

Artificial Intelligence and the Future of Online K–12 Education: Advancing Personalized

Learning: Literature Review

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Foundations of Doctoral Studies in Education

Introduction

The emergence of the COVID-19 pandemic in 2020 and subsequent lockdowns caused significant disruption across the global education sector. The Internet created an accessible learning modality, particularly for individuals with reliable access to educational technologies, hardware, and software. At the same time, the world was beginning to recognize the transformative potential of artificial intelligence (AI). The rapid advancement and adoption of AI within educational environments have given rise to an extensive and rapidly growing body of scholarly literature seeking to distinguish effective from ineffective practices and to establish what works and why. Educational leaders must remain informed of emerging developments, as the ambiguities concerning artificial intelligence may disrupt established educational pathways and exacerbate existing inequities. Mayer (2026) asserts that there is an urgent need to harmonize current K-12 curricula with AI, deliberately integrating ethics and pedagogy, especially in personalized online learning. This paper examines existing peer-reviewed literature published between 2021 and 2026 and focused on interactions with AI among learners, instructors, and institutions. Different scholars address diverse themes on the relationship between AI and personalized learning in the context of K-12 education systems. Through the lens of online educational leadership, this review analyzes, evaluates, and synthesizes the existing literature by addressing two central questions: *“How is AI pedagogy being integrated into personalized learning?”* and *“What impact does AI pedagogy have on personalized learning and student outcomes in online K–12 education?”* In doing so, the review establishes a foundation for future longitudinal research examining the evolving role of artificial intelligence in personalized online learning.

Reimagining Learning Experiences with AI

A developing technological shift in education is the widespread use of Intelligent Tutoring Systems (ITS), specialized computer applications designed to provide learners with personalized instruction and evaluation. Considering the transformative fusion of AI and education, Létourneau et al. (2025) conducted a systematic review of 28 peer-reviewed studies, with findings aimed at guiding the development, implementation, and use of Intelligent Tutoring Systems. From the research, ITS has capacity to augment learning and performance; nonetheless, there are variations in its effectiveness as a result of individual learner engagement and continuity. By contrast, their study does not meet the threshold for generalizability, as the literature analyzed exhibited a bias toward STEM subjects, with only 3 papers covering language. Although Létourneau et al. (2025) emphasize the importance of learner continuity within intelligent tutoring system environments, their analysis gives insufficient attention to ethical concerns and the potential adverse effects of AI dependence on learners' cognitive abilities. Notably, the study did not examine these issues within the context of online education. Willis (2023) reveals that integrating AI into online learning can improve both engagement and instruction. Willis (2023) underscores the technology's potential to improve personalized online learning; however, there is a consensus on the need for ethical considerations in integrating technology into education. Voicu (2026) offers theoretical insight into how massive open online courses (MOOCs) are being reconfigured through the integration of AI, enabling an active interaction between learners and algorithmic cognition. Voicu (2026), while recognizing its effectiveness for personalization and adaptability, proposes that biases and erosion of human mediation portend an ethical and epistemological dilemma. From these studies, ethical considerations appear to be taking priority, providing rationale for further research on defining an ethical pedagogical pathway for online education.

The transformative shifts occurring in education in relation to emerging innovative technologies are unfolding rapidly, resulting gaps necessitate the mitigation of ethical and pedagogical concerns, including equity and accessibility, during design and integration. Lee et al. (2025), in a scoping review focusing on K-12 education, sought to identify equity and accessibility in curricula during design, implementation, and evaluation. Their findings offer a structured approach for educators and scholars to guide the development of pedagogically relevant, inclusive, and equitable AI-integrated systems that address learner diversity. Accordingly, Lee et al. (2025) recommend harmonization of cultural identity with instructions, adoption of current and relevant technology, inclusion of all educational stakeholders during design, developing content that is not rigid, and calculating a sense of belonging among students to ensure amicable relationships with their instructors in delivery of AI tools in educational settings. The authors recognize that existing research on AI in education is biased toward computer science subjects; additionally, the focus has been on middle schoolers, and most studies only investigate the short-term impact of integrating AI in education. According to Miller and Johnson (2026), the efficacy of AI tools in personalized learning systems is dependent on the frameworks of design, implementation, governance, and continuity, rather than the transformative, engaging features, validating Lee et al. (2025) assertions on having a structured framework derived from five key components. Miller and Johnson (2026) further expound on Lee et al. (2025) studies, advocating for a framework that is aligned to public interest structures with deliberate oversight, protecting it from the exploitation of commercialized interests and unchecked innovations. However, such strategic interventions, while well-intentioned, may ultimately impede the development, deployment, and adaptation of AI technologies for education, largely due to the bureaucratic nature of publicly oriented innovation. Conversely, Mayer (2026) affirms need to align AI with Technological Pedagogical Content

Knowledge Framework (TPACK) and constructivist theories, as these two ideologies have been the basis for elementary learning. Constructivist theory in particular stands out, as its alignment builds on AI pedagogy for personalized learning systems.

Professional Development and AI Integration

The rapidly evolving connection between technology and education is outpacing the acquisition of relevant skills and knowledge for all concerned stakeholders. For educators and learners, the proliferation of AI remains perplexing with majority adapting it largely for ad hoc tasks, while ambiguity lingers among researchers. Teacher perception of AI is cited as a major influencer in the effective deployment of AI tools in learning environment. According to Kim (2025), uncertainty among teachers is due to inadequate training and vague policies within institutions. The author explores personalized online learning with the support of AI through mixed methodology study, affirming need for teacher professional development while upholding ethics; nonetheless, the scholar fails to examine instructional pedagogy in adoption of AI. The paper's findings indicate a convergence of thought with Lee et al. (2025) recommendation of a definitive integration framework considering five core principles. Kim (2025) also advocates for a collaborative approach during design and integration, inviting leaders and teachers to share perspectives and insights, as key challenges facing the implementation of AI remain ethics, lack of clear policies, and unfamiliarity with the technology among teachers. These assertions are recurring in many studies; Doty and Lipien (2024) research focusing on online K-12 teachers found that awareness and upskilling significantly contribute to instructors embracing the technology. In their mixed-methods study, Doty and Lipien (2024) theorize that familiarity leads to confidence among online teachers, as this enables them to comfortably incorporate AI into their instructional modules. Doty and Lipien (2024) share similar assertions to Kim (2025), though both

overlook pedagogy as an important component for effective adoption of AI in online learning, further prompting rationale for research on the pedagogy of AI in online education. Doty and Lipien (2024) research sheds light on how AI is redefining teacher roles within online education, and while the majority are embracing change, they see themselves becoming “guides” for students, as the technology transforms online teaching methodologies, personalizes learning, extends scalability, and improves efficiency. A common theme in the analyzed literature is teacher professional development. Cheah et al. (2025), however, present a contrary argument regarding teacher professional development as a prerequisite for the effective integration of AI tools. In their snowball-sampling study, the authors identify a key drawback: instructor uncertainty regarding how these technological systems collect and process large datasets to generate outputs. In some cases, this uncertainty may contribute to data breaches, algorithmic bias, and privacy concerns. Another recurrent theme is “*technology value belief*” among teachers as a major determinant of integration, further justifying need for their involvement during development and design of AI educational tools. Although instructor skills and knowledge have been identified as key components for the successful integration of AI in education, there are gaps in the specifics of professional development (Doty & Lipien, 2024).

AI in Personalized Learning, Governance and Guidance

School leaders are a vital part in advancing the affordances of AI within the K-12 educational system, as these technological tools can complement decision-making skills and improve institutional governance Reis-Andersson et al. (2025), (2025). Even though AI has potential to support education leadership, Reis-Andersson et al. (2025), (2025) study recognizes underlying challenges, raising concern about digital skills, ethics, and integration of the technology within the current institutional structures. Though school leaders are influential in developing and

upholding pedagogical practices, Reis-Andersson et al. (2025) qualitative literature scarcely addresses educators' perspectives on defining AI pedagogy within curricula, as well as their role in shaping it. There is a need for deeper interrogation to obtain factual perspectives on school leaders' role in integrating AI pedagogy in K-12 curricula. The emphasis across the board is for educators to enhance their digital competencies to effectively tap into the affordances of AI, however, the prevalent research fails to identify the modalities for achieving the required thresholds. Additionally, absence of depth in data and comprehensive analysis makes it difficult to generalize most of the findings; this calls for extensive investigations for informed understanding on role of educators rapidly evolving learning environments.

There is consensus regarding the significant opportunities AI systems offer for transforming K-12 education; however, challenges remain in addressing teachers' needs, limiting the adoption of these tools, and mitigating the resulting conflict among stakeholders (Seo et al., 2024). To improve our understanding of teacher perceptions of how technology augments their roles in personalized learning, Seo et al. (2024), through focus group interviews and thematic analysis of literature, sought to identify complementary relations between AI and teachers and, thereafter, conceptualize augmented teachers in the context of K-12 education. The study reveals elementary level teachers rely on AI for managing and evaluating students while looking forward to using the tools for curriculum development, to ultimately improve personalized learning and instructional approach. The small sample size in the study, 15 teachers participated in the focus group interviews, with only 5 being elementary teachers, undermines the validity of the study's findings; moreover, participants were drawn from K-12's three educational levels, further fragmenting the results. Whereas Seo et al. (2024) contribute to our understanding of teacher needs for effective personalized learning with the use of AI, the study fails to explore pedagogical

implications of AI tools on the traditional roles of teachers within K-12, justifying the need to explore integration of AI pedagogy in the current curriculum. Denden and Abed (2025) examine personalized learning within K-12 in a global context, analyzing policies and procedures therein. This comprehensive review argues our understanding of personalized learning is superficial due to limited investigations on the concept's parameters, questioning assessment mechanisms and effectiveness. Notably, Denden and Abed (2025) analyze literature that explores personalized learning through the lens of AI., nevertheless, the paper, from its onset, "*superficially*" links adaption of AI as a tool for complementing personalized learning. From their analysis and conclusions, we can infer that AI tools in education are at the essence of effective personalized learning.

Conclusion

The literature analyzed indicates AI pedagogy is being integrated into personalized learning. Methods include intelligent tutoring systems (ITS), adaptive course environments, data-informed instructional support, curriculum-development tools, and emerging governance. Use of AI applications can assist educators in personalizing content, providing meaningful feedback, pacing, and learner support. The literature, however, consistently indicates the quality of AI integration is predicated on instructional design, educator competence, learner engagement, ethical safeguards, equitable access, and institutional oversight. Thus, the available evidence supports viewing AI as a co-teacher rather than a replacement for human instruction.

The literature concerning student outcomes suggests the potential for improvement in engagement, instructional responsiveness, and academic performance. However, the evidence base is constrained by small sample sizes, short study periods, emphasis on STEM subjects, inconsistent definitions of personalized learning, and limited scope to online K-12 environments.

These limitations prevent broad conclusions about the long-term effects of AI-supported pedagogy on achievement, retention, equity, or cognitive development. A consequential gap exists in K-12 education concerning how clearly defined AI pedagogical practices influence personalized learning and student outcomes measured over time. Longitudinal research involving diverse learners, consistent outcome measurements, and comparisons across implementation models could help determine whether the benefits observed are realized and under which pedagogical and organizational conditions they occur.

References

- Cheah, Y. H., Lu, J., & Kim, J. (2025). Integrating generative artificial intelligence in K-12 education: Examining teachers' preparedness, practices, and barriers. *Computers and Education: Artificial Intelligence*, 8, 100363. <https://doi.org/10.1016/j.caeai.2025.100363>
- Denden, M., & Abed, M. (2025). Personalized learning policies and strategies in K–12 education: Where, when, and for what? *Smart Learning Environments*, 12(1).
<https://doi.org/10.1186/s40561-025-00425-x>
- Doty, K., & Lipien, L. (2024). Online K-12 teachers' perceptions of students' AI utilization and teachers' outlook on the future of education in the context of artificial intelligence. *American Journal of Educational Research*, 12(8), 319–328. <https://doi.org/10.12691/education-12-8-5>
- Reis-Andersson, J., Håkansson Lindqvist, M., & Jaldemark J. (2025). School leaders' perceptions on the potential of using artificial intelligence (AI) in leadership practices. *European Conference on E-Learning*, 24(1), 338–344. <https://doi.org/10.34190/ecel.24.1.3798>
- Kim, J. (2025). School leaders and AI-driven education: A comparative study of readiness, perceptions and implementation strategies. *Artificial Intelligence in Education*, 1–17.
<https://doi.org/10.1108/aiie-03-2025-0048>
- Lee, H., Kim, H., & Yan, W. (2025). Promoting inclusive AI and technology in K-12 education: A review of context, instructional strategies, and learning outcomes. *Computers and Education: Artificial Intelligence*, 9, 100478. <https://doi.org/10.1016/j.caeai.2025.100478>
- Létourneau, A., Martineau, D., Charland, P., Karran, J. A., Boasen, J., & Léger, P. M. (2025). A systematic review of AI-driven intelligent tutoring systems (ITS) in K-12 education. *NPJ Science of Learning*, 10(1), 1–13. <https://doi.org/10.1038/s41539-025-00320-7>

- Mayer, S. J. (2026). Bridging pedagogy and technology: Integrating artificial intelligence into elementary classroom practice. OpenRiver. <https://openriver.winona.edu/eie/vol32/iss1/1>
- Miller, J., & Johnson, M. (2026). AI-driven personalized learning systems for K-12 education: Enhancing educational equity and outcomes in the United States. *International Journal of Artificial Intelligence Research*, 1. <https://doi.org/10.66280/ijair.v1i1.103>
- Seo, K., Yoo, M., Dodson, S., & Jin, S.-H. (2024). Augmented teachers: K–12 teachers’ needs for artificial intelligence’s complementary role in personalized learning. *Journal of Research on Technology in Education*, 1–18. <https://doi.org/10.1080/15391523.2024.2330525>
- Voicu, C.-G. (2026). Algorithmic pedagogies and the reconfiguration of knowledge: Theoretical insights into AI-enhanced MOOCs. In *Implementation Strategies and Effects of Massive Open Online Courses (Working Title)*. IntechOpen. <https://doi.org/10.5772/intechopen.1014728>
- Willis, V. (2023). The role of artificial intelligence (AI) in personalizing online learning. *Journal of Online and Distance Learning*, 3(1), 1–13. <https://doi.org/10.47941/jodl.1689>