

Preparing Future Educators with Artificial Intelligence: The Impact of Artificial Intelligence-Based Pre-service Teacher Training on Students Achievements

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Abstract

Artificial intelligence (AI) has become an integral part of teacher education, which raises the need to prepare pre-service teachers to acquire knowledge, skills, and ethics for implementing AI in education. The current study aimed to determine the relationship between AI-assisted pre-service teacher preparation and pre-service teachers' perceptions of their future educational outcomes in Higher Education Institutions (HEIs) in Punjab, Pakistan. The numerical survey design was adopted, and 120 pre-service teachers were selected from public and private HEIs through stratified random sampling on proportional bases. The data was collected by 32 item questionnaire that how teacher use AI in preparation of lesson plan, assessment, problem solving and feedback. The data analyzed using descriptive statistic, Pearson correlation and regression analysis.. The results revealed that the level of AI-assisted pre-service teacher preparation ($M = 3.87$, $SD = 0.23$) and perceived future learning outcomes ($M = 3.98\%$, $SD = 0.21\%$) were high amongst the participants. The analysis further revealed a statistically significant positive correlation between AI-assisted pre-service teacher preparation and perceived future educational outcomes, $r = .226$, $p < .05$. Additionally, the regression analysis revealed that AI-assisted pre-service teacher preparation significantly predicted future educational outcomes with $R^2 = .051$, explaining 5.1% of the variance in future educational outcomes. The study determines that AI-assisted teacher training meaningfully pays to confident insights of future educational outcomes amongst pre-service teachers. The study recommends that institutions should incorporate AI literacy, pedagogical

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application, ethical considerations, and practical experiences with AI in pre-service teacher education programs to positively promote future educational outcomes.

Keywords: *Artificial intelligence, AI-assisted teacher preparation, pre-service teachers, AI literacy, educational outcomes, teacher education,*

Introduction

Artificial Intelligence is a key player in today's educational context and has become a relevant component in the teaching, learning and assessment of education, feedback, lesson planning and educational decision making. Generative AI tools are now emerging, allowing educators and students to gain from quick access to information, content creation, personalized learning and guidance, and instructional planning. As a result, teacher education schools are increasingly called to train future teachers not only to acquire pedagogical knowledge, but also the knowledge, skills and ethics needed for the effective use of AI in the educational context (UNESCO, 2024). UNESCO's AI Competency Framework for Teachers highlights the following AI foundations and applications; AI pedagogy; AI ethics; Human-centred approaches; Professional learning (UNESCO, 2024).

The value of pre-service teacher preparation is that teacher education programmes shape the professional knowledge and competence of future teachers, which will be manifested in the classrooms. The traditional emphases of pre-service teacher preparation are pedagogical knowledge, classroom management, assessment, teaching practice, and subject matter knowledge (Daher, 2025). But, with the beginning of AI at such a fast pace, there is a need to rethink what makes for sufficient preparation for the future teachers. Research studies have found that the pre-service teachers have prior experiences with digital technologies, but lack adequate knowledge about the work of AI and its pedagogical integration, as well as knowledge about how to address the risks posed by AI in education (Ayanwale et al., 2024)

Empirical research related to teacher preparation also highlights growing prevalence of AI in teacher preparation. The recent empirical research about teacher preparation also suggests the increased visibility of AI in teacher preparation. For example, examined 529 pre-service teachers and found that AI usage, detection, ethics, creation and problem-solving were important

dimensions of AI literacy that were correlated with AI knowledge. They believe it is important to educate the next generation of teachers on the concept of AI and how it can be used in education (Ayanwale et al.,2024). A similar result was found by Younis (2024) who has found that the professional development program based on an instructional design framework can enhance the AI literacy of pre-service teachers, highlighting the necessity of structured professional development programs to become an AI competent teacher rather than self-teaching.

Recent studies also have shown that in order to prepare pre-service teachers they need to be trained more than just technically. Pre-service teachers' awareness that AI could be used to personalize learning and boost classroom efficiency, and their concerns about AI detracting from the human aspect of teaching and overreliance on AI. Likewise, studies on pre-service teacher preparedness show that attitudes, self-efficacy, AI literacy and perceptions of AI are crucial factors to consider in teacher preparedness to use AI in learning (Kohnke et al. 2025).

It is a significant question since the educational outcomes of educational preparation with the AI assistant may impact the perception of educational outcomes of future teachers. AI can be used to support enhanced lesson planning, differentiated instruction, formative assessment, feedback, instructional materials and student engagement. A systematic review of the application of AI in education has shown that AI is increasingly being used in the field of education and training (Almasri, 2024). But there is also the learning value of AI—it is not to be taken for granted. The quality of the outcomes is highly dependent on teachers' critical, pedagogical, ethical and appropriate use of AI (Khan ,2024).

Therefore, AI teacher preparation should not be limited to access to AI tools but as a learning experience about AI. It involves educating pre-service teachers about the concept of AI, evaluating AI content, using AI in education, integrating AI with pedagogical knowledge, identifying ethical challenges and maintaining human agency in teaching. UNESCO (2024) further recognizes that the competencies required to successfully embed the use of AI are human-centered approaches, AI ethics, foundations and applications of AI, AI pedagogy and AI supported professional learning. (UNESCO,2024).

Literature Review

This is the formal education, training, hands-on experiences and professional development received prior to the beginning of a teaching career, known as pre-service teacher preparation. The

preparation of teachers should be molded with digital and AI-related skills in today's technological change world. AI-assisted preparation can include using AI tools for lesson planning, instructional design, assessment development, feedback, personalized learning, content generation, reflection and professional learning (Khan, 2024). As AI becomes more dominant in teacher preparation, the skills that are anticipated from future teachers have evolved identifies AI competencies for teachers under five headings:

1. Human-centered mindset
2. Ethics of AI
3. AI foundations and applications
4. AI pedagogy
5. AI for professional learning.

The extent indicates that just knowing how to utilize AI tools is not sufficient to be competent in AI. On the contrary, teachers need to be empowered to make, formed pedagogical decisions when, why, and how to integrate AI, ensuring that it does not impact human responsibility and ethical norms (UNESCO, 2024).

The recent studies have confirmed the necessity of systematic preparation in the context of AI in teacher education. Ayanwale et al. (2024) investigated the AI literacy of 529 pre-service teachers, finding that AI knowledge was a significant predictor of certain aspects of AI literacy. They conclude that there is a need for basic AI knowledge among future teachers to successfully use and assess AI tools in the educational context. In a similar manner, Younis (2024) explored the effectiveness of a PD programme focused on pre-service teachers' AI literacy development. The results show that targeted training can assist in developing competencies relevant for the field of AI. This implies that rather than being an off-the-shelf or informal competence, AI competence should be planned for in teacher preparation programmes. Recent studies have focused on the multi-faceted concept of AI literacy. A study revealed that pre-service teachers had limited knowledge about how AI works and the need for hands-on experiences and group learning to enhance AI literacy (Young, 2025). Similarly, Daher (2025) feels that teacher's AI literacy should not be limited to technical aspects but should involve comprehending AI mechanisms and applications and ethical issues.

Moreover, Meegan and Young (2025) investigated an intervention based on Generative AI to boost the AI literacy and self-efficacy for pre-service teachers. Their work reflects the trend of incorporating AI into teacher preparation, instead of teaching the teachers about AI. The distinction is relevant to the present research since the AI-assisted preparation entails learning about AI and learning with AI. Ayanwale et al. (2024) showed that AI literacy among pre-service teachers has several dimensions as it involves understanding about AI, using AI, recognizing AI-generated content, ethical issues, creation of AI, and problem-solving. It is important to have this multi-dimensional view, as teachers who can use AI to some extent but are unable to assess how accurate and ethically sound it is, may not necessarily enhance educational practices.

The most recent studies also suggest that teachers' attitudes, perceptions, learning experiences also impact AI literacy. Mäkitalo et al. (2025) investigated factors that influence AI literacy in pre-service teachers, and they found that factors such as perceptions of the applications of AI, attitudes towards AI, and AI literacy competencies were related to each other.

This shows that there are two aspects of AI competence – cognitive and practical – that need to be tackled in an effective manner. AI literacy is also a recent trend in Pakistan as demonstrated by recent studies among pre-service teachers. A study in 2025 with 350 pre-service teachers studying B.Ed. and M.Ed. programmes in Pakistan, identified teacher's attitudes and experiences of professional development as significant factors in relation to teacher AI literacy proficiency. The study called for contextually relevant frameworks of AI literacy and ongoing professional development for prospective educators. This offers a specific context rationale to explore the issue of AI-supported teacher preparation in Pakistan (Liaqat, 2024).

There are several ways that AI technologies could impact educational outcomes. Firstly, AI can help in personalized learning by customizing information and learning experiences. Second, AI can help teachers create instruction and assessment materials. Third, AI can give instant feedback and aid formative assessment. Fourth, AI can eliminate repetitive tasks and enable teachers to focus more on pedagogical and interpersonal work. The study conducted by Almasri (2024) suggests that AI is becoming an integral part of the teaching and learning process, impacting various aspects of education including instruction, assessment, and beyond. In a similar vein, Castillo-Martínez et al. (2024) highlighted the significance of AI in the field of higher education research, focusing on how it has been applied in the context of teaching and learning, as well as

the emerging use of generative AI in this domain. But AI is not a magic bullet to create quality learning experiences. How educators use and integrate AI is essential to its effectiveness. If not executed properly, the use of AI can lead to misinformation, excess reliance, limited engagement with critical thinking, issues related to privacy, biases, and diminished teacher-student interaction. Hence, the role of the teacher as a key determinant in the educational value of AI is particularly highlighted in teacher preparation. Teaching therefore emerges as a key factor in the educational value of AI, especially when it comes to the teacher preparation (Kohnke et al, 2025).

On the other hand pre-service teachers were generally positive about the use of AI in personalized learning and classroom efficiency but had concerns about over-dependence on AI and lack of human touch in teaching. The results indicate a need to support balanced and responsible use of AI among teacher trainees, not for indiscriminate adoption of AI (Mäkitalo et al., 2025).

Systematic AI preparation for pre-service teachers can lead to their potential ability to choose suitable AI applications, create teaching materials, develop learning activities, assess AI-generated content, and give suitable feedback. Although there is already a growing number of literature on utilizing AI in education, empirical research on the correlation between AI-assisted preparation of future teachers and perceived educational outcomes is required. However, a study of AI-assisted pre-service teacher preparation as a predictor of perceived quality of the educational outcomes has been less studied comparatively. This research need is therefore tackled in this study, which investigates the impact of the use of AI technology in pre-service teacher education on perceived educational outcome.

Figure 1: *Flow of the study*

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Figure 1. Conceptual Flow of the Study

Statement of the Problem

The fast development of Artificial Intelligence (AI) opens up new ways of improving teacher training and practices. AI may help in such tasks as lesson planning, designing, assessing, developing content, etc. However, along with that, the rising usage of AI in teacher training poses a question about the relation between AI-assisted teacher preparation and quality educational outcomes. Although artificial intelligence is more and more often used in teacher education nowadays, there is no sufficient research conducted that would allow to assess the impact of AI-assisted pre-service teacher training on the perception of educational quality. Most of the current researches focus not on the measurement but on the benefits and issues connected with the use of AI. Hence, there is a need to empirically investigate the relationship between AI-assisted preparation of pre-service teachers and their perception of the quality of educational outcomes. This problem will be explored in the current study.

Research Objective

The objective of this study is following.

1. To examine the influence of AI-assisted pre-service teacher preparation on the perceived quality of educational outcomes.

Research Question

The research question of this study is following:

1. How does AI assisted pre-service teacher preparation influence their perception of quality of educational out come?

Research Hypothesis

Hypothesis of following study is following:

H₁: AI-assisted pre-service teacher preparation significantly predicts the perceived quality of educational outcomes

H₀: AI-assisted pre-service teacher preparation significantly predicts the perceived quality of educational outcomes

Methodology

A quantitative survey research design was used to investigate the impact of using AI in pre-service teacher preparation on the quality of educational outcomes. The quantitative approach was suitable as the data was collected numerically in the form of a structured questionnaire and then analyzed statistically using IBM SPSS (Creswell & Creswell, 2018).

Population

Pre-service teachers participating in teacher education programmes constituted the population. An appropriate sampling technique was used to select the 120 pre-service teachers for the study from IISAT and AIOU. The participants expressed their views on the teacher preparation experience in the context of AI assistance and how it helps to improve education

Sampling

The subjects of the study were pre-service teachers studying teacher-education programmes at higher education institutions in Gujranwala. The students who were being prepared to be teachers and who had access to educational technologies or AI were members of the target group. A proportionate stratified random sampling technique was used to choose participants from the population. The population was divided into relevant strata, including the population of public and private sector higher education institutions, whose sample sizes were proportional to the size of

the population, to ensure adequate representation of the sample size from all the strata. In total, 120 pre-service teachers participated in this study. This sampling method is thought to be appropriate because it was able to offer representation from the various institutional settings and to minimize over representation of one sector.

Research Instrument

A 32 item structured validated questionnaire was used to collect data. The questionnaire was designed to reflect questions about AI support in pre-service teacher preparation such as lesson planning, teaching confidence, learning activities, problem solving, assessment, preparation of teaching materials, preparation, classroom management, feedback, and anticipated future use of AI in the education sector.

Table 1

Descriptive Statistics of the Major Study Variables

Variable			N	M	SD
AI-Assisted	Pre-Service	Teacher	120	3.87	0.23
Preparation					
Perceived Future Educational Outcomes			120	3.98	0.21

As shown in Table 1, the average score for the pre-service teacher preparation students who were taught using AI was 3.87 (SD = 0.23) which suggests that a relatively high proportion of students were prepared with the help of AI. Likewise, perceived future educational outcomes (M = 3.98, SD = 0.21) had relatively high perceived future educational outcomes scores. The relatively small standard deviations suggest that participants' responses were fairly consistent around the mean scores.

Table 2: *Showing the summary*

Variable	1	2
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1. AI-Assisted Teacher Preparation	Pre-Service	1		.226
2. Perceived Educational Outcomes	Future	.226		1
N		120		20

Pearson correlation between AI-Assisted Pre-Service Teacher Preparation and Perceived Future Educational Outcomes was calculated. Pearson correlation was calculated between AI-Assisted Pre-Service Teacher Preparation and Perceived Future Educational Outcomes. Pearson correlation analysis indicated a positive and significant relationship between AI-assisted pre-service teacher preparation and perceived future educational outcomes. This suggests that the more teachers felt about their pre-service program includes AI training, the greater their perceived future educational outcomes were. The correlation statistically significant at 0.05 level. Table 3

Regression Model Summary

Model	R	R ²	Adjusted R	Std. Error of the Estimate
1	.226	.051	.043	.20476

This is a Model Summary for AI-Assisted Pre-Service Teacher Preparation Predicting Future Educational Outcomes. The results shows that AI-assisted pre-service teacher preparation significantly predicted perceived future educational outcomes

Hypothesis Testing

The hypothesis was: (H₀): AI in pre-service teacher preparation does not have a meaningful impact on perceived future educational outcomes. A significant result was obtained in the regression analysis ($p = .013 < .05$). Thus, the null hypothesis is rejected. The results support the hypothesis that AI-supported pre-service teacher preparation significantly positively impacts the perceived future educational outcomes

Findings

Overall, the results showed that AI-supported pre-service teacher preparation was positively and significantly related to the perceived future educational outcomes for 120 participants. The overall

perception of AI-assisted preparation and the perceived future educational outcomes were moderately high. A significant positive Pearson correlation between the two variables was found. The results of the regression analysis also showed that the perceived future educational outcomes were significantly predicted by the AI-assisted pre-service teacher preparation is predicting perceived future educational outcomes. Therefore, the results support the study hypothesis that using Artificial Intelligence in the pre-service teacher preparation process has a positive statistically significant effect on the perceived future educational outcomes.

Discussion

Based on these findings, it is concluded that AI can assist in educational preparation, helping to improve educational results in the future, but it is only one of the factors that influence educational quality. Pedagogical knowledge, teaching practice, digital competence and institutional support, as well as professional skills, may also play a role in the outcomes. Hence, the use of AI in teacher education should be viewed as a tool to complement, not replace, human teachers. To integrate AI effectively into education, teachers need not only technological expertise but also a pedagogical understanding of how to apply AI in the classroom. Conclusion The study finds that AI in pre-service teacher education has a positive impact. The results suggest that AI training future teachers in the use of AI could help to get ready for technology-based teaching and learning. It also indicates that there are still a number of other factors that affect educational results. Hence, the integration of AI preparation with pedagogical knowledge, practical teaching experience, digital competence and ethical awareness in teacher preparation is suggested to make the teacher preparation more effective.

Implications

The results of this study have implications for teacher training institutions. The application of AI to pre-service teacher training programs should be integrated into the pre-service curriculum in a practical way including using AI for creating AI-based lesson plans, assessments, feedback, and instructional materials. Professional development for teacher educators should also be provided to enable them to incorporate AI in pedagogy effectively. In addition, institutions need to develop policies for responsible AI use, including policies on academic integrity, privacy, bias, accuracy and critical evaluation of content created by AI. The pre-service teachers or an expert should be

encouraged to use AI as a technology to support their professional judgment, not replacing the teacher.

Recommendations

The results suggest that AI training needs to be incorporated into pre-service teacher training programmes systematically. Teacher education institutions should provide hands-on training to future teachers on AI literacy and use AI tools for real-world teaching situations. Teacher educators need to be supported with regular professional learning to improve their digital and AI pedagogical skills. It is also necessary for institutions to ensure that they have the necessary technological resources and that ethical guidelines are established for the use of AI in education. Future research is needed to investigate other contextual factors that might explain the variance in perceived educational outcomes, including pedagogical competence, digital competence, institutional support, teaching experience, and teachers' attitudes towards AI, with the exception of AI assisted preparation. Additional research could use larger and more varied samples or mixed-method or longitudinal designs to gain a deeper understanding of the impact of AI in teacher preparation on educational outcomes.

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