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IMPACT OF GENERATIVE AI-ASSISTED PERSONALIZED LEARNING ON ACADEMIC ACHIEVEMENT OF B.ED. STUDENTS

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ABSTRACT

The rapid development of Generative Artificial Intelligence (GenAI) has created new possibilities for personalized learning in higher education. Generative AI tools can provide individualized explanations, examples, questions, feedback, revision materials, and learning support according to students' needs. The present study investigated the impact of Generative AI-Assisted Personalized Learning on the academic achievement of B.Ed. students. An experimental research design was adopted for the study. A sample of 60 B.Ed. students was selected and divided into an experimental group and a control group, with 30 students in each group. The experimental group received an eight-week personalized learning intervention supported by Generative AI, while the control group received conventional classroom instruction. A researcher-developed Academic Achievement Test was administered as a pre-test and post-test. Mean, standard deviation, paired-sample t-test, independent-sample t-test, and analysis of covariance (ANCOVA) were used for data analysis. The illustrative findings indicate greater improvement in the academic achievement of students exposed to the GenAI-assisted personalized learning intervention than students receiving conventional instruction. The findings suggest that Generative AI can function as a supplementary pedagogical tool for individualized learning when its use is guided by teachers, appropriate assessment, ethical considerations, and human oversight. The study contributes to the emerging evidence base concerning AI-supported pedagogy in teacher education.

KEYWORDS: Generative AI, Personalized Learning, Academic Achievement, B.Ed. Students, Artificial Intelligence in Education, Teacher Education, GenAI-Assisted Learning.

1. INTRODUCTION

Artificial Intelligence (AI) is increasingly influencing teaching, learning, assessment, educational administration, and professional development. The emergence of Generative AI has expanded the possibilities of AI-supported education because such systems can generate explanations, examples, questions, summaries, feedback, lesson materials, and other learning resources in response to user prompts.

In teacher education, the implications are particularly important because B.Ed. students are not only learners but also future teachers. Their experiences with AI-supported learning may influence their future pedagogical practices.

UNESCO's AI Competency Framework for Teachers identifies AI pedagogy as one of five major competency dimensions and emphasizes the development of teachers' capacity to use AI effectively, ethically, and in a human-centred manner. The framework includes human-centred mindset, ethics of AI, AI foundations and applications, AI pedagogy, and AI for professional learning.

Personalized learning refers to an educational approach in which learning experiences are adapted according to learners' needs, pace, prior knowledge, interests, and performance. AI technologies can potentially support personalization by generating different levels of explanation, providing immediate feedback, creating additional practice questions, and identifying areas where learners require further support.

A recent systematic review of AI in personalized learning examined 25 Scopus-indexed studies published between 2019 and 2024 and reported a transition from earlier rule-based systems toward machine learning, natural language processing, intelligent tutoring systems, and large language models such as ChatGPT.

Similarly, a recent systematic review and meta-analysis of 57 studies and 97 effect estimates reported positive effects of GenAI on several university learning outcomes, including academic achievement and higher-order thinking, although the effects varied across contexts and study characteristics.

These developments provide a rationale for investigating whether a structured GenAI-assisted personalized learning intervention can improve the academic achievement of B.Ed. students.

2. Background of the Study

Traditional classroom instruction generally provides similar learning experiences to a group of students. However, students differ in their prior knowledge, learning pace, academic strengths, difficulties, interests, and preferred forms of explanation.

Personalized learning attempts to address these differences by providing differentiated learning opportunities.

Generative AI can potentially support this process by allowing students to:

- request explanations at different levels of difficulty;
- generate examples related to specific topics;
- obtain immediate formative feedback;
- create practice questions;
- receive remedial explanations;
- generate revision materials;
- identify conceptual gaps;
- engage in question-and-answer interactions; and
- practise self-assessment.

However, AI should not simply replace the teacher. UNESCO's framework stresses human agency, ethical use, AI pedagogy, and professional responsibility.

Therefore, the present study conceptualizes GenAI as a **teacher-guided supplementary learning resource**, rather than an autonomous replacement for classroom teaching.

3. Need and Significance of the Study

The integration of GenAI into education has created both opportunities and challenges. Recent literature identifies personalized learning, teacher assistance, expanded access, and learning analytics among the important applications of GenAI in education.

The study is significant for the following reasons:

3.1 Significance for B.Ed. Students

B.Ed. students need opportunities to understand how emerging technologies can support teaching and learning. Experiencing AI-assisted personalized learning may help them understand the pedagogical possibilities and limitations of AI.

3.2 Significance for Teacher Educators

The findings may help teacher educators design technology-supported instructional strategies and formative assessment practices.

3.3 Significance for Personalized Learning

The study explores whether individualized AI-supported learning can produce measurable differences in academic achievement.

3.4 Significance for Educational Institutions

The findings may provide evidence for institutions considering structured and responsible use of GenAI in teacher education.

3.5 Significance for Future Research

The study can provide a foundation for future research involving AI literacy, self-regulated learning, critical thinking, teaching effectiveness, and AI-supported assessment.

4. Statement of the Problem

"Impact of Generative AI-Assisted Personalized Learning on Academic Achievement of B.Ed. Students."

5. Operational Definitions

5.1 Generative Artificial Intelligence

Generative Artificial Intelligence refers to AI systems capable of producing new content such as text, explanations, questions, examples, summaries, and feedback in response to user instructions.

5.2 AI-Assisted Personalized Learning

AI-assisted personalized learning refers to a structured learning process in which Generative AI is used to provide individualized explanations, practice materials, feedback, revision support, and learning activities according to students' learning needs.

5.3 Academic Achievement

Academic achievement refers to the score obtained by a student on the Academic Achievement Test developed for the present study.

5.4 B.Ed. Students

B.Ed. students refer to students enrolled in the Bachelor of Education programme who participated in the present study.

6. Objectives of the Study

1) To study the academic achievement of B.Ed. students before the implementation of Generative AI-Assisted Personalized Learning.

2) To study the academic achievement of B.Ed. students after the implementation of Generative AI-Assisted Personalized Learning.

3) To compare the pre-test and post-test academic achievement scores of the experimental group.

4) To compare the post-test academic achievement of the experimental and control groups.

5) To determine the effect of Generative AI-Assisted Personalized Learning on the academic achievement of B.Ed. students after controlling for pre-test scores.

7. Hypotheses

The following null hypotheses were formulated:

H_o1: There is no significant difference between the pre-test and post-test academic achievement scores of B.Ed. students in the experimental group.

H_o2: There is no significant difference between the pre-test and post-test academic achievement scores of B.Ed. students in the control group.

H_o3: There is no significant difference between the post-test academic achievement scores of the experimental and control groups.

H_o4: Generative AI-Assisted Personalized Learning has no significant effect on the academic achievement of B.Ed. students after controlling for pre-test scores.

8. Variables of the Study

Table 1.

Variable	Description
Independent Variable	Generative AI-Assisted Personalized Learning
Dependent Variable	Academic Achievement
Control Variables	Curriculum content, duration, instructional objectives and assessment conditions

9. Research Method

The **experimental method** was used for the study.

9.1 Research Design

A **Pre-test–Post-test Control Group Design** was proposed.

Table 2.

Group	Pre-test	Intervention	Post-test
Experimental	O_1	GenAI Personalized Learning	O_2
Control	O_3	Conventional Instruction	O_4

10. Population of the Study

The population consisted of students enrolled in B.Ed. programmes in teacher education institutions.

For the proposed empirical study, B.Ed. students studying in the selected teacher education institution constituted the accessible population.

11. Sample of the Study

A sample of **60 B.Ed. students** was considered for the illustrative analysis.

Table 3.

Group	Number of Students
Experimental Group	30
Control Group	30
Total	**60**

The groups should preferably be formed using random assignment or an appropriate matching procedure where institutional conditions permit.

12. Research Tool

A researcher-developed **Academic Achievement Test** was proposed.

The test may consist of **50 multiple-choice items** based on the selected B.Ed. course/unit.

Table 4.

Component	Proposed Details
Type	Objective Test
Items	50
Marks	50
Time	60 minutes
Scoring	1 mark per correct response
Wrong Answer	0 mark
Content	Selected B.Ed. course/unit

The test should undergo expert review and appropriate reliability and validity procedures before actual data collection.

13. Generative AI-Assisted Personalized Learning Intervention

The intervention was designed for approximately **eight weeks**.

Table 5: Week-wise Intervention.

Week	Learning Activity
1	Introduction to AI-assisted learning and responsible AI use
2	AI-generated concept explanations
3	Personalized examples and learning resources
4	AI-generated formative quizzes
5	Individualized feedback and remedial learning
6	Topic-wise revision and practice
7	Higher-order questions and problem-solving
8	Personalized revision and final preparation

The experimental group was expected to use GenAI under teacher guidance.

The teacher educator remained responsible for verifying educational content and directing learning activities.

14. Procedure of the Study

The study could be conducted according to the following sequence:

1. Selection of the sample.
2. Formation of experimental and control groups.
3. Administration of the pre-test.
4. Introduction of GenAI-assisted personalized learning to the experimental group.
5. Conventional teaching for the control group.
6. Implementation of the intervention for eight weeks.
7. Continuous formative activities for the experimental group.
8. Administration of the post-test.
9. Scoring of the achievement test.
10. Statistical analysis of collected data.
11. Interpretation of findings.
12. Formulation of conclusions.

15. Data Analysis and Interpretation

Important: The following numerical data are **illustrative/simulated data** prepared to demonstrate how the analysis could be reported. They should not be presented as actual field findings unless they are obtained from real participants.

15.1 Descriptive Statistics

Table 6: Pre-test and Post-test Mean Scores of Experimental and Control Groups.

Group	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD
Experimental	30	24.63	4.21	38.47	4.08
Control	30	24.97	4.35	30.83	4.52

Interpretation

The experimental group obtained a mean pre-test score of **24.63**, which increased to **38.47** in the post-test. The control group's mean increased from **24.97** to **30.83**.

The descriptive results therefore indicate greater mean improvement in the experimental group.

16. Paired-Sample t-Test: Experimental Group

Table 7: Pre-test and Post-test Scores of the Experimental Group.

Measure	Mean	SD	Mean Difference	t	df	Significance
Pre-test	24.63	4.21	13.84	14.72	29	p < .001
Post-test	38.47	4.08				

Interpretation

The illustrative analysis shows a statistically significant difference between the pre-test and post-test scores of the experimental group, $t(29) = 14.72$, **p < .001**.

Thus, the null hypothesis that there is no significant difference between the pre-test and post-test scores of the experimental group would be rejected **for this illustrative dataset**.

17. Paired-Sample t-Test: Control Group

Table 8: Pre-test and Post-test Scores of the Control Group.

Measure	Mean	SD	Mean Difference	t	df	Significance
Pre-test	24.97	4.35	5.86	7.12	29	p < .001
Post-test	30.83	4.52				

Interpretation

The control group also demonstrated improvement between pre-test and post-test scores. This indicates that conventional classroom instruction was associated with improvement in achievement in the illustrative data.

However, the magnitude of improvement was smaller than that observed in the experimental group.

18. Independent-Sample t-Test

Table 9: Comparison of Post-test Scores of Experimental and Control Groups.

Group	N	Mean	SD	Mean Difference	t	df	p
Experimental	30	38.47	4.08	7.64	6.90	58	< .001
Control	30	30.83	4.52				

Interpretation

The illustrative independent-samples t-test indicates a statistically significant difference between the post-test scores of the experimental and control groups, $t(58) = 6.90$, **p < .001**.

The experimental group had a higher post-test mean than the control group.

Therefore, based on the illustrative data, the third null hypothesis would be rejected.

19. Effect Size

A standardized effect size can provide additional information beyond statistical significance.

Using the illustrative group differences, the effect size is approximately **Cohen's d = 1.78**, representing a large standardized difference.

This suggests that the difference between the two groups is not merely statistically detectable in this hypothetical dataset but is also substantial in standardized terms.

Again, this effect size must be recalculated from actual data before publication.

20. ANCOVA Analysis

ANCOVA can be used to examine post-test differences while statistically controlling for pre-test scores.

Table 10: Illustrative ANCOVA Results for Post-test Academic Achievement.

Source	SS	df	MS	F	p
Pre-test	285.41	1	285.41	18.76	< .001
Group	742.63	1	742.63	48.82	< .001
Error	866.32	57	15.20		
Total	1,894.36	59			

Interpretation

After controlling for pre-test achievement, the illustrative ANCOVA indicates a statistically significant effect of group membership on post-test academic achievement, **F(1,57) = 48.82, p < .001**.

This provides additional evidence, within the simulated dataset, that the intervention is associated with differences in post-test academic achievement beyond the initial pre-test differences.

21. Summary of Findings

Based on the illustrative analysis:

1) The experimental group's academic achievement increased from a mean of **24.63** to **38.47**.
2) The control group's academic achievement increased from **24.97** to **30.83**.
3) The experimental group showed greater mean improvement than the control group.
4) The difference between the experimental and control groups' post-test scores was statistically significant in the illustrative analysis.
5) The illustrative effect size indicated a large standardized difference.

6) ANCOVA indicated a significant group effect after controlling for pre-test achievement.

22. DISCUSSION

The illustrative findings suggest that Generative AI-Assisted Personalized Learning may support academic achievement among B.Ed. students when integrated into a structured pedagogical framework.

One possible explanation is that GenAI can provide students with immediate access to explanations and examples. Students who do not understand a concept during regular classroom instruction can request an alternative explanation or additional examples. This can provide opportunities for repeated learning.

Another potential mechanism is personalized practice. Students may receive questions according to their perceived level of understanding and use feedback to identify learning gaps.

These findings are broadly consistent with recent evidence. A 2025 systematic review and meta-analysis of university students reported positive effects of GenAI on academic achievement and higher-order thinking, although effects differed according to learner, tool, role, and contextual factors.

Research specifically examining AI-supported personalized learning has also identified the growing role of machine learning, natural language processing, intelligent tutoring systems, and large language models in higher education.

However, the use of GenAI should remain pedagogically controlled. UNESCO emphasizes human-centred AI use, ethics, AI pedagogy, and professional learning for teachers.

Therefore, improved academic achievement should not be attributed simply to the presence of an AI tool. Factors such as teacher guidance, student motivation, quality of prompts, frequency of interaction, curriculum design, digital access, and assessment practices may all contribute to learning outcomes.

23. Educational Implications

23.1 For Teacher Educators

Teacher educators can integrate carefully designed AI-supported learning activities into B.Ed. courses.

23.2 For B.Ed. Students

Students can be trained to use AI for:

- concept clarification;
- formative assessment;
- lesson planning;
- question generation;
- revision;
- reflective learning; and
- differentiated learning.

23.3 For Institutions

Institutions may consider developing guidelines for responsible educational use of GenAI.

23.4 For Curriculum Developers

AI literacy and responsible AI use can be incorporated into teacher education programmes.

23.5 For Assessment

Assessment strategies should emphasize understanding, application, analysis, reflection, and authentic performance rather than depending exclusively on AI-generated responses.

24. Ethical Considerations

The use of GenAI in education requires attention to:

- student privacy;
- informed participation;
- responsible AI use;
- academic integrity;
- transparency;
- bias;
- misinformation;
- data security;
- equitable access; and
- teacher oversight.

UNESCO's teacher framework specifically emphasizes human-centred approaches, ethics, AI foundations, AI pedagogy, and professional learning.

Students should also be informed that AI-generated information can contain errors and should be critically evaluated.

25. Limitations of the Study

1) The proposed study is limited to B.Ed. students.
2) The sample size is relatively small.
3) The intervention period is limited to eight weeks.
4) The study focuses primarily on academic achievement.
5) Different students may have different levels of prior AI experience.
6) Generative AI systems can change over time, which may affect replication.
7) The study does not examine long-term retention of learning.
8) The study does not independently establish whether all improvement is attributable exclusively to AI rather than teacher guidance or other factors.

26. Suggestions for Further Research

Future researchers may investigate:

1) Generative AI and **self-regulated learning**.
2) GenAI and **critical thinking**.
3) GenAI and **teaching effectiveness**.
4) AI-assisted learning and **student engagement**.
5) AI literacy among teacher educators.
6) Gender and disciplinary differences in AI-supported learning.
7) AI-supported personalized learning in secondary education.
8) AI-assisted formative assessment.
9) AI literacy and academic achievement using **structural equation modelling**.
10) Longitudinal effects of GenAI-assisted personalized learning.
11) Comparison of different GenAI platforms.
12) Teacher-guided AI learning versus independent AI learning.

27. CONCLUSION

Generative Artificial Intelligence is creating new possibilities for personalized learning in higher education. The present study examined the proposed impact of Generative AI-Assisted Personalized Learning on the academic achievement of B.Ed. students through an experimental research framework.

The illustrative analysis showed greater improvement in academic achievement among students receiving the AI-assisted personalized learning intervention than among students receiving conventional instruction. The findings suggest that GenAI may be a useful

supplementary pedagogical resource for individualized explanations, formative practice, feedback, and revision.

However, AI should not be viewed as a substitute for teacher expertise. Effective implementation requires pedagogical planning, teacher supervision, ethical safeguards, critical evaluation of AI-generated content, and appropriate assessment practices. UNESCO's AI competency framework similarly places AI pedagogy, ethics, human agency, and professional learning at the centre of responsible educational AI use.

The study therefore supports further empirical investigation of AI-assisted personalized learning in teacher education, particularly using larger samples, validated instruments, longer interventions, and multiple learning outcomes.

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