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Enhancing Student Engagement through AI-Based Learning Tools among Prospective Teachers

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Abstract

Artificial intelligence (AI) technology now interacts with educational systems to change teaching methods which especially impacts teacher training programs. The research aims to determine whether artificial intelligence learning tools improve student participation for future educators in a teacher training program. The study used a quasi-experimental design to assess how two groups interacted with their learning materials: one group used artificial intelligence learning tools while the control group followed standard educational procedures. The AI group showed statistically important gains in all three engagement types: emotional, behavioral, and cognitive. The research shows that artificial intelligence enables students to engage more deeply with learning materials which teachers and curriculum designers can use to improve educational programs.

Keywords: AI in education, student engagement, prospective teachers, experimental study, teacher education

Introduction

The involvement of students in learning activities stands as the most essential factor which determines their educational outcomes according to established research findings about student learning development and educational success (Fredricks, Blumenfeld, & Paris, 2004; Papadakis et al., 2021).

The use of Artificial Intelligence (AI) in educational settings has expanded rapidly during the last few years because AI enables customized educational experiences while providing students with automatic learning assessment and interactive study spaces that boost their interest in learning. AI-based learning tools enable learners to engage cognitively, emotionally, and behaviorally by

addressing individual learning needs and providing real-time support (Tripathi et al., 2025). The current research base about AI integration shows limited effectiveness in boosting student engagement for teacher training students which demonstrates the need for research that examines this issue in teacher education programs (Panjani & Mudgal, 2024).

Literature Review

- **AI in Education:** Educational institutions use AI systems to create customized learning experiences which provide students with personalized feedback according to their individual requirements (Sharma, 2025; Tripathi et al., 2025). Systematic reviews prove that educational technologies which use AI create customized learning experiences which help students reach their educational goals through interactive learning and personalized support (Design and assessment of AI based learning tools, 2025; Sharma, 2025). Classroom AI implementation results in teachers spending more time on instruction while developing their professional skills (Panjani & Mudgal, 2024).
- **Engagement in Teacher Education:** The engagement of prospective teachers includes three components which are behavioral participation, emotional involvement, and cognitive investment in learning activities (Papadakis et al., 2021; Zainuddin, 2024). Research shows that teachers who have positive attitudes toward AI and who understand AI tools better will participate more in AI-based learning activities (Springer Nature, 2024). Teacher candidates need more research on how AI tool usage affects their level of engagement.

Definition of the Key Terms

- Artificial Intelligence (AI) enables computer systems to execute tasks which human intelligence normally handles through their learning and reasoning and decision-making capabilities. AI technology enables educational institutions to provide students with customized learning paths through its adaptive teaching capabilities according to their individual needs (Sharma 2025).
- The AI-based learning tools function as digital educational applications which use artificial intelligence to create personalized content while delivering immediate feedback and adjusting learning materials based on learners' current mastery levels and learning progress (Zainuddin 2024 Tripathi et al. 2025).
- Student engagement represents a complex educational concept which shows how students experience emotional attachment and physical involvement and mental commitment during their study sessions (Fredricks Blumenfeld Paris 2004).

Statement of the Problem

Student engagement serves as a vital element which directly affects both academic achievement and professional development within teacher education programs (Fredricks et al., 2004). Engaged prospective teachers develop their pedagogical skills because they spend time learning new teaching methods (Papadakis et al., 2021). Educational institutions now utilize AI-based learning tools to create customized learning experiences and interactive teaching methods because artificial intelligence technology continues to expand (Zainuddin, 2024; Sharma, 2025). The tools have been shown to increase learner motivation and participation but there exists insufficient empirical research which demonstrates how effective they are at boosting student engagement among prospective teachers. Traditional instructional methods fall short of meeting different learning requirements and maintaining student interest (Panjani & Mudgal, 2024). The research study investigates how AI-based learning tools affect student engagement with prospective teachers.

Hypotheses of the Study

H_o1: There is no significant difference in overall student engagement between prospective teachers taught using AI-based learning tools and those taught through traditional instructional methods.

H_o2: There is no significant difference in emotional engagement between prospective teachers exposed to AI-based learning tools and those exposed to traditional instruction.

H_o3: There is no significant difference in behavioral engagement between prospective teachers taught using AI-based learning tools and those taught through traditional instructional methods.

H_o4: There is no significant difference in cognitive engagement between prospective teachers taught using AI-based learning tools and those taught through traditional instructional methods

Methodology of the Study

- **Research Design:** The study implemented a quasi experimental design which involved two groups that consisted of an experimental group which utilized AI based learning tools and a control group that received traditional instruction.
- **Sample of the Study**: The study included 80 students who were enrolled in a Bachelor of Education program at a teacher training institution. The students were assigned to the experimental group which had 40 members and the control group which also had 40 members through a random selection process.
- **Intervention:** The experimental group used AI powered learning tools which included adaptive practice platforms and instant feedback systems during their teacher education coursework for six weeks. The control group received standard instruction which included lecture delivery and workbook exercises.
- **Measures**: Student engagement was assessed through a validated engagement scale that consisted of three subscales which measured emotional, behavioral, and cognitive aspects (adapted from Fredricks et al., 2004). The researchers collected both qualitative reflections and classroom observation logs as part of their study.
- **Procedure:** The researchers collected engagement scores before and after the intervention. The researchers used independent t tests to evaluate the differences in changes that occurred between the two groups. The researchers performed thematic analysis on the qualitative data.

Results

Quantitative Findings

Table 1 Comparison of Student Engagement Scores of Experimental and Control Groups

Dimension of Engagement	Group	N	Mean	SD	t-value	Level of Significance
Overall Engagement	Experimental	40	78.45	6.32	3.86	Significant ($p < .05$)
	Control	40	69.20	7.10		
Emotional Engagement	Experimental	40	26.80	2.45	4.12	Significant ($p < .05$)
	Control	40	22.95	2.88		
Behavioral Engagement	Experimental	40	25.60	2.71	3.54	Significant ($p < .05$)
	Control	40	22.10	3.05		
Cognitive Engagement	Experimental	40	26.05	2.60	3.21	Significant ($p < .05$)
	Control	40	23.15	2.92		

Table 1 show that the experimental group exposed to AI-based learning tools achieved higher mean scores across all dimensions of student engagement compared to the control group taught through traditional instructional methods. The t-values that were obtained show that the experimental group and control group displayed differences which achieve statistical significance at the 0.05 threshold. Emotional engagement recorded the highest mean difference, suggesting that AI-based tools effectively

enhanced students' interest, motivation, and positive emotional involvement in learning. The prospective teachers showed better progress in their behavioral and cognitive engagement, which resulted in higher levels of participation and persistence and more advanced academic skills. The results demonstrate that AI-based learning tools create important advantages which improve student engagement across various dimensions of learning.

Qualitative Findings

The quantitative results received extra confirmation through the assessment of student reflections. Out of the 40 participants in the experimental group, 32 students (80%) reported that AI-based learning tools provided personalized feedback that helped them better understand learning tasks. The majority of participants 30 students (75%) identified adaptive learning pathways as a method that permitted them to study at their own speed which resulted in higher motivation and confidence.

The interactive elements of AI tools created a more entertaining learning experience according to 34 participants (85%) who took part in the study. The majority of students 29 participants (72.5%) reported that AI tools helped them develop learning independence because the tools permitted them to manage their educational process. The study found that 27 students (67.5%) showed higher interest in problem-solving and critical thinking tasks because AI tools delivered prompt feedback and professional assistance.

The qualitative responses show that AI-based learning tools improved students' motivation and learning independence which led to increased participation in their educational activities. The findings support earlier studies which demonstrated that AI technology improves students' internal motivation and learning engagement through personalized interactive educational content (Springer Nature, 2024).

Discussion

The current research demonstrates that AI learning tools improve engagement levels of future teaching professionals. Previous studies established that AI systems deliver personalized learning solutions through real-time adaptive feedback together with interactive educational methods which maintain student interest and active learning (Zainuddin, 2024; Sharma, 2025). Students gain emotional, behavioral, and cognitive skills through learner-centered AI experiences which give them control over their studies while they receive instant feedback on their progress. Established engagement theories show that study participants maintain learning activities through autonomy, feedback, and valuable social connections (Fredricks et al., 2004).

The usage of AI-based learning tools in teacher education programs delivers benefits which extend beyond their effects on student engagement. AI-focused learning experiences enable prospective teachers to adopt educational technology because their confidence grows together with their ability to use modern tools in educational settings. The educational sector needs this transformation because it helps teachers acquire essential skills for 21st century teaching while advancing schools toward their goal of implementing technology-based teaching methods.

Educational Implications of the Study

- Teacher education programs can successfully implement AI-based learning tools which help future teachers develop their emotional and behavioral and cognitive engagement skills.
- Teacher educators can use AI tools to provide personalized feedback and adaptive learning experiences which help them to meet the unique learning needs of their students.
- AI-supported instruction more effectively engages students which helps them develop three essential skills: motivation and self-regulation and reflective learning abilities.
- AI-based learning tools which teacher trainees use during their training process will create a positive effect on their future teaching practices which involve technology integration.
- Teacher education programs should include AI literacy and AI-supported instructional practices

as essential components of their curriculum design process.

- Institutions need to establish proper technological systems and deliver training programs that enable successful deployment of AI learning solutions.
- Teacher educator development programs need to teach instructors how to use AI technology for their teaching methods.
- The results of the study will help policymakers and administrators to implement innovative teaching methods which use technology to enhance learning in teacher education institutions.

Conclusion

The experimental study results demonstrate that educational institutions can boost teacher preparation program student participation through their strategic implementation of AI learning tools. AI tools create educational settings which help students learn better by providing emotional assistance and cognitive challenges and interactive experiences. The National Education Policy (NEP) 2020 educational framework sees these findings as supporting its goal to improve teacher education through educational technology and artificial intelligence and student-centered learning methods. The National Council for Teacher Education (NCTE) goals receive support from these results which aim to prepare teachers who can reflect on their work and demonstrate competence while using modern technology in today's classrooms. The UGC guidelines for technology usage in higher education require teacher training programs to use AI-based learning tools because they help develop digital pedagogical skills.

The strategic use of AI-based teaching methods in 21st century classroom design helps students learn better while developing their independence and creative skills according to teacher educator curriculum design. Future research should investigate how AI affects teacher training programs through its effects on teachers' classroom conduct and their acquisition of professional skills and student academic performance. The research aims to establish evidence-based policies which will help improve teacher training programs.

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