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Systematic Literature Review: The effect of ChatGPT on Education

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Abstract

The dynamics of education in the 21st century are undergoing a transformation through the use of Artificial Intelligence (AI), especially ChatGPT. The use of AI in education still requires development and evaluation to ensure its effective and responsible use. (2) The purpose of this study is to describe how AI influences education based on educational level and year of publication and the extent to which AI improves critical thinking/creativity skills compared to conventional methods. The method used is a Systematic Literature Review (SLR). The data collection technique was carried out by reviewing articles related to the influence of AI or ChatGPT in education in articles published in 2020-2025. Through Google Scholar and Scopus, 24 articles were obtained. The results of this study indicate that AI has the potential to improve the quality of learning in various educational contexts, with implementation that needs to be supported by aspects of ethics, privacy, AI literacy, and long-term impact evaluation.

Keywords AI; education; ChatGPT; AI literacy

INTRODUCTION

Artificial intelligence (AI) technology has advanced rapidly in the 21st century, bringing about significant changes across various sectors, including education(İpek et al., 2023; Rahman, 2023; Tahiru, 2021). AI can be defined as the science and engineering of creating "intelligent machines"—machines that exhibit behavior and ways of thinking similar to humans and are considered intelligent (Suleimenov, 2020). Several researchers have explored the implementation of AI in learning contexts. Yuki and Sophia, for example, are humanoid robots that represent the application of AI in education (Retto, 2017).

The implementation of AI in education enabled it to perform several instructional functions that were traditionally carried out by teachers (Shi & Ding, 2024). However, AI was not able to completely replace teachers, as its capabilities were limited to specific tasks and it lacked the comprehensive reasoning abilities possessed by humans (Tahiru, 2021). Although

previous studies had primarily focused on the challenges of AI implementation in education, relatively limited attention had been given to its potential benefits(An et al., 2024). Several researchers suggested that AI could facilitate the analysis of student data, reveal learning patterns, and provide strategic insights that supported the enhancement of teaching practices (Zhu et al., 2020).

This study was conducted by reviewing relevant previous studies to identify current research trends and gain a more comprehensive understanding of the application of AI technology in education. The results of this review are expected to serve as a reference for educators and researchers in developing innovative learning models. In addition, this study is intended to provide a foundation for future research in similar areas.

METHODS

This study employed a Systematic Literature Review (SLR) approach following the methodological principles proposed by Zawacki-Richter et al. (2020) (Zawacki-Richter et al., 2020). The review process was conducted systematically to ensure transparency, rigor, and reproducibility in identifying, evaluating, and synthesizing relevant empirical evidence concerning the impact of artificial intelligence (AI) in education. The review procedure consisted of several sequential stages. The first stage involved formulating the research questions, which served as the foundation for the entire review process and guided the identification, selection, and synthesis of the literature. Three research questions were developed to comprehensively examine the current state of AI implementation in education. The first question explored how AI influences learning outcomes across various educational levels and subject areas. The second question investigated publication trends related to AI in education during the past five years in order to identify the growth and development of scholarly attention in this field. The third question examined the extent to which AI enhances higher-order thinking skills, particularly critical thinking and creativity, when compared with conventional instructional approaches.

Following the formulation of the research questions, selection criteria were established to ensure that only high-quality and relevant studies were included in the review. These criteria specified the inclusion and exclusion requirements based on publication period, document type, language, research focus, methodological quality, and relevance to the research objectives. Establishing explicit selection criteria minimized potential bias during the screening process and ensured that the final corpus of studies provided reliable evidence for addressing the research questions. The detailed inclusion and exclusion criteria are presented in the following table.

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
1. Studies related to AI at educational levels ranging from primary education to higher education.	1. Articles that did not address the research questions concerning the impact of AI on learning outcomes, publication trends in

Inclusion Criteria	Exclusion Criteria
	AI-based education, or the improvement of critical thinking and creativity.
2. Studies related to the impact of AI in education published within the last five years.	2. Studies on AI not written in English, unless they provided an English abstract.
3. Studies related to the impact of AI on improving critical thinking and creativity compared with conventional methods.	3. Studies on AI not indexed in the predetermined databases.

The literature search strategy was designed systematically to ensure the comprehensive identification of relevant studies addressing the impact of artificial intelligence (AI) in education. The retrieval process was conducted using the Publish or Perish application, which facilitates the extraction of bibliographic data from multiple academic databases. Two major databases, Google Scholar and Scopus, were selected because they provide extensive coverage of peer-reviewed scholarly publications across various disciplines. The search process employed the keywords "AI in education" and "the effect of AI on education", enabling the identification of studies that specifically examined the implementation and educational impact of AI technologies.

After the initial screening process, the selected studies underwent a Quality Assessment (QA) to evaluate their methodological quality and relevance to the objectives of this review. The assessment aimed to ensure that only studies providing reliable and meaningful evidence were included in the final synthesis. The primary evaluation criterion focused on whether each article directly addressed the impact of artificial intelligence in educational contexts. Articles that satisfied the established criterion were assigned a score of Y (Yes), whereas those failing to meet the criterion received a score of T (No) and were excluded from subsequent analysis.

The final stage involved synthesizing the findings obtained from the selected studies to generate comprehensive evidence regarding the role of artificial intelligence in education. Data from the eligible articles were systematically organized, compared, and analyzed according to the predefined research questions. This synthesis process enabled the identification of common findings, emerging patterns, research trends, and variations across different educational contexts. The integrated analysis provided a comprehensive understanding of AI's influence on learning outcomes, publication trends, and its contribution to enhancing critical thinking and creativity compared with conventional instructional approaches.

FINDINGS AND DISCUSSION

Findings

The review process of articles included in the research results can be seen in the following diagram.

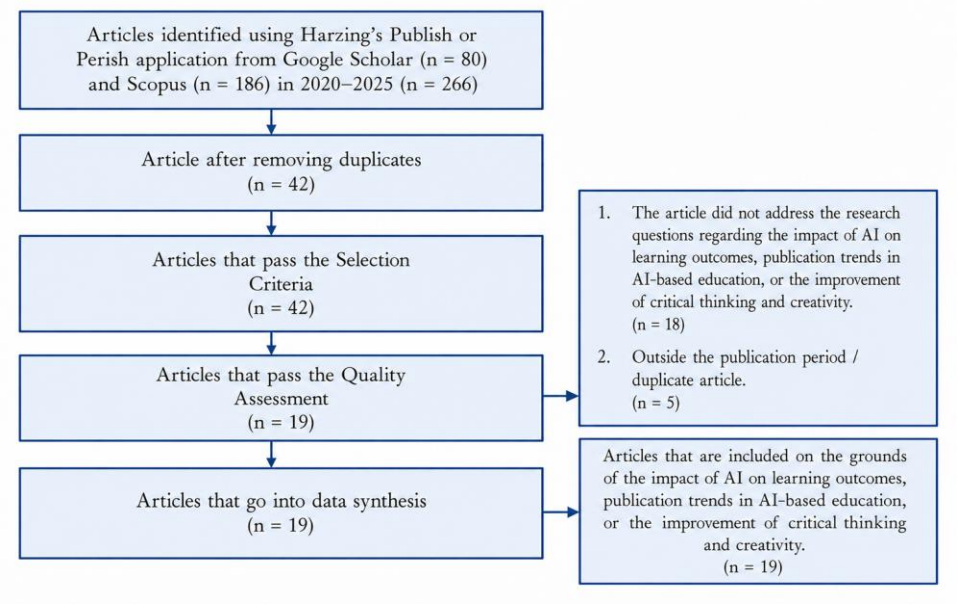

Figure 1. Article Review Flowchart

The literature search process resulted in 266 articles obtained through Harzing's *Publish or Perish* using data sources from Google Scholar and Scopus. The next stage involved screening based on the inclusion and exclusion criteria, resulting in 24 articles that were relevant to the objectives of the study. Information regarding the research data used in this literature review is presented in Table 2.

Table 2. Literature review

No.	Author	Research Topic	Research Findings
1	Fati Tahiru (2021)	AI in Education: A Systematic Literature Review	AI has the potential to improve the quality of learning through adaptive learning, intelligent tutoring systems, and personalized learning (Tahiru, 2021).
2	Ziyaeddin Halid Ipek et al. (2023)	Educational Applications of the ChatGPT AI System: A Systematic Review Research	ChatGPT supports constructivist learning and enhances higher-order thinking skills. However, AI serves only as a supporting tool, and educators remain essential for maintaining academic integrity. Therefore, training is required to optimize the use of AI in education(İpek et al., 2023).
3	Annisa M. Bettayeb et al.	Exploring the Impact of ChatGPT	The study concludes that ChatGPT has the potential to improve learning quality

No.	Author	Research Topic	Research Findings
	(2024)	Conversational AI in Education	through personalization, student engagement, and rapid feedback (Bettayeb & Talib, 2024).
4	Omar Ibrahim O. & A. Hussein Ali (2023)	Impact of ChatGPT on Scientific Research: Opportunities, Risks, Limitations, and Ethical Issues	ChatGPT can enhance creativity, productivity, and the quality of scientific research. However, maximizing its benefits requires ethical implementation and proper risk management (Obaid et al., 2023).
5	Jinhee Kim et al. (2022)	Learning Design to Support Student–AI Collaboration: Perspectives of Leading Teachers for AI in Education	The study suggests that student–AI collaboration has the potential to enhance higher-order thinking skills. However, broader validation is still required(Kim et al., 2022)
6	Michail Giannakos et al. (2024)	The Promise and Challenges of Generative AI in Education	The opportunities include instructional design, feedback, assessment, and self-directed learning. The challenges involve ethical issues, misuse, technological limitations, and the need for policies and further research(Giannakos et al., 2024).
7	Xiao, Alibakhshi, Zamanpour, Zarei, Sherafat, & Behzadpoor (2024)	The Influence of AI Literacy on Students' Academic Well-Being and Educational Achievement in Online Learning	AI literacy positively affects students' academic well-being and educational achievement. AI competencies help students use online learning platforms more effectively, thereby improving learning outcomes(Xiao et al., 2024).
8	Zafari, Bazargani, Sadeghi-Niaraki, & Choi (2022)	AI Applications in K–12 Education: A Systematic Review	AI is widely used for student performance prediction, teaching, learning behavior analysis, and intelligent tutoring systems. Machine learning and intelligent tutoring systems are the most dominant approaches in K–12 education (Zafari et al., 2022).
9	Chen, Chen, & Lin (2020)	A Review of AI Applications in Administration, Teaching, and	AI improves administrative efficiency, assessment, personalized learning, and teaching quality. AI systems can adapt instructional materials to learners' needs,

No.	Author	Research Topic	Research Findings
		Learning	thereby enhancing learning experiences (Chen & Chen, 2020).
10	Egara & Mosimege (2024)	Integrating ChatGPT into Mathematics Education	Teachers using ChatGPT reported improvements in learning effectiveness, student engagement, and understanding of mathematical concepts. However, challenges include technological adaptation, curriculum alignment, and teacher training needs (Egara, 2024).
11	Hakiki, Fadli, Samala, Fricticarani, Dayurni, Rahmadani, Astiti, & Sabir (2023)	The Effect of ChatGPT Usage on Technology Learning Outcomes	Students who used ChatGPT achieved higher learning outcomes than those in conventional learning groups. ChatGPT significantly improved students' academic performance (Hakiki et al., 2023).
12	Wardat, Tashtoush, AlAli, & Saleh (2024)	Mathematics Teachers' Perspectives on AI in Education	Teachers believe that AI can improve motivation, learning performance, and the quality of mathematics instruction. Major challenges include increased workload, limited competencies, and pressures related to AI implementation (Wardat et al., 2024).
13	Peláez-Sánchez, Velarde-Camaqui, & Glasserman-Morales (2024)	The Impact of Large Language Models (LLMs) on Higher Education in the Context of Education 4.0	LLMs such as GPT-4 have considerable potential to improve higher education through more independent, collaborative, and interactive learning. However, human supervision remains necessary to ensure quality, accuracy, academic integrity, and ethical compliance (Peláez-sánchez et al., 2024).
14	Fan Yang, Kangxi Li, & Ruilin Li (2024)	AI-Supported Training to Improve Speaking Awareness in Language Learning	The TalkAI system significantly improved students' speaking performance, particularly in pronunciation, grammar, and language usage. It also enhanced students' self-awareness of their speaking abilities and improvement strategies (Yang et al.,

No.	Author	Research Topic	Research Findings
			2024).
15	Mark Treve (2024)	AI Integration in Education and Its Impact on Student Learning and Innovation	AI implementation increased student engagement by 20–23%, GPA by 9–14%, and innovative thinking from 44% to 57%. Most teachers also perceived AI as having a positive impact on learning (Treve, 2024).
16	Yoshija Walter (2024)	The Relevance of AI Literacy, Prompt Engineering, and Critical Thinking in Modern Education	The integration of AI in classrooms requires three essential competencies: AI literacy, prompt engineering, and critical thinking. These competencies enable the effective use of AI for personalized and inclusive learning(Walter, 2024).
17	Alotaibi & Alshehri (2023)	Opportunities and Challenges of AI Use in Higher Education in Saudi Arabia	AI has the potential to revolutionize teaching methods, enhance personalized learning, and support Saudi Vision 2030. Major challenges include infrastructure readiness, faculty competencies, and technological skill development (Alotaibi & Alshehri, 2023).
18	Kamalov, Santandreu Calonge, and Gurrib (2023)	A new era of AI in education toward a sustainable revolution	AI provides major benefits in personalized learning, intelligent tutoring systems, and automated assessment. However, major challenges include data privacy, algorithmic bias, plagiarism, and academic integrity. The best approach is to adopt AI with appropriate regulations and safeguards (Kamalov et al., 2023).
19	Chiu (2023)	The impact of generative AI (ChatGPT and Midjourney) on educational practices, policies, and research directions	Generative AI is transforming learning, teaching, assessment, and school administration. Students need AI literacy, critical thinking, and digital and information literacy. Teachers need to improve AI literacy, facilitation skills, and interdisciplinary learning. Assessment systems need revision by emphasizing generic skills, while schools need policies, training, and curricula that support

No.	Author	Research Topic	Research Findings
			effective AI integration (Chiu, 2023).

RQ 1 : How does AI affect learning outcomes across different educational levels and subject areas?

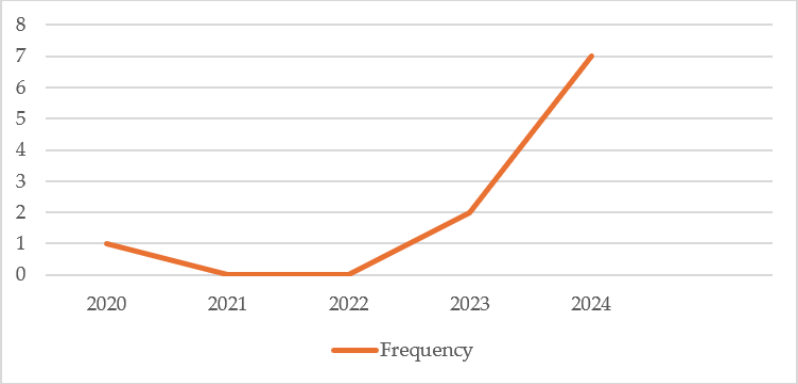

Figure 2. Research data based on year of publication

Figure 2 illustrates the publication trend of studies investigating the impact of artificial intelligence (AI) on learning outcomes across educational levels and subject areas between 2020 and 2024. Based on the reviewed articles, research on this topic exhibited a fluctuating trend during the early years of the observation period. Only one study was published in 2020, while no eligible studies were identified in 2021 and 2022. The number of publications increased to two articles in 2023 and reached its peak with seven publications in 2024.

The substantial increase in publications during 2023–2024 indicates the growing interest of researchers in examining AI implementation within educational contexts. This trend is likely associated with the rapid advancement of generative AI technologies, particularly ChatGPT and Large Language Models (LLMs), which have accelerated research on AI-supported teaching and learning. Overall, these findings demonstrate that research concerning the impact of AI on learning outcomes has become an emerging research area and is expected to continue growing in response to the increasing adoption of AI technologies in education.

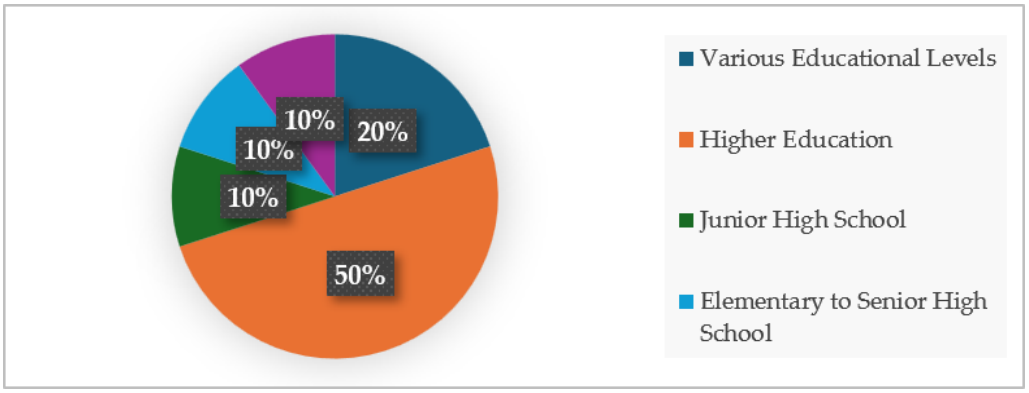

Figure 3. Research data based on education level

Based on Figure 3, the distribution of educational levels among the ten reviewed studies indicates that research on the impact of artificial intelligence on learning outcomes is

predominantly conducted in higher education, representing 50% of the total studies. This finding suggests that universities remain the primary setting for investigating AI-supported learning, particularly in relation to ChatGPT, generative AI, and Large Language Models. Studies classified as Various Educational Levels accounted for 20% of the reviewed articles, indicating that several researchers examined AI implementation across multiple educational contexts rather than focusing on a single educational level. Meanwhile, studies conducted at the Junior High School, Elementary to Senior High School, and Elementary School to Higher Education levels each represented 10% of the reviewed studies.

Overall, these findings demonstrate that AI has been implemented across diverse educational settings. However, research remains highly concentrated in higher education, whereas empirical investigations focusing specifically on primary and secondary education are still relatively limited. This imbalance indicates the need for further studies exploring AI implementation in elementary and secondary education to provide more comprehensive evidence regarding its effectiveness across educational levels. Artificial intelligence generally has a positive impact on learning outcomes across different educational levels and subject areas. AI enhances learning through personalized instruction, adaptive learning, intelligent tutoring systems, and immediate feedback, resulting in improved learning effectiveness and student engagement (Bettayeb & Talib, 2024; Chen & Chen, 2020; Tahiru, 2021). Empirical studies further indicate that AI improves students' academic performance and learning experiences, particularly in higher education. The use of ChatGPT and Large Language Models supports independent learning, increases learning motivation, improves academic achievement, and facilitates students' understanding of learning materials (Hakiki et al., 2023; Peláez-sánchez et al., 2024; Xiao et al., 2024).

At the school level, AI has also demonstrated positive educational outcomes. AI-assisted learning improves students' engagement, conceptual understanding, motivation, and learning performance, particularly in mathematics education, although successful implementation depends on teachers' readiness and appropriate instructional strategies (Egara, 2024; Wardat et al., 2024). Furthermore, AI encourages more innovative and student-centered learning environments(Chiu, 2023; Treve, 2024). Overall, the reviewed studies indicate that AI positively affects learning outcomes across various educational levels and subject areas. However, most empirical evidence is concentrated in higher education, suggesting that further research is needed to investigate AI implementation in primary and secondary education.

RQ 2 : What are the publication trends regarding the impact of AI in education over the last five years?

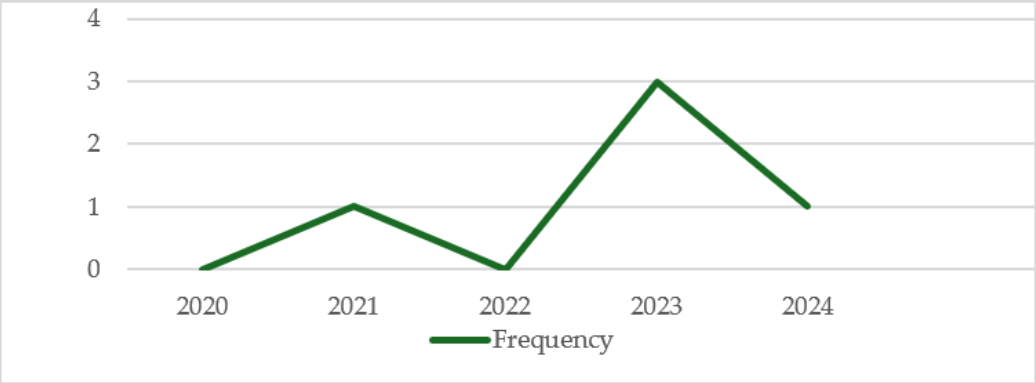

Figure 4. Research data based on year of publication

Figure 4 illustrates the publication trend of studies investigating the impact of artificial intelligence in education over the last five years. The reviewed articles indicate that publications related to this topic have generally increased, despite slight fluctuations during the observation period. Only one study was identified in 2021, followed by no eligible studies in 2022. The number of publications increased substantially in 2023, reaching three studies, before slightly declining in 2024. Overall, these findings demonstrate growing scholarly interest in AI applications in education, particularly following the rapid advancement of generative AI technologies. This trend suggests that research on AI in education will continue to expand as AI becomes increasingly integrated into teaching and learning practices.

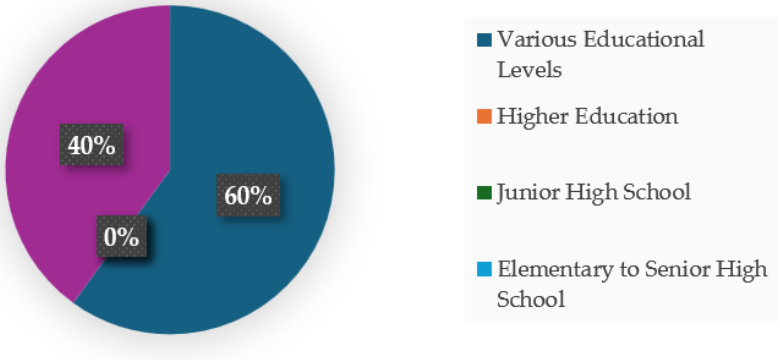

Figure 5. Research data based on education level

Based on Figure 5, the reviewed studies mainly investigated AI across various educational levels, accounting for 60% of the total articles. This finding indicates that most studies examined AI implementation from a broad educational perspective rather than focusing on a single educational level. Meanwhile, studies involving elementary school to higher education represented 40% of the reviewed articles, suggesting that researchers increasingly explored AI applications across multiple educational stages. Overall, these findings demonstrate that research on AI publication trends has primarily emphasized broad educational contexts instead of specific educational levels.

Based on the selected studies, research on artificial intelligence in education has shown a remarkable increase over the last five years. Initially, AI research primarily focused on adaptive learning, intelligent tutoring systems, and personalized learning. However,

recent studies have expanded to investigate generative AI, ChatGPT, AI literacy, educational policy, and the broader implications of AI for teaching and learning (İpek et al., 2023; Tahiru, 2021; Zafari et al., 2022). Furthermore, the literature indicates that AI research has evolved from examining technological capabilities toward exploring pedagogical implementation and educational transformation. Current studies increasingly discuss the integration of AI into instructional design, assessment, educational management, and future educational policies (Chiu, 2023; Giannakos et al., 2024; Kamalov et al., 2023). AI is no longer viewed solely as an educational technology but also as a strategic tool for supporting innovation and improving educational quality.

Overall, the reviewed studies demonstrate that publication trends in AI-based education continue to increase and have gradually shifted toward more comprehensive investigations of AI implementation, educational practices, and future research directions. This trend indicates that AI has become one of the most prominent and rapidly developing research areas in contemporary education.

RQ 3 : To what extent does AI improve critical thinking and creativity compared with conventional methods?

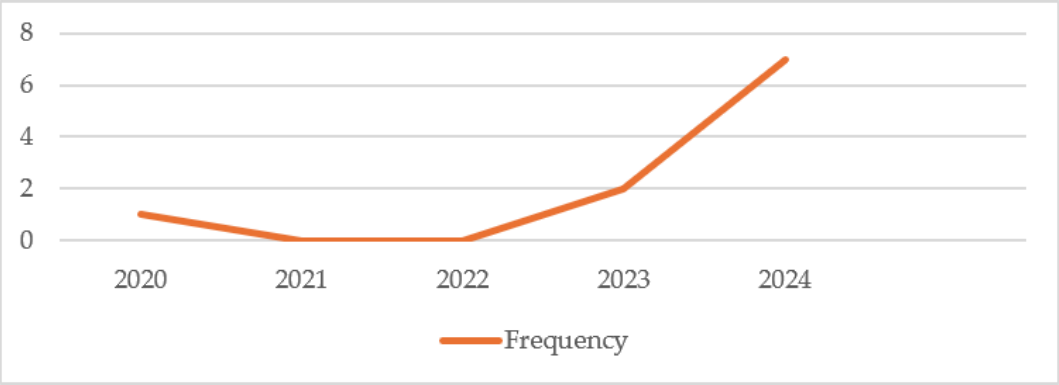

Figure 6. Research data based on year of publication

Figure 6 illustrates the publication trend of studies investigating the effectiveness of artificial intelligence in enhancing critical thinking and creativity compared with conventional learning methods. Based on the reviewed articles, research on this topic remained limited between 2020 and 2022, with only one publication identified in 2020 and no eligible studies in 2021 and 2022. However, the number of publications increased to two studies in 2023 and reached its highest point with seven publications in 2024. This finding indicates that research on the role of AI in developing higher-order thinking skills has grown substantially in recent years. The increasing trend reflects growing academic interest in exploring AI as a tool for fostering critical thinking, creativity, and innovative learning.

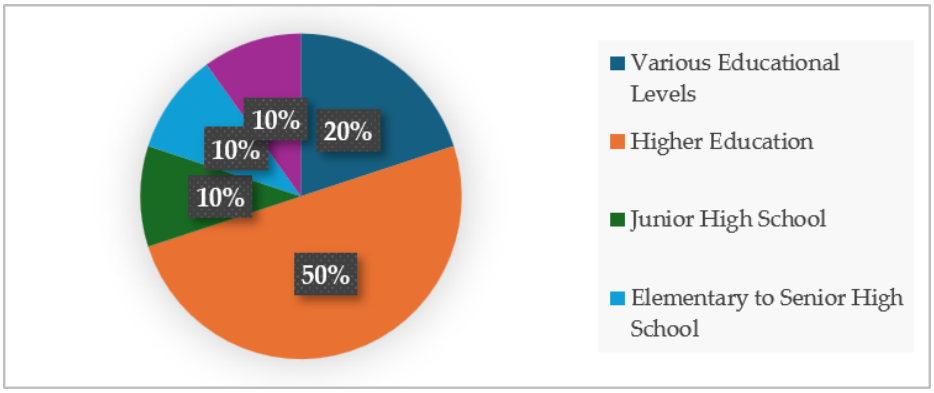

Figure 7. Research data based on education level

Based on Figure 7, the reviewed studies predominantly focused on higher education, accounting for 50% of the total articles. This finding suggests that investigations into the effectiveness of AI in enhancing critical thinking and creativity have mainly been conducted among university students. Studies involving various educational levels represented 20% of the reviewed articles, while research conducted at the junior high school, elementary to senior high school, and elementary school to higher education levels each accounted for 10% of the total studies. Overall, these findings indicate that AI has been examined across diverse educational contexts; however, higher education remains the primary focus, whereas empirical studies involving primary and secondary education are still relatively limited.

Based on the selected studies, artificial intelligence has demonstrated considerable potential to enhance critical thinking and creativity compared with conventional learning approaches. AI facilitates personalized learning, rapid feedback, and interactive learning environments that encourage students to analyze problems, generate ideas, and engage more actively in the learning process(Chiu, 2023; İpek et al., 2023; Kim et al., 2022). Empirical evidence also indicates that AI-supported learning contributes to the development of higher-order thinking skills. AI applications have been reported to improve students' academic engagement, innovative thinking, and problem-solving abilities while promoting more collaborative and student-centered learning experiences (Hakiki et al., 2023; Treve, 2024; Walter, 2024). In addition, AI-assisted learning enables students to receive personalized guidance and immediate feedback, which supports reflective learning and creativity(Wardat et al., 2024)). Overall, the reviewed studies suggest that AI is more effective than conventional learning methods in supporting critical thinking and creativity when implemented as a complementary learning tool. Nevertheless, successful implementation depends on appropriate instructional strategies, teacher facilitation, and students' ability to use AI critically and responsibly.

Discussion

The findings of this systematic literature review indicate that artificial intelligence (AI) has become an increasingly important driver of educational transformation. Across the reviewed studies, AI consistently improves learning quality through personalized learning, adaptive learning, intelligent tutoring systems, and immediate feedback, thereby enhancing

student engagement and academic achievement (Bettayeb & Talib, 2024; Chen & Chen, 2020; Egara, 2024; Hakiki et al., 2023; Peláez-sánchez et al., 2024; Tahiru, 2021; Treve, 2024; Wardat et al., 2024; Xiao et al., 2024; Yang et al., 2024). These findings are consistent with previous studies reporting that AI-supported learning environments facilitate personalized instruction, adaptive learning pathways, and intelligent educational support systems that improve students' learning performance(Chen & Chen, 2020; Zhai et al., 2021).

The present review also demonstrates a substantial shift in AI research over the last five years. Earlier studies mainly focused on general AI applications in education, whereas more recent studies have increasingly investigated generative AI, ChatGPT, AI literacy, instructional design, educational policy, and future educational practices (Alotaibi & Alshehri, 2023; Chiu, 2023; Giannakos et al., 2024; İpek et al., 2023; Kamalov et al., 2023; Walter, 2024). This finding suggests that AI has evolved from being primarily a technological innovation into a strategic educational tool supporting teaching, learning, and educational management (Kasneci et al., 2023; Zhai et al., 2021).

Another important finding is that AI contributes to the development of higher-order thinking skills, particularly critical thinking and creativity. Student–AI collaboration, conversational AI, and generative AI encourage learners to analyze information, solve problems, generate ideas, and construct knowledge through interactive learning experiences (Chiu, 2023; İpek et al., 2023; Kim et al., 2022; Treve, 2024; Walter, 2024; Yang et al., 2024). These findings reinforce previous evidence suggesting that large language models function most effectively as learning partners that support learner autonomy, reflective learning, and higher-order thinking rather than as replacements for human cognition (Kasneci et al., 2023).

Despite these educational benefits, several challenges remain. Ethical issues, academic integrity, data privacy, algorithmic bias, teacher readiness, and students' overreliance on AI continue to influence successful AI implementation (Alotaibi & Alshehri, 2023; Chiu, 2023; Giannakos et al., 2024; Kamalov et al., 2023; Obaid et al., 2023; Peláez-sánchez et al., 2024). Similar concerns have also been highlighted in previous studies, emphasizing that successful AI implementation requires appropriate governance, AI literacy, institutional support, and pedagogically sound instructional design (Chen & Chen, 2020; Kasneci et al., 2023).

Finally, this review found that empirical studies remain concentrated in higher education, while relatively limited evidence is available from primary and secondary education. Although several studies investigated AI across multiple educational levels, universities continue to dominate AI implementation research (Chen & Chen, 2020; Chiu, 2023; Giannakos et al., 2024; Zafari et al., 2022). Therefore, future research should expand empirical investigations across broader educational levels and subject areas to provide more comprehensive evidence regarding AI effectiveness and support the development of sustainable, equitable, and human-centered AI integration in education.

CONCLUSION

This systematic literature review demonstrates that artificial intelligence (AI) has a positive impact on education by improving learning outcomes, increasing student engagement, supporting personalized learning, and fostering critical thinking and creativity. The findings also reveal that research on AI in education has grown rapidly over the last five years, with increasing attention devoted to generative AI, AI literacy, and AI-assisted learning. Although AI has been implemented across various educational levels, most empirical studies have focused on higher education, indicating that evidence from primary and secondary education remains limited. Furthermore, while AI offers significant educational benefits, its successful implementation depends on ethical considerations, teacher readiness, AI literacy, and appropriate instructional design. Therefore, future research should expand empirical investigations across broader educational levels and subject areas while developing sustainable and human-centered AI integration to maximize its educational potential.

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