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THE ROLE AND CHALLENGES OF AI TECHNOLOGY IN THE DEVELOPMENT OF COLLEGE TEACHERS' TEACHER PEDAGOGICAL SKILLS

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Abstract

The integration of artificial intelligence (AI) into teacher education has the potential to revolutionize how educators develop and refine their Teacher Pedagogical Skills. This paper explores the role of AI in enhancing the pedagogical practices of college teachers, focusing on its applications in lesson planning, assessment, and personalized learning. Despite the promising opportunities AI offers, several challenges, including ethical concerns, technical limitations, and a lack of AI literacy among teachers, hinder its widespread adoption. This study highlights the need for a balanced approach that combines AI with human-centered teaching practices, ensuring that AI acts as a support tool rather than a replacement for educators. The paper also discusses the future of AI in teacher education, emphasizing the importance of AI literacy and collaborative teacher-AI models. Ultimately, the successful integration of AI in teacher development will depend on overcoming these challenges and fostering a supportive learning environment for both teachers and students.

Keywords: Artificial Intelligence, Teacher Education, Pedagogical Skills, AI Literacy, Educational Technology

1. Introduction

The rapid advancements in artificial intelligence (AI) have brought about transformative changes across various sectors, with education being no exception. AI-based technologies offer innovative tools that enhance teaching practices, personalize learning experiences, and improve overall educational outcomes (Zawacki-Richter et al., 2019; Holmes et al., 2019). In particular, the college education system has increasingly focused on leveraging AI to foster Teacher Pedagogical Skills, enhance pedagogical methods, and promote personalized professional development for educators (Popenici & Kerr, 2017). With the ever-growing need for educators to adapt to an evolving digital learning environment, the integration of AI in teacher education programs presents significant opportunities. These technologies allow educators to optimize their instructional methods, offer real-time feedback, and enhance learning experiences for their students (Seufert et al., 2020). Thus, AI technology serves as a catalyst in addressing the needs of contemporary educational systems while ensuring that teachers remain equipped to meet the demands of modern classrooms.

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As the adoption of AI in education continues to rise, it becomes clear that AI is not only a tool for delivering content but also for supporting the ongoing professional development of teachers. AI technologies such as intelligent tutoring systems, adaptive learning platforms, and data analytics have the potential to revolutionize how teachers approach instructional design and student engagement (Celik et al., 2022). These advancements can contribute significantly to the professional growth of teachers, providing them with tools that enhance their classroom management, assessment techniques, and instructional strategies.

Despite AI's significant potential to enhance teaching and learning processes, its application specifically in the development of college teachers' Teacher Pedagogical Skills remains an under-researched area. While some studies have explored the use of AI for student learning, limited attention has been paid to its role in advancing the teaching practices of educators, particularly at the college level (Kumar, 2025). Moreover, the challenges that arise from integrating AI into teaching skill development are multifaceted and often overlooked. These include issues such as technological preparedness, resistance to change, ethical considerations, and the need for teacher training in AI literacy (Celik et al., 2022).

This paper aims to bridge this gap by investigating the role of AI in the development of college teachers' Teacher Pedagogical Skills, with a focus on understanding how AI tools can enhance their pedagogical practices. It will also explore the challenges that teachers face when integrating AI into their teaching workflows. The primary objectives of the paper are to:

1. Investigate the different AI technologies used in the development of Teacher Pedagogical Skills among college educators.
2. Examine the impact of AI-based tools on enhancing teaching effectiveness and professional growth.
3. Identify the challenges and barriers that impede the successful integration of AI in teacher development programs.
4. Provide recommendations on how to overcome these challenges and optimize AI's role in the development of Teacher Pedagogical Skills in higher education.

Through this exploration, the paper seeks to contribute valuable insights into how AI can be strategically implemented in teacher education programs, thus enhancing both the quality of teaching and the overall educational experience for students. The findings from this study aim to inform policy decisions, educator training programs, and the development of AI-driven educational tools that are pedagogically sound and contextually relevant.

2. Literature Review

Artificial intelligence (AI) has been rapidly integrated into teacher education programs to enhance the professional development of educators. Among the key AI technologies being utilized are intelligent tutoring systems (ITS) and automated feedback systems. These systems support teachers by offering valuable tools for lesson planning, delivering real-time feedback, and conducting assessments, all of which are crucial for improving teaching

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effectiveness (Cukurova & Luckin, 2019; Akgün & Demir, 2018). One of the primary advantages of AI is its ability to process large amounts of data, providing teachers with insights into student performance and engagement. This data-driven feedback can significantly improve instructional practices by enabling educators to adjust their teaching strategies based on real-time information (Holstein et al., 2019).

AI algorithms, for example, can help teachers design more effective lesson plans by analyzing student learning patterns and engagement levels (Koedinger et al., 2012). This process allows AI systems to generate personalized suggestions and insights that can enhance the learning experience for both students and teachers. Through these tools, teachers can become more attuned to the diverse learning needs of their students, ensuring that instructional methods are adaptive and responsive. AI-driven platforms also enable teachers to monitor student progress continuously, facilitating timely interventions that can address learning gaps before they become significant issues. In this way, AI not only supports the pedagogical growth of teachers but also contributes to improving overall educational outcomes.

Despite the potential benefits of AI in teacher development, the integration of these technologies into educational settings is fraught with challenges. One of the major concerns revolves around data privacy, particularly regarding the vast amounts of personal and academic information AI systems need to process (Celik et al., 2022). Ensuring that these systems protect student data and adhere to privacy regulations is a critical issue for both educators and institutions. Additionally, there are concerns about algorithmic bias, as AI systems might inadvertently perpetuate existing inequalities if not properly designed or monitored. If the data used to train AI systems reflects biased or incomplete educational practices, the resulting algorithms may reinforce these biases in classroom settings, potentially disadvantaging certain groups of students or teachers (Luckin et al., 2016).

Another significant challenge is the lack of AI literacy among teachers, which impedes their ability to effectively integrate AI tools into their teaching practices. Many educators may not possess the necessary technical skills or understanding of AI to fully capitalize on these tools, leading to ineffective or even counterproductive use (Celik et al., 2022). As AI continues to evolve, there is an increasing need for teacher training programs to incorporate AI literacy into their curricula. Teachers must be equipped not only with the skills to use AI-based tools but also with the critical thinking abilities to assess their effectiveness and make informed decisions about their use in the classroom.

Furthermore, as noted by Zawacki-Richter et al. (2019), AI tools must be designed with pedagogical principles in mind. There is a danger of over-relying on automated systems for decision-making, which could undermine the importance of human judgment in teaching. Graham and Robison (2018) argue that AI should complement, rather than replace, the teacher's role in the classroom. The challenge, therefore, lies in finding a balance between leveraging AI to enhance teaching practices and ensuring that teachers remain the primary decision-makers in the educational process. Without careful consideration of these issues, the

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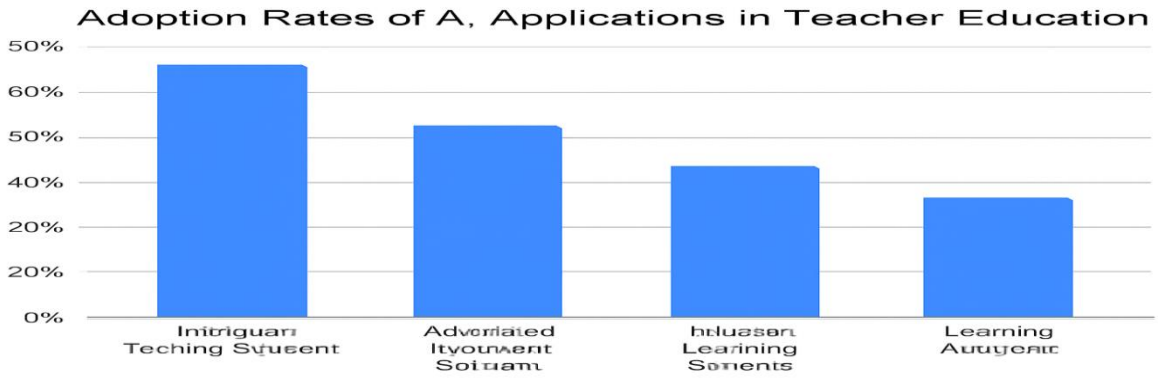
integration of AI in teacher education may fall short of its potential, limiting the overall effectiveness of AI technologies in enhancing Teacher Pedagogical Skills.

3. AI Applications in Teacher Education

Artificial intelligence (AI) is revolutionizing the landscape of teacher education, particularly by offering advanced tools that assist educators in improving their pedagogical practices. Among the most widely used AI applications in teacher education are intelligent tutoring systems (ITS), which provide personalized learning experiences for teachers. These systems adapt to the individual needs of each educator by analyzing their performance and offering real-time support and feedback (Akgün & Demir, 2018). ITS can be used to simulate teaching environments where teachers can refine their skills, such as lesson planning, classroom management, and teaching strategies. By adjusting the complexity of scenarios in real-time, ITS ensure that teachers are challenged at appropriate levels, enhancing their instructional capabilities without overwhelming them.

In addition to ITS, AI-powered systems have been effectively integrated into grading tasks and progress monitoring. These AI systems can automate the grading of assignments and assessments, providing immediate feedback to both students and teachers (Holmes et al., 2019). The automation of grading helps alleviate one of the most time-consuming aspects of teaching, enabling instructors to focus more on enhancing their instructional methods rather than on administrative tasks. AI systems can also track student performance over time, analyzing patterns and offering personalized recommendations for both teachers and students. For example, based on the analysis of student engagement and performance, AI tools can suggest specific instructional strategies or interventions to improve student outcomes.

Moreover, AI applications have the potential to streamline the feedback process. Traditionally, feedback has been limited by the amount of time teachers can devote to reviewing student work. AI can now provide feedback in real-time, identifying key areas of improvement that may otherwise go unnoticed. This immediate, data-driven feedback allows for quicker adjustments in teaching practices, enhancing the learning experience for students while simultaneously improving the teacher's ability to respond to dynamic classroom environments.



Received: August 12,2025

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As shown in *Figure 1: Adoption Rates of AI Applications in Teacher Education* (Popenici & Kerr, 2017), the adoption of AI tools within teacher education programs is on the rise, reflecting their increasing value in fostering a more efficient and personalized approach to teaching.

Through the use of AI-powered pedagogical tools, teacher education programs can offer more tailored, adaptive learning opportunities. These tools assist educators not only in refining their teaching techniques but also in creating a learning environment that is both responsive and conducive to the diverse needs of students. AI technologies, therefore, hold great promise in enhancing teacher development by enabling ongoing improvement, fostering efficiency, and ensuring that teachers are equipped with the skills and knowledge necessary to thrive in an increasingly technology-driven educational landscape.

4. AI and the Pedagogical Roles of Teachers

In the evolving landscape of artificial intelligence (AI) in education, teachers assume a pivotal role as data providers for AI systems. These systems rely heavily on the feedback and data generated through teachers' instructional practices. By offering real-world insights into teaching methods, classroom interactions, and student responses, teachers contribute valuable data that allows AI algorithms to learn and evolve. This process enables AI tools to refine their feedback mechanisms, identify consistent teaching patterns, and provide more precise recommendations for improvement (Luckin & Cukurova, 2019). For instance, AI systems can process data about teachers' classroom management techniques, lesson structures, and assessment strategies, using these inputs to offer suggestions that enhance pedagogical effectiveness. As emphasized by Kelly et al. (2018), teachers' expertise in instructional practices can significantly influence the relevance and precision of AI-driven feedback. By engaging directly in the AI design process, educators can ensure that the technology reflects practical teaching needs and challenges, thus improving its applicability in real-world educational settings.

In addition to refining AI tools, teachers' continuous input enables AI systems to adapt to the changing demands of the classroom environment. For example, AI can be used to analyze how different teaching approaches impact student learning and adjust its feedback accordingly. Teachers' reflections on their instructional practices, such as strategies for managing diverse student needs or integrating technology in teaching, are crucial for AI's ability to offer relevant and actionable insights. This ongoing cycle of data input and feedback contributes to a more responsive and intelligent system, ultimately enhancing the overall teaching and learning experience. Teachers, therefore, play an essential role in shaping AI's capabilities, ensuring that the technology supports their instructional goals rather than replacing them.

Beyond being data providers, teachers also have a crucial role in the active development and fine-tuning of AI algorithms. As collaborators in the development process, teachers can ensure that AI tools are pedagogically sound and meet the needs of real-world classrooms. Involving teachers in AI development is essential to creating systems that align with

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educational goals and practical teaching requirements. Teachers' deep understanding of classroom dynamics, student behaviors, and the intricacies of curriculum delivery allows them to inform AI systems in ways that enhance their pedagogical relevance (Prieto et al., 2018). By contributing their expertise, teachers help guide the development of AI algorithms, ensuring that these systems offer context-sensitive advice and support that is grounded in practical teaching scenarios.

Additionally, AI's role in learning analytics has evolved, offering teachers sophisticated tools for monitoring and analyzing student progress over time. These tools provide real-time insights into students' learning trajectories, helping educators identify areas where students may be struggling and adjust instructional strategies accordingly. Popenici and Kerr (2017) highlight how AI-powered learning analytics can facilitate a more personalized approach to teaching, enabling teachers to make data-driven decisions about lesson pacing, student grouping, and intervention strategies. This increased understanding of student learning paths empowers teachers to better tailor their instruction to meet the diverse needs of their students.

Through their direct involvement in both the provision of data and the development of AI algorithms, teachers are not just passive recipients of AI tools; they are active contributors to a technology that aims to enhance teaching practices. By integrating their pedagogical knowledge into the AI development process, teachers ensure that AI systems remain grounded in educational theory and practice, making them more effective in real-world classroom settings.

Table 1: Teachers' Roles in the Development of AI Algorithms

Role	Description	Examples
Data Providers	Teachers provide real-life classroom data to train AI systems, enabling AI to learn teaching patterns and instructional strategies.	Teachers contribute data on student performance, teaching methods, and classroom activities.
Feedback Providers	Teachers offer feedback on AI system performance and suggest areas for improvement to enhance the system's accuracy and pedagogical relevance.	Providing insights on AI-generated feedback, instructional materials, and lesson plans.
Pedagogical Guide	Teachers help shape the AI algorithms by offering pedagogical guidance, ensuring the AI system aligns with educational goals.	Offering recommendations on suitable instructional strategies and materials for AI tools.

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ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)

Collaborators in Design	Teachers collaborate with AI developers to ensure that the AI systems are designed with practical teaching applications in mind.	Co-designing AI-based applications that address specific classroom needs, such as student engagement.
Testers of AI Systems	Teachers test AI tools in real classrooms to evaluate their effectiveness and provide real-time improvements.	Using AI tools for grading, assessment, or student engagement, and reporting the outcomes for refinement.
Professional Development Contributors	Teachers contribute to the development of AI systems that track and enhance their professional growth.	Participating in AI systems that analyze teacher performance and suggest professional development activities.
Ethical Oversight	Teachers help ensure AI systems are designed and used ethically, protecting student privacy and avoiding biases in AI algorithms.	Reviewing AI systems to ensure fairness, transparency, and the protection of sensitive student data.

As shown in *Table 1: Teachers' Roles in the Development of AI Algorithms*, these collaborative efforts can lead to the creation of AI systems that are both innovative and pedagogically appropriate. The active participation of teachers in the AI development process not only improves the technology but also reinforces the central role of educators in shaping the future of education.

5. Ethical and Practical Challenges

As the integration of artificial intelligence (AI) into teacher development continues to expand, a critical concern that arises is the ethical use of student data. AI tools, particularly those focused on learning analytics and adaptive learning systems, rely on vast amounts of data to function effectively. This often includes sensitive information about students' academic progress, behaviors, and even personal characteristics (Cukurova & Luckin, 2019). The collection and analysis of such data raise significant privacy concerns, particularly regarding how this information is stored, shared, and used. Educational institutions must ensure that robust data protection policies are in place to safeguard students' privacy and that consent is obtained for data use in AI systems. The ethical management of student data is not just about adhering to legal standards but also about building trust among teachers, students, and parents in AI systems' fairness and transparency.

Another pressing ethical issue is the potential for algorithmic bias in AI systems. AI technologies, while powerful, are not immune to the biases present in the data they process. If not carefully designed, AI systems can unintentionally perpetuate existing inequalities,

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Volume 38 No. 5, 2025
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particularly in the context of education (Holstein et al., 2019). For example, if AI algorithms are trained on historical data that reflects biased patterns—such as systemic inequities in educational outcomes—these biases may be reflected and even amplified in the AI's recommendations or assessments. This could result in unfair treatment of certain student groups, exacerbating the disparities in educational opportunities and outcomes. It is, therefore, essential for developers of AI tools to actively address these biases by using diverse and representative datasets, continuously testing AI systems for fairness, and incorporating checks to prevent discriminatory outcomes.

The successful adoption and integration of AI in the classroom are also hindered by several practical challenges faced by teachers. One of the most significant barriers is the lack of technical skills among educators. AI systems, particularly those involved in complex tasks like grading, assessment, and personalized learning, require teachers to possess a certain level of technical proficiency. Unfortunately, many teachers do not have the necessary training to effectively use these technologies, leading to frustration and resistance to adopting AI tools (Graham & Robison, 2018). As the demands on teachers continue to increase, it becomes essential to provide them with adequate professional development opportunities that equip them with the skills needed to integrate AI into their teaching practice.

In addition to technical skills, time constraints also pose a challenge for teachers in adopting AI. Teaching is a time-intensive profession, and the additional time required to learn, implement, and maintain AI systems can be overwhelming for educators who already juggle numerous responsibilities. Moreover, AI systems must be adaptable to a variety of teaching environments, as no two classrooms are identical in terms of student needs, resources, and dynamics. Many AI tools are designed with a one-size-fits-all approach, making them less effective in classrooms with diverse student populations or varying levels of technological infrastructure (Seufert et al., 2020). For AI to be adopted successfully, it must be designed to be flexible, allowing teachers to tailor the tools to their unique teaching contexts. Furthermore, the development of AI systems must prioritize user-friendly interfaces to minimize the learning curve for teachers and ensure the technology's seamless integration into everyday teaching practices.

6. Discussion

As artificial intelligence (AI) continues to revolutionize teaching practices, it is essential to ensure that technological advancements do not overshadow the critical human aspects of education. AI offers significant potential to enhance various dimensions of teaching, such as personalized learning, real-time feedback, and automated assessments. However, it is vital to recognize that AI should serve as a tool to support, rather than replace, human educators (Tondeur et al., 2020). While AI can process vast amounts of data and provide efficient, data-driven solutions, it cannot replicate the nuances of human interaction, such as empathy, intuition, and creativity, which are central to effective teaching (Celik et al., 2022). Teachers bring unique qualities to the classroom, such as the ability to read non-verbal cues, adjust instruction based on emotional and social dynamics, and foster student motivation and

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Volume 38 No. 5, 2025
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engagement. These essential human traits cannot be captured by AI, making the role of the teacher irreplaceable in the educational process.

The challenge, therefore, lies in maintaining a balance where AI is integrated into teaching practices to enhance the effectiveness of educators, while still preserving the human-centered aspects that make education meaningful. AI should be viewed as a complement to human teaching, providing support in areas such as lesson planning, administrative tasks, and formative assessments, while leaving the interpersonal aspects of education to teachers (Seufert et al., 2020). By striking this balance, educators can harness the power of AI without losing the human connection that is vital to the learning experience.

Looking ahead, the future of AI in teacher development will likely focus on several key areas, such as enhancing AI literacy among educators, improving the reliability of AI systems, and addressing the digital divide. AI literacy is critical for teachers to understand how to effectively use AI technologies and incorporate them into their teaching practices. As AI continues to evolve, teacher training programs must place a stronger emphasis on developing the skills needed to work with these technologies. This includes not only technical knowledge of AI tools but also an understanding of their ethical implications and limitations. Teachers who are AI-literate will be better equipped to make informed decisions about how to integrate these tools in ways that complement their teaching style and meet the needs of their students (Zawacki-Richter et al., 2019).

Improving the reliability and adaptability of AI systems is another important area for development. While current AI tools offer promising applications, many still face limitations in their ability to operate in diverse educational contexts and respond to the varying needs of students (Holmes et al., 2019). Ensuring that AI systems are reliable and flexible enough to accommodate different teaching environments is essential for their widespread adoption. Additionally, addressing the digital divide—ensuring that AI-based tools are accessible to all educators regardless of their geographical location, technical resources, or socioeconomic background—will be crucial to prevent exacerbating existing educational inequalities (Luckin & Cukurova, 2019).

Finally, the future of AI in teacher education will likely involve the development of collaborative teacher-AI models. These models will emphasize the partnership between human teachers and AI tools, where AI serves as a supportive partner in the learning process rather than a substitute for teachers. In such a model, AI can assist teachers in analyzing data, providing real-time feedback, and managing administrative tasks, while teachers can focus on the more complex, human-centered aspects of teaching. This collaborative approach will enable educators to leverage the full potential of AI while retaining control over the pedagogical aspects of their practice (Seufert et al., 2020).

Table 2: Future Trends in AI for Teacher Education

Trend	Description
AI Literacy for Educators	Increased focus on training teachers to

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Volume 38 No. 5, 2025
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	understand and effectively use AI in classrooms.
AI-Enhanced Collaborative Models	Development of hybrid human-AI models where AI assists in data analysis and personalized teaching.
Improved System Reliability	Focus on making AI systems more accurate, responsive, and adaptable to diverse educational needs.
Personalized Teacher Professional Development	AI systems providing customized learning pathways for teachers' ongoing professional development.
Addressing the Digital Divide	Efforts to ensure equitable access to AI tools, especially in under-resourced or rural areas.
Ethical AI Integration	Emphasis on designing AI tools that adhere to ethical standards, ensuring transparency and fairness in decision-making.
Integration with Educational Data	AI systems leveraging large-scale educational data to optimize teaching strategies and student outcomes.

This table highlights the anticipated advancements in AI integration for teacher education. These trends include the expansion of AI tools for personalized professional development, the incorporation of AI literacy into teacher training curricula, and the development of more adaptable AI systems that can be customized to suit the diverse needs of teachers and students across different educational contexts. As AI continues to evolve, these trends will shape the future landscape of teacher development, ensuring that AI remains a supportive, ethical, and effective tool in enhancing teaching and learning.

7. Conclusion

This paper underscores the transformative potential of artificial intelligence (AI) in enhancing the Teacher Pedagogical Skills of college educators. The integration of AI technologies such as intelligent tutoring systems (ITS), automated feedback mechanisms, and learning analytics tools offers teachers new ways to personalize instruction, monitor student progress, and improve their overall teaching practices. However, while the benefits of AI are evident, several challenges must be addressed to maximize its effectiveness. Ethical concerns, such as data privacy and algorithmic biases, remain significant barriers to the full implementation of AI tools in education. Additionally, there are practical challenges related to the limited technical infrastructure in schools, a lack of AI literacy among teachers, and concerns about over-reliance on automated systems that may undermine the human aspects of teaching (Celik et al., 2022; Popenici & Kerr, 2017).

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Despite these challenges, the potential for AI to enhance the pedagogical capabilities of teachers is substantial. To fully realize this potential, future research must focus on developing more reliable, adaptable, and ethically sound AI systems. Moreover, AI literacy should become a core component of teacher education programs to ensure that educators are equipped with the knowledge and skills needed to effectively integrate these technologies into their classrooms (Zawacki-Richter et al., 2019). By addressing the technical, ethical, and practical challenges associated with AI, educators can better harness the power of AI to improve teaching outcomes and better prepare students for the future.

References

1. Akgün, E., & Demir, M. (2018). Modeling course achievements of elementary education teacher candidates with artificial neural networks. *International Journal of Assessment Tools in Education, 5*(3), 491–509. https://doi.org/10.21449/ijate.444073
2. Alenezi, H. S., & Faisal, M. H. (2020). Utilizing crowdsourcing and machine learning in education: Literature review. *Education and Information Technologies*, 1–16. https://doi.org/10.1007/s10639-020-10102-w
3. Alharbi, M. A., & Al-Hoorie, A. H. (2020). Turnitin peer feedback: Controversial vs. non-controversial essays. *International Journal of Educational Technology in Higher Education, 17*, 1–17. https://doi.org/10.1186/s41239-020-00195-1
4. Aggarwal, C. C. (2018). *Neural networks and deep learning*. Springer. https://doi.org/10.1007/978-3-319-94463-0
5. Baker, T., & Smith, L. (2019). Educ-AI-tion rebooted? Exploring the future of artificial intelligence in schools and colleges. Retrieved from Nesta Foundation: https://media.nesta.org.uk/documents/Future_of_AI_and_education_v5_WEB.pdf
6. Bonneton-Botté, N., Fleury, S., Girard, N., Le Magadou, M., Cherbonnier, A., Renault, M., ... & Jamet, E. (2020). Can tablet apps support the learning of handwriting? An investigation of learning outcomes in kindergarten classroom. *Computers & Education, 151*, 103831. https://doi.org/10.1016/j.compedu.2020.103831
7. Borges, A. F., Laurindo, F. J., Spínola, M. M., Gonçalves, R. F., & Mattos, C. A. (2020). The strategic use of artificial intelligence in the digital era: Systematic literature review and future research directions. *International Journal of Information Management, 102225*. https://doi.org/10.1016/j.ijinfomgt.2020.102225
8. Burstein, J., Chodorow, M., & Leacock, C. (2004). Automated essay evaluation: The Criterion online writing service. *AI Magazine, 25*(3), 27–27. https://doi.org/10.1609/aimag.v25i3.1774
9. Chassignol, M., Khoroshavin, A., Klimova, A., & Bilyatdinova, A. (2018). Artificial intelligence trends in education: A narrative overview. *Procedia Computer Science, 136*, 16–24. https://doi.org/10.1016/j.procs.2018.08.141
10. Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *IEEE Access, 8*, 75264–75278. https://doi.org/10.1109/ACCESS.2020.2988510

Received: August 12,2025

ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)

11. Chiu, T. K., & Chai, C. S. (2020). Sustainable curriculum planning for artificial intelligence education: A self-determination theory perspective. *Sustainability, 12*(14), 5568. https://doi.org/10.3390/su12145568
12. Cukurova, M., & Luckin, R. (2019). AI in education: A model for teacher-centric pedagogy. *Proceedings of the 10th European Conference on Technology Enhanced Learning*. Springer, Cham. https://doi.org/10.1007/978-3-030-26876-1_33
13. Demir, M. (2015). Predicting pre-service classroom teachers' civil servant recruitment examination's educational sciences test scores using artificial neural networks. *Educational Sciences: Theory & Practice, 15*(5). Retrieved from https://doi.org/10.12738/estp.2015.5.0018
14. Farhan, M., Jabbar, S., Aslam, M., Ahmad, A., Iqbal, M. M., Khan, M., & Maria, M. E. A. (2018). A real-time data mining approach for interaction analytics assessment: IoT-based student interaction framework. *International Journal of Parallel Programming, 46*(5), 886–903. https://doi.org/10.1007/s10766-017-0553-7
15. Graham, C. R., & Robison, W. (2018). The SAMR model and the adoption of emerging technologies in higher education. *Educational Technology, 58*(5), 56–66. https://doi.org/10.1080/00131911.2018.1456784
16. Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning*. Center for Curriculum Redesign.
17. Holstein, K., McLaren, B. M., & Aleven, V. (2019). Co-designing a real-time classroom orchestration tool to support teacher–AI complementarity. *Journal of Learning Analytics, 6*(2), 27–52. https://doi.org/10.18608/jla.2019.62.3
18. Kelly, S., Olney, A. M., Donnelly, P., Nystrand, M., & D'Mello, S. K. (2018). Automatically measuring question authenticity in real-world classrooms. *Educational Researcher, 47*(7), 451–464. https://doi.org/10.3102/0013189X18785613
19. Koedinger, K. R., Corbett, A. T., & Perfetti, C. (2012). The Knowledge Learning-Instruction framework: Bridging the science-practice chasm to enhance robust student learning. *Cognitive Science, 36*(5), 757–798. https://doi.org/10.1111/j.1551-6709.2012.01245.x
20. Luckin, R., & Cukurova, M. (2019). Designing educational technologies in the age of AI: A learning sciences-driven approach. *British Journal of Educational Technology, 50*(6), 2824–2838. https://doi.org/10.1111/bjet.12861
21. Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education*. Pearson Education.
22. McCarthy, T., Rosenblum, L. P., Johnson, B. G., Dittel, J., & Kearns, D. M. (2016). An artificial intelligence tutor: A supplementary tool for teaching and practicing braille. *Journal of Visual Impairment & Blindness, 110*(5), 309–322. https://doi.org/10.1177/0145482X1611000503
23. Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Received: August 12,2025

Volume 38 No. 5, 2025

ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)

24. Popenici, S. A., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology-Enhanced Learning, 12*(1), 1–13. https://doi.org/10.1186/s41039-017-0062-8
25. Prieto, L. P., Sharma, K., Kidzinski, Ł., Rodríguez-Triana, M. J., & Dillenbourg, P. (2018). Multimodal teaching analytics: Automated extraction of orchestration graphs from wearable sensor data. *Journal of Computer Assisted Learning, 34*(2), 193–203. https://doi.org/10.1111/jcal.12232
26. Roll, I., & Wylie, R. (2016). Evolution and revolution in artificial intelligence in education. *International Journal of Artificial Intelligence in Education, 26*(2), 582-599. https://doi.org/10.1007/s40593-016-0110-3
27. Swan, K., & van't Hooft, M. (2021). Preparing teachers to use emerging technologies: Understanding and implementing artificial intelligence in education. *Springer*.
28. Tondeur, J., Scherer, R., Siddiq, F., & Baran, E. (2020). Enhancing pre-service teachers' technological pedagogical content knowledge (TPACK): A mixed-method study. *Educational Technology Research and Development, 68*(1), 319–343. https://doi.org/10.1007/s11423-019-09692-1
29. Touretzky, D., Gardner-McCune, C., Martin, F., & Seehorn, D. (2019). Envisioning AI for K-12: What should every child know about AI? In *Proceedings of the AAAI Conference on Artificial Intelligence* (Vol. 33, pp. 9795–9799). https://doi.org/10.1609/aimag.v25i3.1774
30. Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education—Where are the educators? *International Journal of Educational Technology in Higher Education, 16*(1), 39. https://doi.org/10.1186/s41239-019-0171-0
31. Kumar, A. (2025). The impact of artificial intelligence on higher education in Bihar: A study of certain districts of Bihar. In *The Chitransh Academic & Research, Vol. 1, Number 03* (pp. 394–414). Zenodo. https://doi.org/10.5281/zenodo.15768210

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