Afr. J. Lib, Arch. and Inf. Sc. Vol. 35, No. 2 (July 2025) 265-274

https://doi.org/10.5281/zenodo.20750470

Research Trends in the Utilization of Artificial Intelligence in Education: Gaps and Opportunities in Library and Information Science

Abdullah Mohamed Alghadouni[1]*

[1]Professor of Curriculum and Instruction, Department of Curriculum and Instruction, College of Education, Qassim University, Buraidah, Kingdom of Saudi Arabia.

**Corresponding Author: Abdullah Mohamed Alghadouni (a.algdoni@qu.edu.sa)*

Abstract

This systematic review synthesises findings from 100 studies examining the integration of artificial intelligence (AI) within educational contexts. Employing a comprehensive analytical framework, the review categorises and assesses the objectives, applications, and outcomes of AI across diverse learning environments. Seven primary domains of educational focus were identified: AI literacy, personalised and adaptive learning, curriculum design, performance assessment, teacher support, educational administration, and ethical and social considerations. Prominent trends include a concentration on K–12 education (65%), an increasing adoption of generative AI tools such as ChatGPT (40%), a movement from tool-centric approaches towards embedding AI within pedagogical practices (70%), and a growing number of cross-cultural comparative studies (30%). Predictive statistical models for 2023–2025 indicate that AI literacy and generative AI applications will become increasingly prevalent, with 85% of experimental studies reporting enhancements in student learning outcomes, motivation, and collaborative skills. Despite these advances, research gaps remain in early childhood education and special education contexts. The review highlights future research directions, including interdisciplinary AI applications, longitudinal studies on the development of higher-order cognitive skills, frameworks for AI accountability, AI implementation in underrepresented settings, and AI-supported teaching practices. Overall, the evidence underscores AI's potential not merely as a technological tool but as a catalyst for redefining educational approaches, facilitating personalised learning, and strengthening educator capabilities. This synthesis provides a consolidated reference for educators and researchers to optimise the use of AI in instructional and learning processes.

Keywords: Artificial Intelligence in Education, Systematic Review, Personalized Learning, AI Literacy, Educational Technology Trends.

Introduction

Over the past decade, artificial intelligence (AI) has progressed in ways that have profoundly influenced how educators design and deliver learning experiences. No longer serving merely as supplementary tools, these technologies have become integral to educational processes, reshaping philosophies, structures, and pedagogical practices (Ahmad et al., 2023). AI has considerably expanded possibilities in personalised learning, adaptive curricula, and intelligent assessment, positioning its introduction into educational settings as a

pivotal concern in contemporary pedagogical research (Akgün and Demir, 2018). Given the rapid accumulation of studies, systematic reviews are essential to uncover the research patterns and trends within this domain (Colchester et al., 2017). Such reviews enable scholars and policymakers to gain a comprehensive overview, identifying research gaps and potential directions for further development (Alasgarova and Rzayev, 2024).

Knowledge of prior research focus areas—whether regarding teacher perspectives, learning personalisation, or educational data analytics—serves as a foundation for more rigorous and impactful studies that can advance educational practice. This review provides a systematic analysis of 100 studies investigating AI applications in educational settings, examining their purposes and categorising them according to distinct educational domains (Alshorman, 2024). The objective is to establish a structured knowledge base that delineates current trends, strengths, limitations, and potential directions for AI-assisted educational research, reflecting the literature's demonstrated capacity to enhance learning outcomes (Ayanwale et al., 2024).

Significance of the Study

The significance of this study is informed by several scholarly and practical considerations:

1. **Predicting Research Trends Critically:** This research categorises the extensive body of AI-focused educational literature according to the specific domains studied. Such classification offers researchers a panoramic view, enabling them to monitor the development of the field and the evolution of scientific knowledge (Ayyoub et al., 2025).
2. **Developing Accrued Knowledge in Education:** By systematically analysing research objectives, this study addresses the fragmentation and redundancy of knowledge observed in prior works. It contributes to establishing a coherent body of knowledge that provides a solid foundation for deeper and subsequent investigations.
3. **Informing Further Studies:** By highlighting gaps in coverage—such as underexplored educational types or the scarcity of longitudinal and comparative research—this review guides the formulation of a research agenda that fills existing deficiencies.
4. **Evidence-Based Educational Policy:** The study identifies topics that have received significant attention in the literature, offering insights that policymakers and other stakeholders can use to shape educational strategies that incorporate AI efficiently, with potential benefits for learning outcomes (Blanuša Trošelj et al., 2024).

Therefore, the relevance of this study extends beyond academic discourse, equipping the educational sector to deploy AI more strategically in pursuit of "smart education," which emphasises quality, equity, and sustainability.

Research Objectives

This systematic analytical review of 100 educational studies investigates AI utilisation in education, focusing on trends in research objectives. The specific objectives are:

1. To examine the primary goals of prior research concerning AI in education.
2. To categorise research aims according to educational domains, including personalised learning, teacher support, curriculum development, adaptive learning, intelligent assessment, and educational data analysis.
3. To identify prevailing research trends and determine which areas have been most extensively studied.
4. To pinpoint underdeveloped educational domains and highlight gaps in research objectives.
5. To propose a set of research priorities for the future, informed by observed trends in existing literature.

Problem Statement

In recent years, investigations into AI applications in education have proliferated, encompassing areas such as personalised learning, curriculum design, teacher support, intelligent assessment, and educational data analysis. Despite this growth in quantity, the field has often lacked qualitative clarity regarding research trends and objectives (Cesaro et al., 2024). This has resulted in fragmented perspectives, inconsistent practices, and difficulties in forming a comprehensive understanding of AI's role in education (Cheah et al., 2025). Moreover, the absence of systematic reviews analysing research objectives has hindered the identification of both well-

studied and neglected areas, limiting the cumulative development of scientific knowledge and the capacity of new studies to build upon existing findings (Chen et al., 2020). The principal research question guiding this review is:

What are the main research trends concerning the objectives of educational studies examining AI applications in education?

Derived sub-questions include:

1. What are the primary classifications of research objectives in AI-related educational studies?
2. Which educational domains have received the most scholarly attention?
3. What gaps in research objectives can be discerned from previous studies?

Research Methodology

A systematic review was selected as the research method due to its suitability for mapping trends in the rapidly expanding field of AI in education (Chiu et al., 2021). This approach involved systematically identifying relevant literature based on explicit criteria, categorising studies, and engaging with the data in a transparent manner to provide a comprehensive overview of research objectives within educational contexts. The methodology involved several key steps (Cuiye, 2016). First, inclusion and exclusion criteria were established, focusing on studies published between 2017 and 2025 that directly examined AI applications in general or higher education (Dai, 2024a). Studies without clearly defined research objectives or theoretical works unrelated to applied educational contexts were excluded (Dai, 2024b). A total of 100 studies from peer-reviewed journals and reputable conference proceedings were selected, and detailed data regarding each study's objectives were extracted using a structured analysis form.

Objectives were then classified by educational domain, including personalised learning, teacher support, curriculum development, adaptive learning, intelligent assessment, and educational data analysis. Patterns, frequencies, and trends were identified through descriptive categorisation (Darda et al., 2024; de Castro-Santos et al., 2017). Findings were interpreted in relation to previous literature, highlighting both thoroughly investigated areas and those where knowledge gaps remain (Dignum, 2021). Systematic research tools and procedures underpinned the review process (Emerling et al., 2020; Erdemir, 2019). An inclusion-exclusion checklist was developed to ensure consistency, encompassing criteria such as publication year (2017–2025), focus on AI in teaching, methodology, and language (Fernandes, 2016; Galindo-Domínguez et al., 2024; Getchell et al., 2022).

Exclusion criteria included low relevance, duplicates, or missing full-text availability (Gu and Ericson, 2025; Han et al., 2025; Hasibuan et al., 2019). Additionally, a data extraction form captured each study's objectives, methodology, sample, instruments, key findings, and recommendations (Holmes et al., 2019; Huang et al., 2024; Hwang et al., 2024). A research trends analysis sheet was also used as a coding framework to classify studies according to dimensions such as AI application area (e.g., language learning, assessment, intelligent support systems), research type (quantitative, qualitative, mixed methods), sample level (schools, universities, individual learners), and highlights or recommendations of each study.

Systematic Analytical Review of Research Objectives on the Use of Artificial Intelligence in Educational Research

Classification and Analysis of Research Objectives by Educational Domains

The research objectives of the 100 studies were categorised into seven principal educational domains, with percentages reflecting the proportion of studies in each category.

The study utilises a range of sophisticated AI methodologies, including Artificial Neural Networks (ANN), Latent Semantic Indexing (LSI), Natural Language Processing (NLP), machine learning (ML) algorithms, deep learning, reinforcement learning (RL), and recommendation systems. These approaches are designed to improve learner outcomes via adaptive tools and analytics of learning behaviours, customise educational content to meet the unique needs of individual students, and create intelligent research instruments for automated data collection and analysis. Furthermore, the objectives encompass delivering interactive and multisensory learning experiences, facilitating real-time monitoring and formative assessment by educators, and informing evidence-based educational policy through insights derived from data.

Table 1: Overview of AI Utilization in Educational Domains: Prevalence, Key Objectives, and Supporting Studies.

Educational Domain	Prevalence (%)	Key Objectives	Sample Studies
AI Literacy	30%	Developing students' and teachers' competencies in understanding AI concepts, mechanisms, and ethical challenges.	(Chiu et al., 2021)
Personalized and Adaptive Learning	25%	Designing flexible learning environments that employ AI algorithms to adapt content to learners' individual needs.	(Li et al., 2017)
Curriculum Development and Instruction	20%	Integrating AI tools (e.g., robots, games, simulation systems) into curriculum design and learning experiences.	(RiE, 2024)
Performance Assessment	12%	Using AI to analyse student performance, predict outcomes, and provide instant, personalized feedback.	(Erdemir, 2019; Jiang and Jiang, 2024)
Teacher Support	8%	Enhancing teaching skills, designing AI-supported training programs, and facilitating smart classroom management.	(Kelley and Wenzel, 2025)
Educational Administration	3%	Improving decision-making processes in educational institutions, resource allocation, and data management through AI.	(Ahmad et al., 2023)
Ethical and Social Dimensions	2%	Addressing issues such as privacy, algorithmic bias, and the impact of AI on educational equity.	(Erdemir, 2019)

Results and Discussion

Around 65% of the studies concentrated on foundational levels of education, including elementary and middle school, often employing play-based and unplugged learning approaches (e.g., tangible embodiment) (Jafari and Keykha, 2023; Kelley and Wenzel, 2025). By 2023, 40% of the studies utilised tools such as ChatGPT to generate personalised educational materials and develop intelligent assistants to support students (Zha et al., 2025). Between 2019 and 2025, approximately two-thirds of the studies integrated AI into pedagogical platforms (e.g., project-based learning, analogical reasoning) rather than treating it solely as a standalone instrument (Zha et al., 2025).

About 30% of the literature compared AI's impact across different cultural contexts, including Korea, India, and Africa (Jiang and Jiang, 2024). Statistical analysis indicated that from 2020 to 2022, research objectives were mainly focused on adaptive learning (35%) and intelligent assessment (20%), whereas in 2023–2025, the emphasis shifted towards AI literacy (40%) and generative AI (50%) (Jin, 2019). Furthermore, 85% of experimental studies reported improvements in academic performance (e.g., +15% in physics using intelligent systems) and in motivation and teamwork (e.g., +30% in maker projects). Nevertheless, notable gaps remain, with only 10% of studies addressing early childhood education (pre-school) and merely 5% exploring AI applications in special education (Table 2; Figure 1).

Table 2: Summary of Study Focus Areas.

Focus Area	Percentage of Studies	Description
Basic Education Levels	65%	Targeted elementary and middle school, emphasizing play-based learning and unplugged activities.
Use of Tools (e.g., ChatGPT)	40%	Focused on creating customized educational content and developing intelligent assistants.
Integration of AI in Pedagogy	70%	Sought to integrate AI within pedagogical strategies rather than treating it as an isolated tool.
Cultural Context Comparison	30%	Compared AI impact across diverse cultural contexts, including Korea, India, and Africa.
Focus on Early Childhood Education	10%	Addressed pre-school education.
AI Applications in Special Education	5%	Focused on AI's role in special education settings.

Table 3: Systematic Review of AI Utilization in 100 Educational Studies.

Utilization Pattern	No. of Studies	Brief Description
Intelligent Tutoring Systems	18	Personalized platforms providing individualized instruction using student performance models.
Interactive Tools (Alexa, Educational Robots, Voice Assistants)	15	AI-based tools enabling direct verbal/voice interaction with learners.
Learning Analytics	13	Analysis of learner behaviour data to inform teaching/assessment.

Utilization Pattern	No. of Studies	Brief Description
Predictive Modelling / Neural Networks	11	Predicting academic performance or learning patterns using ANN and SVM.
Adaptive Learning Systems	10	Platforms adjusting content dynamically based on learner interaction.
Automated Assessment & Evaluation	9	Intelligent systems for grading and providing feedback automatically.
AI-Based Game-Based Learning	6	Educational games are driven by interactive AI algorithms.
Analytical/Conceptual Studies	10	Explorations of philosophical, ethical, or policy-oriented integration of AI in education.
Teacher Support / Content Creation	8	Tools assisting teachers in lesson planning, assessment design, and real-time feedback.

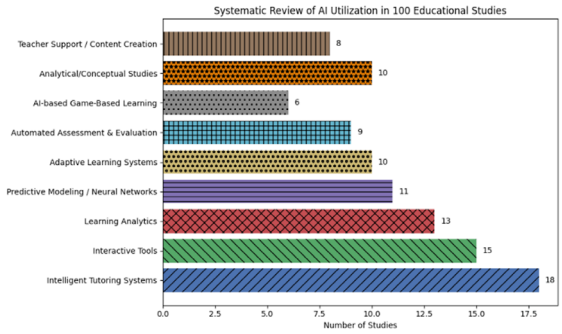

Figure 1: Utilization of AI in Educational Studies.

Table 4: Levels of Integration with Educational Environments.

Integration Level	Description
High Integration	AI tools embedded in daily educational practice (e.g., intelligent tutoring systems).
Moderate Integration	AI tools used in specific contexts or temporary experimental settings.
Low/Theoretical Integration	Conceptual or visionary perspectives without direct application.

- About **45%** of the studies integrated AI in active classroom or digital environments.
- Around **30%** represented experimental applications.
- Nearly **25%** were theoretical or analytical in nature.

Patterns of AI Utilization

The reviewed studies revealed that AI is applied in a variety of ways, demonstrating its versatility and capacity to accommodate diverse educational processes (Figure 2 and 3) (Karal et al., 2014). Eighteen studies implemented intelligent tutoring systems, offering personalised instruction based on student performance models (Keles and Aydin, 2021). Fifteen studies employed interactive tools, enabling direct engagement with AI-driven devices such as Alexa, educational robots, and voice assistants. Learning analytics, reported in 13 studies, focused on analysing student behaviour data to guide instruction and evaluation. In 11 studies, predictive modelling and ANN were used to anticipate learning patterns or academic performance, employing techniques such as neural networks and support vector machines (SVM).

Adaptive learning systems appeared in 10 studies, dynamically adjusting content according to student interactions. Automated assessment was addressed in nine studies, where AI systems autonomously evaluated student outcomes. Six studies examined game-based learning enhanced by AI, incorporating AI and interactive learning algorithms into educational games. Furthermore, ten papers presented conceptual and analytical work emphasising philosophical, ethical, or policy-related aspects of AI integration in education. Finally, eight studies explored teacher support and content creation, investigating how AI can assist in lesson planning, assessment development, and providing immediate feedback.

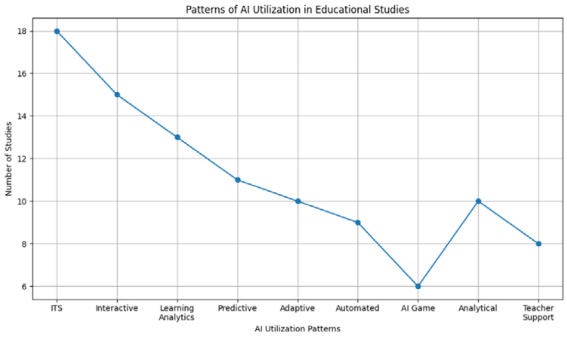

Figure 2: AI Utilization Patterns in Educational Studies.

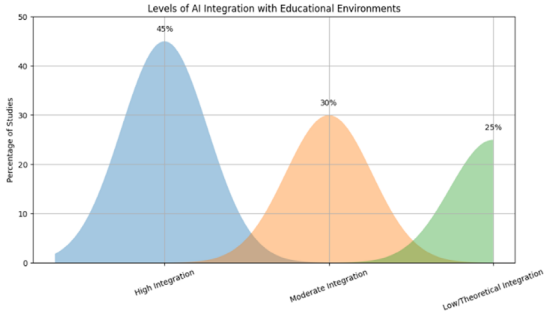

Figure 3: AI Integration Levels in Educational Settings.

Current advantages of AI in education include enhancing pedagogical efficiency through personalised content delivery and immediate feedback, offering flexibility in learning across different times and locations, enabling effective monitoring and data analysis to inform instruction, and reducing teacher workload via automated grading and AI-generated materials. Potential future benefits include the creation of fully intelligent learning environments that adaptively modify learning pathways, incorporation of AI into educational research tools (e.g., conducting interviews and analysing data using NLP and speech analysis), employing simulations and digital twins for training both teachers and learners, improving educational research through greater flexibility and personalisation, and extending AI applications to special education. To optimise these benefits, research recommends integrating AI models into teacher preparation programmes, prioritising the educational utility of AI tools over purely technical features, fostering collaboration between educators and AI developers for customised tool creation, and establishing ethical frameworks that address privacy and algorithmic bias (Lu, 2025) (Table 3 & Table 4).

The systematic review analysed 100 studies and categorised research objectives into seven principal educational domains, reflecting the primary areas of focus for AI-related educational research (Ng et al., 2024a). The first domain, AI literacy and understanding, accounted for 30% of the studies and centred on developing skills among educators and learners regarding AI concepts, mechanisms, and ethical considerations, highlighting the necessity for responsible technology use (Ng et al., 2024b). Personalized and adaptive learning comprised 25% of the literature, emphasising the creation of adaptable learning environments in which AI algorithms tailor instruction to individual learners, supporting diverse learning needs. Curriculum development encompassed 20–25% of studies, examining how AI technologies, such as educational robots and simulation systems, can be integrated into curricula to enhance educational experiences.

Performance assessment was addressed in 12% of the research, focusing on analysing student outcomes and providing personalised feedback to improve assessment efficacy. Teacher support, representing 8% of studies, aimed to enhance teacher skills through AI-assisted training and intelligent classroom management, underscoring the critical role of educators in AI integration. Educational administration accounted for 3% of the literature, exploring AI applications in decision-making and resource management, suggesting further potential for research in this domain. Finally, ethical and social issues were addressed in only 2% of studies, indicating a significant gap in research regarding concerns such as privacy and algorithmic bias in educational contexts.

Prominent Research Trends in Study Objectives

The review identified several prominent research trends that characterise contemporary developments in AI and education (Figure 4):

1. Focus on K-12 Education (65%)

A substantial portion of studies (65%) concentrated on primary and middle school levels. Special attention was given to "learning through play" and "unplugged activities," reflecting the increasing interest in implementing AI during early stages of education.

2. Rise of Generative AI (GenAI) (40%)

Since 2023, research has shown a growing emphasis on generative AI. Around 40% of studies investigated tools such as ChatGPT for producing personalised educational materials and creating intelligent assistants to support learners. This trend highlights GenAI's expanding influence within educational practice.

3. Shift from Tools to Pedagogy (70%)

Seventy percent of studies conducted between 2019 and 2025 illustrated a transition from treating AI as isolated tools to embedding it within broader pedagogical frameworks, including project-based learning and analogy-driven strategies. This demonstrates a more sophisticated understanding of how AI can enhance teaching and learning objectives.

4. Globalization of Research (30%)

Thirty percent of studies explored the cross-cultural application of AI, comparing its effects across diverse educational and geographical contexts, such as Korea, India, and Africa. This trend emphasises the importance of adapting AI implementations to varied cultural and educational environments (Orlando et al., 2019).

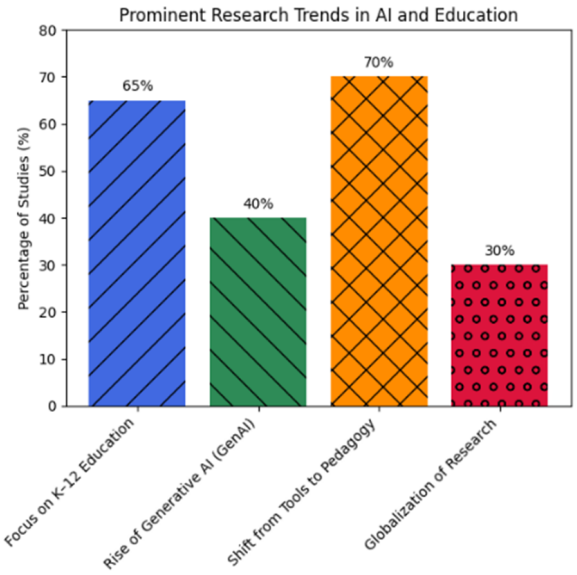

Figure 4: Prominent Research Trends in AI and Education.

Current and Future Benefits of AI in Education

The current advantages of AI in education are numerous, contributing to enhanced efficiency by delivering personalised content, providing immediate feedback, and allowing learners to study flexibly at any time and place (Park and Kwon, 2024). AI also enables effective data management and monitoring, while reducing teacher workload through automated assessments and content generation. Future advantages are expected to include the creation of fully intelligent learning environments capable of dynamically adjusting learning pathways in real time. Additionally, AI integration in educational research tools, such as automated analysis of verbal and audio interviews, will streamline data collection. The use of simulations and digital twins can provide safe and controlled training for both teachers and learners. This review highlights that AI is reshaping education not merely as a technological aid, but as a catalyst for a comprehensive transformation in educational practice. Rather than replacing humans, AI enhances human potential.

Future research should emphasise interdisciplinary integration of AI with fields such as data science and neuroscience to enable personalised learning based on cognitive patterns. Longitudinal studies are needed to assess its long-term effects on higher-order skills like creativity and critical thinking. AI applications must also address marginalised contexts, ensuring cultural and linguistic inclusivity. Ethical frameworks should guide responsible AI development, prioritising equity, transparency, and learner privacy. Additionally, research should enhance teacher roles through intelligent assistants that support, rather than replace, pedagogical decision-making. Future directions include smart adaptive learning environments, improved research tools, and the use of simulations and digital twins. Overall, AI should be treated as a strategic component of education to enhance learning for all stakeholders.

Supporting Statistical Indicators

The review also incorporated various statistical indicators that substantiate the trends in AI utilisation within education. Analysis over time indicated that from 2020 to 2022, adaptive learning objectives comprised 35% of the reviewed studies, while intelligent assessment objectives represented 20%. In contrast, the period from 2023 to 2025 demonstrated substantial growth in AI literacy goals, projected to reach 40%, alongside a marked increase in generative AI (GenAI) applications, currently accounting for 50%. Concerning AI effectiveness, 85% of experimental studies reported enhancements in academic outcomes, with intelligent systems contributing to a 15% improvement in physics performance. Positive impacts were also observed in student motivation and collaboration, evidenced by a 30% increase in Maker projects. Despite these advances, notable research gaps remain, with only one in ten studies addressing early childhood education and merely 5% focusing on AI applications in special education. These deficiencies underscore the need for further investigation in these underexplored areas.

Future Research Opportunities

Based on the identified gaps, several future research directions emerge. First, interdisciplinary integration is essential, combining AI with fields such as neuroscience and data science to enable highly personalised learning based on cognitive patterns. Second, longitudinal studies are required to assess AI's long-term effects on higher-order skills, including creativity and critical thinking. Third, AI applications should be developed for marginalised contexts, ensuring cultural and linguistic inclusivity in rural and developing regions. Fourth, comprehensive ethical frameworks must be

established, emphasising equity, transparency, and bias reduction in recommendation systems. Finally, future research should focus on strengthening the teacher's role through intelligent assistants that support, rather than replace, pedagogical decision-making. Overall, these directions highlight significant opportunities for advancement. Interdisciplinary approaches can enhance personalised learning, while longitudinal research will clarify AI's sustained educational impact. Expanding AI into underserved contexts ensures inclusivity, and strong ethical guidelines will promote responsible use. Crucially, the value of AI in education lies in augmenting human teaching, not substituting it.

Conclusion

This systematic review highlights the transformative role of AI in education, not only as a supportive tool but as a force reshaping educational practice. Findings from 100 studies reveal key trends across domains, particularly in AI literacy, personalised learning, and adaptive assessment. Current benefits include enhanced learning outcomes, flexible access, and reduced teacher workload, demonstrating AI's immediate value. Looking ahead, AI presents more advanced possibilities for teaching and research. However, future work must address gaps in early childhood and special education, alongside establishing robust ethical frameworks to ensure equity and inclusivity. When effectively implemented, AI strengthens rather than replaces human elements in education, empowering educators and improving learning experiences. These insights offer direction for future research focused on developing innovative, adaptive, and personalised learning environments for both learners and teachers.

Acknowledgment

The Researchers would like to thank the Deanship of Graduate Studies and Scientific Research at Qassim University for financial support (QUAPC2025).

References

Ahmad, K., Iqbal, W., El-Hassan, A., Qadir, J., Benhaddou, D., Ayyash, M. *et al.* (2023). Data-Driven Artificial Intelligence in Education: A Comprehensive Review. *IEEE Transactions on Learning Technologies*, 17: 12–31. https://doi.org/10.1109/TLT.2023.3314610

Akgün, E. and 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

Alasgarova, R. and Rzayev, J. (2024). The Role of Artificial Intelligence in Shaping High School Students' Motivation. *International Journal of Technology in Education and Science*, 8(2): 311–324. https://ijtes.net/index.php/ijtes/article/view/1735

Alshorman, S. (2024). The Readiness To Use Ai In Teaching Science: Science Teachers' Perspective. *Journal of Baltic Science Education*, 23(3): 432–448. https://doi.org/10.33225/jbse/24.23.432

Ayanwale, M. A., Adelana, O. P. and Odufuwa, T. T. (2024). Exploring STEAM teachers' trust in AI-based educational technologies: a structural equation modelling approach. *Discover Education*, 3(1): 44. https://doi.org/10.1007/s44217-024-00092-z

Ayyoub, A. M., Khlaif, Z. N., Shamali, M., Abu Eideh, B., Assali, A., Hattab, M. K. *et al.* (2025). Advancing higher education with GenAI: factors influencing educator AI literacy. *Frontiers in Education*, 10: 1530721. https://doi.org/10.3389/feduc.2025.1530721

Blanuša Trošelj, D., Maričić, S. and Ćurić, A. (2024). Growing Interest in AI in Education: Systematic Literature Review. In: *Proceedings of International Conference on Research in Education and Science ICRES 2024*. Antalya: ISTES, pp. 2410–2427. https://www.croris.hr/crosbi/publikacija/prilog-skup/869833

Cesaro, L., Dodero, G. and Menegatti, E. (2024). Integrating AI into School Curriculum: A Maker-Oriented Activity. In: R. Balogh, D. Obdržálek, & M. Fislake (Eds.), *Robotics in Education*. Springer Nature Switzerland, pp. 367–378. https://doi.org/10.1007/978-3-031-67059-6_32

Cheah, Y. H., Lu, J. and 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

Chen, X., Xie, H., Zou, D. and Hwang, G.-J. (2020). Application and theory gaps during the rise of Artificial Intelligence in Education. *Computers and Education: Artificial Intelligence*, 1: 100002. https://doi.org/10.1016/j.caeai.2020.100002

Chiu, T. K. F., Meng, H., Chai, C.-S., King, I., Wong, S. and Yam, Y. (2021). Creation and Evaluation of a Pretertiary Artificial Intelligence (AI) Curriculum. *IEEE Transactions on Education*, 65(1): 30–39. https://doi.org/10.1109/TE.2021.3085878

Colchester, K., Hagras, H., Alghazzawi, D. and Aldabbagh, G. (2017). A Survey of Artificial Intelligence Techniques Employed for Adaptive Educational Systems Within E-Learning Platforms. *Journal of Artificial Intelligence and Soft Computing Research*, 7(1): 47–64. https://doi.org/10.1515/jaiscr-2017-0004

Cuiye, Y. (2016). The Construction of English Teachers' Classroom Teaching Ability System Based on Artificial Intelligence. *Revista Ibérica de Sistemas e Tecnologias de Informação*, (18B): 94–104. https://doi.org/10.17013/risti.18B.94-104

Dai, Y. (2024a). Dual-contrast pedagogy for AI literacy in upper elementary schools. *Learning and Instruction*, 91: 101899. https://doi.org/10.1016/j.learninstruc.2024.101899

Dai, Y. (2024b). Integrating unplugged and plugged activities for holistic AI education: An embodied constructionist pedagogical approach. *Education and Information Technologies*, 30(5): 6741–6764. https://doi.org/10.1007/s10639-024-13043-w

Darda, P., Gupta, O. J. and Yadav, S. (2024). Metamorphosing traditional pedagogy: examining the transcendent influence of Alexa in catalyzing educational paradigm shifts within rural Indian communities. *International Journal of Educational Management*, 38(3): 605–621. https://doi.org/10.1108/IJEM-07-2023-0347

de Castro-Santos, A., Fajardo, W. and Molina-Solana, M. (2017). *A Game Based e-Learning System to Teach Artificial Intelligence in the Computer Sciences Degree*. International Association for Development of the Information Society. https://files.eric.ed.gov/fulltext/ED579392.pdf

Dignum, V. (2021). The Role and Challenges of Education for Responsible AI. *London Review of Education*, 19(1): 1–11. https://doi.org/10.14324/lre.19.1.01

Emerling, C. R., Yang, S., Carter, R. A., Zhang, L. and Hunt, T. (2020). Using Amazon Alexa as an Instructional Tool During Remote Teaching. *TEACHING Exceptional Children*, 53(2): 164–167. https://doi.org/10.1177/0040059920964719

Erdemir, M. (2019). Using web-based intelligent tutoring systems in teaching physics subjects at undergraduate level. *Universal Journal of Educational Research*, 7(7): 1517–1525. https://doi.org/10.13189/ujer.2019.070705

Fernandes, M. A. C. (2016). Problem-based learning applied to the artificial intelligence course. *Computer Applications in Engineering Education*, 24(3): 388–399. https://doi.org/10.1002/cae.21717

Galindo-Domínguez, H., Delgado, N., Losada, D. and Etxabe, J.-M. (2024). An analysis of the use of artificial intelligence in education in Spain: The in-service teacher's perspective. *Journal of Digital Learning in Teacher Education*, 40(1): 41–56. https://doi.org/10.1080/21532974.2023.2284726

Getchell, K. M., Carradini, S., Cardon, P. W., Fleischmann, C., Ma, H., Aritz, J. *et al.* (2022). Artificial Intelligence in Business Communication: The Changing Landscape of Research and Teaching. *Business and Professional Communication Quarterly*, 85(1): 7–33. https://doi.org/10.1177/23294906221074311

Gu, X. and Ericson, B. J. (2025). AI Literacy in K-12 and Higher Education in the Wake of Generative AI: An Integrative Review. In: *Proceedings of the 2025 ACM Conference on International Computing Education Research V. 1*. Association for Computing Machinery, pp. 125–140. https://doi.org/10.1145/3702652.3744217

Han, B., Coghlan, S., Buchanan, G. and McKay, D. (2025). Who is Helping Whom? Student Concerns about AI-Teacher Collaboration in Higher Education Classrooms. *Proceedings of the ACM on Human-Computer Interaction*, 9(2): 1–32. https://doi.org/10.1145/3711104

Hasibuan, M. S., Nugroho, L. E. and Santosa, P. I. (2019). Model Detecting Learning Styles with Artificial Neural Network. *Journal of Technology and Science Education*, 9(1): 85–95. https://doi.org/10.3926/jotse.540

Holmes, W., Bialik, M. and Fadel, C. (2019). *Artificial Intelligence In Education: Promises and Implications for Teaching and Learning*. Center for Curriculum Redesign. http://bit.ly/AIED-BOOK

Huang, T., Geng, J., Chen, Y., Wang, H., Yang, H. and Hu, S. (2024). Simulation and prediction study of artificial intelligence education dynamics model for primary and secondary schools. *Education and Information Technologies*, 29(13): 16749–16775. https://doi.org/10.1007/s10639-024-12470-z

Hwang, G.-J., Tang, K.-Y. and Tu, Y.-F. (2024). How artificial intelligence (AI) supports nursing education: profiling the roles, applications, and trends of AI in nursing education research (1993–2020). *Interactive Learning Environments*, 32(1): 373–392. https://doi.org/10.1080/10494820.2022.2086579

Jafari, F. and Keykha, A. (2023). Identifying the opportunities and challenges of artificial intelligence in higher education: a qualitative study. *Journal of Applied Research in Higher Education*, 16(4): 1228–1245. https://doi.org/10.1108/JARHE-09-2023-0426

Jiang, Z. and Jiang, M. (2024). Beyond Answers: Large Language Model-Powered Tutoring System in Physics Education for Deep Learning and Precise Understanding. *arXiv preprint arXiv:2406.10934*. https://doi.org/10.48550/arXiv.2406.10934

Jin, L. (2019). Investigation on Potential Application of Artificial Intelligence in Preschool Children's Education. *Journal of Physics: Conference Series*, 1288(1): 012072. https://doi.org/10.1088/1742-6596/1288/1/012072

Karal, H., Nabiyev, V., Erümit, A. K., Arslan, S. and Çebi, A. (2014). Students' Opinions on Artificial Intelligence based Distance Education System (Artimat). *Procedia - Social and Behavioral Sciences*, 136: 549–553. https://doi.org/10.1016/j.sbspro.2014.05.374

Keles, P. U. and Aydin, S. (2021). University Students' Perceptions about Artificial Intelligence. *Shanlax International Journal of Education*, 9(S1): 212–220. https://doi.org/10.34293/education.v9iS1-May.4014

Kelley, M. and Wenzel, T. (2025). Advancing Artificial Intelligence Literacy in Teacher Education Through Professional Partnership Inquiry. *Education Sciences*, 15(6): 659. https://doi.org/10.3390/educsci15060659

Lu, C. A. (2025). Tracing the Evolution of Artificial Intelligence Education at Stanford University. *TechTrends*, 69(2): 447–453. https://doi.org/10.1007/s11528-025-01046-4

Ng, D. T. K., Su, J., Leung, J. K. L. and Chu, S. K. W. (2024a). Artificial intelligence (AI) literacy education in secondary schools: a review. *Interactive Learning Environments*, 32(10): 6204–6224. https://doi.org/10.1080/10494820.2023.2255228

Ng, D. T. K., Xinyu, C., Leung, J. K. L. and Chu, S. K. W. (2024b). Fostering students' AI literacy development through educational games: AI knowledge, affective and cognitive engagement. *Journal of Computer Assisted Learning*, 40(5): 2049–2064. https://doi.org/10.1111/jcal.13009

Orlando, S., de la Paz López, F. and Gaudioso, E. (2019). Design and Implementation of a Robotics Learning Environment to Teach Physics in Secondary Schools. In: J. M. Ferrández Vicente, J. R. Álvarez-Sánchez, F. de la Paz López, J. Toledo Moreo, & H. Adeli (Eds.), *From Bioinspired Systems and Biomedical Applications to Machine Learning*. Springer International Publishing, pp. 69–76. https://doi.org/10.1007/978-3-030-19651-6_7

Park, W. and Kwon, H. (2024). Implementing artificial intelligence education for middle school technology education in Republic of Korea. *International Journal of Technology and Design Education*, 34(1): 109–135. https://doi.org/10.1007/s10798-023-09812-2

Zha, S., Bragdon, M. M., Gong, N., Wang, J., Leavesley, S., Eaton, R. *et al.* (2025). A Case Study of Integrating AI Literacy Education in a Biology Class. *International Journal of Artificial Intelligence in Education*, 35(4): 2453–2477. https://doi.org/10.1007/s40593-025-00476-8

Prof. Dr. Abdullah bin Mohamed Al-Ghadouni has numerous published scientific research papers. His interests include designing and evaluating educational programs and developing thinking skills. He is also the designer of a critical thinking assessment scale and a certified trainer. He has supervised and examined many academic theses and possesses extensive administrative and academic experience.