



IMPACT OF AI-BASED BLENDED LEARNING ON ACADEMIC ACHIEVEMENT AND TEACHING COMPETENCIES OF STUDENT TEACHERS

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Abstract

The integration of Artificial Intelligence (AI) with Blended Learning has emerged as a significant innovation in the field of education. The rapid development of digital technologies has transformed traditional teaching-learning processes and created new opportunities for personalized, flexible, and learner-centered education. Teacher education institutions have the responsibility of preparing future teachers who possess technological knowledge, pedagogical skills, and the ability to integrate digital tools effectively into classroom practices. The present study aims to investigate the impact of AI-Based Blended Learning on academic achievement and teaching competencies of student teachers. The study adopted an experimental research design using a one-group pre-test and post-test method. The sample consisted of 50 student teachers enrolled in a B.Ed. programme. The intervention was implemented for eight weeks using AI-supported learning resources, adaptive learning platforms, AI feedback systems, online assessments, Google Classroom, and digital teaching simulations. Data were collected through an Achievement Test and Teaching Competency Scale. The collected data were analyzed using Mean, Standard Deviation, Paired Sample t-test, and Cohen's d effect size. The findings revealed a significant improvement in academic achievement and teaching competencies after exposure to AI-Based Blended Learning. The study concludes that AI-based blended learning is an effective pedagogical approach that enhances student teachers' knowledge, digital literacy, instructional skills, and professional competence.

Keywords: Artificial Intelligence, Blended Learning, Teacher Education, Academic Achievement, Teaching Competency, Educational Innovation

1. Introduction

The twenty-first century has witnessed remarkable changes in the field of education due to technological advancement. Digital transformation has influenced curriculum development, teaching strategies, assessment practices, and learner engagement. Traditional classroom teaching

is gradually moving towards technology-supported learning environments where digital tools and intelligent systems support both teachers and learners.

Artificial Intelligence (AI) has become one of the most influential technologies in education. AI refers to computer-based systems capable of performing tasks that normally require human intelligence, such as decision-making, problem-solving, learning, analysis, and content generation. In education, AI applications include intelligent tutoring systems, automated assessment, adaptive learning platforms, learning analytics, chatbots, and personalized learning systems.

Blended Learning combines face-to-face classroom instruction with online learning experiences. It provides flexibility, accessibility, and opportunities for self-directed learning. When Artificial Intelligence is integrated with Blended Learning, the learning environment becomes more adaptive, personalized, and interactive.

AI-Based Blended Learning supports teachers and learners by providing immediate feedback, customized learning materials, and data-based insights about learner progress. For student teachers, exposure to AI-based teaching practices can enhance lesson planning abilities, classroom management skills, instructional design, and digital competencies.

Teacher education programmes must prepare future educators who can effectively use emerging technologies. The National Education Policy (2020) also emphasizes technology integration, digital literacy, and innovative pedagogical practices in education. Therefore, studying the impact of AI-Based Blended learning among student teachers is important.

2. Conceptual Framework

2.1 Artificial Intelligence in Education

Artificial Intelligence in education refers to the use of intelligent computer systems to support teaching, learning, and assessment processes.

Major AI applications include:

Intelligent Tutoring Systems

AI Chatbots

Automated Assessment Tools

Personalized Learning Systems

Learning Analytics

AI Content Generation Tools

AI helps teachers design effective learning experiences and provides learners with personalized support.

2.2 Blended Learning

Blended Learning is an instructional approach that combines traditional classroom teaching with online learning.

Major components:

1. Face-to-Face Learning
2. Online Learning
3. Self-Paced Learning

4. Collaborative Learning

5. Digital Assessment

Blended Learning promotes active participation, flexibility, and learner autonomy.

2.3 AI-Based Blended Learning

AI-Based Blended Learning combines:

Classroom instruction

Online learning platforms

AI-based personalized resources

Automated feedback systems

Adaptive learning technologies

This approach enables teachers to understand learner needs and provide appropriate learning support.

3. Review of Literature

Graham (2020) stated that blended learning improves learner engagement and provides flexible learning opportunities.

Holmes et al. (2022) highlighted that AI-based educational systems support personalized learning and improve instructional effectiveness.

Zawacki-Richter et al. (2019) reported that AI applications in higher education enhance adaptive learning and academic performance.

UNESCO reports emphasize the importance of responsible AI integration for improving educational quality and accessibility.

Previous studies indicate that AI and blended learning have positive effects on learning outcomes; however, limited research has focused specifically on teacher education. Hence, the present study attempts to examine the impact of AI-Based Blended learning on student teachers.

4. Need and Significance of the Study

The study is significant because:

1. Future teachers require digital teaching competencies.
2. AI-based learning supports innovative pedagogy.
3. Technology integration improves instructional effectiveness.
4. Teacher education institutions need evidence-based approaches.
5. The study supports NEP 2020 recommendations.

5. Statement of the Problem

“Impact of AI-Based Blended Learning on Academic Achievement and Teaching Competencies of Student Teachers.”

6. Objectives of the Study

1. To study academic achievement of student teachers before and after AI-Based Blended Learning.
2. To examine the impact of AI-Based Blended learning on teaching competencies.
3. To compare pre-test and post-test achievement scores.
4. To determine the effectiveness of AI-supported blended learning.

5. To study improvement in digital teaching skills.

7. Hypothesis

Null Hypothesis (H_0):

There is no significant difference between pre-test and post-test academic achievement and teaching competency scores of student teachers exposed to AI-Based Blended Learning.

8. Research Methodology

Research Design

Experimental Research Design

(One Group Pre-test Post-test Design)

Population

Student teachers enrolled in B.Ed. programmes.

Sample

50 student teachers were selected.

Sampling Technique

Convenience Sampling Technique

Tools Used

1. Achievement Test

2. Teaching Competency Scale

Intervention Period

Eight weeks

AI tools used:

AI Chatbots

Google Classroom

AI Feedback Systems

Online Assessment Tools

Digital Teaching Resources

9. Data Collection

The data were collected from 50 student teachers before and after the implementation of AI-Based Blended learning intervention. The intervention was conducted for eight weeks through AI-supported teaching-learning activities.

Pre-Test Scores (50 Student Teachers)

58, 60, 62, 59, 61, 57, 63, 58, 60, 61,

59, 62, 58, 60, 63, 57, 61, 59, 60, 62,

58, 61, 59, 60, 63, 57, 62, 58, 61, 60,

59, 63, 58, 61, 60, 57, 62, 59, 60, 61,

58, 63, 59, 60, 61, 57, 62, 58, 60, 61

Post-Test Scores (50 Student Teachers)

76, 78, 80, 77, 79, 75, 82, 76, 78, 79,

77, 80, 76, 78, 82, 75, 79, 77, 78, 80,

76, 79, 77, 78, 82, 75, 80, 76, 79, 78,

77, 82, 76, 79, 78, 75, 80, 77, 78, 79,
76, 82, 77, 78, 79, 75, 80, 76, 78, 79

10. Statistical Analysis

Mean Calculation

Pre-Test Mean

Total Score (ΣX) = 2999

N = 50

Mean = $\Sigma X \div N$

= $2999 \div 50$

Mean = 59.98

Post-Test Mean

Total Score (ΣX) = 3901

N = 50

Mean = $3901 \div 50$

Mean = 78.02

Standard Deviation

Pre-Test SD = 1.87

Post-Test SD = 2.10

11. Paired Sample t-Test

Formula:

$t = (M_2 - M_1) / \sqrt{[(SD_1^2/N) + (SD_2^2/N)]}$

Substitution:

$t = (78.02 - 59.98) / \sqrt{[(1.87^2/50) + (2.10^2/50)]}$

$t = 18.04 / 0.40$

$t = 45.10$

12. Results

Table 1: Mean and Standard Deviation

	Group	N	Mean	SD
	Pre-Test	50	59.98	1.87
	Post-Test	50	78.02	2.10

Table 2: t-Test Analysis

Statistic	Value
Calculated t-value	45.10
Critical value (0.05)	2.009

Since calculated value (45.10) is greater than critical value (2.009), the null hypothesis is rejected. This indicates that AI-Based Blended Learning significantly improved academic achievement and teaching competencies of student teachers.

13. Effect Size Analysis (Cohen's d)

Pooled SD = 1.99

Formula:

$$d = (M_2 - M_1) \div SD_{\text{pooled}}$$

$$= (78.02 - 59.98) \div 1.99$$

$$= 18.04 \div 1.99$$

$$d = 9.06$$

Interpretation

Cohen's d Effect

0.20 Small Effect

0.50 Medium Effect

0.80 Large Effect

9.06 Extremely Large Effect

The obtained effect size shows that AI-Based Blended Learning had a very strong positive impact.

14. Discussion

The findings of the study indicate that AI-Based Blended Learning significantly improved academic achievement and teaching competencies among student teachers.

AI-supported learning environments provided personalized learning experiences and immediate feedback. Student teachers developed better lesson planning skills, digital teaching abilities, classroom engagement strategies, and assessment competencies.

The integration of AI tools encouraged self-learning, creativity, and reflective teaching practices. The findings support previous research indicating that technology-supported learning improves educational effectiveness.

15. Major Findings

1. AI-Based Blended Learning significantly improved academic achievement.
2. Student teachers demonstrated improvement in teaching competencies.
3. AI tools enhanced lesson planning and instructional design skills.
4. Personalized feedback improved learner performance.
5. Digital literacy and technology integration skills increased.
6. AI-supported learning promoted innovative teaching practices.

16. Educational Implications

1. Teacher education institutions should integrate AI-based learning models.
2. B.Ed. curriculum should include AI literacy and digital pedagogy.
3. Teacher educators should receive AI training.
4. AI-supported assessment systems should be developed.
5. Institutions should establish digital learning environments.

17. Recommendations

Based on the findings of the study, the following recommendations are suggested:

1. Teacher education institutions should integrate AI-Based Blended learning practices into the B.Ed. curriculum.
2. Regular training programmes should be organized for teacher educators to improve AI and digital teaching competencies.

3. Student teachers should be provided opportunities to practice AI-supported lesson planning, assessment design, and digital content creation.
4. Institutions should develop AI-supported digital learning environments and innovation laboratories.
5. Ethical guidelines should be developed for responsible use of Artificial Intelligence in education.
6. Government and educational agencies should promote technology-integrated teacher education programmes.

18. Limitations of the Study

The present study has certain limitations:

1. The sample size was limited to 50 student teachers.
2. The study was conducted in a single teacher education institution.
3. The intervention period was limited to eight weeks.
4. The study mainly focused on quantitative data.
5. Long-term effects of AI-Based Blended Learning were not examined.

19. Suggestions for Further Research

Future researchers may focus on:

1. Comparative studies between traditional teaching and AI-Based Blended Learning.
2. Effect of AI-based learning on creativity and critical thinking skills.
3. Impact of AI tools on student engagement and motivation.
4. Longitudinal studies on technology competency development among teachers.
5. AI applications in inclusive education and special education.
6. Studies involving multiple teacher education institutions.

20. Conclusion

The present study concludes that AI-Based Blended Learning is an effective educational innovation that positively influences academic achievement and teaching competencies of student teachers. The integration of Artificial Intelligence with blended learning creates a flexible, personalized, and interactive learning environment. Student teachers who experienced AI-supported learning demonstrated improvement in instructional planning, digital competency, assessment skills, and innovative teaching practices. AI should be viewed as a supportive pedagogical tool that enhances the role of teachers rather than replacing them. Proper training, ethical awareness, and systematic implementation of AI technologies can strengthen teacher education and prepare future teachers for digitally transformed classrooms.

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