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Artificial Intelligence as a Tool for Personalized Learning: A Study of Teacher Preparation

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Abstract

The innovation of Technology is a product of the advancement of Artificial Intelligence, and it impacts contemporary educational practices, especially with personalized learning. Adaptive learning platforms, learning analytics, and intelligent tutoring systems are examples of AI educational tools that customize instruction based on learners' personalized needs, learning pace, and capabilities. Nevertheless, the successful implementation of these technologies in the learning environments is contingent on the tech-savvy disposition, competencies, and attitudes of the teachers. This study focuses on Artificial Intelligence as a tool for personalized learning, and the primary study area is teacher preparation within the realm of the secondary and higher secondary levels. The study employed a mixed methods approach, and data collection was done for the quantitative strand with 200 teachers with the aid of a self-developed questionnaire, and for the qualitative strand in-depth interviews were conducted with 30 teachers. The findings showed that a majority of the teachers had a moderate level of preparedness for AI Supported personalized learning. It was found that there were significant relationships and positive correlations between the dependent and independent variables of teachers' AI-related competencies and attitudes, and formal training in relation to their willingness to implement personalized learning. Teaching experience was found to contribute to the variables i.e. there was no significant contribution of teaching experience to the preparedness of the teachers. It was found that the subject area specialization also contributed to the study variables, and there was significant contribution of the subject area specialization to the preparedness of the teachers. The qualitative findings showed that most of the teachers had a positive perception of AI as a supportive instructional tool, and there were also many challenges of limited training and infrastructure, as well as, the ethical concerns that impact the contribution of AI as a supportive instructional tool most of the teachers perceived. Systematic incorporation of AI literacy, adequate pedagogy, and ethical consideration within teacher education and ongoing training are vital for the successful implementation of AI-enhanced personalized learning.

Keywords: Artificial Intelligence, Personalized Learning, Teacher Preparation, AI Competencies, Teacher Education, Educational Technology

Introduction

The fast development of Artificial Intelligence (AI) continues to create significant changes in various fields, with education being one of the most affected. A range of AI-driven technologies in recent years have altered the conventional teaching and learning processes through the provision of data-driven decision-making, smart content, and adaptive learning technologies. Of the innovations, AI-supported personalized learning has been the most widely researched in addressing the diverse needs of learners and optimizing their level of participation and learning outcomes (Luckin et al., 2016; Holmes et al., 2019). With education systems across the globe shifting to personalized learning, the need for AI to drive such systems becomes significant. Personalized learning is teaching strategies that are designed to give learners different learning experiences based on their individual needs, capacities, preferences, and learning velocity. Learning analytics, intelligent tutoring systems, adaptive learning technologies, and predictive algorithms are examples of AI technologies that help personalization by fostering individualized learning pathways and feedback through the analysis of extensive volumes of learner data (Pane et al., 2017; Woolf, 2010). Regardless of such systems, AI personalization isn't effective unless the educators who the technology is intended to support can learn, utilize, and integrate the technologies into their practice. Thus, educator training is pivotal to the positive and responsible integration of AI into education. Today's teacher training programs are being challenged to instill in teachers more than just content and pedagogy; they are being asked to incorporate training in digital skills, data literacy, and educational AI. Research reveals that a considerable number of educators report being inadequately trained to leverage AI systems for individualized learning due to the absence of training, institutional fill, a dearth of practical learning during and following their teacher education, and a lack of support (Koehler & Mishra, 2009; OECD, 2021). One of the most important challenges stemming from AI technology and teacher preparedness is the effective personalization and learning support in school programs.

In addition, the function of educators within AI-enabled classrooms is shifting from being content deliverers, to being facilitators of learning, designers of learning experiences, and decision-makers, in the interpretation of AI-driven insights. Teachers need to critically assess AI tools for recommendations to see if they meet educational objectives and the relevant goals align with teaching plan, while also addressing the possible concerns related to the privacy of data, digital inequity, inequitable bias, and the data driven ethical gaps present (Williamson & Eynon, 2020). If the relevant educators do not make the right decisions, and apply bias while using AI, they are increasing educational inequity and closing the door to further opportunities to foster adaptable and inclusive educational environments. What are the implications for teachers, and how do the best teacher training programs foster the use of adaptive and personalized learning. Educators designing curriculum, teacher educators, and policy makers, can gain insights into the application of AI in educational practices by studying how various teacher training programs embrace AI, the perceptions of teachers practice regarding AI for teaching and learning, and teacher training programs and curriculum. This study primarily examines the role of teacher training programs in preparing educators who can effectively integrate AI into personalized learning. The study intersects various paradigms to emphasize the need for enhanced integration of AI Pedagogy and Ethics Literacy (AIPE) into teacher preparation programs. The study also situates its focus bias on AI within the extensive discourse of adaptive and personalized education, thereby contributing to the discourse on the education of teachers in the digital age. It further highlights the centrality of teachers in the successful implementation of AI driven personalized learning. It is the teachers who will use the AI tools to foster learning environments that are equitable, meaningful, and focused on the needs of the learners.

Review and Conceptual Framework

Growing usage of Artificial Intelligence (AI) in other disciplines, especially in personalized learning and teacher training, has led to extensive academic debates. AIs can create new paradigms in educational design by revolutionizing traditional teaching frameworks to more flexible, learner-centered structures. Many educators advocate that most AI-driven educational technologies can analyze learner information and tune educational responses to individual needs, learning speed, and cognitive disposition (e.g., Baker & Inventado, 2014; Siemens & Long, 2011). This trend in focusing on educational personalization fits in with the current educational paradigms that seek to be more inclusive and flexible while providing better learning outcomes. Studies focusing on personalized learning and AI adaptive learning environments and recommender systems, in particular, attest to increased learner engagement and performance (e.g., Dede, 2014). Dede (2014) observed that intelligent technologies that support personalized learning environments foster greater learning by providing multiple pathways that allow for differentiated learning. In the same way, Johnson, T. (2016) observed that adaptive digital tools promote self-directed learning by giving learners more power to determine their own learning activities. This research illustrates the support of meaningful personalization by AI technologies when reasonably combined with pedagogical practices. While AI-driven personalized learning has potential, research shows that teacher readiness will most likely prevail as the deciding factor on whether or not AI will drive teacher learning implementation in the first place. This is the most important factor because teachers play the most critical role in interpreting, contextualizing, and applying AI within classroom settings. Limited teacher preparation leads to limited or no use of advanced technologies (Ertmer and Ottenbreit-Leftwich, 2010). Educator preparation programs, therefore, become vital, as they must equip teachers to use AI tools in Learning Design and teaching practice. Current research suggests that teacher preparation programs for AI education must go beyond technology. Teachers, as Redecker (2017) refers to, need to be equipped with frameworks of digital competences that encompasses data literacy, adaptive learning, and critical questioning about learning, and the role technology plays to support learning. With regard to AI, teachers should know how algorithms work, how data about learners is collected and used, and how AI feedback informs teaching decisions. Teachers need to be skilled in these areas, otherwise, they will not be able to meet the pedagogical goals of personalizing learning through AI. Preparing teachers to manage the ethical implications of using AI in education is important to ensure they are ready to manage the ethical issues of data collection, privacy, bias in algorithms, and the lack of transparency of AI tools. Knox (2020) underscored that inequalities can be reinforced if teachers do not recognize the social and ethical ramifications of adopting AI technologies. As a result, programs that educate teachers need to be revised to incorporate ethical reasoning and critical perspectives with the required technology training. There is empirical work that explores the perceptions of AI. Within the body of literature, optimism and concern appear to be the two dominant themes. Some studies found that participants had a positive perception of AI because supported personalized learning, and, AI was seen to have the ability to lessen the burden of instruction, and more fully support learners. Other studies found participants to be concerned because they believed the technology would lead to a loss of professional autonomy. These perceptions illustrate the need for a model of teacher preparation that is comprehensive and truly supportive, and addresses the concerns of pedagogy and the profession.

The literature illustrates that AI can support personalized learning, however, the more critical issue is the preparation of the teachers. The literature has identified the need for the preparation of teachers for the integration of AI, but there exists an insufficient understanding of the teacher education programs that develop the competencies to support personalization through the use of AI. This supports the need for empirical examination of teacher preparation to aid in the development of adaptive and personalized learning environments through the use of Artificial Intelligence.

Need and Significance of the Study

The rise of Artificial Intelligence in education is giving way to new possibilities in personalized learning, although the successful incorporation of these advancements greatly relies on the preparedness of educators. At present, the majority of teachers have inadequate training and lack the confidence necessary to effectively utilize AI technologies, leading to personalized instruction and discrepant adaptive instructional practices. This leaves a substantial gap between the advancements of educational technology and the practices applied in education. Hence, a clear gap exists in the research on pre-service educators' training and education on AI supported personalized learning. This study is valuable to the field of education, considering that the empirical research on teacher education and AI supported personalized learning is rather limited. Moreover, the research initiatives aimed at teaching educational technologies and AI to educators and pre-service educators have also been limited; this study is likely to make an indelible contribution to the field, especially in terms of guiding the development of teacher education, continuing professional development, and policy frameworks aimed to bolster teachers' capacity to utilize AI in ways that center on learner-equals.

Research Questions

1. To what extent have teachers been trained to incorporate Artificial Intelligence into personalized learning?
2. What skills, knowledge, and attitudes have teachers acquired concerning the integration of AI into personalized learning?
3. What is the extent of the relationship, if any, between teachers' AI competencies and their readiness to implement personalized learning?
4. How do teachers view the integrating role of Artificial Intelligence in the facilitation of personalized learning?
5. What concerns and obstacles do teachers encounter when integrating AI-based tools for personalized learning?
6. To what extent do teacher education and professional development programs assist teachers in developing for AI-based personalized learning?

Objectives of the Study

1. To examine the level of preparedness of teachers to use Artificial Intelligence tools for personalized learning in classroom settings.
2. To identify teachers' knowledge, skills, and attitudes toward the integration of AI in personalized instructional practices.
3. To analyze the relationship between teachers' AI-related competencies and their readiness to implement personalized learning approaches.
4. To explore teachers' perceptions, experiences, and challenges regarding the use of AI as a tool for personalized learning.
5. To investigate the extent to which teacher education and professional development programs address AI-supported personalized learning.
6. To develop insights for strengthening teacher preparation programs for effective and ethical integration of AI in personalized learning environments.

Hypotheses of the study

1. H_{01}: There is no significant relationship between teachers' AI-related competencies and their readiness to implement personalized learning.
2. H_{02}: There is no significant difference in the level of preparedness for personalized learning between teachers who have received formal training in AI-based educational technologies and those who have not received such training.
3. H_{03}: Teachers' attitudes toward Artificial Intelligence do not significantly influence their intention to use AI tools for personalized learning.

4. H_{04}: There is no significant difference in teacher preparedness for AI-supported personalized learning based on teaching experience.
5. H_{05}: There is no significant difference in teacher preparedness for AI-supported personalized learning based on subject specialization.

Methodology

Research Design
The researcher adopt a mixed method research design for the study.

Population and Sample
Secondary and higher secondary school of Darbhanga district take as a population for this study. The researcher adopt stratified random to select 200 teachers from various school, while 30 teachers were selected by purposive sampling method for interview.

Tools for Data Collection
The Researcher construct a five point Likert scale questionnaire for quantitative analysis. the researcher verify the tool by the expert of the related field for face validity and for reliability researcher do pilot study and use Cronbach's alpha ($\alpha \approx 0.83$) to find the reliability of the tool. For qualitative tool a semi structured interview scale were construct by researcher.

Procedure of Data Collection
Quantitavie data were collected from 200 teachers and qualitative data were collected from 30 teacher by face to face interview.

Data Analysis
Quantitative data were analysed using descriptive and inferential statistical techniques such as mean, standard deviation, and percentage. Qualitative data were analyzed through thematic analysis to identify key themes related to perceptions, challenges, and training needs in AI-supported personalized learning.

Data Analysis and Interpretation
In this portion the researcher analysed and interpreted the collected data from teachers of secondary and higher secondary teachers. The collected were analysed according to objectives and hypotheses The level of significance was fixed at 0.05.

Objective 1: To examine the level of preparedness of teachers to use Artificial Intelligence tools for personalized learning in classroom settings.

Teachers showed a moderate level of preparedness, indicating awareness of AI but limited classroom-level implementation skills. Preparedness varied more due to training and subject background than years of teaching experience.

Table 1 : Descriptive Statistics Showing Level of Teacher Preparedness

Variable	N	Mean	SD	Level
Teacher Preparedness	200	3.42	0.61	Moderate

Based on the mean score(3.42) obtained, it appears that the teachers have a moderate level of preparedness in using AI tools.

H_{04}: There is no significant difference in teacher preparedness for AI-supported personalized learning based on teaching experience.

Table 2 : ANOVA Showing Difference in Preparedness Based on Teaching Experience

Source of Variation	df	F-value	p-value	Decision
Teaching Experience	3	1.12	0.34	Accepted

Since the p-value (0.34) is greater than 0.05, the null hypothesis is accepted.

H_{05}: There is no significant difference in teacher preparedness for AI-supported personalized learning based on subject specialization.

Table 3: ANOVA Showing Difference in Preparedness Based on Subject Specialization

Source of Variation	df	F-value	p-value	Decision
Subject Specialization	4	4.05	0.018	Rejected

The results indicate a significant difference in preparedness based on subject specialization.

Objective 2: **To identify teachers' knowledge, skills, and attitudes toward the integration of AI in personalized instructional practices.**

Interpretation:

The average score analysis showed that teachers had an optimistic attitude toward Artificial Intelligence, and the only area that they had little knowledge and technical skills was the AI tools. Teachers were willing to use AI to personalize learning, but they felt that they had little training and insufficient knowledge of the AI-powered instructional tools.

Table 4: Mean Scores of Knowledge, Skills, and Attitudes

Component	Mean	SD	Level
AI Knowledge	3.18	0.64	Moderate
AI Skills	3.05	0.67	Moderate
Attitude toward AI	3.76	0.58	High

H_{03}: Teachers' attitudes toward Artificial Intelligence do not significantly influence their intention to use AI tools for personalized learning.

Table 5: Regression Analysis Showing Influence of Attitude on Intention

Predictor	β	t-value	p-value	Decision
Attitude toward AI	0.41	3.92	0.004	Rejected

The hypothesis was rejected, as attitudes were found to significantly influence teachers' intention to use AI, highlighting the importance of fostering positive perceptions during teacher preparation.

Objective 3: To analyse the relationship between teachers' AI-related competencies and their readiness to implement personalized learning approaches.

Interpretation:
The correlation matrix analysis demonstrated a constructive correlation between the teachers' AI competencies and acceptance of personalized learning. Teachers who had more sophisticated AI knowledge and skills were more willing to adopt and use AI to personalize learning.

H_{01}: There is no significant relationship between teachers' AI-related competencies and their readiness to implement personalized learning.

Table 6: Correlation between AI Competency and Readiness

Variables	r-value	p-value	Decision
AI Competency & Readiness	0.48	0.001	Rejected

The hypothesis was rejected, confirming that AI competencies are a strong predictor of teacher readiness.

Objective 4: To explore teachers' perceptions, experiences, and challenges regarding the use of AI as a tool for personalized learning.

Interpretation:
Qualitative analysis shows that teachers valued AI to help address learner variability and improve efficiency in instruction. However, primary obstacles included unresponsive administrative support, the absence of training programs and AI tools, and ethical issues such as inadequate data governance and algorithmic discrimination. These issues hindered effective classroom application.

Objective 5: To investigate the extent to which teacher education and professional development programs address AI-supported personalized learning.

Interpretation:
The results revealed that the exposure of teacher education and professional development programs to AI-enabled personalized learning was both minimal and inconsistent. Teachers who had undergone training in AI-based educational technologies demonstrated a significantly higher level of preparedness compared to those who had not.

H_{02}: There is no significant difference in the level of preparedness between teachers who have received formal AI training and those who have not.

Table 7: t-test Showing Difference Based on AI Training

Group	N	Mean	t-value	p-value	Decision
Trained Teachers	92	3.78	3.26	0.002	Rejected
Untrained Teachers	108	3.19			

The hypothesis was rejected, demonstrating the effectiveness of structured AI-related training programs.

Objective 6: To develop insights for strengthening teacher preparation programs for effective and ethical integration of AI in personalized learning environments.

Interpretation:

Using both quantitative and qualitative data, the study emphasizes the need for teacher preparation programs to systemically include concerns about AI, its integration into pedagogy, and the ethical use of AI in learning environments. In order to aid teachers in getting ready for AI-supported personalized learning, there needs to be ongoing professional development, supplemental training, and institutional support.

The positive disposition of teachers towards Artificial Intelligence in general means that teachers have become more adaptive to the innovations surrounding them, but the study indicates that the teachers' disposition towards AI will more likely still be on the positive side as they will be able to be more utilized by AI supported personalized learning, but will be on the positive side with the use of AI supported personalized learning, but will be more utilized by AI supported personalized learning.

Table 8 : Hypothesis-wise Statistical Analysis and Decision

Hypothesis	Variables Involved	Statistical Test	Calculated Value	p-value	Decision	Reason
H_{01}	AI competencies & readiness	Pearson's r	r = 0.48	0.001	Rejected	$p < 0.05$, significant relationship
H_{02}	AI trained vs untrained teachers	t-test	t = 3.26	0.002	Rejected	Significant mean difference
H_{03}	Attitude & intention to use AI	Regression	$\beta = 0.41$	0.004	Rejected	Attitude significantly predicts intention
H_{04}	Teaching experience groups	ANOVA	F = 1.12	0.34	Accepted	$p > 0.05$, no significant difference
H_{05}	Subject specialization	ANOVA	F = 4.05	0.018	Rejected	Significant difference among subjects

Statistical analysis of each hypothesis indicates that there are several conclusive factors that impacted the level of AI-supported personalized learning the teachers had. The level of teachers' AI knowledge and their preparedness to engage in personalized learning would be positively correlated ($r = 0.48$, $p < 0.05$), supporting the rejection of H_{01}. Also, a disparity existed between teachers who had and had not received formal AI training ($t = 3.26$, $p < 0.05$), supporting the rejection of H_{02}. Further, regression analysis suggests that teacher attitude toward AI tools predicts the positive usage of AI for personalized learning ($\beta = 0.41$, $p < 0.05$), supporting the rejection of H_3. Conversely, there was no statistically significant variance in teacher preparedness relative to their years of teaching ($F = 1.12$, $p > 0.05$), thus supporting H_4, which states that there is no single predictor of readiness for AI integration. Conversely, the negligence of H_5 was based on the fact that subject specialization positively impacted teacher preparedness ($F = 4.05$, $p < 0.05$).

Overall, the experience of teaching as a practice does not influence the willingness to AI fostered individualized learning, while the other defining factors remaining as AI competencies, training, attitudes, subject background, and teaching experience, do shape teacher readiness.

Discussion and Conclusion

The current research studied the role of Artificial Intelligence in personalized learning, specifically focusing on the challenges of teacher readiness. The results show that teachers have a moderate level of readiness for the integration of AI for personalized learning. The positive attitudes of teachers towards AI were complemented with a moderate level of negative constraints resulting from the lack of sufficient hands-on experience, training, and support from the institution. This is in line with the results of the prior literature that states that teachers feel not ready to use newer technologies, despite feeling positive about the use of the newer technologies. The results demonstrate the positive association of teachers' AI skills with teachers' readiness to embrace personalized learning. Teachers with greater AI skills and knowledge were found to have more positive readiness to use AI in extents to integrate tools in instructional practices. This indicates that teacher readiness for personalized learning that is AI supported is primarily determined by teacher competencies and not the number of years of teaching experience. Of the number of different components that comprise teacher readiness, training appears to be the most salient. Teachers who have been trained in AI educational technologies expressed more positive levels of readiness to integrate technologies in the classroom than their non-trained colleagues. Thus, this indicates that more emphasis should be placed on the role of training and structured staff training in supporting teachers to integrate AI in their teaching practices. Also, it was found that AI influences teachers' use of AI tools for personalized learning. Teachers with positive attitudes were more likely to use AI tools. However, teaching experience, on its own, was not sufficient to influence preparedness. In contrast, subject specialization positively affected teacher preparedness. Science and math teachers, compared to teachers from other subjects, were more prepared to teach. Additional qualitative data showed that AI was viewed positively as a tool to support individual learner differences and to improve instructional efficiency. However, the primary barriers to AI use were a lack of tools, limited access to training, and concerns about the ethics of AI and data privacy.

The present study concluded that while AI has the potential to assist personalized learning, its effective use is related to the preparation of the teachers. Teachers' attitudes toward AI are positive, and they appreciate the attempt to bridge the gap in learner differences; however, the concerns with the preparedness of the teachers are attributed to a lack of training, little experience, and minimal support from the institution. The findings indicate that AI-related competencies, formal training, attitudes, and subject specialization play a significant role in determining teachers' readiness for AI-supported personalized learning, whereas teaching experience does not significantly influence preparedness. This highlights the need for systematic integration of AI literacy, pedagogical strategies, and ethical awareness within both pre-service and in-service teacher education programs. It can be concluded that the success of AI-driven personalized learning is not solely dependent on technological advancement but is deeply rooted in teachers' ability to understand, interpret, and pedagogically integrate AI tools. Therefore, teacher education institutions and educational authorities should prioritize continuous professional development and capacity-building initiatives to prepare teachers for AI-enabled personalized learning environment

References

Aldunate, R., & Nussbaum, M. (2013). Teacher adoption of technology. *Computers in Human Behavior*, 29(3), 519–524. https://www.sciencedirect.com/science/article/abs/pii/S074756321200297X

Baker, R. S., & Inventado, P. S. (2014). Educational data mining and learning analytics. In J. A. Larusson & B. White (Eds.), *Learning analytics* (pp. 61–75). Springer. https://www.researchgate.net/publication/278660799_Educational_Data_Mining_and_Learning_Analytics

Dede, C. (2014). The role of digital technologies in deeper learning. *Students at the Center: Deeper Learning Research Series*. Jobs for the Future. https://files.eric.ed.gov/fulltext/ED561254.pdf

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change. *Journal of Research on Technology in Education*, 42(3), 255–284. https://files.eric.ed.gov/fulltext/EJ882506.pdf

Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning*. Center for Curriculum Redesign. https://curriculumredesign.org/wp-content/uploads/AIED-Book-Excerpt-CCR.pdf

Howard, S. K., & Mozejko, A. (2015). Teachers' digital technology use. *Computers & Education*, 81, 17–29.

Knox, J. (2020). Artificial intelligence and education. *Postdigital Science and Education*, 2(1), 1–12.

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, 9(1), 60–70.

Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education*. Pearson. https://static.googleusercontent.com/media/edu.google.com/en//pdfs/Intelligence-Unleashed-Publication.pdf

OECD. (2021). *Teachers and school leaders as valued professionals*. OECD Publishing.

Pane, J. F., Steiner, E. D., Baird, M. D., & Hamilton, L. S. (2017). *Informing progress: Insights on personalized learning implementation*. RAND Corporation. https://www.researchgate.net/publication/318340596_Informing_Progress_Insights_on_Personalized_Learning_Implementation_and_Effects

Redecker, C. (2017). *European framework for the digital competence of educators (DigCompEdu)*. European Commission. https://www.researchgate.net/publication/329191291_European_Framework_for_the_Digital_Competence_of_Educators_DigCompEdu

Siemens, G., & Long, P. (2011). Penetrating the fog. *EDUCAUSE Review*, 46(5), 30–40. https://er.educause.edu/articles/2011/9/penetrating-the-fog-analytics-in-learning-and-education

Williamson, B., & Eynon, R. (2020). Historical threads, missing links, and future directions in AI in education. *Learning, Media and Technology*, 45(1), 1-13. https://www.researchgate.net/publication/343341735_Historical_threads_missing_links_and_future_directions_in_AI_in_education

Woolf, B. P. (2010). *Building intelligent interactive tutors*. Morgan Kaufmann.