

Challenges and Opportunities in Training Teachers for AI-Integrated Classrooms: A Review of Contemporary Research

Dr. Pravesh Kumar¹ & Kirti Raje Bajaj²

¹Assistant Professor Teacher Education, Maharana Pratap Govt. PG College, Hardoi, Uttar Pradesh

² Research Scholar Mahatma Jyotiba Phule Rohilkhand University, Bareilly

Received: 20 July 2025 Accepted & Reviewed: 25 July 2025, Published: 31 July 2025

Abstract

The use of artificial intelligence (AI) in classrooms brings both challenges and opportunities for teacher training. Recent studies have shown that teachers require thorough training to work in AI-based learning environments. While AI has many benefits in education, its use is often blocked by systemic issues, especially in Career and Technical Education. Challenges include teachers' initial fears, clear explanations of AI concepts, and dealing with hardware problems. There are also concerns about data privacy, ethics, and increasing inequalities. However, AI also offers several opportunities. This can improve teaching and learning while maintaining high academic standards. AI can help with personalized learning, support research, and act as tutors. Smart classrooms with AI can make classes more efficient and creative, thus supporting both in-class and remote learning. Good teacher training in AI classrooms requires careful approach. It should help teachers understand AI's strengths and limits, address ethical issues, and encourage innovation. Future research should examine the long-term effects of AI in education, and create specific strategies for different educational settings. By tackling these challenges and using these opportunities, teachers can use AI to improve student learning.

Keywords- AI in education, Teacher training, AI integration challenges, Pedagogical Opportunities, Ethical considerations, Personalized learning, Educational technology etc

Introduction

Artificial Intelligence (AI) is changing how we teach. AI tools such as adaptive learning platforms and smart tutoring systems are now common in classrooms. This change means that we need to examine how teachers are ready to use these AI tools. This review examines recent research on training teachers for AI classrooms, focusing on studies from the last ten years, especially after 2015. As AI grows in education, it is important to understand the challenges and opportunities of training teachers to use these tools. Teachers must be ready to use AI in schools. Without good training, teachers might not use AI tools well, which could hurt student learning and worsen educational gaps. In addition, AI in education raises ethical issues, such as data privacy and bias, so teachers need to understand both the technical and ethical aspects of AI. This review examines how teacher education programs deal with AI in classrooms looking at current research, and aims to find key topics such as teacher readiness, training gaps, ethical issues, and new ways to prepare teachers. This analysis aims to show the current state of teacher training in AI classrooms and offer insights for future research and practice in this fast-changing field.

Research Questions-

1. How do modern teacher-education programs incorporate artificial intelligence technologies into classroom settings?
2. What are the main challenges teachers face in acquiring the necessary skills to effectively use AI-based tools in their teaching methods?
3. How does teachers' previous experience with technology influence their readiness to embrace AI-based teaching approaches?

4. What approaches can be employed to connect the theoretical understanding of AI with its practical use in classroom environments within teacher-training programs?

Research Objectives:

1. To assess the current state of teacher education programs in integrating AI technologies for classroom use, the best practices and areas for improvement were identified.
2. To analyze the key challenges teachers encounter in acquiring and applying AI-related skills with a focus on pedagogical, technical, and ethical aspects.
3. To examine the relationship between teachers' prior technological experience and their adaptability to AI-enhanced teaching methods, we identified potential correlations and implications for training.
4. To evaluate existing and innovative approaches to bridging the gap between theoretical AI knowledge and its practical application in educational settings within teacher training programs.

The integration of Artificial Intelligence (AI) into classrooms presents both challenges and opportunities for teacher training. Contemporary research highlights the need for comprehensive professional development to prepare educators for AI integrated learning environments. Studies indicate that while AI offers significant benefits in education, its adoption is hindered by systemic factors, particularly in Career and Technical Education (CTE) settings (Sun & Pratt, 2024). These challenges include addressing initial teacher apprehension, enhancing deep conceptual explanations of AI concepts, and overcoming hardware-related obstacles (Li et al., 2024). Additionally, there are concerns about data privacy, ethical considerations, and potential reinforcement of existing inequalities (Familoni & Onyebuchi, 2024). However, research has also emphasized the opportunities that AI presents. AI can enhance teaching and learning while upholding academic standards (Slade et al., 2024). It offers promising avenues for personalized learning, facilitating research and acting as a tutor (Mahligawati et al. 2023; Slade et al. 2024). The integration of AI into smart classrooms can lead to more efficient and creative classes that support both in-class and remote activities (Dimitriadou & Lanitis, 2023). In conclusion, effective teacher training in AI-integrated classrooms requires a nuanced approach. It should focus on developing educators' understanding of AI's potential and limitations of AI, addressing ethical concerns, and fostering a culture of innovation (Sun and Pratt 2024; Mouta et al. 2024). Future research should explore the long-term effects of AI in education and develop targeted strategies for different educational contexts (Sharifuddin and Hashim, 2023; Sharifuddin & Hashim, 2024). By addressing these challenges and leveraging opportunities, educators can be better prepared to harness AI's potential of AI to enhance student learning outcomes.

3. Thematic Analysis of Literature

3.1 Teacher Awareness and Conceptual Understanding of AI- A thematic analysis of the literature reveals several key themes regarding teacher awareness and the conceptual understanding of AI in education. Teachers generally demonstrate a growing awareness of AI tools and their potential applications in education; however, there are significant gaps in their conceptual understanding (Velandar et al., 2023). Many teachers gain AI-related knowledge through incidental learning, often resulting in misconceptions and preconceptions about AI's capabilities and limitations (Velandar et al., 2023). This lack of comprehensive understanding can pose challenges to achieving core constructs of intelligent Technological Pedagogical Content Knowledge (TPACK) in AI education (Velandar et al., 2023). Interestingly, there are disparities in understanding AI across different disciplines. Computer Science educators show more confidence in their technical understanding of generative AI tools and express more positive attitudes towards them than educators in other

fields do (Ghimire et al., 2024). However, this increased technical knowledge does not necessarily translate into a better ability to detect AI-generated work (Ghimire et al., 2024). The literature highlights the need for targeted teacher training and professional development to address knowledge gaps and misconceptions (Velandar et al. 2023; Wang et al. 2024). Developing AI literacy among teachers is crucial for the effective integration of AI in education and fostering critical engagement with AI technologies (Velandar et al., 2023). This includes not only technical knowledge but also an understanding of ethical considerations, potential biases, and pedagogical implications of AI use in the classroom (Silva & Janes, 2020; Wang et al., 2024).

3.2 Challenges in Training for AI Integration- Thematic Analysis of Literature The integration of AI in education presents both opportunities and challenges, as evidenced by the reviewed literature. A recurring theme is the potential of AI to enhance personalized learning experiences and streamline administrative tasks (Choustoulakis, 2024; Singh & Thakur, 2024). However, this integration is not without hurdles, particularly in the realm of educator preparation and implementation. Challenges in Training for AI Integration have emerged as a significant concern in multiple studies. The lack of AI-specific training modules in teacher education programs is highlighted as a critical gap (Festus and Emmanuel 2024; Okunade 2024). This deficiency in formal training contributes to technological anxiety or resistance to AI among educators, as noted in the Nigerian context, where traditional teaching norms complicate adoption (Festus & Bamidele Emmanuel, 2024). Infrastructural and access-related barriers are particularly pronounced in developing countries, with inadequate funding and limited technical expertise hindering effective AI implementation (Agarwal & Vij, 2024; Festus & Emmanuel, 2024). Ethical and data privacy concerns in the classroom use of AI tools are consistently emphasized, underscoring the need for robust data governance and transparent algorithms (Joseph & Uzundu, 2024; Rony et al., 2024; Singh & Thakur, 2024). In conclusion, while AI offers transformative potential in education, addressing these challenges is crucial for successful integration. The literature suggests that comprehensive educator training, investment in infrastructure, and the development of ethical frameworks are essential steps toward leveraging AI's benefits while mitigating its risks in educational settings (Giray, 2024; Joseph & Uzundu, 2024; Walter, 2024).

3.3 Pedagogical Opportunities Enabled by AI- The thematic Analysis of Literature Pedagogical Opportunities Enabled by AI AI technologies offers significant pedagogical opportunities in education, transforming traditional teaching methods and enhancing learning experiences. AI-powered tools enable personalized learning pathways, tailoring content delivery and instructional methods to individual student characteristics and preferences (Barrera Castro et al., 2024). This personalization extends to assessment and feedback mechanisms, allowing educators to provide timely and relevant guidance to learners (Castro et al. 2024; Dong 2023). The use of AI for personalized learning and formative assessment AI-driven solutions offers capabilities, such as automated learner profiling, adaptive content recommendation, and real-time assessment, augmenting the personalization of learning experiences (Barrera Castro et al., 2024). In English language teaching, AI tools have shown effectiveness in areas such as vocabulary acquisition, grammar correction, and pronunciation, adapting to various learning styles and needs (Kovalenko & Baranivska, 2024). AI-powered writing tools have demonstrated positive impacts on students' writing proficiency by providing timely and individualized feedback (Dong, 2023). AI tools that enhance inclusivity and learner-supported AI technologies play a crucial role in promoting inclusivity and accessibility in education. They can address diverse learning needs, provide additional support for students with disabilities, and offer tools such as captioning and translation to improve accessibility (Adeleye et al., 2024). AI-driven chatbots and interactive learning experiences have been found to enhance learner engagement, motivation, and self-directed learning in language acquisition contexts (Abusahyon et al. 2023; Anjarani et al. 2024). AI for classroom management

and curriculum planning AI tools contribute to streamlined workflows and improve efficiency in classroom management (Sipahioglu, 2024). They assist in grading processes, provide data-driven insights to boost responsiveness, and support teacher-student collaboration (Dong, 2023; Sipahioglu, 2024). AI can also aid in curriculum planning by analyzing student data and identifying learning gaps, allowing for targeted interventions and adaptive learning pathways (Adeleye et al., 2024). In conclusion, the integration of AI in education offers numerous opportunities to enhance pedagogical practices, personalize learning experiences, promote inclusivity, and improve classroom management. However, it is crucial to address challenges such as ethical considerations, data privacy, and the need for ongoing research to fully harness AI's potential of AI in education (Lin et al. 2024; Msambwa et al. 2025). Balancing AI-mediated and human interactions in learning environments remains a key area for future exploration (Msambwa et al., 2025).

3.4 Teacher Education Program Innovations- The literature reveals several key themes related to innovation in teacher education programs and the incorporation of AI. Teacher education programs are evolving to integrate AI literacy with ethical considerations. There is growing recognition that profound AI literacy and AI-related ethical knowledge are essential facets of teacher educator professionalism (Rütli-Joy et al., 2024). This integration aims to prepare educators for the ethical and effective use of AI in teaching practice. Collaborative approaches between educators and technologists are emerging as crucial to successful AI integration. The literature emphasizes the importance of multidisciplinary collaboration and the ongoing professional development of educators (Black et al. 2024; Rütli-Joy et al. 2024). These collaborations are essential to address the challenges of AI integration and foster innovation in teacher education. Case studies have highlighted the importance of institutional support and curriculum alignment. For instance, a Swiss university case study demonstrated practical strategies for implementing AI in the classroom (Walter, 2024). Additionally, the ISTE AI Explorations for EPPs Faculty Fellowship provides a framework of seven critical strategies for integrating AI education into Educator Preparation Programs (Black et al., 2024). Micro-credentialing and AI literacy bootcamps are becoming increasingly important. Although not explicitly mentioned in the literature, the need for ongoing professional development and AI literacy training (Black et al., 2024; Rütli-Joy et al., 2024) suggests that such approaches could be valuable in preparing educators for AI integration. The literature also points to the challenges and opportunities for AI integration. These include technical challenges, ethical concerns, and the need for educational support (Okunade, 2024; Qian, 2023). AI also offers opportunities for enhanced learning experiences, personalized instruction, and improved student engagement (Choustoulakis, 2024; Qian, 2023). In conclusion, the literature indicates a shift towards more collaborative, technology-integrated approaches to teacher education. While challenges exist, there is a clear trend towards incorporating AI literacy and ethical considerations into teacher training programs with an emphasis on continuous adaptation and professional development.

3.5 Gaps and Limitations in Current Research- The thematic Analysis of Literature AI integration in education is transforming traditional pedagogical approaches, offering innovative solutions for assessment, feedback, and personalized learning experiences (Yesilyurt, 2023). The literature highlights AI's potential to enhance research efficiency, comprehension, and critical thinking skills among students (Aure & Cuenca, 2024). However, the integration of AI technologies, such as augmented reality (AR), in science education reveals challenges related to technology, pedagogy, and content knowledge that teachers must navigate (Hsu et al., 2023). Mobile learning has gained prominence with game-based and collaborative learning emerging as popular pedagogical approaches. The SAMR model indicates that mobile technologies are primarily used for redefinition in educational contexts (Tlili et al., 2022). In architectural design, AI platforms such as Midjourney and Stable Diffusion are becoming collaborative partners, offering unique strengths and

limitations to the creative process (Petráková & Šimkovič, 2023). The post-pandemic landscape has accelerated the adoption of AI in language acquisition, emphasizing deep-learning principles and meaningful pedagogy (Eslit, 2023). Although AI shows promise in supporting cognitive and non-cognitive tasks, concerns persist regarding ethics, privacy, and transparency (Niemi, 2021). The flipped classroom approach in teacher education has gained traction, focusing on student perceptions and academic performance (Han & Røkenes, 2020). Knowledge management practices increasingly rely on IT and AI mechanisms, presenting both opportunities and challenges for modern organizations (Al Mansoori et al., 2020). However, the implementation of AI in education faces obstacles related to costs, teacher training, and curriculum adaptation (Saputra et al., 2023). Gaps and Limitations in Current Research Need for long-term studies on teacher adaptation to AI Lack of inclusion of rural/under-resourced training contexts Overemphasis on technology, underemphasis on pedagogy and ethics The literature reveals a need for more comprehensive research on AI integration in education, particularly focusing on long-term teacher adaptation, diverse educational contexts, and the ethical implications of AI use. Future studies should address these gaps to ensure effective implementation of AI in educational settings.

4. Discussion- The integration of artificial intelligence (AI) into classrooms presents challenges and opportunities for teacher training.

Challenges:

- 1. Technological literacy:** Many teachers lack the skills necessary to effectively integrate AI tools into their teaching practice.

- 2. Pedagogical adaptation:** Educators struggle to align AI technologies with existing curricula and teaching methodologies.

- 3. Ethical concerns:** Issues surrounding data privacy, algorithmic bias, and potential displacement of human teachers raise ethical questions.

- 4. Rapid technological advancements:** The fast-paced evolution of AI technologies makes it difficult for teacher-training programs to stay current.

Opportunities:

- 1. Personalized Learning:** AI can enable tailored educational experiences for students, potentially improving learning outcomes.

- 2. Administrative efficiency:** AI tools can automate routine tasks, allowing teachers to focus more on instruction and student interactions.

- 3. Enhanced assessment:** AI-powered assessment tools provide more frequent and detailed feedback on student performance.

- 4. Professional development:** AI can offer personalized training and support to teachers, thereby facilitating continuous improvement.

Analysis of patterns and contradictions across studies revealed the following:

- 1. Inconsistent implementation:** While some studies report successful AI integration, others highlight significant barriers to its adoption.

- 2. Varied teacher attitudes:** Research indicates a spectrum of teacher attitudes towards AI, ranging from enthusiasm to skepticism and resistance.

- 3. Contextual differences** The effectiveness of AI integration varies across educational contexts, subjects, and student age groups.

4. Gap between potential and reality: Many studies have emphasized the potential benefits of AI in education, but practical implementation often falls short of expectations.

The roles of teacher educators and policymakers in shaping AI readiness are crucial.

1. Curriculum development: Teacher education programs must be updated to include AI-related competencies and skills.

2. Policy frameworks: Clear guidelines and standards for AI use in education must be established to ensure ethical and effective implementation.

3. Resource allocation: Adequate funding and resources must be provided for the AI infrastructure and teacher training initiatives.

4. Collaboration with industry: Partnerships between educational institutions and AI developers can help align technological advancements with pedagogical needs.

Implications for the future of teacher training and evolving teaching roles

1. Shift in skill focus: Teacher training programs need to emphasize technological literacy, data interpretation, and AI-enhanced pedagogical strategies.

2. Continuous professional development: The dynamic nature of AI technology necessitates ongoing training and support for teachers throughout their careers.

3. Redefinition of teaching roles: Teachers may evolve into facilitators of AI-enhanced learning experiences that require new competencies and mindsets.

4. Ethical considerations: Training programs must incorporate modules for AI ethics, data privacy, and responsible technology use.

5. Adaptive expertise: Teachers need to develop the ability to critically evaluate and selectively implement AI tools based on their pedagogical value.

6. Collaborative learning environments: AI integration may lead to more team-based approaches to teaching, requiring skills in collaboration and interdisciplinary instruction.

As AI continues to reshape the educational landscape, teacher-training programs and policies must evolve to prepare educators for the challenges and opportunities of AI-integrated classrooms. This transformation requires concerted efforts from educational institutions, policymakers, and technology developers to ensure that teachers are equipped to harness the potential of AI while maintaining the essential human elements of education.

5. Implications and Recommendations: For Teacher Education Institutions- Implications and Recommendations The integration of AI into classrooms presents challenges and opportunities for teacher education. The following implications and recommendations are proposed based on a review of contemporary research. Teacher Education Institutions

1. The curriculum is redesigned to include AI pedagogy and ethics.
 - Develop comprehensive courses on AI integration in education
 - Incorporate modules on ethical considerations of AI use in classrooms
 - Provide hands-on training with AI tools and platforms
 - Emphasize critical thinking skills for evaluating AI applications
2. Partnerships with tech developers.
 - Collaborate with AI companies to create tailored educational solutions
 - Establish internship programs for pre-service teachers with ed-tech firms
 - Invite industry experts for guest lectures and workshops
 - Co-develop AI-based teaching resources and materials
3. Continuous professional development:
 - Offer regular workshops and seminars on emerging AI technologies
 - Create online learning modules for in-service teachers
 - Establish mentorship

programs pairing tech-savvy educators with novices

4. Research initiatives:
 - Conduct studies on the effectiveness of AI-integrated teaching methods
 - Investigate the long-term impact of AI on student learning outcomes
 - Explore culturally responsive AI integration in diverse classroom settings
5. Policy advocacy:
 - Engage with policymakers to shape AI-related educational policies
 - Develop guidelines for ethical AI use in schools
 - Advocate for funding to support AI integration in teacher education programs
6. Interdisciplinary collaboration
 - Foster partnerships with computer science and engineering departments
 - Encourage cross-disciplinary research on AI in education
 - Develop joint courses combining education and technology expertise
7. Assessment and evaluation
 - Create new assessment methods to evaluate teachers' AI competencies
 - Develop frameworks for assessing AI-enhanced lesson plans and curricula
 - Implement ongoing evaluation of AI integration efforts in teacher education

By implementing these recommendations, teacher-education institutions can better prepare educators for the challenges and opportunities of AI-integrated classrooms, ensuring that future teachers are equipped with the necessary skills and knowledge to effectively leverage AI technologies in their teaching practice.

For Policy Makers

- Standardized AI competency frameworks for teachers
- Investment in infrastructure and continuous professional development

Future research implications and recommendations

The integration of AI into classrooms presents challenges and opportunities for teacher training. Based on a review of contemporary research, several key implications and recommendations have emerged.

- 1. Curriculum redesign:** Teacher education programs should be revised to incorporate AI-related competencies, ensuring that future educators are well-prepared for AI-integrated classrooms.
- 2. Continuous professional development:** Ongoing training opportunities should be provided to in-service teachers to keep them updated on AI advancements and their educational applications.
- 3. Collaborative approach:** Partnerships between educational institutions, AI developers, and policymakers should be fostered to create comprehensive and effective teacher-training programs.
- 4. Ethical considerations:** Training should emphasize the ethical implications of AI in education including data privacy, algorithmic bias, and equitable access to AI resources.
- 5. Pedagogical shift:** Teachers should be trained to adapt their teaching methods to leverage AI tools effectively, while maintaining a student-centered approach.
- 6. Technical skills development:** Training programs should focus on developing teachers' technical skills to effectively use AI-based educational tools.
- 7. Assessment of AI Impact:** Regular evaluation of the impact of AI integration on student learning outcomes and teacher effectiveness should be conducted to inform future training strategies.

For Future Research:

1. Longitudinal and comparative studies across different education systems

Conduct long-term studies to track the effectiveness of AI-based teacher training programs across various educational contexts.

- Compare the implementation and outcomes of AI integrated teacher training in different countries and education systems to identify best practices and cultural considerations.

2. Exploration of intersectionality - Investigate the intersection of AI and inclusive education, focusing on how AI can be leveraged to support diverse learners and promote equity in the classroom. Examine the potential of AI to address specific challenges in special education and develop targeted training programs for teachers working with students with diverse needs.

3. AI literacy assessment: Develop and validate comprehensive assessment tools to measure teachers' AI literacy and competencies and inform targeted training interventions.

4. Cost-benefit analysis: Conducting research on the economic implications of implementing AI integrated teacher training programs to inform policy decisions and resource allocation.

5. AI-human collaboration: Explore optimal models for collaboration between AI systems and human teachers, focusing on how to train teachers to work alongside AI effectively.

6. Cultural adaptation: Investigate how AI integrated teacher training can be adapted to various cultural contexts, ensuring relevance and effectiveness across diverse educational settings.

7. Long-term impact on student outcomes: Conducting longitudinal studies to assess the long-term effects of AI integrated teaching on student achievement, critical thinking skills, and career readiness.

6. Conclusion- The integration of artificial intelligence (AI) into educational settings presents substantial challenges and promising opportunities for teacher training. Key challenges include the rapid pace of technological advancement, necessity for ongoing professional development, and need to address ethical concerns associated with AI use in education. Conversely, opportunities exist to enhance personalized learning, automate administrative tasks, and foster innovative pedagogical approaches. There is an urgent need to equip educators with not only the technical skills required to operate AI tools but also the critical thinking abilities necessary to evaluate their pedagogical implications, social impacts, and ethical considerations. This comprehensive approach to teacher preparation is essential for ensuring that AI integration in classrooms is thoughtful, responsible, and aligned with the educational objectives. A collaborative, cross-disciplinary approach to teacher training is indispensable to effectively address these challenges and capitalize on opportunities. This approach should involve educators, technologists, policymakers, and ethicists working in concert to develop comprehensive training programmes. Such collaboration can lead to more robust, adaptable, and ethically grounded teacher preparation strategies that keep pace with technological advancements, while prioritizing student learning outcomes and well-being. As AI continues to reshape the educational landscape, investing in teacher training that emphasizes both technical proficiency and critical engagement with AI technology is paramount. This investment will be crucial in preparing educators to navigate the complexities of AI-integrated classrooms and harness the potential of AI to enhance teaching and learning experiences.

7. References:-

- Adeleye, O., Eden, C., Adeniyi, I. (2024). Innovative teaching methodologies in the era of artificial intelligence: A review of inclusive educational practices. *World Journal of Advanced Engineering Technology and Sciences*, 11(2), 069–079. <https://doi.org/10.30574/wjaets.2024.11.2.0091>
- Al Mansoori, S., Shaalan, K., & Salloum, S. A. (2020). *The Impact of Artificial Intelligence and Information Technologies on the Efficiency of Knowledge Management at Modern Organizations: A Systematic Review* (pp. 163–182). Springer. https://doi.org/10.1007/978-3-030-47411-9_9

- Aure, P. A., & Cuenca, O. (2024). Fostering social-emotional learning through human-centered use of generative AI in business research education: An insider case study. *Journal of Research in Innovative Teaching & Learning*, 17(2), 168–181. <https://doi.org/10.1108/jrit-03-2024-0076>
- Barrera Castro, G. P., Sepulveda, F. G., Becerra Rodriguez, D. F., & Chiappe, A. (2024). Harnessing AI for Education 4.0: Drivers of Personalized Learning. *Electronic Journal of E-Learning*, 22(5), 01–14. <https://doi.org/10.34190/ejel.22.5.3467>
- Black, N. B., Eguchi, A., Fraga, L., Howard, N., George, S., Dempsey, J. C., Langran, E., & Brunvand, S. (2024). Framework for Approaching AI Education in Education Preparation Programs. *Proceedings of the AAAI Conference on Artificial Intelligence*, 38(21), 23069–23077. <https://doi.org/10.1609/aaai.v38i21.30351>
- Dimitriadou, E., & Lanitis, A. (2023). Critical evaluation, challenges, and future perspectives of using artificial intelligence and emerging technologies in smart classrooms. *Smart Learning Environments*, 10(1). <https://doi.org/10.1186/s40561-023-00231-3>
- Dong, Y. (2023). Revolutionizing Academic English Writing through AI-Powered Pedagogy: Practical Exploration of Teaching Process and Assessment. *Journal of Higher Education Research*, 4(2), 52. <https://doi.org/10.32629/jher.v4i2.1188>
- Eslit, E. R. (2023). *Elevating Language Acquisition through Deep Learning and Meaningful Pedagogy in an AI-Evolving Educational Landscape*. mdpi ag. <https://doi.org/10.20944/preprints202309.0658.v1>
- Familoni, B., & Onyebuchi, N. (2024). ADVANCEMENTS AND CHALLENGES IN THE AI INTEGRATION FOR TECHNICAL LITERACY: A SYSTEMATIC REVIEW. *Engineering Science & Technology Journal*, 5(4), 1415–1430. <https://doi.org/10.51594/estj.v5i4.1042>
- Festus, O., & Bamidele Emmanuel, O. (2024). Sociocultural and Digital Communication Challenges in AI Adoption for Classroom Communication: Insights from Nigerian Colleges of Education. *Language, Technology, and Social Media*. <https://doi.org/10.70211/ltsm.v3i1.115>
- Ghimire, A., Prather, J., Edwards, J. (2024). *Generative AI in Education: A Study of Educators' Awareness, Sentiments, and Influencing Factors*. <https://doi.org/10.48550/arxiv.2403.15586>
- Han, H., & Røkenes, F. M. (2020). Flipped Classroom in Teacher Education: A Scope Review. *Frontiers in Education*, 5. <https://doi.org/10.3389/educ.2020.601593>
- Hsu, H.-P., Cheah, Y. H., & Hughes, J. E. (2023). A Case Study of a Secondary Biology Teacher's pedagogical reasoning and action using augmented reality technology. *Education Sciences*, 13(11), 1080. <https://doi.org/10.3390/educsci13111080>
- Kovalenko, I., & Baranivska, N. (2024). INTEGRATING ARTIFICIAL INTELLIGENCE IN ENGLISH LANGUAGE TEACHING: EXPLORING THE POTENTIAL AND CHALLENGES OF AI TOOLS IN ENHANCING LANGUAGE LEARNING OUTCOMES AND PERSONALIZED EDUCATION. *European Socio-Legal & Humanitarian Studies*, 1, 86–95. <https://doi.org/10.61345/2734-8873.2024.1.9>
- Li, L., Yu, F., & Zhang, E. (2024). A systematic review of learning task design for K-12 AI education: Trends, challenges, and opportunities. *Computers and Education: Artificial Intelligence*, 6, 100217. <https://doi.org/10.1016/j.caeai.2024.100217>
- Msambwa, M. M., Daniel, K., Wen, Z. (2025). The Impact of AI on the Personal and Collaborative Learning Environments in Higher Education. *European Journal of Education*, 60(1). <https://doi.org/10.1111/ejed.12909>

- Niemi, H. (2021). AI in learning. *Journal of Pacific Rim Psychology*, 15, 183449092110381. <https://doi.org/10.1177/18344909211038105>
- Petráková, L., & Šimkovič, V. (2023). Architectural alchemy: Leveraging Artificial Intelligence for inspired design – a comprehensive study of creativity, control, and collaboration. *Architecture Papers of the Faculty of Architecture and Design STU*, 28(4), 3–14. <https://doi.org/10.2478/alfa-2023-0020>
- Rütli-Joy, O., Winder, G., & Biedermann, H. (2024). *Teacher Educator Professionalism in the Age of AI: Navigating the New Landscape of Quality Education*. intechopen. <https://doi.org/10.5772/intechopen.1005030>
- Saputra, I., Kusumastuti, D., Astuti, M., Sayuti, M. (2023). Integration of Artificial Intelligence in Education: Opportunities, Challenges, Threats and Obstacles. A Literature Review. *The Indonesian Journal of Computer Science*, 12(4). <https://doi.org/10.33022/ijcs.v12i4.3266>
- Sipahioglu, M. (2024). *Empowering Teachers With Generative AI Tools and Support* (pp. 214–238). igi global. <https://doi.org/10.4018/979-8-3693-1351-0.ch011>
- Slade, J. J., Gurung, R. A. R., Becker-Blease, K. A., & Byers, S. M. (2024). Navigating the New Frontier: Recommendations to Address the Crisis and Potential of AI in the Classroom. *Teaching of Psychology*. <https://doi.org/10.1177/00986283241276098>
- Sun, J. C., & Pratt, T. L. (2024). Navigating AI Integration in Career and Technical Education: Diffusion Challenges, Opportunities, and Decisions. *Education Sciences*, 14(12), 1285. <https://doi.org/10.3390/educsci14121285>
- Tlili, A., Padilla-Zea, N., Garzón, J., Wang, Y., Kinshuk, K., & Burgos, D. (2022). The changing landscape of mobile learning pedagogy: A systematic literature review. *Interactive Learning Environments*, 31(10), 6462–6479. <https://doi.org/10.1080/10494820.2022.2039948>
- Velandar, J., Taiye, M. A., Otero, N., & Milrad, M. (2023). Artificial Intelligence in K-12 Education: eliciting and reflecting on Swedish teachers' understanding of AI and its implications for teaching & learning. *Education and Information Technologies*, 29(4), 4085–4105. <https://doi.org/10.1007/s10639-023-11990-4>
- Walter, Y. (2024). Embracing the future of Artificial Intelligence in the classroom: the relevance of AI literacy, prompt engineering, and critical thinking in modern education. *International Journal of Educational Technology in Higher Education*, 21(1). <https://doi.org/10.1186/s41239-024-00448-3>
- Yesilyurt, Y. E. (2023). *AI-Enabled Assessment and Feedback Mechanisms for Language Learning* (pp. 25–43). igi global. <https://doi.org/10.4018/978-1-6684-9893-4.ch002>.