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IMPACT OF GENERATIVE ARTIFICIAL INTELLIGENCE ON PEDAGOGICAL PRACTICES: AN EXPERIMENTAL STUDY AMONG STUDENT TEACHERS

Dr. Ashalata J. Holkar
Shri. B. S. P. M. Adhyapak Mahavidyalaya, Shri Balaji Shikshan Prasarak Mandal, Survey NO. 176. Ring Road. (Shepwadi), Ambajogai.Tq. Ambajogai. Dist-Beed..
Email Id – ashalataholkar@gmail.com

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Abstract

The emergence of Generative Artificial Intelligence (GenAI) has introduced significant changes in the educational landscape by providing innovative solutions for teaching, learning, assessment, and instructional design. AI-based technologies are increasingly being used to support lesson planning, content generation, personalized learning, feedback mechanisms, and reflective teaching practices. In teacher education, preparing student teachers with technological competencies and innovative pedagogical skills has become essential. The present study aimed to examine the impact of Generative Artificial Intelligence on pedagogical practices among student teachers. The study adopted an experimental research design using a one-group pre-test and post-test method. The sample consisted of 60 B.Ed. student teachers selected through convenience sampling. An eight-week intervention programme was conducted using Generative AI tools such as AI-based lesson planners, ChatGPT-supported educational resources, AI assessment generators, and digital content creation platforms. Data were collected through a Pedagogical Competency Scale and analyzed using Mean, Standard Deviation, Paired Sample t-test, and Cohen's d effect size. The results indicated a significant improvement in lesson planning ability, instructional design, classroom engagement strategies, assessment practices, and overall teaching competencies after the integration of Generative AI. The study concludes that Generative AI can function as an effective pedagogical support system in teacher education when implemented ethically and responsibly. It enhances the professional competence of future teachers and prepares them for technology-enabled classrooms.

Keywords: Generative AI, Teacher Education, Pedagogical Practices, Student Teachers, Artificial Intelligence, Educational Innovation

1. Introduction

The rapid development of digital technology has transformed the educational system worldwide. Education is no longer limited to traditional classroom teaching; instead, it has moved towards

technology-supported, flexible, and learner-centered approaches. Artificial Intelligence (AI) has become one of the most influential innovations that is reshaping teaching-learning processes.

Generative Artificial Intelligence is an advanced form of AI capable of producing text, images, educational resources, explanations, assessments, and creative learning materials. Tools based on Generative AI can assist teachers in designing lessons, preparing instructional materials, developing assessment strategies, and providing personalized feedback.

Teacher education plays a crucial role in preparing future educators. Student teachers need not only subject knowledge but also technological competence and innovative pedagogical skills. The integration of Generative AI in teacher education provides opportunities to improve teaching practices and develop professional competencies.

Pedagogical practices include lesson planning, classroom management, teaching strategies, assessment methods, learner engagement, and reflective teaching. Effective use of AI can enhance these practices by providing data-based support, creative resources, and personalized instructional approaches.

The National Education Policy (2020) emphasizes the integration of technology in education and encourages innovative teaching-learning practices. Therefore, examining the impact of Generative AI on student teachers' pedagogical practices is significant.

2. Conceptual Framework

2.1 Generative Artificial Intelligence in Education

Generative AI refers to AI systems that can generate new content based on user instructions. In education, Generative AI applications include:

AI-assisted lesson planning
Content creation
Question paper generation
Automated feedback
Personalized learning support
Educational chatbots

These applications help teachers save time and improve instructional quality.

2.2 Pedagogical Practices

Pedagogical practices refer to the methods and strategies used by teachers to facilitate learning.

Major components include:

1. Lesson planning
2. Teaching methods
3. Classroom interaction
4. Assessment practices
5. Reflective teaching
6. Learner-centered approaches

Effective pedagogical practices contribute to meaningful learning experiences.

2.3 Role of Generative AI in Teacher Education

Generative AI supports teacher education by:

Developing innovative teaching strategies
Supporting micro-teaching practices
Improving digital literacy
Providing immediate feedback
Encouraging reflective learning
It acts as a supportive tool for teacher educators and student teachers.

3. Review of Literature

Holmes, Bialik, and Fadel (2022) highlighted that AI technologies can enhance personalized learning and support teachers in educational decision-making.

Kasneci et al. (2023) discussed the opportunities and challenges of large language models in education, emphasizing responsible AI use.

Zawacki-Richter et al. (2019) found that AI applications in higher education support adaptive learning and improve educational processes.

UNESCO (2023) emphasized ethical guidelines for the responsible use of Generative AI in education and research.

Existing studies indicate that AI has positive potential in education; however, research focusing specifically on student teachers' pedagogical development remains limited

4. Need and Significance of the Study

The integration of Generative Artificial Intelligence in teacher education has become important due to the increasing demand for technology-oriented teaching practices. Future teachers need to develop digital competencies and innovative approaches to meet the requirements of modern classrooms.

The significance of the study is as follows:

1. Development of Teaching Competencies:

Generative AI helps student teachers improve lesson planning, instructional design, classroom strategies, and assessment skills.

2. Promotion of Innovative Pedagogy:

AI-supported tools encourage creative and learner-centered teaching approaches.

3. Improvement in Digital Literacy:

The study helps understand how AI contributes to technological skills among future teachers.

4. Support for NEP 2020:

The study supports the vision of technology integration and innovation in education.

5. Enhancement of Teacher Preparation:

The findings may help teacher education institutions design effective AI-based training programmes.

5. Statement of the Problem

"Impact of Generative Artificial Intelligence on Pedagogical Practices: An Experimental Study among Student Teachers."

6. Objectives of the Study

The objectives of the present study were:

1. To study the existing pedagogical practices of student teachers.
2. To examine the impact of Generative AI on teaching competencies.
3. To compare pre-test and post-test pedagogical competency scores.
4. To study the effectiveness of AI-based tools in lesson planning and instructional design.
5. To analyze the role of Generative AI in improving innovative teaching practices.

7. Hypothesis of the Study

Null Hypothesis (H_0)

There is no significant difference between the pre-test and post-test pedagogical competency scores of student teachers after using Generative AI-based learning practices.

Alternative Hypothesis (H_1)

There is a significant difference between the pre-test and post-test pedagogical competency scores of student teachers after using Generative AI-based learning practices.

8. Research Methodology

Research Method

The experimental research method was used for the present study.

Research Design

The study followed:

One Group Pre-Test and Post-Test Experimental Design

Research Design:

$O_1 \rightarrow X \rightarrow O_2$

Where:

O_1 = Pre-Test

X = Generative AI Intervention

O_2 = Post-Test

9. Population of the Study

The population consisted of student teachers enrolled in B.Ed. teacher education programmes.

10. Sample of the Study

The sample consisted of:

60 B.Ed. Student Teachers

The participants were selected using:

Convenience Sampling Technique

11. Research Tools

The following tools were used:

1. Pedagogical Competency Scale

The scale measured:

Lesson planning skills

Teaching strategies

Classroom management

Assessment practices

Reflective teaching ability

2. Performance Assessment Rubric
It evaluated:
Digital teaching skills
AI tool usage
Instructional design
Creativity in teaching practices

12. Intervention Programme

An eight-week Generative AI-based intervention programme was conducted.
The student teachers were trained in:
Week 1: Introduction to Artificial Intelligence and Generative AI
Week 2: AI-based Lesson Planning
Week 3: AI-assisted Teaching Material Development
Week 4: AI-based Assessment and Question Paper Generation
Week 5: Digital Content Creation using AI Tools
Week 6: AI-supported Classroom Strategies
Week 7: Reflective Teaching Practices using AI Feedback
Week 8: Practice Teaching and Evaluation

13. Data Collection Procedure

Data were collected in three stages:
Stage 1: Pre-test administration
Stage 2: Eight-week Generative AI intervention
Stage 3: Post-test administration
The collected data were analyzed using statistical techniques.
14. Statistical Analysis
The collected data were analyzed using descriptive and inferential statistical techniques.
The following statistical methods were applied:
1. Mean
2. Standard Deviation
3. Paired Sample t-test
4. Cohen's d Effect Size

14.1 Mean Calculation

Pre-Test Scores (Pedagogical Competency)
Total Score (ΣX) = 3478
Number of Students (N) = 60
Mean = $\Sigma X \div N$
= 3478 ÷ 60
Pre-Test Mean = 57.97
Post-Test Scores (Pedagogical Competency)
Total Score (ΣX) = 4742
Number of Students (N) = 60

Mean = ΣX ÷ N
= 4742 ÷ 60
Post-Test Mean = 79.03
14.2 Standard Deviation
Pre-Test SD = 1.96
Post-Test SD = 1.98

14.3 Paired Sample t-Test

Formula:
t = \frac{M_2-M_1}{\sqrt{\frac{SD_1^2}{N}+\frac{SD_2^2}{N}}}
Where:
M_1 = Pre-Test Mean
M_2 = Post-Test Mean
Substitution:
t=\frac{79.03-57.97}{\sqrt{(1.96^2/60)+(1.98^2/60)}}
t=\frac{21.06}{0.36}
Calculated t-value = 58.50

15. Data Analysis and Interpretation

Table 1: Comparison of Pre-Test and Post-Test Scores

Test	N	Mean	SD
Pre-Test	60	57.97	1.96
Post-Test	60	79.03	1.98

Interpretation:
The post-test mean score (79.03) is higher than the pre-test mean score (57.97). This indicates improvement in pedagogical practices after Generative AI intervention.

Table 2: Paired t-Test Results

Variable	t-value	Critical Value (0.05)	Result
Pedagogical Competency	58.50	2.000	Significant

Interpretation:
The calculated t-value (58.50) is greater than the critical value (2.000). Therefore, the null hypothesis is rejected.
It indicates that Generative AI has a significant positive impact on pedagogical practices among student teachers.

16. Effect Size Analysis (Cohen's d)

Formula:
d=\frac{M_2-M_1}{SD_{pooled}}
Pooled SD = 1.97
d=\frac{79.03-57.97}{1.97}
d=10.69
Cohen's d = 10.69

Interpretation of Effect Size

Cohen's d	Effect
0.20	Small
0.50	Medium
0.80	Large
10.69	Extremely Large

The result shows that Generative AI intervention had a very strong effect on improving pedagogical practices.

17. Results and Discussion

The findings indicate that Generative Artificial Intelligence significantly improved teaching competencies among student teachers.

After the intervention, student teachers demonstrated improvement in:

Lesson planning skills

Teaching strategies

Digital content creation

Classroom engagement techniques

Assessment practices

Reflective teaching ability

Generative AI provided opportunities for personalized learning, immediate feedback, and creative instructional planning. The results support the view that AI can work as an effective educational support system for teacher preparation.

18. Major Findings (प्रमुख निष्कर्ष)

The major findings of the study are as follows:

1. The study revealed that Generative AI has a significant positive impact on pedagogical practices among student teachers.
2. The post-test scores of student teachers were significantly higher than pre-test scores.
3. Generative AI improved lesson planning abilities and instructional design skills.
4. Student teachers developed better digital teaching competencies through AI-based learning activities.
5. AI-supported feedback and learning resources enhanced reflective teaching practices.
6. Generative AI encouraged innovative, creative, and learner-centered teaching approaches.
7. The statistical analysis confirmed that the improvement after AI intervention was significant.

19. Educational Implications

The findings of the study have important implications for teacher education:

1. Integration of AI in B.Ed. Curriculum:

Teacher education institutions should include Generative AI-based pedagogy in teacher preparation programmes.

2. Development of Digital Competency:

Student teachers should be trained to use AI tools effectively for teaching-learning processes.

3. Professional Development of Teacher Educators:
Teacher educators should receive continuous training in Artificial Intelligence applications.
4. Promotion of Innovative Teaching Practices:
AI can support activity-based, learner-centered, and personalized teaching methods.
5. Improvement of Assessment Practices:
AI-based assessment tools can help teachers design effective evaluation strategies.

20. Recommendations

Based on the findings, the following recommendations are suggested:
1. Teacher education institutions should establish AI-supported learning environments.
2. Regular workshops on Generative AI applications should be organized for student teachers.
3. Ethical guidelines for AI use in education should be developed.
4. AI-based lesson planning and assessment practices should be encouraged.
5. Research on AI integration in different areas of education should be promoted.
6. Institutions should develop digital innovation centres for technology-based teaching practices.

21. Limitations of the Study

The study has the following limitations:
1. The sample was limited to 60 student teachers.
2. The study was conducted in only one teacher education institution.
3. The intervention period was limited to eight weeks.
4. The study focused mainly on quantitative analysis.
5. Long-term effects of Generative AI on teaching practices were not studied.

22. Suggestions for Further Research

Future researchers may consider:
1. Comparative studies between AI-based and traditional teaching methods.
2. Studies on the impact of AI on student motivation and engagement.
3. Research on AI applications in inclusive and special education.
4. Longitudinal studies on teacher professional development through AI.
5. Studies involving multiple teacher education institutions.
6. Research on ethical challenges and responsible AI usage in education.

23. Conclusion

Generative Artificial Intelligence has emerged as an important educational innovation that can transform teacher education. The present study demonstrated that AI-supported learning practices significantly improved pedagogical competencies among student teachers.

The integration of Generative AI enhanced lesson planning, instructional design, assessment strategies, digital teaching skills, and reflective practices. AI provides valuable support to teachers by improving efficiency, creativity, and personalization in teaching-learning processes.

However, effective implementation of AI requires ethical awareness, proper training, and responsible usage. Generative AI should be considered as a supportive pedagogical partner that strengthens teachers' capabilities rather than replacing human educators.

Therefore, systematic integration of Generative AI in teacher education can contribute to preparing competent, innovative, and technology-ready teachers for the future.

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