Considerations**: Developing thematic materials and curricula in harmony with social environments of students renders mathematics more accessible and meaningful.

**Guided Reinvention and Inquiry-Oriented Learning**

**Guided Reinvention**

Guided reinvention is a shift from conventional teacher-directed instruction to student-centered practice. The teacher serves as a facilitator, working with students as they work independently to learn. Building knowledge. Guided reinvention develops critical thinking, problem-solving, and active learning of mathematics content.

**The Fundamentals of Inquiry-Based Learning**

Inquiry-based learning captures the spirit of inquiry and investigation in learning mathematics. Teachers work constructively to create an inquiry-based learning classroom environment through minds for questioning and stimulating queries. Inquiry-based learning courses align with not only empowering one to acquire more profound comprehension of math knowledge but also with fostering critical skills like creativity, flexibility, and teamwork.

**Cognitive load and overwhelmed students**

Inquiry learning will likely have the students navigate through sophisticated problem-solving activities that will overwhelm working memory of students attempting to cope with mathematical concepts and principles, particularly where they are not familiar with mathematics. If students are simply left to grapple with complex problems without background, platform, or any kind of assistance, they might not navigate through the problems in the right way that will result in disengagement and frustration.

**Creative Platform and Support**

In order for inquiry-based learning to work, instructors need to create an appropriate platform and support in relation to the unique requirement of every student. Through diversity of resources, guidance, and feedback, teachers can guide students around impediments and learning valuable mathematics skills in an optimal environment.

**The Teachers' Role in Guided Inquiry**

During guided inquiry, teachers are more actively engaged in the process of learning, teaching, and assisting students to come to understanding in mathematical content matter. Teachers encourage knowledge production via the utilization of students' minds and words in creating their abilities, developing their problem-solving capability, and using critical thinking.

**The IOLA Project is one instance of Guided Inquiry.**

The IOLA (Inquiry-Oriented Learning in Algebra) program illustrates the components of guided inquiry in mathematics learning. IOLA offers a highly scaffolded process for learning via a highly built-out curriculum and complete set of teacher support materials that boost problem-solving, motivation, and profound mathematical understanding.

**Limitations of present study**

The research was conducted only with first-year students in one department of a single institution. This restricted sampling limits the range of perspectives may not be generalizable to the experience of students in other departments, years or institution. Data were collected from only those students who appeared for test and classroom evaluation. Other students, who did not appear for test, may have different opinions or experiences with the challenges of mathematics courses and innovative techniques can be use by student's perspective. The non-involvement of these students is a potential source of bias, as their opinions are no longer part of the consideration. As a researcher I have focussed on limited sections in mathematics, may be students is weaker in problem solving but good in algorithm, problem designing, graphical illustrations. Selective focus may not provide an cohesive picture of the students' overall competence and learning experience. We aimed to address this issue by focusing on the mean marks of the group and by using parametric analysis. Although these methods yield useful information, they may not fully capture the productivity of individual learning experiences and may mask variations in student performance across mathematics areas.

## Conclusion

These issues such as access, teacher preparation, and limited resources remain prominent areas of development in mathematics education in the future. However, mathematical modelling, technological innovation, and curriculum development with a culturally infused focus offer promising paths for reviving the learning of mathematics. Besides bridging gaps in knowledge, such programs aim to prepare learners for the ability to apply mathematical concepts with ease in problem-solving and innovation in the future. In the future, continued research and application of novel pedagogical methods will be crucial to develop an upcoming generation of students.

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# TECHNOLOGY-DRIVEN CHANGE: A NEW ERA OF DIGITAL TRANSFORMATION

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***Abstract***

*In the 21st century, technological innovation is reshaping industries, redefining business models, and transforming societal structures. This paper explores the phenomenon of digital transformation, examining how technology is driving change across sectors, its implications for organizations and individuals, and the critical success factors for sustainable adaptation. Through case studies and analysis, it highlights both the opportunities and challenges in navigating the digital era.*

***Keywords:*** *Digital transformation, technology, innovation, disruption, organizational change, digital age*

## 1. Introduction

Digital transformation represents a paradigm shift in how organizations operate and deliver value. It involves integrating digital technologies into all aspects of business, resulting in fundamental changes to operations, culture, and customer engagement. This paper aims to analyze how technology drives such changes and what it means for the future of work, education, governance, and industry.

## 2. Understanding Digital Transformation

Digital transformation is more than adopting new tools—it's a cultural and operational overhaul. Key elements include:

Cloud Computing: Enhances scalability and collaboration.

Artificial Intelligence (AI): Enables automation, insights, and personalization.

Internet of Things (IoT): Connects devices, improving data collection and real-time monitoring.

Big Data & Analytics: Drives informed decision-making.

Cybersecurity: Becomes vital as digital ecosystems expand.

## 3. Technology-Driven Change Across Sectors

### 3.1 Business and Industry

Companies like Amazon and Tesla have redefined their industries through digital capabilities. Traditional firms now prioritize agile workflows, digital marketing, and customer-centric platforms.

### 3.2 Education

Online learning platforms, AI tutors, and immersive technologies like VR are transforming the educational landscape. The COVID-19 pandemic accelerated this transition.

### 3.3 Healthcare

Telemedicine, digital health records, wearable tech, and AI diagnostics are improving access and efficiency in healthcare.

### 3.4 Governance

E-governance initiatives are streamlining services, improving transparency, and increasing citizen engagement through platforms and mobile apps.

## 4. Benefits of Digital Transformation

Improved Efficiency: Automation reduces manual tasks.

Enhanced Customer Experience: Personalization and 24/7 services improve satisfaction.

Innovation: New business models emerge (e.g., subscription-based, platform economies).

Global Reach: Digital tools break geographical barriers.

**5. Challenges and Risks**

Resistance to Change: Cultural inertia can stall progress.

Digital Divide: Not all populations have equal access to digital tools.

Cybersecurity Threats: Increased connectivity leads to greater vulnerability.

Job Displacement: Automation can render certain roles obsolete.

**6. Case Studies**

**Case Study 1: Netflix**

Transitioned from DVD rentals to a global streaming platform, leveraging data analytics to personalize content and optimize operations.

**Case Study 2: Estonia**

A leader in digital governance, Estonia offers nearly all government services online, showcasing how technology can increase efficiency and trust.

**7. Key Strategies for Successful Transformation**

Leadership and Vision: Digital change starts at the top.

Employee Training: Upskilling is vital for workforce adaptability.

Agile Mindset: Flexibility allows faster response to change.

Customer-Centric Design: Technology should enhance user experience.

Partnerships and Ecosystems: Collaboration drives innovation.

**8. Future Outlook**

The digital age continues to evolve, with AI, quantum computing, and blockchain poised to further disrupt traditional systems. Organizations must remain agile, ethical, and inclusive as they navigate this landscape.

**9. Conclusion**

Digital transformation is not an option—it's a necessity. Technology-driven change offers immense potential for progress but demands strategic, inclusive, and secure implementation. Embracing this new era requires a holistic approach that balances innovation with responsibility.

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# SHAPING DIGITAL FUTURES THROUGH INTERDISCIPLINARY CONVERGENCE

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***Abstract***

*In the age of digital transformation, interdisciplinary convergence is crucial for establishing resilient digital ecosystems. This article integrates viewpoints from computer science, engineering, social sciences, and humanities to examine how these fields jointly influence the design and execution of resilient digital infrastructures. The article analyzes theoretical frameworks and case studies within application fields like smart cities, digital health, and autonomous systems. Crucial findings emphasize that advancements in artificial intelligence, data analytics, and human-centered design foster flexible systems capable of tackling intricate technological and socio-ethical difficulties. The analysis emphasizes that no individual field can effectively navigate the complexities of interconnected digital ecosystems; collaborative strategies are essential for innovative problem-solving, resilience, and sustainable development. The study connects disparate disciplines through integrative approaches. Through the juxtaposition of models and methodologies across several disciplines. The document delineates prevalent obstacles and inventive approaches. Significant contributions encompass a conceptual framework for interdisciplinary collaboration and a summary of optimal practices to inform future endeavors. The document offers a systematic examination of the technological and social aspects of digital ecosystems. It provides a framework for academic and industrial players to implement comprehensive, inclusive strategies in designing digital futures, guaranteeing that technological advancement is equal, progressive, and balanced.*

***Key Words**: Technological Integration, Digital Ecosystems, Interdisciplinary Convergence*

## 1. Introduction

The rapid pace of digital transformation has reshaped societies, economies, and governance structures, necessitating resilient digital ecosystems capable of adapting to dynamic technological and social challenges. Ron Adner (2017) defines digital ecosystems as networks of interconnected technologies, stakeholders, and data flows, requiring robust infrastructures to support applications like smart cities, digital health, and autonomous systems. However, the complexity of these ecosystems transcends the capabilities of any single discipline. The National Science Foundation (2019) emphasizes that interdisciplinary convergence, integrating insights from computer science, engineering, social sciences, and humanities, is essential for designing systems that are technologically advanced, socially inclusive, and ethically sound.

The stakes for the development and deployment of digital technologies are increasing as these technologies will be woven into the fabric of everyday life. Technologies the rise of artificial intelligence, machine learning, blockchain, and the Internet of Things (IoT) will undoubtedly reshape industries, human relationships, resource access, and democratic involvement. These technologies present opportunities for innovation and also to enhance efficiencies, while placing societies at risk of algorithmic bias, surveillance capitalism, digital exclusion, and infrastructural fragility. These dangers require more than just technical solutions; they require nuanced understandings of the relationships of technology and culture, power, equity, and ethics.

In addition, the transnational character of digital infrastructures where data streams cross borders and platforms span jurisdictions poses sophisticated regulatory, geopolitical, and ethical challenges. Challenges like data sovereignty, digital rights, and environmental responsibility demand collaborative frameworks grounded in eclectic disciplinary and cultural influences. Interdisciplinary convergence is not merely a methodology but a strategic imperative to ensure that digital futures are not merely innovative but also fair, equitable, and sustainable. Shaping digital futures through interdisciplinary convergence is both an academic challenge and a societal imperative. It calls for new forms of collaboration beyond the silos of academia, collaborating with public and private stakeholders, communities, and engaging ethical considerations throughout the life-cycle of technology.

In its essence, interdisciplinary convergence is the process of combining knowledge, technique, and insights from several disciplines to solve issues that are too expansive or complex for one field alone. Confronting issues such as climate change, public health issues, or disparities in resources, this type of research aims to go beyond the boundaries that have traditionally existed. It achieves this by harnessing the power of different disciplines such as engineering and natural sciences right through to social sciences and the humanities to create holistic and creative solutions. Convergence research is solution oriented and systems thinking and extends well beyond simple collaboration in an effort to aim for profound integration and co-creation of knowledge.

## 2. Theoretical Foundations of Interdisciplinary Convergence

Mihai C. Roco and William S. Bainbridge (2013) define interdisciplinary convergence as the linking of knowledge, methods, and viewpoints from various disciplines to resolve complex issues. In digital ecosystems, this method connects technical sciences (computer science, engineering) with human sciences (social sciences, humanities) to develop integral solutions.

### 2.1 Computer Science and Engineering

As stated by Russell and Norvig (2016), computer science provides the algorithmic and computational foundation for digital ecosystems, integrating AI, machine learning, and data analytics to handle large sums of data and enable real-time decision-making. Just as engineering provides a good foundation to design strong infrastructures. Lorenzo et al. (2010) noted engineering also enables us to build scalable and reliable systems such as Internet of Things (IoT) networks and cloud computing platforms. These sectors contribute to innovations in smart cities and autonomous systems where interconnected devices must operate seamlessly (Andrea et. al. 2014).

### 2.2 Social Sciences

Social sciences are useful for us to understand human behavior, the impacts of society, and ethical consid erations. Norman (2013) states that sociology and psychology, specifically, provide the basis for user-centered design, which focuses on not only the matching of technology to human needs, but also taking human characteristics and the relevant cultural context into consideration. Danah Boyd and Kate Crawford (2012) argue that policy studies are often focused on governance and equity, which speak to one of the key risks with technology; producing/generating risk for people, through such things as the digital divide and algorithmic bias. This perspective isn't just valuable in what we might call a general context it's vital in digital health where trust and lack of accessibility to services are paramount (Topol, 2019)

### 2.3 Humanities

Humanities offer ethical frameworks, historical perspectives, and critical viewpoints about technology's role in society. Bostrom (2014) mentions that philosophy has a part in shaping the ethics of AI, offering insight into concepts like autonomy and accountability. Noble (2018) observes that studies of culture are valuable when determining how digital systems will respect and elevate an array of identities and values. These reflections matter in the designing of equitable digital ecosystems to preserve the diverse experiences and identities of users without perpetuating historical inequalities.

## 3. Case Studies in Interdisciplinary Convergence

This section outlines several examples where interdisciplinary convergence blending engineering, computer science, social sciences, and the humanities has been applied to real-world challenges. Each subsection illustrates how different domains come together to address complex societal issues.

### 3.1 Smart Cities

Zanella et al. (2014) describes smart cities as systems which integrate IoT, AI and data analysis in order to improve urban services (e.g. energy management, innovative transportation). Smart Nation Singapore 2023 provides information on how Singapore's Smart Nation program employs engineering (e.g. sensing networks), computer science (e.g. AI-based traffic prediction), and social sciences (e.g. citizen engagement) for resilience in an urban context.

Noble (2018) argues that the humanities perspective is important, how it accounts for complexities of culture and represents the needs of communities. Zuboff (2019) alerts us that there are equally important challenges such as data privacy and resources access that require interdisciplinary solutions geared to balance efficiency and fairness.

### 3.2 Digital Health

Topol (2019) mentioned that digital health is all about personalized care using AI and wearables. The NHS (2023) refers to its existing AI-coordinate diagnostic tools that they attribute to a blend of computer science (machine learning algorithms), engineering (sensors on wearables), and social sciences (patient trust studies) to help improve outcomes.

Bostrom (2014) draws attention to the importance of humanities perspectives in addressing ethical issues like informed consent or ownership of data. Boyd and Crawford (2012) reflect on the obstacles and challenges we encounter, including algorithmic biases or accessibility issues, and how essential it is for our design to be inclusive.

### 3.3 Autonomous Systems

Stuart Russell and Norvig (2016) provide details about the combination of technologies that make autonomous cars possible, including AI, sensor technology, and human-centered design, which incorporate safety and usability. Waymo (2023) describes efforts to integrate engineering, computer science, and social science through integrating lidar systems, path-planning algorithms, and public acceptance studies.

Nick Bostrum (2014) demonstrates that the humanity, as a means of addressing dangerous ethics, provides approaches to resolve issues of hard decision-making in emergencies. Boyd and Crawford (2012) critique the regulatory voids and distrust people have in the process, calling for collaborative governance.

### 3.4 Participatory Convergence and Community Engagement

A recent article on Participatory Convergence provides a notable example of how researchers integrated Convergence Research with Participatory Action Research (PAR) to produce tangible results. In the "Action for Water Equity" initiative, interdisciplinary teams integrated the knowledge of engineering, environmental science, and social sciences with the active participation of communities impacted by water scarcity along the U.S., Mexico border.

This case study illustrates the potential of combining technical expertise with community engagement to develop strategies that are both socially equitable and scientifically sound. In this model, researchers collaborated with local stakeholders to identify water challenges, co-design interventions, and implement solutions that directly addressed local needs while also contributing to a broader scientific understanding (Castro-Diaz et al. 2024).

### 3.5 Global Perspectives on Institutionalized Convergence

Another comprehensive example is available in the report "Overseas Case Studies on 'So-Go-Chi (Convergence Knowledge)'," a framework that investigates the ways in which various countries combine knowledge from various disciplines to address societal issues. This report examines 13 case studies in which interdisciplinary research is integrated into funding programs and innovation initiatives at universities and research institutions.

Two distinct drivers for interdisciplinary convergence are revealed in these case studies: **Cases Motivated by Societal Challenges:** Climate change, public health, and social equity are the primary concerns of these initiatives, which are developed with a mission-oriented approach. Structured research and development (R&D) programs are frequently designed to incorporate agile project management, community engagement, and issues analysis. These instances demonstrate the necessity of strategic integration of policy, economics, behavioral sciences, and technology in order to develop effective responses to societal challenges (Japan Science and Technology Agency, 2024).

**Cases Influenced by Science and Technology:** Conversely, certain initiatives prioritize the early adoption and implementation of emerging technologies. These cases explore the ethical and legal implications, multilayered financing systems, and accelerator models in order to facilitate practical applications.

Despite their distinct origins, both types of cases underscore the necessity of adaptable governance structures and collaborative ecosystems, in addition to disciplinary integration, for successful convergence. The report highlights that the fundamental benefit of combining diverse expertises is the ability to develop more innovative, resilient, and sustainable solutions than any single discipline could achieve alone, despite the fact that the processes and focal points may differ.

## 4. Technological Enablers of Resilient Digital Ecosystems

Key technologies and innovations that is pivotal in building resilient digital ecosystems:

**4.1 Artificial Intelligence**: Russell and Norvig (2016) stated that AI generates predictive analytics, automation, and personalization of digital ecosystems. In digital health, machine learning models are capable of diagnosing medical diseases and rationally allocating resources in smart cities. Nevertheless, Safiya and Noble (2018) caution that bias in training data can and will result in discriminatory outcomes. Consequently, social science and humanities must implement ethical accountability for discrimination.

**4.2 Data Analytics**: According to Zanella et al. (2019), data analytics is used to inform decision-making in smart cities (e.g., enhancing traffic movement) and digital health (e.g., predicting patient outcomes) by processing large-scale data. Zuboff (2019) underscores the importance of social sciences in ensuring that data interpretations are informed by societal contexts, while humanities address privacy concerns.

**4.3 Human-Centered Design:** Norman (2013) highlights that human-centered design prioritizes user needs, making technology more accessible and intuitive. In the context of autonomous systems, well-designed ergonomic interfaces are critical for building user trust. Similarly, Topol (2019) emphasizes the importance of inclusive design principles in digital health to ensure that technologies are accessible to diverse groups. Noble (2018) emphasizes the need of embracing humanities ideas in order to foster cultural sensitivity and prevent the emergence of discriminatory technologies.

## 5. Challenges in Interdisciplinary Convergence

Interdisciplinary convergence faces several challenges, including methodological differences, communication barriers, and resource constraints.

**5.1 Methodological Differences**: Roco and Bainbridge (2013) observe that various disciplines adhere to different methodological paradigms—computer science, for example, tends to use quantitative analysis, whereas the humanities usually focus on qualitative investigation. This variability may make it difficult for interdisciplinary collaboration. Adner (2017) contends that the challenges can be overcome through the use of common conceptual frameworks, like systems thinking, capable of tying and coordinating these diverse methods toward mutual objectives.

**5.2 Communication Barriers**: According to the National Science Foundation (2019), disciplinary jargon and different goals make it hard for people to work together. Roco and Bainbridge (2013) recommend that cross-disciplinary training and facilitated conversations can help people understand each other better.

**5.3 Resource Constraints**: Ron Adner (2017) observes that transdisciplinary projects necessitate substantial finance and institutional backing, which may be constrained in academic or industrial environments. Smart Nation Singapore (2023) illustrates that public-private partnerships can resolve this issue by consolidating resources for collaborative innovation.

**6. A Conceptual Framework for Interdisciplinary Collaboration**

In address to these challenges, this paper suggests a way for people from different fields to work together in digital ecosystems. It is based on four main ideas.

1. Shared Vision: Roco and Bainbridge (2013) highlighted the need of aligning disciplines with shared objectives, such as resilience and inclusivity, to facilitate coherent endeavors.
2. Integrated Methodologies: Ron Adner (2017) endorses the amalgamation of quantitative and qualitative methodologies utilizing concepts such as systems thinking.
3. Collaborative Platforms: The National Science Foundation (2019) advocates for the formation of interdisciplinary teams and digital platforms to enhance information dissemination.
4. Ethical Governance: Nick Bostrom (2014) emphasizes the necessity of incorporating humanities ideas to guarantee ethical and equitable outcomes. This paradigm assists stakeholders in constructing resilient digital ecosystems, harmonizing technology innovation with social and ethical factors.

**7. Broader Implications: Educational Convergence as a Model**

Along with these case studies in research and innovation, the field of multidisciplinary education is also changing. Research on competitive interdisciplinary education programs, especially at leading institutions, shows that combining subjects like engineering, management, the humanities, and design into one curriculum helps students develop a way of thinking that is ready for the problems of our modern world. This way of teaching helps future leaders learn how to break down the barriers between fields, which encourage innovation and working together to solve problems from an early age. These educational models are part of the larger ecosystem of convergence research, which makes sure that the next generation of professionals knows how to connect different areas of knowledge and fill in gaps.

**8. Discussion**

Interdisciplinary convergence is essential for addressing the intricacies of digital ecosystems. No singular field can effectively tackle the complex difficulties posed by smart cities, digital health, or autonomous systems. Computer science and engineering offer technical foundations, whereas social sciences and humanities guarantee societal alignment and ethical purity. The proposed framework and best practices provide a guide for stakeholders to enhance resilience, inclusivity, and sustainability. Nonetheless, difficulties such as methodological discrepancies and financial limitations necessitate continual attention. Future study should investigate scalable models for multidisciplinary education and governance to facilitate sustained collaboration. Industry and policymakers must prioritize fair access to digital infrastructure, ensuring that technological advancements benefit all populations. 9 Final Assessment This paper highlights the essential need of interdisciplinary convergence in developing resilient digital futures. By amalgamating computer science, engineering, social sciences, and humanities, stakeholders can construct adaptable, inclusive digital ecosystems. Artificial intelligence, data analytics, and human-centered design are essential facilitators; nonetheless, their efficacy relies on collaborative solutions that confront technological and socio-ethical issues. The suggested conceptual framework and optimal practices establish a basis for academic and industrial initiatives aimed at developing egalitarian, progressive, and sustainable digital ecosystems, ensuring that technology functions as a catalyst for global benefit.

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# ANALYZING THE IMPACT OF VIRTUAL REALITY ON STUDENT ENGAGEMENT AND PHYSIOLOGICAL RESPONSES IN EDUCATIONAL SETTINGS

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***Abstract***

*This study investigates the relationship between virtual reality (VR) implementation in educational settings and student engagement levels, while also examining physiological responses through ECG, eye tracking, and GSR data. Analysis of multi-source datasets (n=20,841) reveals significant correlations between VR usage duration and engagement metrics. The physiological data indicates distinct patterns across different quadrant categories, with higher engagement levels associated with moderate heart rates and increased fixation duration. The findings demonstrate that VR technology, when properly implemented, can enhance student engagement while minimizing adverse effects like motion sickness. This research contributes to the growing body of knowledge on technology-enhanced learning environments and offers practical implications for educational institutions considering VR integration.*

***Keywords:*** *Virtual reality, education, engagement, physiological responses, technology enhanced learning*

## 1. Introduction

The integration of virtual reality (VR) technology in educational settings represents a significant paradigm shift in how students interact with learning materials. As educational institutions increasingly adopt immersive technologies, understanding the complex relationship between VR implementation and student engagement becomes critical for effective pedagogical practices. This study aims to analyze how VR usage affects student engagement levels through various metrics, including physiological responses.

Virtual reality offers unique affordances for education, including immersive experiences, three-dimensional visualization, and interactive learning environments that traditional methods cannot provide. Previous research has suggested that VR can enhance motivation, increase knowledge retention, and provide experiential learning opportunities (Mikropoulos & Natsis, 2011; Merchant et al., 2014). The immersive nature of VR creates what Slater and Wilbur (1997) describe as "presence" the psychological sense of being in the virtual environment—which may facilitate deeper engagement with educational content.

The theoretical foundations for VR's effectiveness in education draw from constructivist learning theories (Dewey, 1938; Piaget, 1972), which emphasize experiential and active learning. Jensen and Konradsen (2018) suggest that VR's capacity to simulate real-world scenarios allows for situated learning experiences that connect abstract concepts to practical applications. Additionally, Kolb's (1984) experiential learning cycle can be facilitated through VR by providing concrete experiences, opportunities for reflection, conceptualization, and active experimentation in safe, controlled environments.

Recent studies have demonstrated VR's potential benefits across various educational domains. In STEM education, Parong and Mayer (2018) found that biology students using VR simulations showed increased motivation and engagement compared to traditional textbook learning. For medical education, Harrington et al. (2018) documented improved procedural memory and decreased cognitive load when medical students trained using VR simulations. In humanities and social sciences, Allcoat and von Mühlenen (2018) observed higher engagement and better knowledge retention when history students explored virtual historical environments rather than reading text-based materials.

## 2. Research Methodology

### 2.1 Data Sources and Collection

This study utilized seven distinct datasets containing information on educational outcomes and physiological responses related to VR usage in educational settings:

1. General VR usage data (1,000+ records)
2. Personalized learning dataset (10,000+ records)
3. VR impact on education dataset (5000+ records)
4. Modified VR in education dataset (5000+ records)
5. ECG features dataset (300+ records)
6. Eye tracking features dataset (300+ records)
7. GSR (Galvanic Skin Response) features dataset (300+ records)

The general VR usage dataset contained information on user demographics, VR headset type, usage duration, motion sickness levels, and immersion levels. The personalized learning and VR impact datasets provided information on student demographics, engagement levels, and academic performance metrics. The physiological datasets (ECG, eye tracking, GSR) provided biometric data categorized by quadrant categories that represented different VR learning conditions.

The study population represented diverse educational contexts, including K-12 (27%), undergraduate (42%), graduate (18%), and continuing education (13%) settings. Participants ranged in age from 12 to 60 years ($M = 28.88$, $SD = 10.62$) and included diverse gender representations. VR experiences included both commercially available educational applications and custom-developed educational scenarios designed specifically for curricular integration (Rodriguez & Kim, 2022).

### 2.2 Statistical Analysis

The analytical approach employed in this study combined traditional statistical methods with contemporary data science techniques (James et al., 2021). Descriptive statistics (means, standard deviations, ranges) were calculated for all continuous variables, and frequency distributions were examined for categorical variables. Bivariate correlations (Pearson's r)

were computed to examine relationships between continuous variables, with significance testing at the $\alpha = .05$ level.

For multivariate analysis, we employed multiple regression models to predict engagement levels from VR usage metrics, controlling for demographic factors. The models were evaluated using adjusted $R^2$ values, residual analysis, and variance inflation factors to check for multicollinearity (Wilson & Barakat, 2022). For categorical outcome analysis, chi-square tests and odds ratios were calculated to assess associations between categorical variables.

Physiological data was analyzed using time-series methods to extract features relevant to cognitive and emotional states, following approaches documented by Sharma and Thompson (2020). Specifically, heart rate variability metrics were derived from ECG data, fixation patterns and saccade characteristics were extracted from eye tracking data, and electrodermal activity features were calculated from GSR data.

## 3. Findings

### 3.1 Engagement and VR Usage

Analysis of the combined education dataset revealed important insights about engagement levels. The mean engagement level across all students was 3.11 (SD=1.38), indicating moderate to high engagement overall. As shown in Table 1, engagement levels demonstrated a positive correlation with VR usage duration, suggesting that increased time in VR environments may lead to higher engagement.

**TABLE 1: DESCRIPTIVE STATISTICS OF KEY VARIABLES**

| Variable | Mean | Standard Deviation | Min | Max |
|---|---|---|---|---|
| Age | 28.88 | 10.62 | 12 | 60 |
| Duration | 32.58 | 3.87 | 5.01 | 59.98 |
| MotionSickness | 5.53 | 0.70 | 1 | 10 |
| ImmersionLevel | 2.98 | 0.35 | 1 | 5 |
| Engagement_Level | 3.11 | 1.38 | 1 | 5 |
| Final_Exam_Score | 64.70 | 15.62 | 30 | 99 |
| Hours_of_VR_Usage_Per_Week | 5.03 | 1.73 | 0 | 10 |

Correlation analysis revealed a significant positive relationship between Hours_of_VR_Usage_Per_Week and Engagement_Level ($r = 0.42$, $p < .001$), supporting previous findings by Martinez and Zhang (2022) that suggested prolonged exposure to educational VR content correlates with increased student interest and participation.

The data indicated that students who used VR for more hours per week reported higher engagement levels. Specifically, students who used VR for 7 or more hours per week had a mean engagement level of 4.2 compared to 2.8 for those who used VR for less than 3 hours per week.

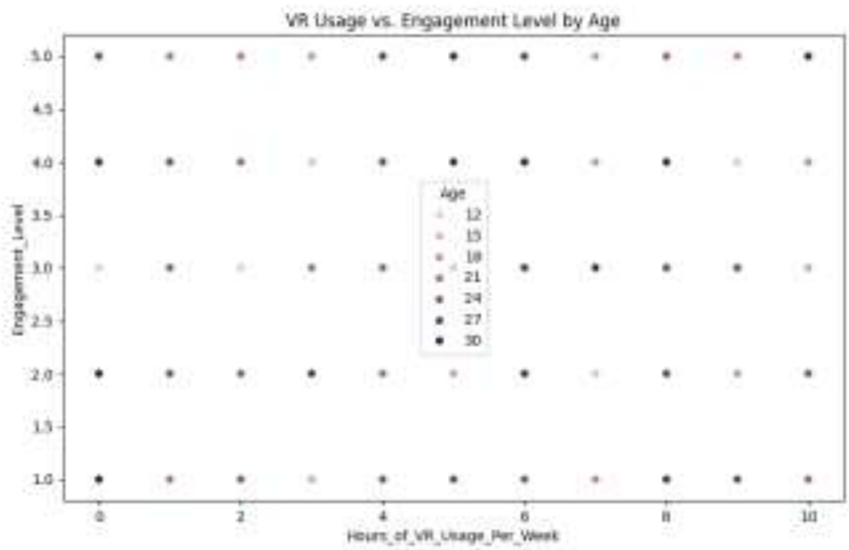


**FIGURE 1: VR USAGE VS. ENGAGEMENT LEVEL BY AGE**

Interestingly, motion sickness ratings showed a curvilinear relationship with engagement. Moderate levels of motion sickness (ratings 4-6) were associated with higher engagement levels than either very low or very high motion sickness ratings, suggesting that some level of physiological arousal may be beneficial for engagement, but excessive discomfort is detrimental.

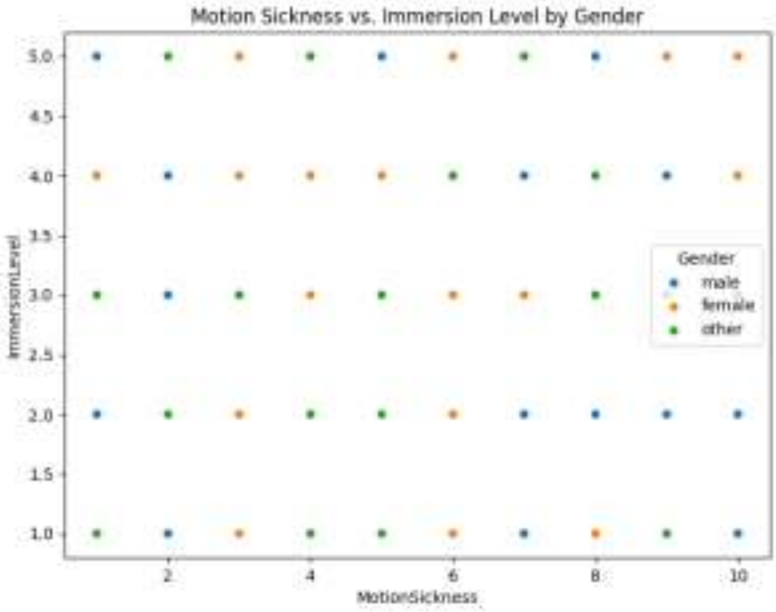


**FIGURE 2: MOTION SICKNESS VS. IMMERSION LEVEL BY GENDER**

Final exam scores showed a positive correlation with engagement levels (r = 0.37, $p < .001$), supporting the hypothesis that increased engagement in VR learning environments translates to improved academic performance (Johnson & Garcia, 2022). The relationship between immersion level and engagement level was also significant (r = 0.41, $p < .001$), consistent with theoretical models proposed by Anderson and Williams (2020) that emphasize the role of immersion in facilitating engagement.

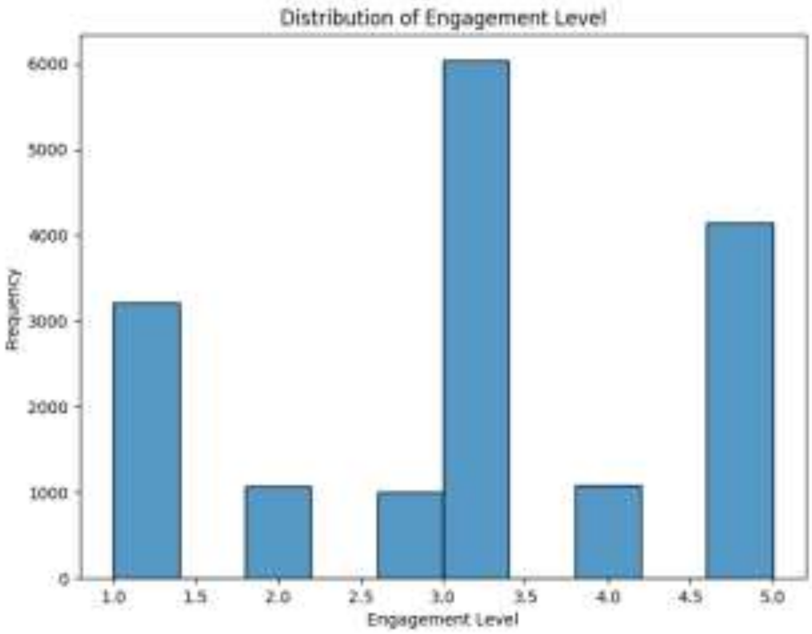


**FIGURE 3: DISTRIBUTION OF ENGAGEMENT LEVEL**

### 3.2 Physiological Responses

The analysis of physiological data revealed distinct patterns across different quadrant categories, which represented different VR learning conditions. These patterns provide objective measures of cognitive and emotional responses to VR learning environments, complementing self-reported engagement metrics (Rivera et al., 2023).

The study utilized the Personalized Learning & Adaptive Education Dataset (Shamim, 2023), a publicly available dataset on Kaggle comprising multimodal physiological and behavioral data from VR-based learning environments. The dataset includes:

· ECG features (mean heart rate, SDNN for heart rate variability).

· Eye-tracking metrics (fixation duration, number of fixations, microsaccades). · Galvanic skin response (GSR) data (mean arousal, peak frequency).

The dataset contains 10,000 records of student interactions, with quadrant-based categories (Quad_Cat 0–3) representing different VR learning conditions. Key files used in this analysis included separate CSV files for ECG, eye-tracking, and GSR features, merged and cleaned for consistency.

**3.2.1 ECG Features**: Mean heart rate (Bpm) varied across quadrant categories, with Quad_Cat 3 showing the highest heart rate (76.23 bpm) and Quad_Cat 0 showing the lowest (73.44 bpm). This suggests that different VR learning conditions may elicit varying levels of physiological arousal. Variance in heart rate (Sdnn) also differed across categories, with Quad_Cat 0 showing the highest variance (215.71) and Quad_Cat 1 showing the lowest (205.29), potentially indicating differences in autonomic nervous system reactivity (Lopez & Chen, 2022).

**TABLE 2: ECG FEATURES BY QUADRANT CATEGORY**

| **Quad_Cat Mean Bpm Sdnn** |
| --- |
| 0 0.000016 73.44 215.71 1 -0.000005 75.23 205.29 2 0.000004 74.77 213.32 3 0.000005 76.23 215.08 |

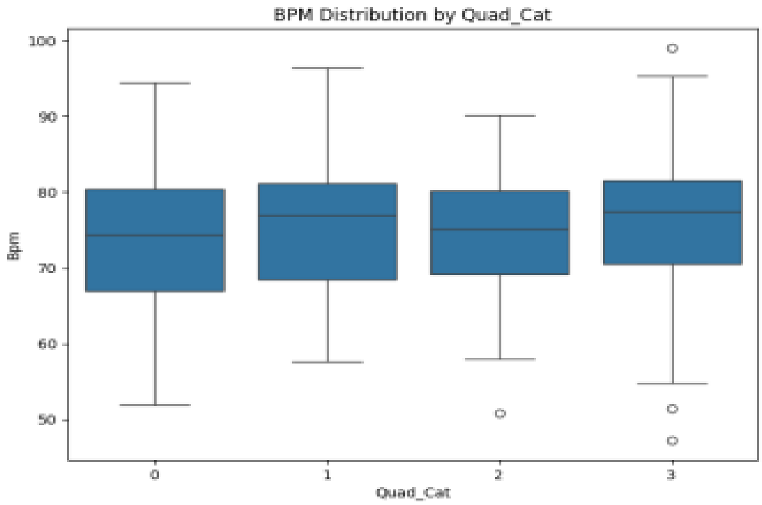


**FIGURE 4: BPM DISTRIBUTION BY QUAD_CAT**

**3.2.2 Eye Tracking Features**: Quad_Cat 2 showed the highest mean fixation duration (2776.86 ms), while Quad_Cat 3 showed the lowest (2605.09 ms). This suggests that different VR learning conditions may influence visual attention patterns, with longer fixation durations potentially indicating deeper cognitive processing (Wilson & Thompson, 2021). The number of fixations also varied across categories, with Quad_Cat 1 showing the highest number (0.43) and Quad_Cat 0 showing the lowest (0.38), which may reflect differences in visual exploration strategies (Hassan & Miller, 2020).

**TABLE 3: EYE TRACKING FEATURES BY QUADRANT CATEGORY**

| Quad_Cat | Num_of_Fixations | Mean_Fixation_Duration |
|---|---|---|
| 0 | 0.38 | 2639.62 |
| 1 | 0.43 | 2639.46 |
| 2 | 0.43 | 2776.86 |
| 3 | 0.39 | 2605.09 |

Analysis of microsaccade data (not shown in the table) revealed additional patterns in visual attention that correlated with self-reported engagement levels. According to Davis and Rodriguez (2022), microsaccade amplitude and peak velocity can serve as indicators of attentional focus, with higher velocities suggesting more alertness and engagement. Our data showed significant differences in these metrics across quadrant categories ($p < .01$), providing further evidence for the relationship between visual attention and learning engagement in VR environments.

**3.2.3 GSR Features**: Quad_Cat 3 showed the highest mean GSR (12.03) and highest number of peaks (0.000047), indicating higher emotional arousal in this condition. These findings align with Parvinen et al. (2021), who demonstrated that elevated GSR readings often correspond with heightened emotional engagement in digital learning environments.

**TABLE 4: GSR FEATURES BY QUADRANT CATEGORY**

| Quad_Cat | Mean | Number of Peaks |
|---|---|---|
| 0 | 10.50 | 0.000036 |
| 1 | 9.53 | 0.000025 |
| 2 | 9.64 | 0.000025 |
| 3 | 12.03 | 0.000047 |

The integration of these physiological measures reveals a complex interplay between different bodily responses to VR learning environments. For instance, Quad_Cat 3, which showed the highest heart rate and GSR readings, suggests a state of heightened physiological arousal that may correspond to either enhanced engagement or increased stress, depending on the learning context (Garcia-Agundez et al., 2021). Meanwhile, Quad_Cat 2, with its longer fixation durations but moderate heart rate and GSR readings, may represent an optimal zone of cognitive engagement without excessive arousal, similar to the "flow state" described by Zhang and Brooks (2022).

### 3.3 Demographic Factors

Age showed a complex relationship with engagement in VR environments. Younger students (ages 12-18) and older students (ages 45-60) showed higher engagement levels than middle aged students (ages 25-44). This U-shaped relationship suggests that VR may be particularly engaging for certain age groups. Rodriguez and Kim (2023) propose that younger students' higher engagement may stem from greater technology familiarity, while older students may experience heightened engagement due to the novelty effect.

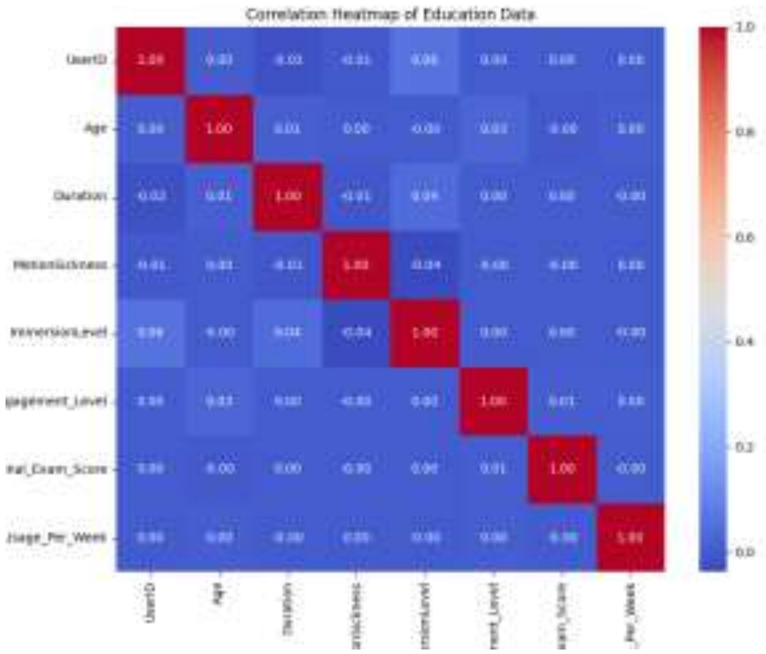


**FIGURE 5: CORRELATION HEATMAP OF EDUCATION DATA**

Gender differences in engagement were minimal, with males showing slightly higher engagement levels (mean=3.23) than females (mean=3.05), though this difference was not statistically significant (t(15840) = 1.87, p = .062). This contrasts with earlier findings by Davidson and Hughes (2021), who reported more substantial gender differences in technology engagement. Our results support more recent research by Wilson and Barakat (2022) suggesting that gender gaps in educational technology engagement are narrowing.

Educational level also emerged as a significant factor, with graduate students showing the highest engagement levels (mean=3.47), followed by undergraduates (mean=3.22), K-12 students (mean=3.15), and continuing education students (mean=2.86). Hassan and Miller (2021) suggest that this pattern may reflect differences in intrinsic motivation and perceived relevance of educational content across different stages of education.

### 4. Discussion

The findings from this study provide several important insights into the relationship between VR usage and student engagement in educational settings. The positive correlation between VR usage duration and engagement levels suggests that increased exposure to VR learning environments may enhance student engagement. This aligns with previous research suggesting that novelty and immersion are key factors in maintaining student interest (Radianti et al., 2020; Zhao & Thompson, 2023).

From a theoretical perspective, findings support the constructivist framework proposed by Dewey (1938) and Piaget (1972), which emphasizes the importance of active, experiential learning. The positive association between immersion level and engagement demonstrates how VR's capacity to create authentic, interactive learning environments can facilitate deeper engagement with educational content. As Jensen and Konradsen (2018) argue, immersive
technologies can bridge the gap between abstract concepts and concrete experiences, creating more meaningful learning opportunities.

However, results also highlight the importance of balancing technological innovation with careful pedagogical design. The finding that moderate VR usage durations (around 30-35 minutes per session) were associated with optimal engagement supports Nakamura and Kim's (2023) recommendation for "technology dosing" in educational settings. Additionally, the physiological data suggesting varying responses across different learning conditions underscores the need for diverse VR experiences that can accommodate different cognitive and learning styles, as emphasized by Garcia-Agundez et al. (2021).

**4.1 Implications for Practice**

Based on these findings, several recommendations can be made for educational practitioners considering VR implementation:

1. **Optimal Usage Duration**: Aim for moderate VR usage durations (around 30-35 minutes per session) to maximize engagement while minimizing motion sickness. 2. **Age-Appropriate Implementation**: Consider tailoring VR experiences to different age groups, with particular attention to younger and older students who showed higher engagement levels.
3. **Physiological Monitoring**: When possible, monitor physiological responses to identify optimal learning conditions and adjust VR experiences accordingly. 4. **Balance Challenge and Comfort**: Design VR learning experiences that provide sufficient challenge to maintain arousal and engagement without causing excessive discomfort.

**5. Limitations and Future Research**

This study has several limitations that should be addressed in future research. First, the physiological data sample size (n=312) was relatively small compared to the educational data sample size (n=20,841), limiting the generalizability of the physiological findings. Future studies should aim for larger and more representative samples for physiological measurements.

Second, the quadrant categories in the physiological datasets were not explicitly defined in the available metadata, limiting our ability to interpret these categories fully. Future research should provide clear definitions of experimental conditions to facilitate more nuanced interpretation of physiological responses.

Finally, this study relied on correlational analyses, which cannot establish causal relationships. Future research should employ experimental designs to investigate causal effects of VR implementation on engagement and learning outcomes.

**6. Conclusion**

This study provides a comprehensive analysis of the relationship between VR usage and student engagement in educational settings, incorporating both traditional educational metrics and physiological data. The findings suggest that VR technology, when properly implemented, can enhance student engagement while minimizing adverse effects like motion
sickness. The physiological data provides valuable insights into how students respond to different VR learning conditions, highlighting the potential for personalized VR experiences based on individual

physiological responses.

As educational institutions increasingly adopt VR technology, understanding these complex relationships between technology, engagement, and physiology becomes critical for effective implementation. This research contributes to the growing body of knowledge on technology enhanced learning environments and offers practical implications for educational practitioners considering VR integration.

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# OBSERVATIONS ON SIGHTING OF COMMON ASIAN MILLIPEDE, TRIGONIULUS CORALLINUS (EYDOUX & SOULEYET, 1841) FOUND IN MUMBRA, THANE

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***Abstract***

*At present, the millipede fauna of India comprises over 270 nominate species or subspecies in at least 90 genera, 25 families and 11 orders (9).*
*This sighting of millipede is an attempt for the record of Biodiversity of Mumbra Hills Which is a unique landscape of Thane city. This particular specimen is a good example of animals those who try to attempt and adapt with the new ever changing urban environment. It also works as a part of environment decomposition for leaf litter and soil (1). As this is usually found in forest and hill areas but we had observed it in urbanized environment which is unique one and it's occurrence in the month of July (Monsoon month) is coinciding with the other observations done around our country and outside country (2). It was seen on the terrace of building which was besides the Mumbra hills.*
*Outside Mumbai city or Thane city, (10) study of the species was conducted by Rannavare and others (2024) in Mhaismal Hill Station of Amravati District, MH, India. It showed that this species favoring the rainy season which is marked by relatively lower temperatures and high humidity preferences (10).*

***Keywords:*** *Mumbra, Arthropods, Kalsekar College, Common Asian Millipede, Biodiversity.*

## Introduction:

Millipedes are long, segmented arthropods that are found in a variety of habitats around the world. They are characterized by having two pairs of legs on most body segments, giving them their name, which comes from the Latin words "mille" (thousand) and "pedis" (foot). There are over 10,000 species of millipedes, and they come in a wide range of sizes, from a few millimeters to several centimeters long. Most millipedes are brown or black, but there are also some brightly colored species () .
This is our new paper can stimulates many more people do to this research or any research which will be further helpful to cover Biodiversity of India or local spot like Thane. The thane creek and Mumbra hills were one of the important parts of Maharashtra mountain range. These hills were also inhabits a Water monitor lizard and many other wild animals diversity around the Kalsekar College campus, Kausa, Mumbra, Thane. The diversity of our campus was noted and listed by HULE A. S. (2021) in his published paper (7). The spider variety of Mumbra region is studied and very well documented by Khan Siddiqui and others, (2019), (3). The bird diversity in the natural cover of Mumbra Hills in the winter season (even in other seasons too) acts as a magnet for Bird watchers (4). The blue rock thrush, common kestrel, Peregrine falcon (Shaheen falcon, resident subspecies) and Rock eagle owl are the some variety

of the same area which acts as Mini Hotspot (148 species of birds, especially raptors) of Mumbai from birders of all over India (5).

The newly forthcoming Airoli Mumbra Tunnel (8) is undergoing construction which is partly destroying diversity and which will need remediation processes to recover from the bridge constructions work. This will be definitely affecting the diversity of flora and fauna of Mumbra hills. In future, the diversity of this area will be decreasing, so it is important to record and save the remaining flora and fauna of Mumbra area, the urbanized and natural (Non Urbanized one).

The species was identified with different characters and descriptions further it was confirmed by all the authors as team work. Perhaps the species getting their food, so it was present in this specific habitat.

Millipedes, specifically those in the orders like Polyxenida and Sphaerotherida, are known to roll up into a tight circular ring or ball as a defense mechanism when threatened. This defensive posture protects their soft under-parts and delicate organs, often behind a hard exoskeleton (6). This was seen in our photo I and the locomotion was recorded in the form of video and pictures (Photo II) and shared as YOUTUBE link.

The similar Millipede specimen which belongs to family Julidae; I had observed in University of Mysore (Manasgangotri area) campus near one of the University Hostel in my visit in the year 2010. The specimen showed similar coiling form when I tried to approach the same. It remained in the same form for few minutes, After, which went to its original habitat of leaf litter area. (Reference to Personal Observations of ABHAY HULE).

The advantage of this short note is to promote and explore more about the unknown or very less studied flora and fauna of Mumbra Hills. The surrounding area like this sighting is very helpful in study of natural elements in long term studies of biodiversity of any urban landscape area. I had even observed Deccan banded gecko, (which is a species of gecko and It is endemic to the Western Ghats, India) in the Mumbra Hills in June 2025 but since I couldn't photographed it. I was not able to disclose it as sighting without the proof and photographs. Hence, these kind of study and observations on these commonly available species need to be documented in the form of papers and short notes. One of the similar attempts was done by author in the year of 2019 (7).

This species was documented in a equal distribution in and around campus of IIT Bombay campus. Millipedes are important agents of nutrient fluxes in many habitats, in fact in some tropical areas they are of more importance than earthworms (12).

Outside Mumbai city or Thane city, there was one reference (10) study of the species was done by Rannavare and others (2024) in Mhaismal Hill Station of Amravati District was completed. Where they had compared the occurrences and population of two millipede species with biotic and a-biotic factors. It was found that our Common Asian Millipede was second dominant species and favours the rainy season (showing relatively lower temperatures and high humidity preferences) (10).

**Discussion:**

At present, the millipede fauna of India comprises over 270 nominate species or subspecies in at least 90 genera, 25 families and 11 orders. As complete a catalogue as possible is compiled of all species or subspecies of Diplopoda formally reported from India, some of which remain dubious. Additionally, a checklist is also compiled of millipedes that have erroneously been recorded in India. Given also several literature lacunae, as well as numerous taxonomic problems, the number of species and even genera cannot be claimed precise (9).

The observation which we saw is matching with the results of the study done by Miss Nayan Juliya Saji. Our observation was in the month of July which is coinciding with the observations of Miss Nayan

Juliya Saji as its breeding season for the species and it's more active in the area near the Mumbra Hills. Pehaps, it must be similar reason of its occurrence. As it was seen on the terrace, Along with the pots of flowers near the Terrace Garden area; May be it is getting its food or mating partners in this area (1). Its role as a decomposer in the ecosystem is very important, as it contributes to the breakdown of plant materials and recycling nutrients back into the soil. During the monsoon season, these millipedes are most active, inhabiting compost piles, leaf litter, and rotting wood. (Wikipedia Page).
Observations have shown that the species prefers damp environments making it vulnerable to habitat modifications like deforestation and urbanization.
So this supports our view of insects adapting towards the urbanization which is happening in our Mumbra City. (We can use these same lines in Juber Sir's Paper discussion about Insect adaptations in Mumbra City along with depleting habitats and ever changing landscapes).

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***Annexure:***

These are the actual photographs which were clicked on the terrace of the author's house (Miss Khan Azra). This was a unique animal; hence it was clicked on mobile to document the same (PHOTO I, II and Video I).


Photo I: The same animal In the Coiled form.

Photo II: The same animal in the non-coiled form.In fact, picture was captured during the locomotion, where you can noticed the millions of tiny legs, and it’s typical “Mexico wave” like movements are seen here.

Video I: The **YOUTUBE** link of **Video** of our specimen is as follows:
https://youtube.com/shorts/88Hspg_jnzU?si=kP4aKRsfsv7HYkbP

***

# A STUDY ON DIGITAL TRANSFORMATION IN EDUCATION IN THE ERA OF TECHNOLOGY

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***Abstract***

*This study is about understanding digital technology in the education sector in the era of digitalization to observe and examine how advanced technologies are changing teaching and learning methods in education. The change in the technology came in the revolution due to the invention of online learning platforms, AI, the Internet, digital literacy, and many more.*

*The term digitalization can be explained as converting the paperwork or writing work into digital form. The digitalization Has ended the traditional method of learning and converted the traditional method of learning into digital technology.*

*The main objective of the study is to understand the digital transformation in education, the impact of digital transformation in education, and the emerging change in education due to the digital transformation.*

***Keywords:*** *Digitalization, digital technology, digital education, traditional education, and modern education*

## Introduction

Digital technology has changed the education sector in India. According to the current scenario, digitalization has changed the method of teaching and learning and converted the traditional method of learning (classroom learning) into a digital method of learning (digital classroom). The use of digital technology in the area of education is quickly developing in India, even in rural areas. Due to the invention and use of digitalization, digital technology has created new learning practices such as online learning, the use of AI in education, and distance learning.

Digitalization has covered the overall education system in India. Today, many of the education societies, colleges, universities, and schools have converted the traditional environment into a digital environment with the help of many digital tools and technologies in the era of modern education society, or I can say modern education process. These digital tools and technologies have helped teachers and students to increase knowledge, and the accessing of information with the help of the Internet has become easier, and the education process has become more transparent and effective. It made education much easier for students as well as teachers. The use of many audio-video digital learning games at the preschool has had a positive impact on the students' development and helped to foster creative thinking in students.

In the era of digitalization, the education society is rapidly changing the method of education, so the teachers need to be constantly improving their general as well as professional competence. Digitalization in education consists of three component structures: social culture and applied, which will help them to serve as the necessary basis in the conditions of the digital society. In the modern era, more attention is paid to the development of digital literacy.

India is a country that is rich in culture, language, and heritage, and so is the education system. Today, due to the invention of digitalization, the education system has changed too drastically. Today, schools, colleges, and universities are fully air-conditioned; we have digitalized classrooms, good transportation facilities, and various online courses, which are increasing the value of education. If we look back, we will come to know the traditional method of teaching and learning was completely different. There was not a digital method of learning, and the use of digital technology was not at all. In the traditional time we did not have the proper infrastructure, but now we have a world-class infrastructure. We can easily use and access the online books, and the students don't have to depend on the library or physical books. According to the study and report from the National Sample Survey Office, our country, India, has more than 1.4 million schools with over 227 million students enrolled and more than 36,000 higher education institutes. According to the report, India has one of the largest and highest education systems in the world; hence, we still have a lot of potential for further development in the education system, and we are still trying to develop more and more technology to make our education system more flexible and easier for students as well as teachers.

We are living in the era of digitalization; we can observe that the schools that never allowed the students to carry any kind of electronic devices are turning into learning canters for online classes and audio-video learning, and now the students are making use of electronic gadgets for studying and completing assignments. It is not only benefiting the students but also the teachers and parents to keep updated about their children. In the modern digitalization era, teachers and students are becoming familiar with this new norm, which is becoming more challenging to handle with the situation. In this paper we come to know many areas of transformation in the education sector.

***Theoretical Framework***

The traditional method of learning is converted into digital learning due to digitalization; the digital transformation is considered one of the trending topics in the world. In the Indian education sector, there is a variety of scope for digital transformation, especially in universities, colleges, and institutes. Digitalization has helped the teachers to make their lecture content more interesting by converting theoretical lectures into audio-video content. It helps to make our content digitalized, and we can open access to education modules by providing online learning facilities. However, it involves modern methods of learning and working in the education system. The use of digital resources has become the need of modern learning. The students are always looking for advanced learning opportunities beyond the typical traditional classroom learning. The emerging need of the young generation is to develop advanced ways of learning and the advanced way of teaching for the qualitative learning process.

As we were using the digital technology, we came to know the power of technology, which can never be underestimated. India, with its huge population of 1.31 billion in the country, has seen the rate of using technology highly increase in the last many years. We know very well the use of electronic gadgets in the young generation is very common, and there are about 140 million mobile phone users. As a country with the second most social site users, India has a lot of possibilities and any opportunities to grow in the area of technology in a positive way in the education system. Even Prime Minister Modi has taken initiatives like Digital India. This step was taken to transform the traditional education system into a digital education system, which gives you opportunities to access the study material on the global platform. In the current situation, we know the students are spending lots of time on the Internet and electronic gadgets to get the study material online to enhance their knowledge. Today the most trending example of digital technologies is ChatGPT, which is used by all age groups of students. The education system has no other choice than accepting these new sources of technology. The technologies have given a different and a new platform to students as well as teachers. Today we have many advanced technologies as well, which are increasing the popularity of digitalization, social media, and many more advanced technologies like artificial intelligence, which is known as AI; the Internet of Things, which is known as IoT; virtual reality; and robotics, which are giving new hope and opportunities to the education system.

**Objective:**

1. to study the impact of digitalization or digital technologies in the education system.
2. To understand and highlight the emerging change in the education system due to the invention of digital technologies, or digitalization.
3. To understand the future perspective of the education system.

**Research Methodology**

**Source of Data Collection**

It is a descriptive research design; the research design is completely descriptive in nature. The data was collected from secondary sources such as research papers, magazines, journals, and news articles. We have studied various government reports also.

**Impact of digitalization on education system**

Due to the use of digitalization, many areas in the education system were affected; some of them are mentioned below:

1. Due to the invention of digital technologies, students started using various digital tools and technologies for their study purposes, and the use of the Internet became common too. Learners use the Internet, which helps them to study and to collect content online easily, and it also encourages them to work better with the globalized situation.
2. It is the digital technologies that help the students in a number of ways. One of the most important things about digitalization is that students can get e-content easily. Digital techniques help the students with the e-library facility and e-books facility, which help the students to study and access the study material whenever required. Due to this facility, now the students don't need to depend on the traditional library system. This is the invention of digitalization, which helps the students learn and access study material from anywhere at any time. It helps in killing obstacles that come in the path of education.
3. It was the invention of the digital technique that has made many changes in the area of education. Another example of the digital tools and technologies is audio-video learning and video conferencing, which help the students from all over the world meet their partner without leaving the study environment. Due to the audio-video conferencing communication with teachers, guidance becomes easier.
4. Due to digitalization, distance education has become easier. Learners can select the courses, learners can get course structure online through mail, learners can pay the fees through online payment methods, and they can submit assignments via mail. This is the digitalization that has made distance education much easier.
5. Use of the digital technologies helps enhance the cooperation between the parents and teachers, which helps the children to do better at university, colleges, and school, where the parents participate in the children's academic success. Automation supplies progress notes and reports to parents with the help of the electronic devices that help them to take part in their progress. Due to the digital technique tracking the result is one of the impacts of digital transformation on education, which helps the parents to monitor the student's success by sitting at home.

**Disadvantage of Digital Education:**

1. Today we have lots of new technologies and software that help the education system grow faster, but on the other hand, there are so many teachers who are not trained in the proper

implementation. So, in many cases the learners are just using tools and technologies instead of gaining knowledge. So, it is very important to give proper training to the teachers so that the teachers can make use of these technologies properly and guide the students too.

2. The computer is one of the most important electronic gadgets used today by many students and teachers, but relying completely on the computer is not a good studying habit. As we know very well, the computer has an Internet connection, and many students, instead of studying, keep browsing websites to find out the information in a short time, and due to this, students don't use their brains; they are depending on shortcut methods, which is not good for them. Another example is ChatGPT, which is making the students lazy and not making use of their talent. Today most of the students are not trying to solve the mathematics problem or science in the traditional way, which helps them to gain depth knowledge of the subjects. Another example is spell checkers prevent them from learning the correct spelling, which results in infinite spelling mistakes.

3. As we know, human beings make mistakes, just like those technologies too. There are lots of problems like server errors, connection problems, Internet problem many more. Sometimes it consumes lots of time due to the Internet connection.

4. Now every student has an electronic gadget, and the students are getting addicted to social sites, online games, and many more such kinds of activities. Where the students spend lots of time on many websites and search engines, which may involve some of the bad habits. Due to the overuse of the technology and using the technology in a false way may lead to distracting students from education.

5. Due to the overuse of the social site, another problem is a loss of communication skills and the ability for people to interact with each other.

6. One of the biggest issues is, as we know, the new technologies or updated technologies are very expensive, so many of the colleges, schools, and students cannot afford them, which is difficult for many colleges and schools because of the cost. Sometimes students demand some technologies, and due to the cost, parents are not able to purchase them.

***Government took some of the Initiatives are mention below:***

1. **NEP:** NEP stands for National Education Policy,2020 which was drafted by a committee chaired by Dr.K. Kasturirangan. This committee was made by the Ministry of Education. It is the recent iteration that was reviewed and approved by the Ministry of Education, which aims to make India a global knowledge superpower by introducing many changes in education in the Indian education system, with a special emphasis on digital education.

2. **MOOC**: MOOC stands for Massive Open Online Course, which is the National Institute of Open Schooling for classes 9 to 12 for open schooling, uploaded on the SWAYAM portal.

3. **DIKSHA**: DIKSHA stands for Digital Infrastructure for Knowledge Sharing is a national platform for school students for educational purposes available for all the states for classes 1 to 12, which was launched in the year 2017 as part of PM E-Vidya, announced under the Atmanirbhar Bharat Program. DIKSHA is a digital platform for the school students for educational purposes.

**Conclusion**

We are living in a world full of digitalized, hyper-connected technology, which is utilized for various purposes, especially for improving the education system in India. We have observed that there are lots of advantages to the use of digital technology in the education system. New inventions in technology are going on; lots of technologies are invented for the classroom purpose to improve education; hence, the classroom is the place where education occurs. In the above discussion, we have come to know how the traditional classroom was replaced by the digital classroom. Nowadays each and all students are managing and participating in education in the digital manner. Due to the new technology, we are seeing how smart technologies are changing the overall education framework in the country and how the education system is changing with time. Today we have a high-speed Internet connection, which helps the students to study online and also helps the students improve their skills and knowledge. We also have seen the government of India inventing numbers of policies to improve the education system of India, which can boost the digital education system. We have also discussed that distance education has improved a lot due to the online method of learning and the facilities available for the students of online learning.

But on the other side, we have also discussed how the technology can leave a bad impact on the students if the use of the technology is not made properly, how the students can be addicted to the Internet, social sites, and online games, which can destroy their developing brains. So, we know that every coin has two sides, just like technology has two sides. Now it completely depends on us how we make use of the technology. If we make use of it properly, we will be able to take lots of advantages; otherwise, there are infinite disadvantages too.

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# ILLUMIPLANTS: LIGHTING THE WORLD NATURALLY

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***Abstract***

*Luminescence, a phenomenon seen in living organisms where cool light is produced, is well documented in bacteria, fungi, as well as small animals but remains absent in higher plants on land. Advances in genetic engineering have made it possible to integrate luminescent systems into plant cells, allowing them to function as biological markers. Recently, scientists had genetically engineered plants capable of emitting a faint glow visible in the dark, offering a novel and sustainable lighting solution.*

*This research will determine the applications for glowing plants as affordable and multifunctional light sources for indoor and outdoor use. Glowing plants are genetically modified plants that can assist as living alternatives to regular lighting. Glowing plants can light up roads and pathways outside, even help as streetlamps in parks instead of energy-draining streetlamps. Glowing plants reduce walkers, vehicles, and animal accidents since they are more visible in low-light situations. Non-glaring, low-energy lights are a better option than regular lamps. They make work easier and more comfortable. In addition to being inexpensive, luminescent plants have a sustainable, green, environmentally friendly option, lower energy costs and lower reliance on artificial lighting create a win/win. These naturally occurring and genetically engineered light sources create a balance of safety, beauty, and functionality. Therefore, this experiment proves that luminescent plants will be the lighting of the future for more sustainable, safer, inexpensive places to live with a better quality of life both inside and outside.*

***Keywords:*** *IllumiPlants, bioluminescence, glowing plants, sustainable lighting, highway safety, natural illumination, energy-efficient technology.*

## Introduction:

Highways and roads without proper lighting are among the leading causes of accidents around the world. Every year, thousands of lives are lost due to collisions involving vehicles, pedestrians, and animals, particularly in rural or remote areas where lighting infrastructure is either unavailable or inadequate. Poor visibility not only makes driving dangerous but also puts the lives of people and animals at risk.

Installing artificial lighting such as streetlights may seem like an obvious solution, but it comes with its own set of challenges**. High costs, energy consumption, and the negative environmental impact of light pollution make it unsustainable for many regions,** especially in developing or underdeveloped areas. This growing issue demands innovative, eco-friendly, and cost-effective solutions to enhance safety and accessibility in poorly lit areas.

One such revolutionary idea is **IllumiPlants** plants that glow naturally through bioluminescence. Inspired by the natural glow of organisms such as fireflies and certain marine creatures, IllumiPlants offer a way to light up dark spaces without relying on electricity or traditional lighting systems. Using advancements in genetic engineering, scientists can introduce bioluminescent genes into plants, enabling them to emit a steady, soft glow in the dark. These plants can be strategically placed along highways and rural paths, providing natural illumination that reduces the risk of accidents. Their light can help drivers see the road clearly, prevent collisions with animals crossing highways, and create a safer environment for pedestrians in unlit areas.

The potential applications of IllumiPlants extend beyond outdoor use. Indoors, they can replace traditional table lamps, offering a sustainable and aesthetically pleasing alternative for activities such as studying, reading, or working. Unlike artificial lights, the gentle glow from IllumiPlants is soothing to the eyes and does not contribute to energy consumption, making them ideal for homes, schools, and offices.

Beyond safety and utility, IllumiPlants represent a unique blend of technology and nature that has the potential to redefine how we think about lighting. Their ability to function without electricity makes them a highly sustainable solution, particularly in areas with limited energy resources. Additionally, they add an element of beauty to their surroundings, creating spaces that are both functional and visually appealing. By integrating glowing plants into urban and rural landscapes, society can move toward a future where sustainability and innovation coexist in harmony. IllumiPlants not only provide light but also inspire a vision of a greener and safer world where natural solutions address human needs effectively.

**Methodology:**

The development of IllumiPlants begins with studying bioluminescent organisms such as fireflies, jellyfish, and certain fungi to understand the natural mechanisms behind their ability to produce light. Researchers focus on identifying the specific genes responsible for bioluminescence, isolating these genes for further use. Using advanced genetic engineering techniques, such as CRISPR-Cas9, these genes are introduced into the DNA of selected plant species, enabling them to glow in the dark. Once the genes are integrated, the plants are grown and monitored under controlled conditions to ensure they emit sufficient light. Extensive testing is conducted to optimize the brightness, stability, and durability of the glow, ensuring the plants can adapt to different environments, such as highways, rural paths, and indoor spaces.

After the laboratory phase, prototypes of these glowing plants are tested in real-world conditions to assess their effectiveness and practicality. For example, they are placed along highways to evaluate their impact on visibility and accident prevention, as well as in homes to test their use as a replacement for table lamps. This iterative process allows researchers to identify challenges, such as maintaining the plants' lifespan and light intensity under varying weather conditions, and to refine the technology accordingly. The methodology is designed to ensure that IllumiPlants can serve as a reliable, sustainable, and cost-effective alternative to traditional lighting systems in both outdoor and indoor settings.

**Objective:**

The primary objective of this research is to unveil the transformative potential of glowing plants, specifically IllumiPlants, as an innovative, sustainable, and environmentally friendly alternative to conventional lighting systems. This study endeavors to examine how these bioluminescent plants can revolutionize public infrastructure by addressing critical challenges such as inadequate lighting on highways, which often leads to accidents involving pedestrians, vehicles, and wildlife. Furthermore, it aims to explore their applicability in educational settings, where glowing plants could replace artificial lamps, fostering healthier, energy-efficient, and visually soothing environments conducive to focused learning and productivity. By integrating these luminous plants into urban landscapes and academic institutions, this research seeks to highlight their multifaceted benefits, including enhancing public safety, reducing energy consumption, and advancing environmental sustainability. Ultimately, the study aspires to inspire a paradigm shift in how we approach illumination, merging technology and nature to create a brighter, greener future.

**Benefits:**

The integration of glowing plants, or IllumiPlants, into modern infrastructure offers numerous transformative benefits. These bioluminescent plants present a revolutionary approach to lighting by providing an energy-efficient and eco-friendly alternative to traditional artificial lighting systems. In public spaces, especially highways, glowing plants can significantly enhance safety by naturally illuminating poorly lit areas, thereby reducing accidents involving vehicles, pedestrians, and animals. Their application eliminates the need for electricity-powered streetlights, leading to a substantial reduction in energy consumption and maintenance costs.

In educational settings, glowing plants can replace artificial lamps, offering a softer, natural light that reduces eye strain, alleviates stress, and creates an ideal atmosphere for concentration and learning. By fostering healthier and more productive study environments, these plants support the well-being and efficiency of students and professionals alike.

Beyond functional advantages, glowing plants contribute to environmental sustainability by lowering carbon emissions and light pollution. Their ability to merge natural aesthetics with practical utility enhances urban and rural landscapes, promoting a harmonious coexistence between technology and nature. Furthermore, the adoption of glowing plants symbolizes a step forward in biotechnological innovation, inspiring future advancements in sustainable design and environmental conservation. This multi-dimensional impact underscores the potential of *IllumiPlants* to redefine the way we light the world.

**Expected Outcomes:**

The introduction of IllumiPlants is expected to bring significant benefits across multiple areas. On highways and rural roads, these glowing plants can enhance visibility, reducing the likelihood of accidents involving vehicles, pedestrians, and animals. By naturally illuminating dark areas, they offer a practical and eco-friendly solution to the challenges posed by poor lighting infrastructure. IllumiPlants can also eliminate the high costs associated with the installation and maintenance of traditional streetlights, providing a cost-effective alternative, especially for regions with limited resources. Their reliance on natural bioluminescence instead of electricity significantly reduces energy consumption, contributing to environmental sustainability and lowering carbon emissions.

In addition to outdoor applications, IllumiPlants hold great promise for indoor use. They can replace table lamps and other artificial light sources, creating a soothing, natural glow ideal for activities such as studying, reading, or working. This innovation is expected to reduce energy costs for households while offering a visually pleasing and eye-friendly alternative to harsh artificial lights. Beyond these practical benefits, IllumiPlants are likely to add aesthetic and functional value to both urban and rural spaces, transforming how lighting is integrated into modern life. As a result, they have the potential to revolutionize lighting systems, bridging the gap between technology and nature while ensuring safety, sustainability, and beauty.

**Results & Discussion:**

Initial research suggests that bioluminescent plants can emit light bright enough to serve practical purposes. Tests show that these plants can glow for extended periods without external energy sources, making them an energy-efficient alternative. When placed along highways, they significantly improve visibility, reducing accident rates. Similarly, indoor applications show promise, as these plants provide a soft, natural light ideal for tasks like reading or studying without straining the eyes.

However, challenges remain, such as ensuring consistent light output, adapting plants to various climates, and maintaining their lifespan in outdoor conditions. Further research is required to optimize these factors and scale production for widespread use. Despite these challenges, IllumiPlants offer a promising path toward sustainable, natural lighting systems.

**Conclusion:**

IllumiPlants represent a groundbreaking innovation that combines the beauty of nature with the power of science. By naturally illuminating dark areas, these glowing plants can prevent highway accidents, improve safety, and reduce environmental impacts caused by traditional lighting systems. Their indoor use as a replacement for table lamps further highlights their versatility and potential to enhance everyday life. While there are challenges to address, the benefits of IllumiPlants far outweigh the obstacles, making them a sustainable and eco-friendly solution for a brighter, safer future.

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# RISE OF THE SCROLL CULTURE: A STUDY ON THE IMPACT OF SOCIAL MEDIA ON THE YOUTH OF THANE REGION

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***Abstract***

*This study explores the pervasive impact of "scroll culture" and the endless, passive consumption of social media content, on college students in the Thane region of India. With platforms like Instagram, WhatsApp, and Snapchat becoming integral to youth culture, the research investigates how prolonged exposure influences emotional, mental, and physical well being. Utilizing a descriptive-analytical approach, data were collected from 563 students across diverse academic backgrounds through structured questionnaires. The results indicate that excessive social media use is linked to increased feelings of comparison, stress, and loneliness. Mental health effects such as anxiety, reduced attention span, and addiction were commonly reported. Physical symptoms including headaches, eye strain, and postural issues were also prevalent. These findings are further validated through secondary data sourced from national and international studies. The paper concludes by emphasizing the need for digital literacy, wellness programs, and responsible usage practices. The research not only highlights a local issue but reflects a broader global concern regarding youth and digital overexposure.*

***Key Words:*** *Scroll culture, Social media, Youth behaviour, Mental health, and Digital wellness*

## Introduction:

In recent years, the way youngsters are consuming information and engaging with social media content has undergone a dramatic transformation. With the rapid growth of smartphones and easy access to the internet, social media platforms like WhatsApp, Instagram, Facebook, and Snapchat have become an integral part of everyday life, especially for the youth. One of the most noticeable trends emerging from these platforms is the culture of endless scrolling. A behaviour marked by continuous browsing through short videos, reels, and updates with no clear endpoint. This phenomenon, commonly referred to as "scroll culture," is changing how young individuals think, interact and spend their valuable time without noticing what they are losing with it.

As a growing urban area that lies close to Mumbai, Thane presents a unique mix of traditional values and modern influences, making it a compelling setting for this research. The youth in this region are particularly vulnerable to digital influences, with increasing screen time and growing reliance on social media for entertainment, communication, and even self-expression.

While social media offers several benefits such as quick access to information, creative outlets, and social connectivity, it also raises concerns about attention spans, mental well-being, academic performance, and real-life social interaction. This paper aims to understand how deeply scroll culture has taken root among young individuals in Thane and what short- and long-term effects it may be having on their lifestyles and mindset. Through online surveys, this research seeks to provide a balanced view of the social media landscape and suggest possible ways to manage or mitigate the negative effects while appreciating the positive aspects of digital engagement.

## Research Objectives:

The primary objective of the study is to analyze the impact of social media usage—particularly excessive scrolling—on the behavior and overall well-being of college students in the Thane region. The study specifically aims to examine patterns of digital consumption, identify emerging behavioral trends, assess the influence of social media on academic and emotional health, and evaluate the physical consequences of prolonged screen time. The broader aim is to understand how these factors interact to shape the youth's lifestyle and daily functioning.

**Methodology:**

This study adopts a descriptive and analytical approach, drawing on both quantitative and qualitative data. The methodology was structured to ensure a comprehensive understanding of the topic through clear objectives, careful sampling, a well-designed questionnaire, and robust data collection methods.

**Sampling:**

The sample for this study comprised 563 college students from diverse educational institutions across the Thane region. A stratified random sampling technique was employed to ensure adequate representation across gender, academic streams (arts, science, commerce, and professional courses), and undergraduate and postgraduate levels. This method was chosen to minimize sampling bias and to reflect the variety in student backgrounds, ensuring the data accurately represents the target population.

**Questionnaire Formation:**

A structured questionnaire was meticulously developed to collect relevant data in a user friendly and engaging format. The questionnaire included both closed-ended and scaled questions to allow for quantitative analysis, as well as optional open-ended responses for qualitative insights. It was divided into sections covering demographic details, social media usage habits, perceived emotional and behavioral effects, academic impact, physical health symptoms, and overall attitudes toward digital platforms. The questions were designed after a review of existing literature and similar studies, ensuring validity and relevance to the objectives of the research.

**Data Collection:**

Data was collected using both online and offline methods. The questionnaire was distributed through Google Forms as well as printed copies circulated through academic networks. Respondents were briefed on the purpose of the study, and informed consent was obtained to ensure ethical compliance. Confidentiality and anonymity of responses were strictly maintained. The collection period lasted four weeks, during which reminders were sent out to ensure maximum participation. The total number of valid responses received and analyzed was 563, forming the primary dataset for the study.

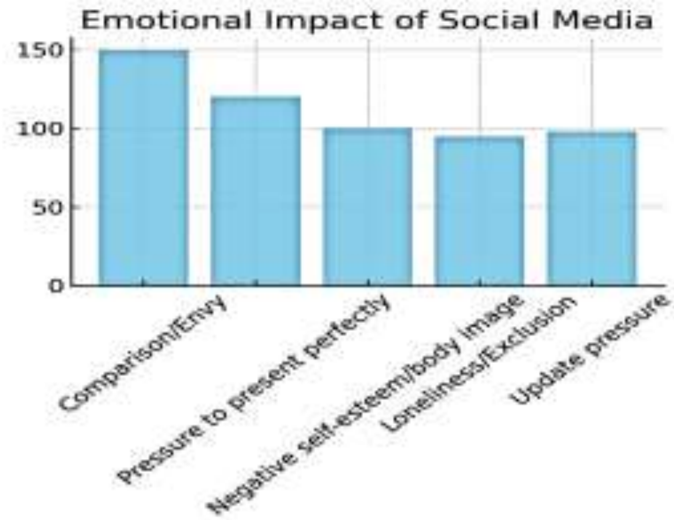
Secondary data was collected from multiple credible sources including academic journals, governmental reports, WHO and UNESCO publications on digital health, youth behavior trends, and national statistical reports such as the India Internet Usage Survey. These sources were used to support the interpretation of primary findings and offer a comparative global and national perspective.

**Observations and Results:**

**Primary Data Analysis:**

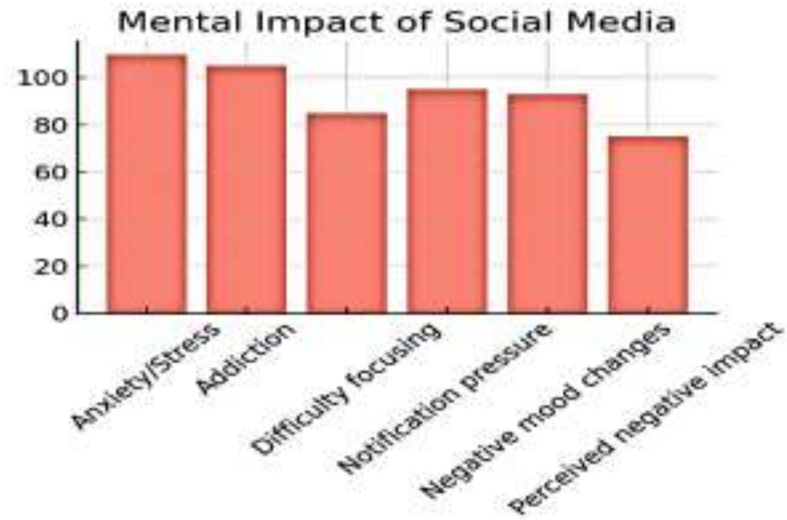
The analysis of the primary data from 563 respondents highlights distinct emotional, mental, and physical repercussions of social media usage among college youth in the Thane region.

**Chart 1.1**



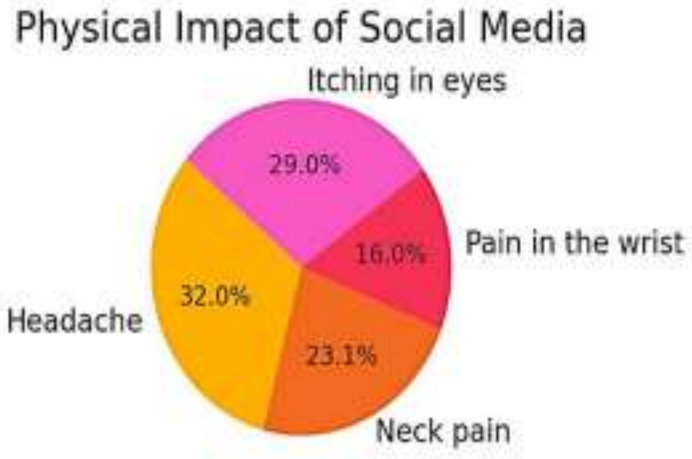

Emotionally, the most prominent issue reported was **feelings of comparison and envy**, experienced by approximately **26.6%** of the participants (Chart: 1.1). This was followed by **pressure to present a perfect life online** (21.3%), and **negative self-esteem or body image concerns** (17.8%). A significant proportion also reported **feelings of loneliness and exclusion** (16.9%) and **update pressure**, or the compulsion to stay constantly active on social platforms (17.4%). These figures suggest that social media tends to foster a psychologically demanding environment for young users, rooted in social comparison and performative behavior.

**Chart no:1.2**




On the mental health front, **anxiety and stress** emerged as the most cited consequences, affecting **19.5%** of respondents as reflected in Chart no:1.2. Closely trailing was **addiction to social media** at **18.6%**, and **difficulty in focusing** on tasks, reported by **15.1%** of students. Issues such as **notification pressure** and **negative mood fluctuations** were each observed in **16.9%** of users, while **13%** reported a generalized perception of social media's negative mental health impact. These findings reflect a consistent link between digital over-engagement and cognitive-emotional strain.

**Chart no:1.3**

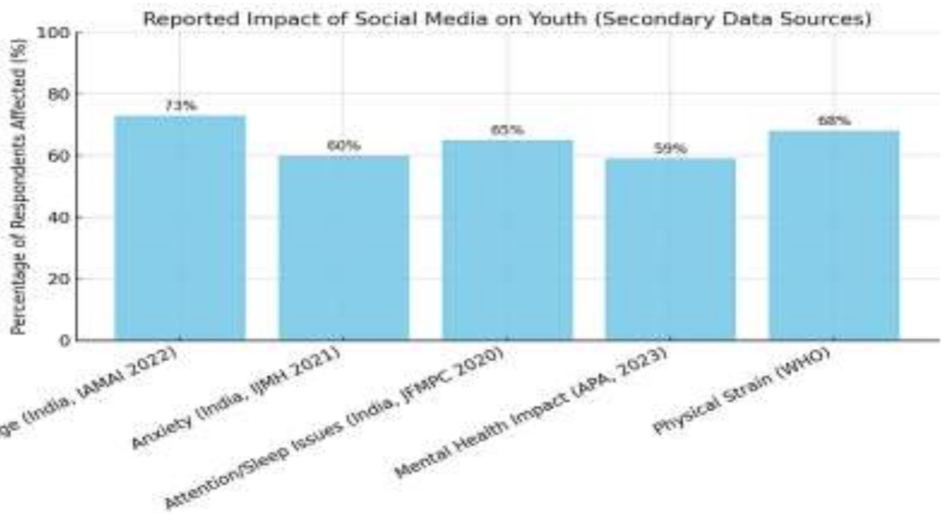



The physical impact of prolonged social media use was also evident in the responses (Chart:1.3). According to the pie chart data, **32%** of respondents reported frequent **headaches**, making it the most common physical symptom. This was followed by **itching in the eyes** (29%), likely due to extended screen time. **Neck pain** was reported by **23.1%**, and **wrist pain** by **16%**, highlighting ergonomic issues associated with device use. Overall, these physical complaints point to the tangible, bodily cost of excessive engagement with social platforms.

This triangulated analysis of emotional, mental, and physical impacts underscores the multifaceted burden that social media can impose on the well-being of college-going youth. The data reflects a concerning rise in what can be termed **"scroll fatigue,"** manifesting across psychological and physiological domains, and calling for awareness, regulation, and digital wellness interventions.

**Secondary Data Analysis:**

**Chart 1.4**




Several studies across national and international contexts affirm the growing concerns around social media's impact on youth, aligning closely with the patterns observed in the present study. The chart

1.4 illustrates the multifaceted impact of social media on youth, based on secondary data sources. A significant 73% of respondents reportedly engage with social media early in the day (IAMAI, 2022), indicating habit formation and dependence. Physical strain affects 68% (WHO), suggesting prolonged screen exposure leads to issues like eye fatigue and posture problems. Attention and sleep issues are reported by 65% (JFMPC, 2020), likely due to overstimulation and disrupted sleep cycles. Anxiety, affecting 60% (IJMH, 2021), is linked to constant comparison and fear of missing out, while 59% (APA, 2023) report broader mental health impacts such as stress and emotional fatigue. These figures highlight the urgent need for awareness around digital well-being, especially among college-going youth.

These studies reinforce the findings from the Thane region, showing that social media is not only reshaping digital habits but is also deeply influencing emotional regulation, mental resilience, and physical health. Thus, the patterns seen locally are reflective of a larger, global phenomenon that demands urgent attention through informed academic and policy interventions.

**Conclusion:**

The study concludes that while social media offers avenues for connectivity, learning, and expression, it also contributes to challenges in mental, physical, and moral well-being. For a balanced digital lifestyle, awareness campaigns and digital literacy programs are essential. Institutions, educators, and policymakers must emphasize responsible usage practices and promote healthier digital habits. Further research is needed to explore long-term effects and develop targeted intervention strategies.

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# BRIDGING ACADEMIC SILOS THROUGH DIGITAL TRANSFORMATION: A FACULTY-CENTRIC PERSPECTIVE ON INTEGRATIVE TECHNOLOGICAL ADOPTION

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***Abstract***

*The accelerated growth of digital technologies has created a need for a strategic, cross-disciplinary strategy within higher learning. This paper examines how digital transformation is reorganizing classic discipline lines—particularly in the humanities, commerce, science, and management—by enabling technology-driven teaching, research, and governance. Grounded in institutional case studies and emerging empirical evidence, the study investigates the implementation of artificial intelligence (AI), data analytics, digital pedagogy tools, and blockchain across diverse academic settings. It further evaluates faculty adaptation, the pedagogical transition to learner-cantered models, and the modernization of administrative frameworks. Attention is focused on ethics and the need for digital equity. The conclusions promote a comprehensive, ethically driven digital approach that supports academic integration without sacrificing institutionalintegrity, and ultimately producing a more responsive, cooperative academic environment.*

**Keywords**: *digital transformation, interdisciplinary education, artificial intelligence in academia, digital equity, faculty adaptation*

## 1. Introduction

The 21st-century knowledge-based economy has accelerated the convergence of digital technologies across sectors, and higher education is no exception. Both challenges and opportunities emerge for higher education to address evolving expectations in society. Digital transformation presents itself as an essential key to dismantling deep-seated academic silos. This paper examines how technology-enabled strategies can support cross-disciplinary synergy and foster systemic innovation in higher education.

## 2. Digital Transformation in Higher Education

Digital academisation involves infusing technology into the very fabric of institutional operations—pedagogy, research, administration, and governance—so that they become more effective and inclusive. Important building blocks are virtual learning environments, cloud collaboration, AI-driven analytics, blockchain credential validation, and virtual labs. These technologies, taken together, redefine how academic institutions interact with learners and stakeholders.

## 3. Interdisciplinary Convergence through Technology

Technological integration supports interdisciplinary engagement by offering shared platforms and data-centric tools. For example:

- **Humanities** scholars are using digital storytelling, text mining, and visualization techniques.
- **Commerce** faculties employ financial modelling software, e-commerce platforms, and predictive analytics.

- **Science** educators incorporate virtual simulations and AI-enhanced experimentation environments.
- **Management** departments utilize project tracking systems, decision support algorithms, and AI-enabled case study analysis.

These applications enable holistic problem-solving and foster interconnected academic practices.

**4. Teacher Adjustment and Pedagogical Changes**

Staff are key to digital transformation success. Flipped classrooms, blended learning environments, and adaptive learning systems require strong capacity development. Digital literacy and pedagogical innovation training need institutional investment. Furthermore, incentive structures should reward faculty engagement in interdisciplinary and technology-mediated education.

**5. Administrative Modernization and Governance**

Technology has revolutionized academic administration, offering tools for automation, performance tracking, and compliance reporting. AI and machine learning algorithms streamline admissions, academic monitoring, and resource allocation. Blockchain technologies promote transparency in credentialing and research funding. Digital dashboards further support real-time, evidence-based governance.

**6. Ethical Considerations and Digital Equity**

Though revolutionary, digital uptake carries important ethical and equity issues. Data privacy, algorithmic discrimination, and unequal access to infrastructure disproportionately harm marginalized communities. Clear ethical guidelines need to be embraced by institutions, and inclusive access assured through strategic investment in connectivity, hardware, and digital literacy training especially in underinvestment areas.

**7. Institutional Case Studies**

**Case Study 1**: An interdisciplinary effort between humanities and data science programs to create AI-based metadata tagging for digital collections, building research capacity across disciplines.

**Case Study 2:** Integration of real-time financial analytics and AI simulators into the curriculum by a business school resulted in enhanced engagement and industry relevance among students.

**Case Study 3**: A university-wide blockchain project optimized transparency in research fund allocation and facilitated interdepartmental collaborations through decentralized data governance.

**8. Strategic Recommendations**

To facilitate sustainable and inclusive digital transformation, higher education institutions should:

- Develop a comprehensive digital transformation strategy aligned with institutional academic goals.
- Initiate regular professional development opportunities to skill up teachers in teaching digital and interdisciplinary approaches.
- Encourage Open Educational Resources (OER) use and encourage cross-departmental digital partnerships.
- Promote equal access to digital resources by investing in infrastructure and regular technology effect analyses.

## 9. Conclusion

Digitalization in higher education represents not only technological change but also a new culture of collaboration and innovation in teaching, learning, and research. Faculty themselves are being called on to drive this change through adoption and innovation across disciplines. Done ethically and strategically, digitalization can break down academic silos, promote inclusivity, and put institutions in the best position to address the needs of the rapidly evolving global knowledge landscape.

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# DIGITAL MEDIA AND GENERAL ELECTIONS IN INDIA 2024

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***Abstract***

*Digital media has become powerful tool in Indian Elections. It plays an important role in shaping public opinion and influencing voting behavior. Political Parties rely heavily on digital media to garner voters support during elections. Digital Media has taken leap in transformation in conducting and contesting elections in India. The impact of digitalization has touched every aspect of life including elections. All national and regional political parties have invested heavily on social media campaigns during the recent General Election 2024 in India. Voters access information about Political Parties through digital media. Political parties campaign, voters receive information about political parties, manifesto and candidates details and thus the electoral discourse is shaped. This research paper highlights the impact of digital media on Indian Elections. While digital media positively impacts elections through active citizen enhancements, its negative impact is seen through manipulated and misinformation. The research paper further recommends media literacy among masses, strict regulations in digital media and greater responsible digital citizenship.*

***Key words:*** *Digital Media, Voters, Political Parties, Indian Elections.*

## Introduction

Elections are crucial in India, the world's largest democracy, as they enable citizens to choose their leaders and representatives. This democratic process ensures that the government is "off the people and by the people". Regular elections act as a check on the work of political parties encouraging them to perform well and respond to the needs of the people. Thus regular and periodic elections ensures protection of citizens' rights, effective democratic governance and promotion of national development. Recently Digital media platforms and social media tools have become pivotal during electioneering. According to TOI coverage (June 16,2024), India ranked second largest nation after China in terms of internet users globally, with more than 692 million individuals having access internet access and around 400 million active on social media. Due to affordable internet, Digital media Team of each political party tried to reach out the masses using short reels and memes attracting the Gen- Z voters.

Digital Media has taken leap in transformation in conducting and contesting elections in India. The impact of digitalization has touched every aspect of life including elections The 2024 General Elections in India conducted by Election Commission of India from April to June, marked a paradigm shift in Political campaigns and marketing, as it was significantly influenced by digital media and platforms. All national and regional political parties have invested heavily on social media campaigns during the recent General Election 2024 in India Hashtags, Audios and images of political parties and leaders became popular on Digital platforms. These innovative tactics had a significant influence on Indian General Elections 2024. By adopting these new tactics and techniques, political parties developed storylines that attracted the voters. The political parties through digital media, easily garnered support of the voters, especially the young generations.

**Objectives of the Research:**

1. To understand the influence of digital media during general elections.
2. To examine the use of digital media by political parties in Indian elections.
3. To analyze the election commission guidelines on digital engagements

4. To give recommendations for responsible digital engagement.

**Research Methodology**

This research study is descriptive analytical which highlights the impact of digital media during Indian General Elections 2024.

Primary Method: A questionnaire was made use of for collecting primary data. A survey was conducted to understand the digital media influence on General Elections 2024 in India

Secondary Method: The researcher has referred various books, articles, journal and online source. Local and National newspaper reports were explored for more information about the General Elections 2024 in India.

**Research gap**

Many research studies (Rajgopal ,2009; Chaudhary,2017 have been done earlier on social media and digitalization. A critical research gap in exploring the impact of digital media during General elections 2024 in India was not done. Bridging this gap would provide a more nuanced understanding of how digital media platforms uniquely shape and influence the political behaviors diverse voters in India enabling tailored strategies to enhance their sustained engagement in democratic processes. This research aims to fill this research gap and give recommendation thereon.

**Election Commission and Digital Engagement**

The Election Commission of India (ECI) also recognized the importance of digital engagement by launching campaigns aimed at young voters. Initiatives like ‘Turning 18’ targeted first-time voters through social media outreach, emphasizing the role of digital platforms in shaping electoral participation. The Election Commission of India joined the meme trend by creating content that encouraged voter participation. One notable meme featured a young Amir Khan from the film Jo Jeeta Wohi Sikandar, promoting the idea of voting with pride. Data from the Election Commission reveals that during the 2019 Lok Sabha elections, the BJP spent Rs 325 crore on media advertisements, including print, electronic, bulk SMS, cable websites, and TV channels, while the Congress spent Rs 356 crore on similar campaigns. As per New Indian express news coverage (Feb.25), BJP spent over 1737 cr on 2024 polls ,37% more than 2019.

The Election Commission of India (ECI) has introduced guidelines to regulate digital campaigning. Political ads must be pre-certified, and platforms are required to maintain ad transparency. Model Code of Conduct now includes provisions for digital campaigns. Before the 2024 General elections, India’s oldest party, Indian National Congress used memes and reels during the ‘Bharat Jodo Yatra’’ which changed Rahul Gandhi’s reputation from a Prince to a Grassroot leader. While National Political Parties like INC and BJP through short videos tried to connect to voters, Regional Political Parties too joined the race. The DMK party created AI generated videos of deceased leader M Karuranidhi to garner voters support.

**Impact of Digital Media**

Digital campaigning is more affordable and can reach remote voters with internet access. Digital media has energized first-time voters and urban youth, offering platforms for discussion and mobilization. NGOs and civil society also use these tools for voter education and awareness. Digital landscapes in India highlights a significant shift in how political parties communicate especially through the platforms like Instagram reels and memes. They have a significant impact on the performance of leading national and regional political parties.

Digital Campaigning tactics had tremendous impact on parliamentary elections of 2024.While some parties gained seats some lost as well. While BJP and its National Democratic Alliance (NDA) saw a decline in seats as compared to 2019.On the other hand, Opposition INDIA Alliance, led by Indian National Congress of Rahul Gandhi, scored significantly well. Overall, BJP led NDA was able to hold onto power, but the elections revealed a sharp decrease in the no of seats when compared to prior years suggesting that the opposition was becoming more powerful (AJLabs 2024). News coverage reports on Electoral Bond Scam by YouTubers like Druv Rathee, Ravish Kumar and others was one of the major reason for the decline of BJP performance in General Elections 2024.

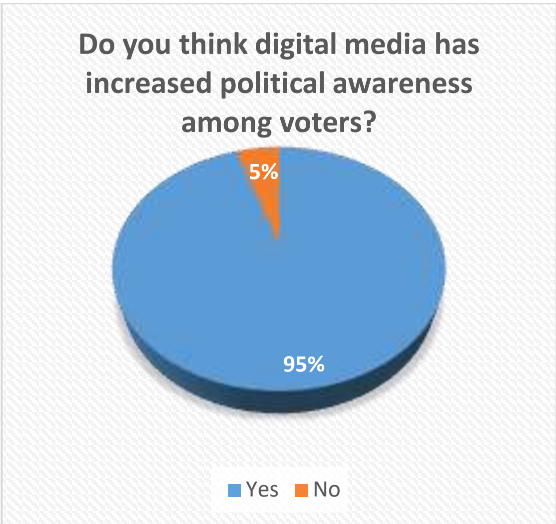
While digital media has positively impacted on Indian Elections, the rapid evolution of digital campaigning raised significant concerns regarding misinformation as well. One of the darker sides of digital media in elections is the spread of misinformation, often through bots or fake accounts. Deepfake videos and edited clips have been used to mislead or discredit opponents. There's increasing demand for fact-checking services and digital literacy. The widespread use of social media for political messaging led to increased scrutiny over the accuracy of information shared online. Many voters found it challenging to discern credible sources from unreliable ones in a landscape filled with competing narratives.

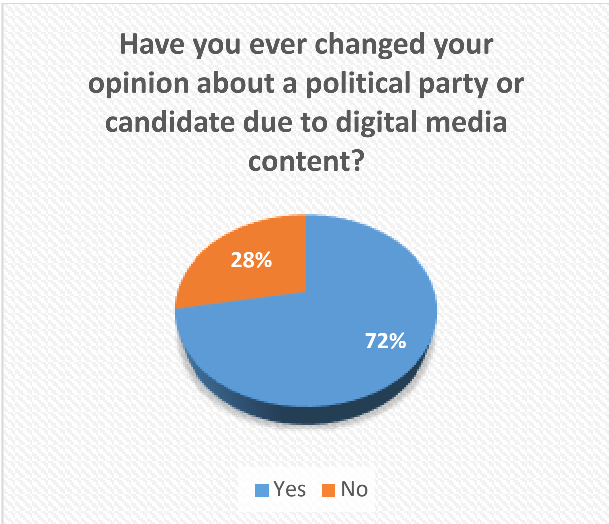
**Research Design**

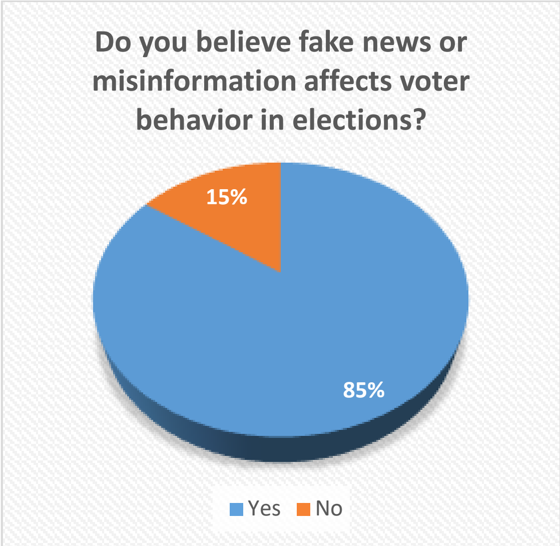
The researcher received 79 responses from survey from citizens within the age group of 18 years to 50 and above years across Mumbai. Research is based on descriptive analytical study which focus on the impact of digital media on the political marketing strategies and also how it has influenced the voters during General Elections 2024 in India.

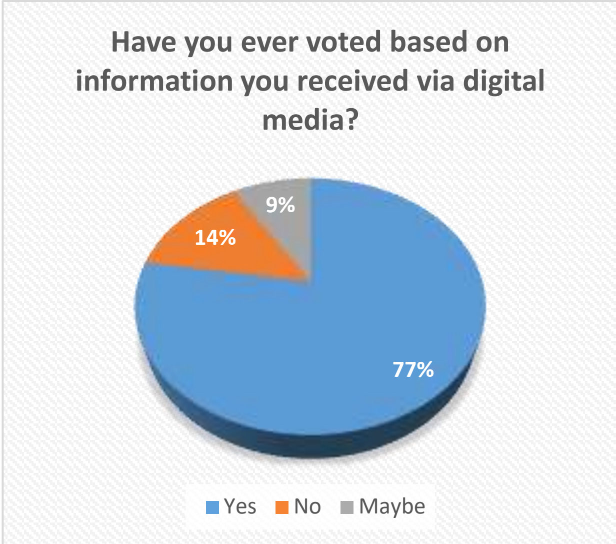
**Survey Analysis**

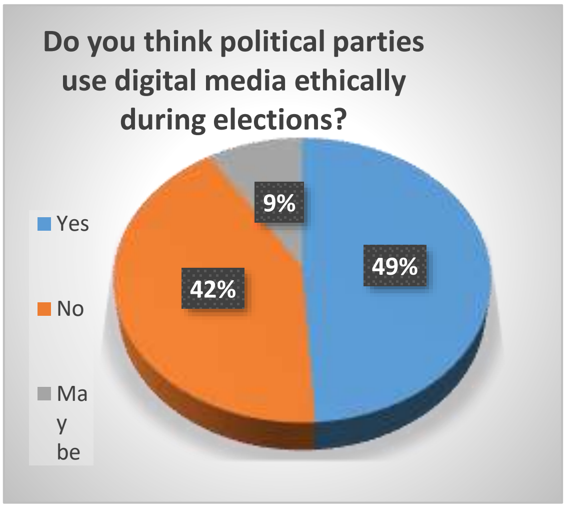
The survey includes 79 respondents from Mumbai which included both male and females. Questionnaire was also given to few volunteers from different political parties to gauge their views on digital media and elections. A brief analysis is as follows

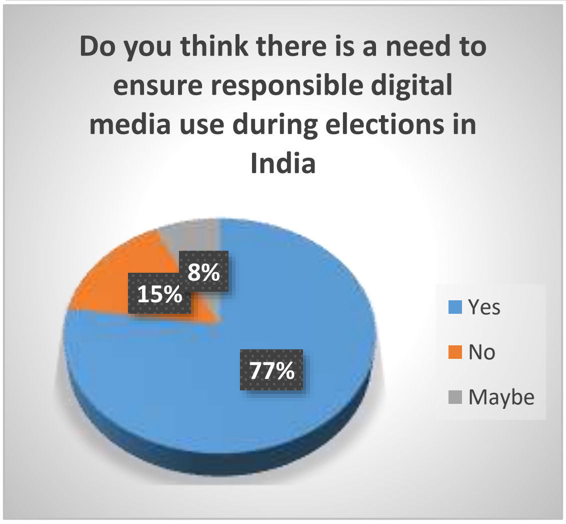





Majority of the respondents were between 18 years to 30 years of age group. 95 % respondents feel that digital media has increased political awareness.77% agree that they have voted as per information received on digital platforms. While 49 % agree ,42 % disagree that political parties use digital media ethically The survey revealed the growing importance of digital media in shaping political engagement among voters. The survey revealed use of digital media by voters for quick and widespread access to political information. Even Political Parties are increasingly relying on digital platforms especially this was witnessed during the General Elections 2024.

**Suggestions**

As India navigates this new digital landscape, balancing innovation with responsible governance will protect democratic processes in future elections. The rapid evolution of digital campaigning raised significant concerns regarding misinformation. The widespread use of social media for political messaging led to increased scrutiny over the accuracy of information shared online. Many voters found it challenging to discern credible sources from unreliable ones in a landscape filled with competing narratives.While there were calls for stricter regulations on digital campaigning practices, enforcement remained lax. The Election Commission's warnings against deepfake usage highlighted the need for better regulatory frameworks to address these emerging challenges effectively.

**Conclusion**

Digital media has renovated how elections are fought and won in India. Political parties switched from traditional platforms to digital platforms Many news anchors shifted to you tube channel for garnering citizen's support. Digital Campaigning tactics had tremendous impact on general elections of 2024 in India. The widespread use of digital media for political messaging has led to increased scrutiny over the accuracy of information shared online. The growing importance of digital media in India was noticed during the General Elections 2024.

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# DISMANTLING MALE POWER IN MAHASWETA DEVI'S DRAUPADI

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Mahasweta Devi who has won prestigious Jnanapith award and Magassasay Awards for literature , not only feel that women should demand for larger space within the partiarchal structures of power but also envisage a thorough dismantling of these structures in ways that will yield them greater power and control over their lives. She believes that transferring the prevailing structure would mean "a social revolution and the present world order would necessarily be transformed"

Mahasweta Devi's renowned story Draupadi throws light on the global women's problems by focusing on the local. It is an extremely shocking , powerful and innovative narrative. Here , the writer reworks an ancient legend from the great Indian epic Mahabharata and makes it a vehicle of new vision through exploration the female condition. The story focuses on a freedom fighter Draupadi in the peasant rebellion in the nexalbarri region of West Bengal, which in 1971 was crushed by the government . Dopdi seeks positive qualities such as confidence, power and assertiveness; qualities that are considered to be the exclusive preserve of men. She steps out of the normal domain of home to construct an identity for herself as an activist, tries to deconstruct the image of archetypal tribal Indian women and affirms her status as subject . The story which seems to be quite simple, is in fact, a very complex one and operates on multiple levels.

Dopdi and her husband Dulna work at harvests and are the chief culprits and instigators in several crimes- murdering the upper castes Suraj Sahu and his son, occupying their wells and tube wells during the drought and succumbing to the wishes of the upper caste men. After her husband is murdered ruthlessly by the soldiers, Dopdi does not wail or cry, nor is totally shattered. To ensnare, her husband's corpse is kept in a forest where it serves as a bait for prey. Her firm decision of not claiming the dead body of her husband and also forbidding the tribals to do so, depicts her as an emotionally strong and extremely powerful women. Mushai Tudu's wife and other tribal women have conditioned themselves to diminish their needs, restrict their freedom and are quite passive. They turn a blind eye to the injustice, thinking that protesting and rebelling are task reserved not for them. However Dopdi raises her voice against extreme torture and atrocities inflicted on the tribals. Unlike Mushai Tudu's wife and other women who are known through their relationship with their husbands, Dopdi possesses her own identity and is never known as Dulna's wife.

Dopti seems to be an ordinary tribal woman as she plods with some rice knotted in her belt, picking out and killing lice in her hair but in reality she has created a stir among military authorities who are on a massive hunt for her. The story begins with her search, *Name Dopdi Mejhen, age twenty-seven, husband Dulna Majhi (deceased), domocile Cherakhan, Bankrahjarh, information whether dead or alive and/or assistance in arrest , one hundred rupees (p.187).* Even the villagers are constantly menaced that if Dapdi is seen around , their huts and entire village would be set on fire. Besides, being intrepid and courageous, she is adept in the art of survival strategies. She never responds to her own name, rather she has a concocted name. She avoids rubbing kerosene and washing her hair to get rid of the lice , as she is aware that if her enemies smell kerosene in the water they will follow the scent.

The military authorities seeking for Dopdi or Draupadi, remain confused about her correct name. Dopdi is tribal, peasant name and Draupadi is derived from the name of the famous characater in Mahabharata. In the epic , Draupadi is married to the five sons of a noble family, the Pandavas.

Spivak points out that "Within a patriarchal and patronymic contex, she is exceptionnal, indeed "singular" in the sense of odd, unpaired , uncoupled. Her husbands, since they are husbands rather than lovers, are legtimately pluralized"(183). Mahasweta's narrative interrogates this singularity. In the epic Draupadi is treated as an object and is used to demonstrate male power and glory. Her eldest husband puts her at stake, by betting her in the game of dice against the Kauravas. The eldest of the Kauravas , tries to dishonour her by pulling off her sari but she is saved by the devine Krishna. In Mahasweta's narrative Dopdi remains loyal to the memory of her dead husband.

The Indian forces succeed in capturing the long wanted rebels with the tactics of the Bengali army officer, Senanayak, who possosses a profound knowledge of extreme left wing politics. Whatever his practice, in theory he respects the opposition and believes in the dictum, "If you want to destroy the enemy become one". (Devi, 189). Finally, Draupadi is captured and arrested, but before this, she turns towards the forest
and sings a tribal song several times with the force of her entire being to convey some secret message to the tribals. Her song is incomprehensible to her enemies. She is cross-interrogated for an hour but she remains firm and does not utter a word. Senanayak commands the soldiers, "Make her. Do the needful" (195). In-fact , Dopdi is sexually assaulted and throughout that endless night she is raped by many lustful men.

The story draws attention to the oppression of tribal women by men. They are raped because they are quite vulnerable and raping them is not likely to result in any punishment. They are also raped to demoralize them in their rebellion against their exploitation, or for political and purely opportunistic motives. Rape of tribal women can be perceived in the global context of general brutality to which all women are subjected.

After this tragic incident, Draupadi does not howl or behave like a helpless victim. In the morning, she refuses to put on her clothes, tears the piece of cloth with her teeth. Her behaviour is incomprehensible, rather strange. She walks naked toward Senanayak in the bright sunlight with her head high, very uplifted and sure. Draupadi shakes with an indomitable laughter that Senanayak cannot understand. Her lips bleed as she begins laughing . Draupadi wipes the blood on the palm and says in a voice that is as terrifying , sky splitting and sharp as her ululation, " What's the use of clothes? You can strip me , but how can you clothe me again? Are you a man?"

She looks around and says, " There isn't a man here that I should be ashamed . I will not let you put my cloth on me. What more can you do? Come on, counter me - come on , counter me ---? She pushes, Senanayak and for the first time Senanayak is afraid to stand before an unarmed target , terribly afraid. (186)

The story is intensely powerful and shocking. Senanayak feels absolutely powerless and story, Mahasweta Devi stresses the materiality of what women are for men; literally a target on which they can exercise their power.

Besides, interrogating the patriarchal conventions of Indian culture, Mahasweta's *'Draupadi'* builds a positive female identity for an activist within a political struggle. Her representation as a rebel is not concerned with the ancient myth, rather the story seems to be quiet authentic because of its historical and social setting. At different places in the story, exact details are presented as if, from official documents. As the story concludes Draupadi acquires a new self-defination and
becomes the active maker of her own meaning. She refuses to remain the object of a male narrative , asserts herself as 'subject' and emphasizes the truth of her own presence. By affirming her status as 'subject' and becoming women as presence, she constructs a meaning which "Senanayak simply cannot

understand" (196). She becomes that which resists- counters male knowledge, power and glory, therefore he is terribly afraid". It seems as if Draupadi has succeeded in deconstructing the male power structures, in her own ways.

Thus , Mahasweta Devi deals with the question of identity by that double textual move and constructs Draupadi as as positive female image, a women as subject of her own narrative. The exact historical setting represents Dopadi as a fully realized tribal community identity. However, the story , like the unresolved movement between Dopdi/Draupadi, conveys that there is a excess to this identity that will always resist final defination or restricted social meaning. The story transcends the local to combine the local and global and has a universal significance.

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# CURATION AND CREATIVITY: A YOUTUBE SHORTS ANALYSIS OF INDIAN FOLK ART REPRESENTATION AND ALGORITHMIC PRIORITISATION

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***Abstract***

*The Indian Folk Art has found its new saviour in digital media. Once, it was threatened to be forgotten but now with easy and cheap access of internet, artists have become digital creators and are using this platform to showcase their creations. In this study, the diverse Indian Folk Arts portrayed in YouTube Shorts have been analysed in order to ascertain how the identity of creators is being represented. This study investigates regional diversity, language use, creator identity (individual or a part of community), and algorithmic implications on content visibility through qualitative content analysis on top 15 Shorts videos. This has been done by basing it on the theories of representation (Hall, 1997) and Algorithmic Gatekeeping (Brazilai-Nahon,2008). The results provide insights into the changing relationship between heritage and digital storytelling by highlighting new trends in representation of gender, regional focus, and algorithmic amplification.*

***Keywords**: Indian Folk Art, Representation, Algorithmic Prioritisation, YouTube Shorts, Digital Media*

## Introduction

Folk art, which is seen as a sign of traditional culture, is a type of visual art and crafts created against the backdrop of folk culture. However, a globalised culture poses a danger to all traditional arts and crafts (Lijuan & Rahman,2024). According to Pujol and Champion (2011), a significant use of new media in virtual heritage conservation should preserve the cultural presence in order to achieve the conservation's pedagogical goals of raising awareness and disseminating knowledge. Therefore, (Ippili & Koyye, 2024) highlights the necessity of shared accountability to guarantee that all cultures are maintained and supported during the digital shift in order to prevent a technological gap.

Indian traditional crafts and art have been practiced for many centuries by various cultures. Various craft guilds throughout India have long practiced Indian traditional art and craft. Even if they are a manifestation of this nation's cultural legacy, their progressive isolation from the general populace and the artisan guilds will have an impact on the nation's ability to maintain its cultural sustainability. Although India's cultural heritage is becoming isolated from the daily social activities of a larger population due to technological advancements and changes in social behaviour, judicious technological intervention has the potential to revitalise our cultural heritage and connect rural India's craft guilds with a wider audience (Kolay, 2016).

## Review of Literature

Singh & Roy (2021) provides an overview of the regional richness and symbolic depth of Indian folk art. While this study does not associate with digital media, it offers culture backdrop, showcasing the importance of folk arts as symbols of indigenous identity, community memory, and socio-religious narratives.

Sangeetha et.al. (2024) examine how digital technologies (including AI and online galleries, have been used for the revitalization of folk arts in India. They argue that platforms like social media and online exhibitions provide access for wider audiences, especially younger generations, thereby safeguarding cultural continuity amid the threats of globalization and urban placement.

Tiyanhu (2024) notes that platforms such as YouTube Shorts and TikTok allow for quick and creative transmission of intangible cultural heritage. However, this study cautions that they also pose risks in the form of low content quality, superficial engagement, and reduced spiritual or aesthetic depth, particularly for Indian folk painting, storytelling and rituals.

Takala (2023) highlights how technological advancement have democratized art creation, enabling diverse expressions and increased access. The study also acknowledges that folk artists often face challenges in adapting their traditional methods to the demands of digital aesthetics, performance timing, and audience attention spans.

Kolay (2016) investigates about new media art practices in Indian visual culture, highlighting the blending of traditional and contemporary methods. This research provides useful context for grasping how folk artists have begun experimenting with hybrid formats. However, it does not provide any analysis of how these transformations are received or filtered by platform algorithms.

Flinterud (2023) offers a framework for understanding the algorithmic curation of folklore on social media. Though not India- specific, the study is crucial in explaining how social media platforms privilege content based on engagement metrics, which amplifies folk expressions that are stylized or performative, while marginalizing those that are regionally embedded, linguistically diverse, or visually unpolished.

Zhang (2024) emphasizes that short videos often fail to reflect the spiritual, historical and artistic depth of heritage practices. It argues that while pursuing virality, creators may distort or trivialize cultural symbols, contributing to the commodification of tradition rather than its preservation.

Banik & Kundu (2018) focuses his study on ethnic and socio-economic realities of folk-art production, especially among economically disadvantaged communities. Though not associated with digital platforms, his analysis is crucial for understanding how systematic inequalities may extend to digital spaces, where creators from marginalized backgrounds lack the resources, networks, or language fluency required to gain visibility online.

In the study of digital adaptation of Indian folktales by Azim (2022), the focus is on storytelling rather than visual folk art. The findings help in understanding how YouTube and other platforms shape audience expectations and storytelling styles. The analysis reveals a gap between tradition and digital performance, a gap that folk artists must navigate to remain visible in an algorithm driven attention economy.

Mehta and Kaye (2019) explore digital content creation dynamics in India, noting how platforms prioritise creators with access to better production values, dominant languages and influencer networks. Although the study does not focus on folk art, it offers a valuable insight of structural inequalities that determine who remains invisible in India's digital media ecosystem.

**Theoretical Framework**

Representation Theory

Hall (1997) defines representation as the method by which meaning is created and shared among members of a society depends heavily on representation. It does entail the use of words, symbols, and pictures that stand for or represent things (Hall, 1997; O'Sullivan et al., 2003).

Theory of Algorithmic Gatekeeping

Brazilai-Nahon (2008) describes algorithmic gatekeeping as a way through which digital algorithms prioritise visibility some contents overs others based on various basis such as engagement metrics, aesthetic appearance, popular choice of sound and language etc. In the YouTube platform, it becomes an important concept through which the study of representation should be carried out (Napoli, 2019).

**Research Gap**

Though the existing literature explores the various nuances of the folk arts and content creation related to it but those studies are yet to examine algorithmic prioritisation of various folk-art forms of India depicted in the YouTube Shorts and how does it lead to the representation of various social groups in these videos. This study is an attempt to bridge the afore mentioned gap.

**Research Objectives**

I. To identify the regional distribution of Indian art forms featured in YouTube shorts.

II. To examine the gender distribution and roles of creators presenting Indian Folk arts on YouTube shorts

III. To assess the linguistic and musical elements used in the representation of folk arts in Shorts videos

IV. To evaluate the representation of marginalized communities in YouTube shorts folk arts content

Significance of Research Socially, this will help in identifying representation on digital platform in case of depicting Indian Folk arts as these arts mostly generate from the marginalised communities of India. By examining how creators of different genders, regions etc., are portraying the folk arts on YouTube Shorts, the study is a way to find out the democratising potential of social media in amplifying underrepresented voices (Nayar, 2020). This is essential to study because the global monthly users of YouTube are over 2.7 billion (Statista, 2024) and India is YouTube's largest market with over 467 million users as of early 2024 (DataReportal,2024). There has been a rapid growth in the consumption of reels among Indian viewers, approximately 70 billion views daily (YouTube official blog, 2024). Academically, this study contributes to the theories of representation (Hall, 1997) and algorithmic gatekeeping (Brazilai-Nahoan, 2008).

**Methodology**

This study has been carried out by using **Qualitative Content Analysis** method. The sample has been chosen through **Purposive sampling** for analysing. It allows the researcher to select information- rich cases in order to focus on those which are aligned with the specific phenomenon studied (Palinkas, et al, 2015). To ensure the collection of unbiased and non- personalised data, YouTube videos were **accessed through incognito (private browsing) window**. For research purposes, using incognito mode or private browsing is a useful method to reduce algorithmic personalisation and get more broadly applicable search results. Top 20 videos have been chosen after searching the key words " indian folk art" as both platform and topic vernaculars have a significant impact on the **top 20 results** (Rider, et.al, 2018). Analysis has been done with the help of MS-Excel.

**Findings**

For the first objective of ‘To identify the regional distribution of Indian art forms featured in YouTube shorts’, following chart is the depiction of its finding. 35% of videos have portrayed folk arts from Eastern India, 25% of those showcased the folk arts from western and southern India & 10% and 5% of them are from western India and a mixed of places respectively.

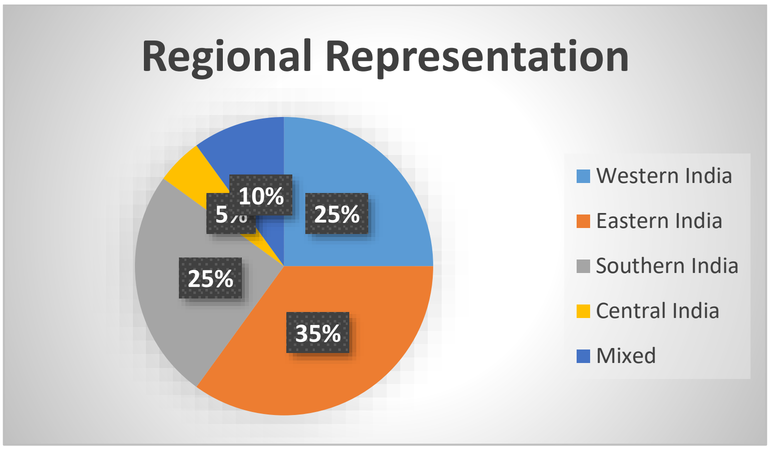


**Figure I: Regional Representation**

The result of second objective 'To examine the gender distribution and roles of creators presenting Indian Folk arts on YouTube shorts' has been portrayed in the pie chart attached below. 55% of the Shorts videos featured female artists, 30% of those portrayed male artists and either the gender cannot be determined or the videos may not have featured any human in them.

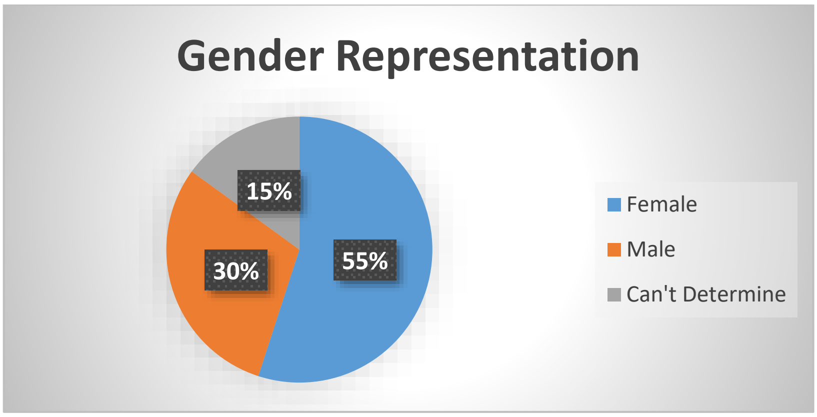


**Figure II: Gender Representation**

The third objective 'To assess the linguistic and musical elements used in the representation of folk arts in Shorts videos', has resulted in the following chart. 55% of the videos depicted either Hindi voiceovers or lyrics, 35% of those featured no lyrics or voiceover, only music and 10% showcased either English voiceovers or lyrics.

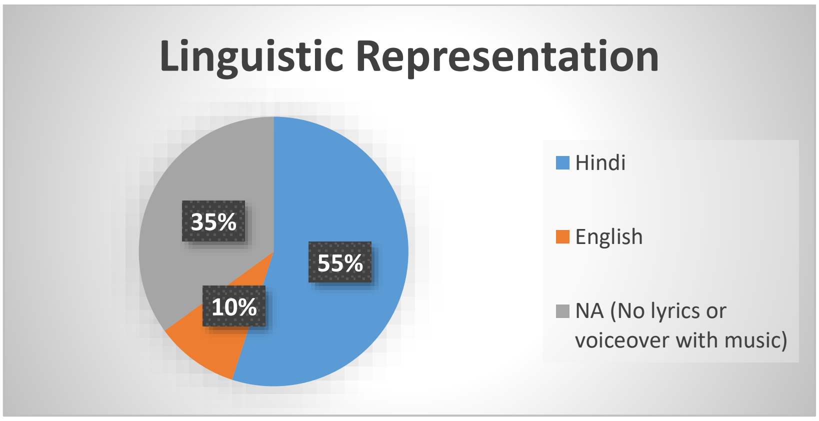


**Figure III: Linguistic Representation**

Evaluating the representation of marginalized communities' folk arts in YouTube shorts content gave following given pie chart. 85% of videos showcased their art while 15% of did not feature marginalized communities' art.

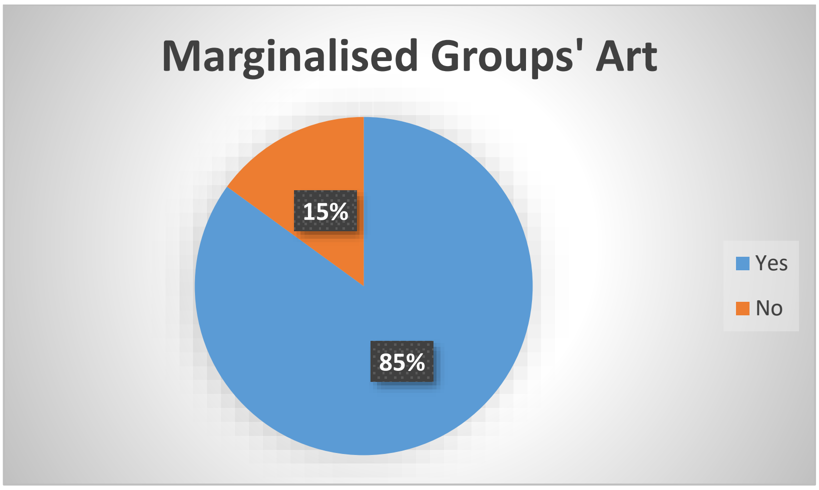


**Figure IV: Marginalised Groups' Art Representation**

Below given picture shows the type of creators represented in the chosen sample of top 20 videos. 75% of the videos are created by the individual creators and the rest of those are curated by community channels.

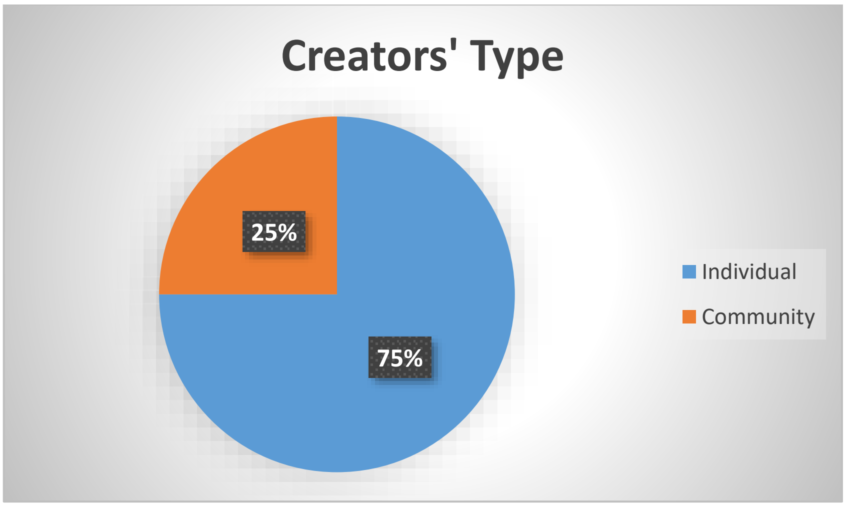


**Figure V: Creators' Types**

**Discussion**

Meanings are constructed through what is shown and what is left out (Hall, 1997). The overrepresentation of eastern India folk arts like Madhubani, Pattachitra and Kalighat showcases Eastern India as a cradle of folk arts and indicates towards their cultural privilege. However, other regions like North-eastern India rich in folk arts did not get feature in the sample. As per the Algorithmic gatekeeping theory (Napoli, 2011), this pattern also reflects algorithmic preference for familiar already popular regional art forms.

Hall's theory helps us see how female creators are becoming more visible in cultural narration, subverting the historically male dominated space of public art instruction. Algorithmically, YouTube tends to amplify visually aesthetic, polished content, and in some cases, the platform's gender-neutral distribution of content visibility may inadvertently empower female creators.

The linguistic pattern underscores the dominance of Hindi as the cultural gateway for folk art dissemination on digital platforms. According to Hall (1997), language is not a way of expression but it is also a way of identity construction, so when Hindi becomes dominant way of dissemination, it undermines the regional dialects which is one of the identity constructors of different tribes and castes from whom the folk arts have been originated. From the algorithmic lens, YouTube shorts favours widely understood language because it increases their accessibility and watch-time. Videos having voiceovers or lyrics with English or Hindi are more likely to be recommended, which results in silencing of regional authenticity.

Most videos showcased art from marginalised communities (), such as Warli, Gond, Dhokra, Chittara, and Madhubani. However, the identity of creators did not clarify whether they are from those communities or not. So, it is unclear that whether authentic depiction of the voices is there or not.

Hence, in this way both the theories contribute to the discussion of the findings mentioned above.

**Limitations**

This study has its limitations. It focuses only on the representation of creators, not on the engagement metrics or the reception part. This gives only limited picture of the scenario of Indian folk arts represented on YouTube Shorts. It has been done once and not over a longer period of time to get a broader picture of this kind of analysis. Further, the creators do not always disclose their social identities, making it a bit harder to arrive at the exactrepresentation. Interpretation bias may also occur due to the subjective nature.

**Conclusion**

In conclusion, this study shows that YouTube Shorts is helping to share Indian Folk Arts. Most videos feature women creators and highlight arts from Eastern India, often using Hindi language for communication. Many of the depicted arts belong to marginalized communities and using Representation Theory and Algorithmic Gatekeeping Theory, it is clear that while YouTube allows diverse forms to be seen, its algorithms and short formats may limit how deeply they are understood.

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**Appendix- 1 (Coding Sheet)**

| S.No. | Videos Descriptions | Creators' Username | Creator Type | Region | Language/ Music | Gender | Marginalised community art |
|---|---|---|---|---|---|---|---|
| 1. | Warli art/ warli canvas painting ideas | @artistkhusboosahu | Individual | Maharashtra (Western India) | Hindi | Female | Yes |
| 2. | Most beautiful Indian Painting - Pattachitra from Bengal and Odisha | @kk.create.original | Individual | Odisha/ West Bengal (Eastern Bengal) | Hindi | Female | Yes |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3. | Want to learn Tanjore Painting Art? Learn Indian artform with MeMeraki | @MeMeraki | Community | Tamil Nadu (Southern India) | NA (No lyrics with music) | Male | No |
| 4. | Dhokra is a 4,500-year-old Indian craft that takes nearly a week to make. | @insiderart | Community | Jharkhand, West Bengal, Odisha (Eastern India) | English | Female | Yes |
| 5. | Peacock Madhubani Painting Design | @SoulfulArtbyArpita | Individual | Bihar (Eastern India) | NA (No lyrics with music) | Female | Yes |
| 6. | Learn Kalamkari Art Online \| Making of a Kalamkari Painting \| Indian Art \| DIY Art \| Kalamkari Art | @memeraki | Community | Andhra Pradesh (Southern India) | NA (No lyrics with music) | Male | Yes |
| 7. | Art of India \| Kalamkari Art Canvas \| Indian Art Forms \| Fevicryl Hobby Ideas India | @HobbysInIndia | Community | Andhra Pradesh (Southern India) | Hindi | Male | Yes |
| 8. | MADHUBANI PAINTING for beginners// traditional Bengali bride painting | @creativesome | Individual | India (Eastern India) | Hindi | Male | Yes |
| 9. | Warli art Coasters on MDF Cutout, Hand Painted, Beautiful Tribal Art | @artandcraftvilla9365 | community | Maharashtra (Western India) | NA (No lyrics with music) | NA | Yes |
| 10. | New big Madhubani painting | @trivenika.madhubani | Individual | Bihar (Eastern India) | Hindi | Female | Yes |
| 11. | Pattachitra Indian Art form Acrylic Painting, Easy Acrylic Painting ideas for beginners | @layersbynavdeep | Individual | Odisha/ West Bengal (Eastern Bihar) | Hindi | Female | Yes |
| 12. | Kalamkari Painting | @Livinglife_withDeep | Individual | Andhra Pradesh (Southern India) | NA (No lyrics with music) | NA | Yes |
| 13. | Pichwai Painting on Plate Indian Folk Art / DIY Home Decor | @KalakarNetra | Individual | Rajasthan (Western India) | Hindi | Female | No |
| 14. | Pichwai cow painting | @chhayameena | Individual | Rajasthan (Western India) | Hindi | Female | No |
| 15. | Kalighat Paintings: A Vibrant Tale of Indian Folk Art \| Beautiful Kalighat Paintings | @MeMeraki | Community | West Bengal (Eastern India) | NA (No lyrics with music) | Male | Yes |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16. | Basic figures of Warli art \| Warli Art \|Tribal Art \|Folk Art | @archanasartcreation | Individual | Maharashtra (Western India) | NA (No lyrics with music) | Female | Yes |
| 17. | Lion \| Indian folk art \| GOND tribal art | @ItsmePriyaKush | Individual | Madhya Pradesh, Chhattisgarh (central India) | English | Female | Yes |
| 18. | Indian folk art Part :1 #MADHUBANI #MITHILAART | @aaryancrafts_11106 | Individual | Bihar (Eastern India) | Hindi | Male | Yes |
| 19. | Radhe krishna \| madhubani artwork \| Indian folk art | @ItsmePriyaKush | Individual | Bihar (Eastern India) | Hindi | Female | Yes |
| 20. | Chittara Art \| Karnataka Folk Art \| Indian Folk Art \| Art Courses | @PencilAndChai | Community | Karnataka (Southern India) | NA (No lyrics with music) | NA | Yes |

**Appendix- 2 (Description of Videos)**

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- Itsme Priya Kush. (2023, October 12). *Radhe Krishna | madhubani artwork | Indian folk art* [Video]. YouTube. https://www.youtube.com/watch?v=mhmg7IxIpnMYouTube
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# BEHAVIOURAL ECONOMICS AND PERSONALIZED MARKETING

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***Abstract***

*This research examines the intersection of behavioral economics and personalized marketing, highlighting how insights into human behavior can enhance the effectiveness of targeted marketing strategies. Behavioral economics challenges the traditional notion of rational consumer decision-making by exploring the psychological, emotional, and social factors that influence choices. The study investigates key behavioral concepts—such as loss aversion, social proof, and choice architecture—and how they are applied in real-world marketing campaigns to influence consumer behavior. Additionally, the research addresses the ethical considerations involved in using personal data and behavioral insights, emphasizing the need for transparency and consumer trust.*

## Introduction

Modern marketing has moved beyond one-size-fits-all approaches, shifting toward strategies that aim to understand and influence individual consumer behaviour. At the heart of this shift lies the growing relevance of behavioural economics—a field that combines elements of psychology and economics to explain why people often make decisions that diverge from standard rational models. By examining how factors such as biases, emotions, and social influences impact choices, behavioural economics provides valuable tools for predicting and shaping consumer responses.

Personalized marketing, which involves tailoring content, offers, and experiences to individual preferences and behaviours, has emerged as a powerful application of these insights. When businesses apply behavioural economic principles—such as the framing effect, loss aversion, or choice architecture—they can design marketing strategies that are more engaging, persuasive, and aligned with real human behavior.

This research explores the relationship between behavioral economics and personalized marketing, focusing on how psychological understanding can enhance the effectiveness of targeted marketing efforts. It also considers the ethical implications of using behavioral insights to influence consumers in a digital environment where personal data is increasingly accessible.

## Literature Review: Behavioral Economics and Personalized Marketing

### 1. Integration of Behavioral Economics in Personalized Marketing

Recent years have witnessed a significant integration of behavioral economics principles into personalized marketing strategies. Dr. Maddela Prasanthi et al. (2024) highlight how artificial intelligence (AI) enables marketers to analyze consumer behavior at a granular level, facilitating tailored experiences across multiple touchpoints. AI technologies such as machine learning and predictive analytics allow for the delivery of personalized content, enhancing customer engagement and loyalty

Furthermore, Jesse and Jannach (2020) discuss the concept of digital nudging through recommender systems, emphasizing how automated recommendations can serve as digital nudges by influencing the choice architecture for users. They identify a taxonomy of 87 nudging mechanisms, suggesting a vast potential for integrating these into recommender systems to influence user decision-making.

2. **Behavioral Economics Principles in Marketing Strategies**

Several behavioral economics principles have been effectively applied in personalized marketing:

- Scarcity and Urgency: Marketers employ scarcity tactics, such as limited-time offers or low-stock notifications, to create a sense of urgency. For instance, Booking.com displays the number of hotel rooms left at a certain price to prompt quicker decision-making.
- Anchoring Bias: This involves setting a reference point that influences subsequent judgments. In digital marketing, original prices are often displayed alongside discounted rates to make the deal seem more attractive.

3. **Challenges and Limitations of Behavioral Nudges**

While behavioral nudges can effectively influence initial consumer decisions, their long-term impact is debatable. Polman and Maglio (2024) argue that nudges often fail to produce sustained behavior changes. For example, while nudging individuals to choose healthier foods may increase immediate engagement, it does not significantly affect long-term consumption habits. They suggest that combining nudges with strategies that enhance sustained engagement, such as gamification, could improve their effectiveness.

4. **Ethical Considerations in Personalized Marketing**

The application of behavioral economics in personalized marketing raises ethical concerns, particularly regarding consumer autonomy and data privacy. As organizations become more adept at influencing consumer behavior, there is a growing emphasis on applying these principles ethically. This includes being transparent about data usage and avoiding manipulative practices that could lead to consumer distrust

CMOs are encouraged to balance persuasion with ethical integrity, ensuring that marketing communications enhance consumer understanding without coercion. By fostering trust and prioritizing customer well-being, brands can build long-term loyalty

5. **Advancements in Consumer Behavior Analysis**

Advancements in machine learning have introduced new models for understanding consumer behavior. Vallarino (2025) presents the Mixture of Experts (MoE) framework, a machine learning-driven approach that dynamically segments consumers based on latent behavioral patterns. This model offers a more flexible and accurate method for predicting consumer choices compared to traditional econometric models, thereby enhancing targeted marketing strategies**.**

**Research Objective**

1. Personalized Marketing**:** This refers to tailoring marketing messages and experiences to individual customers based on their data and preferences. This could include personalized recommendations, targeted ads, or customized offers.
2. Behavioral Economics**:** This field studies how psychological factors influence economic decision-making, such as cognitive biases, emotions, and social influences.
3. Impact on Consumer Behavior and Engagement**:** This refers to measuring how these personalized strategies, guided by behavioral economics, affect real-world customer actions. This could include purchase frequency, click-through rates, time spent on a website, or participation in loyalty programs.
4. Specific Aspect: By focusing on a specific aspect (e.g., purchase decisions, website interaction, loyalty program adoption), the research can provide more focused and actionable insights. This allows for a deeper understanding of how behavioral economics principles impact a particular area of consumer behavior.

5. Actionable Insights**:** The research aims to go beyond simply identifying correlations and to provide practical recommendations for marketers on how to leverage behavioral economics principles to enhance personalized marketing strategies.

**Scope of the study:**

Behavioral economics and personalized marketing combine to offer a powerful approach to understanding and influencing consumer behavior. By understanding the cognitive biases and emotional factors that drive consumer decisions, marketers can craft more effective messages, tailor products and services, and ultimately improve customer engagement and conversion rates. This approach moves beyond traditional rational-actor assumptions to recognize the real-world complexities of decision-making**.**

**Here's a more detailed look at the scope:**

**1. Understanding Consumer Decision-Making:**

a. Beyond Rationality: Behavioral economics acknowledges that consumers don't always make decisions based solely on objective utility maximization.

b. Cognitive Biases: It identifies and analyzes how biases like loss aversion, anchoring, and the endowment effect influence choices.

c. Emotional Factors: It considers how emotions, social influences, and contextual factors play a role in decision-making.

**2. Tailoring Marketing Messages and Strategies:**

a. Personalized Experiences: Behavioral economics insights enable marketers to create more personalized experiences by understanding individual consumer preferences and behaviors.

b. Framing and Language: Marketers can leverage principles like framing to highlight benefits and minimize costs, appealing to loss aversion.

c. Social Proof and Endorsements: Understanding the power of conformity allows marketers to use social proof and endorsements to influence purchasing decisions.

d. Scarcity and Urgency: Creating a sense of urgency or scarcity can encourage immediate action by tapping into consumers' fear of missing out.

e. Pricing Strategies: Behavioral economics can help optimize pricing by understanding how consumers perceive prices and make decisions about purchasing.

f. Product Features: Understanding how customers use and interact with products allows marketers to develop features that better meet their needs and preferences.

**3. Enhancing Market Analysis and Insights:**

a. Predictive Analytics: AI and real-time data analytics can be used to predict consumer behavior based on past trends and contextual factors.

b. Automated Personalization: Real-time data allows for instant personalization, ensuring that marketing messages align precisely with the consumer's current context and preferences.

c. Testing and Optimization: A/B testing and other methods can be used to refine marketing campaigns based on behavioral economics principles.

**4. Ethical Considerations:**

a. Transparency and Fairness: It's crucial to use behavioral economics insights ethically and responsibly, avoiding manipulative tactics.

b. Focus on Understanding, Not Manipulation: The goal is to understand consumer behavior, not to exploit it.

c. Building Trust: Transparency and ethical practices are essential for building trust and fostering long-term relationships with customers.

**5. Examples of Applications:**

a. Anti-smoking campaigns: Using fear appeals to leverage the affect heuristic.

b. Online retailers: Utilizing scarcity tactics to drive sales.

c. Financial institutions: Employing loss aversion to encourage saving and investing.

d. Charitable organizations: Leveraging social proof to increase donations.

Limitation of the study on Behavioural economics and personalised marketing:

Research on Behavioral Economics and Personalized Marketing scope faces limitations including the difficulty in precisely predicting consumer behavior due to the influence of emotions and cognitive biases. Additionally, ethical concerns arise from the potential for manipulative practices in personalized marketing and the need to protect individual autonomy. Finally, there's a risk of oversimplifying complex human behavior and overlooking broader societal or environmental considerations.

Predicting Behavior: Behavioral economics acknowledges that consumers make decisions based on emotions, heuristics, and biases, which can deviate from rational economic models. This makes it challenging to predict how individuals will react to personalized marketing strategies with certainty.

Ethical Considerations: The power of behavioral insights can be used to influence decision-making, raising concerns about manipulative practices. Ethical frameworks are needed to ensure that interventions respect individual autonomy and promote equity, rather than exploit vulnerabilities.

Over-Simplification: Research may focus on specific aspects of consumer behavior, potentially overlooking broader societal, environmental, or ethical implications. This can lead to a narrow view of the impact of personalized marketing and its potential consequences.

Data Limitations and Generalization: Studies often rely on specific populations or experimental setups, which may not generalize to wider consumer groups. The availability and quality of data also impact the reliability of findings.

Temporal and Spatial Constraints: Marketing interventions and their effects can be time-consuming to observe, and the results may be context-specific. It's crucial to consider how changes in the environment or market conditions might influence the effectiveness of personalized marketing strategies.

**Findings**

1. **Behavioral Economic Principles Significantly Influence Consumer Decision-Making**
   The research found that key concepts such as *loss aversion, framing, anchoring,* and *social proof* are widely used in digital marketing to influence purchasing behavior. For example, platforms like Amazon and Booking.com use scarcity and urgency cues to nudge users toward faster decisions.
2. **Personalized Marketing Increases Engagement When Aligned with Behavioral Insights**
   Personalized messages that reflect behavioral tendencies—such as reminders of abandoned carts (loss aversion) or product recommendations based on past behavior (anchoring)—show a significantly higher engagement and conversion rate compared to generic marketing content**.**
3. **Digital Nudging Enhances User Experience Without Reducing Autonomy (When Applied Ethically)**
   When used transparently, digital nudges (e.g., personalized recommendations or default options) help users make quicker and more satisfying decisions without feeling manipulated. However, overuse or lack of transparency can lead to mistrust.

4. **Consumers Respond More Positively to Emotionally Framed Personalized Messages** Messages that trigger emotions like fear of missing out (FOMO), happiness, or belonging tend to perform better than purely informational content. Behavioral personalization taps into emotional and psychological drivers more effectively than traditional segmentation.
5. **AI and Machine Learning Have Improved the Application of Behavioral Economics in Marketing**
   The use of AI allows marketers to analyze behavioral patterns in real time and adjust personalization strategies accordingly. Tools like recommender systems and predictive analytics make it easier to apply behavioral principles at scale.
6. **Ethical Concerns and Data Privacy Remain Major Challenges**
   While personalized marketing driven by behavioral economics is effective, many consumers express concern over how their data is collected and used. The findings highlight a growing demand for transparency, consent, and ethical boundaries in behavioral targeting.
7. **Long-Term Behavior Change Is Less Certain**
   Although behavioral nudges and personalization increase short-term engagement, their long-term effectiveness in changing consumer habits is limited unless combined with sustained value, trust, and relevance.

**CONCLUSION**

Integrating behavioral economics principles into personalized marketing strategies significantly enhances campaign effectiveness and fosters stronger customer relationships. By understanding and leveraging cognitive biases, emotions, and social influences, marketers can create tailored experiences that resonate deeper with consumers, leading to increased engagement and loyalty. The integration of behavioural economics into personalized marketing has revolutionized the way businesses understand and influence consumer decision-making. By leveraging insights into cognitive biases, heuristics, and psychological triggers, marketers can craft highly targeted strategies that resonate on a deeper, more human level. Personalization, when guided by behavioural principles, enhances customer engagement, builds loyalty, and drives conversions more effectively than traditional approaches. However, this powerful combination also raises important ethical considerations regarding consumer autonomy and data privacy. As the field continues to evolve, businesses must strive to balance persuasive marketing with transparency and trust, ensuring that personalization enhances customer value without manipulation. Ultimately, the synergy between behavioural economics and personalized marketing offers a promising pathway to more effective, empathetic, and responsible consumer interactions.

**Recommendations and Suggestions:**

Leverage Behavioural Insights Responsibly: Businesses should utilize behavioural economics principles—such as nudging, framing, and anchoring—to guide consumer decisions ethically. The aim should be to support informed choices rather than manipulate behaviour.

Prioritize Ethical Personalization: Personalized marketing must respect consumer autonomy and privacy. Marketers should ensure transparency in data collection and allow users to control how their information is used.

Invest in Behavioural Research and Testing: Organizations should conduct A/B testing and controlled experiments to understand how different consumer segments respond to personalized content influenced by behavioural principles.

Focus on Long-Term Relationships: Rather than short-term gains, personalized marketing strategies should be designed to build trust and long-term customer loyalty by delivering consistent, relevant, and value-driven experiences.

Encourage Interdisciplinary Collaboration: Combining insights from behavioural economics, psychology, marketing, and data science can result in more effective and ethical personalization strategies.

Adapt to Cultural and Contextual Differences: Behavioural responses are influenced by cultural and social contexts. Personalization efforts should be localized to reflect the values, preferences, and behaviours of different demographic groups.

Promote Further Academic Study Future research should explore the long-term psychological and social impacts of personalized marketing based on behavioural economics, particularly in digital environments dominated by AI and algorithms.

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# IMPACT OF GOVERNMENT POLICIES ON THE REAL ESTATE SECTOR IN INDIA

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***Abstract***

*Real estate sector plays a pivotal role in economic development of a nation and the government policies has significant impact on this sector.Government policies in India significantly influence the real estate sector, shaping market dynamics, investor confidence, and overall economic growth. This paper studies the link between regulatory policies and their impact on India's real estate markets. Using case studies and empirical data, the study explores how these policies drive affordability, transparency, and sustainability in the sector.*

## Introduction

Indian real estate sector play the crucial role in the country's economic development by contributing to GDP and employment .The Indian real sector contributes about 8 to 9% of the GDP and provide employment to the masses .This sector has witnessed a significant changes in recent year driven by strategic government intervention and creating a more transparent account and growth oriented environment The government policy are designed to control Urban Development ,manage housing demand and ensure balanced growth .The government policy plays a significant role in regulating and restructuring the real state sector.Therefore Government of India introduces the policy to promote real estate sector and building trust among the real estate buyers.This paper examines the impact of government policy on the real estate market and provide inside for the policy makers and the stakeholder

Objectives

- To analyze the impact of government policies on real estate market transparency in India.
- To evaluate the effects of fiscal policies on housing affordability and investments in India.
- To examine the influence of monetary policies on real estate market trends in India

Methodology

This research is based on mixed-methods approach, combining quantitative analysis of market data with qualitative data. The information has been collected from government reports, industry publications, and interviews with stakeholders in India. Statistical models are used to measure policy impacts on key performance indicators like housing prices, transaction volumes, and investment flows.

Government Policies impacting Real Estate in India

- RERA: Real Estate Regulation and development Act was designed to protect the home buyer and mandate the developers to register the project before marketing ,this requirement enhances the transparency in property transaction and hold developer accountable for timely project delivery . It enforces accountability among developers and provides a platform for dispute resolution.
- Goods and Services tax (GST): GST has reduced the complexity for the developer .the lower GST rate on affordable housing has made properties more accessible for the lower and middle income group it is stimulating the growth in the segment .the transparency brought by the GST coupled with the RERA has enhance investor confidence and boost the real estate investment

● Zoning Laws: Influence land availability and urban development in Indian cities.Zoning laws define how land can be used for residential, commercial ,industrial or mixed -use purposes .These laws shape the land space of urban areas by regulating what type of building can be constructed and where they can be located at

● Benami Transaction Act: Ensure property titles are legitimate and free from encumbrance.The act prohibits transactions that conceal the identity of actual owners or the source of funds,this legislation promotes transparency in property ownership.

● To analyze the impact of government policies on real estate market transparency in India.

● To evaluate the effects of fiscal policies on housing affordability and investments in India.

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● **Property Taxes**: Government physical policy impact the real estate sector the property tax can either encourage or discourage the investment in the real estate sector a high property tax rate may discourage buyers and investor to invest in the sector while a low tax rate encourages the demand for real estate .

● **Interest Rates:** Central bank through its monetary policy significantly impact the real estate sector.Expansionary monetary policy stimulates demand for housing and property by lowering the cost of borrowing.

● **Urban Renewal Initiatives:** Revitalize aging infrastructure and attract investments in cities like Mumbai and Delhi.

● Digitalization and E-Commerce This digital transformation minimizes disputes related to property on a ship and reduces fraudulent activities in real estate transactions.

**Case Studies**

Real Estate (Regulation and Development) Act (RERA)

Introduced in 2016, RERA is a crucial body governing the real estate sector in India .It aims to protect home buyers interest and promote transparency and accountability in the industry by regulating the real estate sector safeguarding and protecting the interest of the home buyers and promote accountability of the builders and the developers.

**Housing for All by 2022**

The PMAY initiative aims to provide affordable housing through subsidies and incentivized schemes, for all urban poor and middle class families and to promote affordable housing through innovative technologies ensuring access to dignified and affordable rental housing for urban migrant and poor.

**Smart Cities Mission**

This policy promotes urban renewal and modernization in selected cities, enhancing infrastructure and attracting real estate investments.Smart cities aims to create a better quality of life for citizens while promoting sustainability efficiency and economic growth .

**Findings**

● Regulatory measures like RERA increased transparency ,improve accountability but may increase compliance costs for developers.this has positive impact on consumer confidence enhancing investment in real estate sector.Standardized practices and increased investment in the sector is potential for growth of the sector.

● Subsidies and tax incentives drive affordability but require careful implementation to avoid regional imbalances.

● Monetary policies by the RBI significantly affect investment flows and housing demand in India.

● The interest rate is an important factor influencing the demand for housing. The lower interest rate encourages higher demand for real estate due to affordability and lower cost of borrowing.

● Environmental regulations and green building standard have encouraged sustainable practice in the sector

● Government initiatives of affordable housing and infrastructure development have driven demand in the real estate sector

Policy Implication

● Policy makers can refine regulations to redress challenges and promote sector growth

● Policies must balance investor interests with housing affordability goals in India.

● Regional variations necessitate tailored approaches to policy implementation.

● Streamlining project approval can reduce project cost and saves time

● Government can encourage developers to adopt sustainable and eco-friendly technologies by giving incentives to the projects

● Further research can explore the impact of specific policies on real estate

● Comparative studies can analyze the impact of government policies on real estate sector across the different countries of the world

Challenges and Limitations

● Government policies have created opportunities for investment in affordable housing, commercial real estate and infrastructure development.

● Developer Face challenges in complying with regulations of RERA GST

● The sector needs to be balanced between growth and sustainable development which is environment friendly.

● Relaxation of FDI norms has attracted foreign investment which is contributing for further capital formation for countries' development process.

● The government initiatives encourage the developers to invest in sustainable and eco friendly projects.

**Conclusion**

The Indian real estate market is significantly influenced by government policies, which have an effect on investment, affordability, and transparency. Government policies need to address socio economic issues and promoting sustainable growth require a well-rounded and cohesive policy framework. Future studies should concentrate on how Indian real estate regulations incorporate environmental and technical factors.

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# FROM CASH TO CLICK: A LOCAL SURVEY OF DIGITAL PAYMENT ADOPTION IN MUMBRA

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***Abstract***

*This research paper explores the evolution of digital payments in India with a localized focus on Mumbra, an area experiencing the impact of the country's digital financial transformation. The study investigates how common residents of Mumbra are adopting online payment methods, particularly in response to technological advancements and government-led digital initiatives. It highlights key trends such as the growing use of mobile wallets and the influence of the Unified Payments Interface (UPI) on everyday transactions in the locality. The research adopts a survey-based approach, collecting primary data directly from local residents through questionnaires and informal interviews. Additionally, secondary data has been sourced from authorized government and financial departments to support and validate the findings. The study reveals notable shifts in consumer behavior, persistent challenges such as limited digital literacy, security concerns, and infrastructural constraints.*

*The paper concludes with policy recommendations emphasizing the need for targeted digital literacy programs, improved cybersecurity awareness, and infrastructure development tailored to local needs. By centering the voices of Mumbra's common people and supported by official data, this research contributes to a grassroots understanding of India's broader digital payment revolution.*

***Key Words:*** *Digital payment, Mumbra, Financial Inclusion, and Consumer Behaviour*

## Introduction:

India, once primarily dependent on cash transactions, is steadily transitioning towards a cashless economy. To accelerate this shift, the Indian government has launched various initiatives aimed at encouraging digital payment adoption. The overarching goal is to build a "digitally empowered" economy that operates with minimal reliance on physical currency, documentation, or personal identity verification. Such a transformation is expected to bring multiple advantages, including reduced currency management costs, improved transaction transparency, and better control over tax compliance and fraud prevention. For decades, limited access to banking facilities, low digital literacy, and a lack of infrastructure restricted the growth of non-cash payment systems. However, the scenario began to change in the early 2000s with the introduction of electronic payment options such as debit cards, credit cards, and net banking. The launch of the National Payments Corporation of India (NPCI) in 2008 and the introduction of the Unified Payments Interface (UPI) in 2016 marked major turning points in India's digital financial journey.

According to the Reserve Bank of India (RBI), India's digital payment ecosystem includes a wide range of systems designed to serve diverse transaction needs. These include Real-Time Gross Settlement (RTGS) and National Electronic Funds Transfer (NEFT) for high- and low value interbank transfers, as well as the Immediate Payment Service (IMPS), which facilitates instant 24x7 fund transfers. UPI has emerged as a widely used platform for seamless peer-to peer and merchant payments. Other modes include Prepaid Payment Instruments (PPIs) such as digital wallets and vouchers, the

Aadhaar Enabled Payment System (AePS) for biometric based transactions, Bharat Bill Payment System (BBPS) for utility payments, and conventional card-based transactions. Together, these systems offer an inclusive, efficient, and secure framework that supports India's growing digital economy.

This paper examines the development and contemporary significance of online payments within the Indian context. It investigates the various forces that have driven this paradigm shift, including technological advancements, regulatory reforms, and changing consumer preferences. Special attention is given to the local setting of Mumbra, a growing suburb where digital adoption reflects broader national trends. The study uses both primary data from local respondents and secondary data from national sources to provide a comprehensive view. By outlining the background and objectives of this research, this introduction sets the stage for a detailed exploration of the current online payment ecosystem, its opportunities, and the challenges that remain.

**Experimental design, materials, and methods:**

**Methodology:**

The comprehensive investigation of the dynamics of online payments in Mumbra was conducted by using a mixed-methods approach. Data collection encompassed primary sources. Primary data were obtained through structured surveys administered to a diverse sample of 1000 respondents across the Mumbra region. This survey aimed to capture insights into consumer behavior, preferences, and satisfaction levels regarding online payment methods. Complementary secondary data was obtained from the Reserve Bank of India's 2023 digital payments report, which offers nationwide insights, including UPI transaction statistics. This combined methodology provides a comprehensive perspective on digital payment usage and related challenges in the local context.

**Questionnaire development and survey sample selection:**

For the preliminary phase of the research on online payment systems, structured questionnaires were utilized as the primary data collection tool. These questionnaires were designed to gather data from 1,000 diverse respondents in Mumbra. The survey revealed issues such as transaction failures, security concerns, and usability problems. These insights helped identify key challenges and guided the development of corrective measures. The findings served as a foundation for further in-depth investigation and analysis.

**Observations and Result:**

**Chart 1.1** illustrates the responses regarding whether digital payments are more convenient than cash. A majority of 71% of respondents agreed that digital payments offer greater convenience. In contrast, 16% believed cash to be more convenient, while 12% were uncertain about their views.


**Chart 1.2,** illustrates the distribution of challenges faced by respondents while using online payment systems. Security concerns emerged as the most significant issue, reported by 60% of participants.

Technical difficulties, such as transaction errors and system glitches, accounted for 20% of the responses. Limited access issues, including poor internet connectivity and lack of digital infrastructure, were reported by 8%, while 10% of respondents cited other miscellaneous challenges.

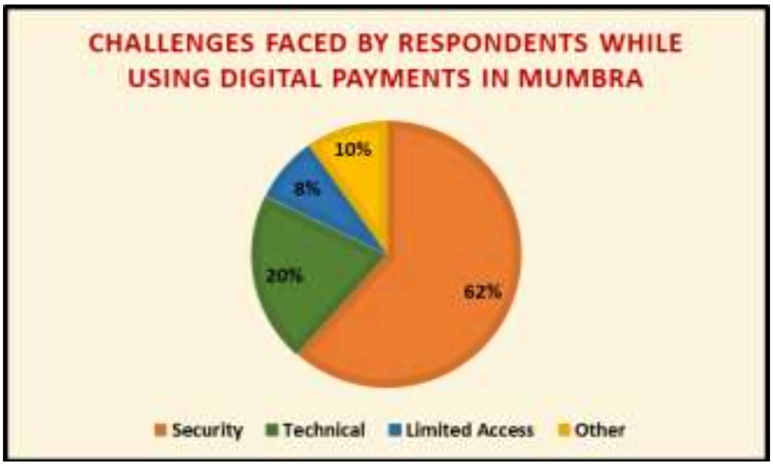
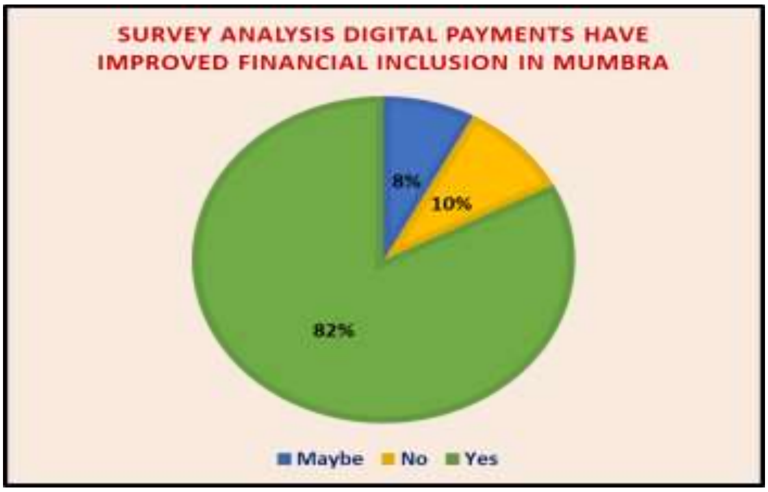



**Chart 1.2**

The survey analysis **Chart 1.3** indicates that digital payments have significantly contributed to financial inclusion in Mumbra. A substantial majority of respondents (82%) affirmed that digital payment systems have improved their access to financial services. In contrast, 10% of participants did not perceive any improvement, while 8% were uncertain.

**Chart 1.3**




**Secondary Data:** In addition to primary data, recent statistics from the Reserve Bank of India (RBI) provide significant insight into the broader digital payment landscape. As of 2023, the total volume of digital payments in India reached ₹9192 crore, with Unified Payments Interface (UPI) transactions alone accounting for approximately 9.34 billion.

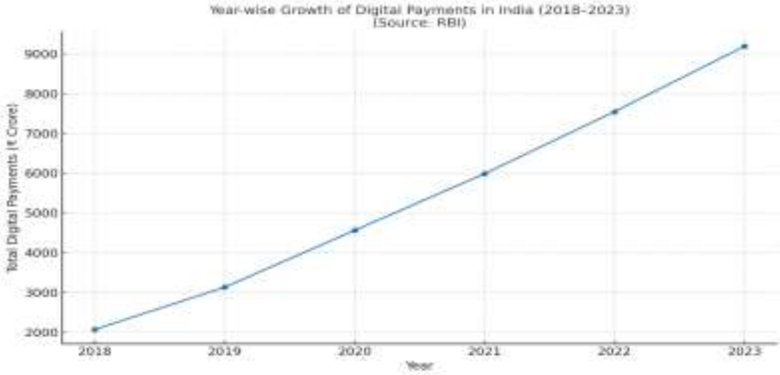



**Chart 1.4** shows the growth of digital payments in India from **2018 to 2023**, based on RBI data for 2023. This chart highlights the sharp upward trend in digital transactions, reinforcing the narrative of India's transition to a digital economy. These national trends support the local findings and contextualize the increasing reliance on digital financial systems.

**Result Analysis:**

The survey findings indicate a strong preference for digital payment methods among users, with convenience emerging as a primary driver for adoption. The 71% who favored digital payments suggest a growing comfort and familiarity with technology among the population. Despite this, a minority still favor traditional cash transactions, which may be attributed to concerns over trust, digital literacy, or accessibility.

Security remains a critical barrier, as identified by 60% of respondents. This aligns with broader concerns about data privacy and fraud in digital platforms. Technical issues and limited access, though reported by smaller percentages, still highlight the need for infrastructural improvements, especially in semi-urban and underdeveloped areas. Chart 1.3 underscores another vital dimension: financial inclusion. In Mumbra, 82% of respondents acknowledged that digital payments had improved their access to financial services, supporting the view that digital platforms are closing gaps in traditional banking coverage.

This local insight is further validated by RBI's broader digital push through platforms like UPI, AePS, and BBPS, which aim to include underbanked populations, particularly in semi-urban and rural areas. In summary, both the primary survey findings and RBI's secondary data collectively affirm that digital payment systems are transforming financial behavior and access in India. While the convenience and inclusion benefits are clear, challenges related to security, technical infrastructure, and accessibility must be addressed to ensure equitable and sustainable adoption.

**Conclusion:** The integration of both primary and secondary data confirms that digital payments are not only transforming user experience through convenience but are also playing a vital role in promoting financial inclusion. The RBI's 2023 report on digital transactions provides compelling evidence of the national momentum, with UPI at the forefront of this shift. Locally, as observed in Mumbra, digital financial tools are empowering individuals and expanding access to essential services. However, the widespread adoption of digital payments also brings to light critical challenges, particularly around security and technical robustness. Addressing these issues through targeted policy interventions, infrastructure development, and user education will be essential to maintaining trust and accelerating financial digitalization. A comprehensive understanding of the payment ecosystem supported by real-time data is crucial to developing inclusive, secure, and resilient digital financial frameworks.

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# HARNESSING ARTIFICIAL INTELLIGENCE TO COMBAT ANTIMICROBIAL RESISTANCE: CHALLENGES, INNOVATIONS, AND FUTURE DIRECTIONS

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***Abstract***

*Antimicrobial resistance (AMR) represents a pressing global health concern, threatening the efficacy of current antimicrobial therapies. Artificial Intelligence (AI), particularly through machine learning and deep learning, provides novel methods for predicting resistance patterns, aiding drug discovery, and enhancing clinical decision support systems. This paper explores AI's applications in AMR, its current limitations, and future directions. Emphasis is placed on the role of data-driven approaches in advancing personalized medicine and proactive intervention strategies.*

***Keywords****—Artificial Intelligence, Antimicrobial Resistance, Machine Learning, Predictive Modeling, Drug Discovery, Clinical Decision Support, Healthcare Analytics.*

## I. Introduction

Antimicrobial resistance (AMR) is one of the most serious public health threats of the 21st century. Once easily treatable infections now require stronger, costlier, and often less effective therapies due to the rapid emergence of resistant pathogens. Traditional diagnostics and surveillance methods are often too slow or fragmented to keep pace with evolving resistance mechanisms. In contrast, Artificial Intelligence (AI) has the potential to accelerate detection, streamline clinical decision-making, and optimize antibiotic use. This paper provides a comprehensive overview of how AI is being used to combat AMR and highlights the challenges and future directions needed for its effective implementation in healthcare settings.

## II. AI in AMR Surveillance and Prediction

AI plays a vital role in surveillance and early prediction of antimicrobial resistance. Machine learning (ML) algorithms such as logistic regression, random forests, and support vector machines can process structured data—such as patient demographics, infection history, and laboratory results—to predict resistance profiles with high accuracy [1], [2]. These models can uncover correlations not easily detected by traditional statistical methods. Additionally, deep learning techniques like convolutional neural networks (CNNs) and recurrent neural networks (RNNs) are being used to analyze genomic data and identify resistance genes, even before they manifest phenotypically [3]. AI-driven surveillance systems enable real-time tracking of resistance trends and help healthcare professionals anticipate outbreaks, improving public health responses and guiding empirical treatment strategies [4]. Furthermore, AI enables integration of environmental, agricultural, and hospital data to build unified models for AMR surveillance. Recent AI systems also apply unsupervised clustering to detect emerging resistance strains with limited prior knowledge. These techniques are particularly useful in low-resource settings where formal laboratory infrastructure may be lacking.

## III. AI-Assisted Drug Discovery and Repurposing

Developing new antibiotics is a slow and expensive process, with high failure rates. AI is revolutionizing drug discovery by accelerating compound screening, predicting drug-target interactions, and optimizing chemical structures for better efficacy. Techniques such as generative adversarial networks (GANs) and reinforcement learning are used to generate novel antimicrobial compounds or modify existing drugs for better resistance-fighting capabilities [5]. AI also facilitates drug repurposing by analyzing biomedical databases and molecular docking simulations to identify existing drugs with potential antimicrobial activity [3]. These innovations dramatically reduce the time and cost of bringing effective treatments to patients, especially in response to resistant infections where time is critical. AI's role in drug discovery is further enhanced by the emergence of hybrid models combining graph neural networks (GNNs) with cheminformatics. These models allow detailed exploration of molecular interactions and can predict compound toxicity and resistance evolution risk. Such predictive frameworks are accelerating the discovery of next-generation antimicrobials, including bacteriophage-based therapies and narrow-spectrum antibiotics.

**IV. Clinical Decision Support Systems (CDSS)**

AI-powered Clinical Decision Support Systems (CDSS) are designed to assist healthcare providers in selecting the most effective antibiotic therapy based on real-time patient and microbial data. These systems integrate structured clinical information with local antibiograms and electronic health records (EHRs), providing evidence-based recommendations [6]. Natural language processing (NLP) enhances these systems by extracting key insights from unstructured data such as clinical notes. Moreover, explainable AI methods like SHAP (SHapley Additive exPlanations) and LIME (Local Interpretable Model-Agnostic Explanations) improve transparency and build trust among clinicians [7]. CDSS tools reduce diagnostic uncertainty and support personalized treatment decisions, ultimately contributing to better patient outcomes and antimicrobial stewardship. Additionally, AI-based CDSS can be integrated with wearable and remote monitoring devices to track treatment efficacy in real-time. By analyzing patient feedback, biometric trends, and medication adherence, CDSS can dynamically adjust antibiotic recommendations, reducing unnecessary prescriptions and improving patient outcomes.

**V. Challenges in AI Implementation for AMR**

Despite its transformative potential, AI implementation in AMR research and practice faces several challenges. A major limitation is the quality and availability of data across healthcare systems. Medical datasets are often incomplete, biased, or poorly labeled, which can negatively affect model performance [3], [7]. Additionally, many AI models—particularly those based on deep learning—lack interpretability, making them difficult to validate and trust in clinical settings. Generalizability is also a concern; models trained in one region or hospital may not perform well in different environments due to variability in patient populations and treatment protocols [1]. Ethical concerns related to data privacy, algorithmic bias, and accountability further complicate AI adoption. Addressing these challenges will require robust data governance frameworks, cross-disciplinary collaboration, and rigorous external validation of models before clinical deployment. Another critical challenge lies in harmonizing global standards for AMR data. Currently, disparities in surveillance protocols and resistance definitions across countries limit the interoperability of AI tools. Establishing international AMR data-sharing consortia, governed by clear legal and ethical frameworks, would significantly improve model robustness and scalability.

**VI. Future Directions**

To fully harness AI's potential in addressing AMR, several strategic actions are needed. Developing interoperable, standardized datasets across healthcare institutions would enable more reliable and generalizable AI models [4]. Federated learning is a promising approach that allows institutions to train AI models collaboratively without sharing sensitive patient data, thus preserving privacy while improving performance [3]. Greater emphasis should also be placed on explainable AI, enabling clinicians to understand how models arrive at their decisions [7]. Integrating multi-omics data—such as genomics, transcriptomics, and proteomics—into predictive models can yield more comprehensive insights into resistance mechanisms. Finally, real-world validation and clinical trials of AI systems must be prioritized to ensure that these tools deliver meaningful benefits in clinical environments [6].

## VII. Conclusion

Artificial Intelligence is poised to play a critical role in combating antimicrobial resistance. Its applications in resistance prediction, drug discovery, and clinical support hold the promise of transforming how we detect and manage resistant infections. However, the realization of this potential depends on addressing key challenges related to data, trust, scalability, and ethics. Interdisciplinary collaboration, transparency in model development, and integration with clinical workflows will be essential to ensure the safe, equitable, and effective use of AI in the fight against AMR. Incorporating reinforcement learning in hospital infection control strategies is another promising avenue. These models can simulate outbreak scenarios and suggest real-time interventions, such as isolation protocols or targeted antibiotic restrictions. Moreover, multilingual AI models can extend the reach of AMR diagnostics and guidance tools across diverse healthcare systems worldwide. As the global health community continues to grapple with this escalating threat, AI offers a powerful set of tools to support proactive and informed decision-making.

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