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AI in Education: Review and Prospect

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Abstract

The application of artificial intelligence in education is undergoing a paradigm shift from "tool embedding" to "system reshaping". This study uses 1,181 relevant articles from the 2013-2025 Web of Science core collection as samples, employing a combination of bibliometric analysis and thematic content analysis to map the spatiotemporal evolution, knowledge networks, and research hotspots in this field. The findings reveal that annual publications surged from 1 in 2013 to 715 in 2025, with citation counts reaching 8,385. Since 2024, the field has demonstrated "dual leaps in quantity and quality". Major research contributors include China, USA, and Australia, with papers predominantly published in the journal ***Education and Information Technologies***. Research themes can be categorized into six major sectors, extending to eight application scenarios such as language learning, basic education, special education, and teacher development. Current studies predominantly adopt cross-sectional designs, lacking long-term tracking and causal inference, while insufficient attention is given to rural areas, low-resource languages, and special education contexts. Ethical risk governance frameworks also require further refinement. This paper proposes future research directions focusing on three dimensions: paradigm innovation, contextual expansion, and ethical governance, aiming to provide references for advancing AI in Education research and informing policy practices.

CCS Concepts

• **Applied computing** → Education; Computer-assisted instruction.

Keywords

AI in Education, Generative AI, Educational Ethics, Teacher Professional Development

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1 Introduction

The exponential evolution of artificial intelligence (AI) is propelling education—a slow-moving variable—into an unprecedented paradigm shift. Since the first AI in Education paper was included in the WoS core collection in 2013, the field has made a leap from "proof-of-concept" to "system implementation." Starting in 2024, it has reached a turning point marked by dual leaps in quality and quantity: annual publications surged from one to 715 by 2025, with citations skyrocketing to 8,385. Technologically, the proliferation of large models, multimodal systems, and generative AI has transformed slogans like "personalization, automation, and intelligence" into classroom realities. Educationally, fundamental concepts—from teacher roles and learning paradigms to evaluation standards and ethical foundations—are being redefined. Yet beneath this prosperity lie growing concerns: fragmented research, limited contexts, and lagging ethics demand a comprehensive blueprint to map knowledge landscapes, identify gaps, and guide future development. This study conducts a dual-layer analysis of 1,181 AI in Education papers in the WoS core collection between 2013 and 2025, addressing three core questions: First, how has the knowledge landscape evolved? Second, where are the hotspots and blind spots in research across different educational stakeholders, contexts, and themes? Third, what direction should future research take toward building a trustworthy, inclusive, and sustainable AI in Education ecosystem?

Research shows that AI and education research networks have expanded across multiple countries including China, the United States, Australia, and the United Kingdom. Although China started later (2018), it quickly emerged as the largest contributor with 428 publications and a 0.23 mediating centrality. The United States maintained its second position by leveraging its early-mover advantage from 2013 and extensive international collaborations. In terms of journals, *Education and Information Technologies* led the way with 242 articles. With the help of co-occurrence clustering and manual interpretation, we merged the literature into six themes: impact of AI on education, AI-student interaction, AI in learning tools, AI in teacher development, AI literacy & ethics, AI in education evaluation. It is worth noting that the emergence of generative AI has led to an explosive growth in the two major topics of "impact of AI on education" and "AI-student interaction" in 2024-2025, with annual increases of 208 and 181 respectively, indicating that the research focus is shifting from "tool efficacy" to "system remodeling".

However, current research still faces structural gaps: Firstly, studies lack longitudinal causal evidence across years and contexts; Secondly, research subjects and contexts are overly concentrated in English-speaking regions, higher education institutions, and resource-rich areas, while rural areas, less commonly taught languages, and special education remain long-term neglected; Thirdly,

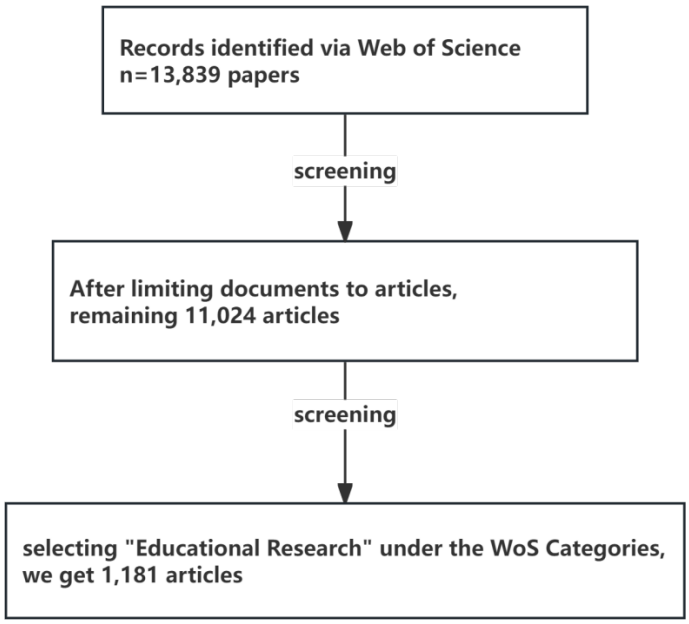

Figure 1: Article Selecting Procedures

although ethical risks are frequently mentioned, there is a lack of empirically validated intervention frameworks and governance tools. This paper proposes three-dimensional approaches- "paradigm innovation, contextual expansion, and ethical governance" —to establish credible evidence chains through large-scale randomized controlled trials (RCTs), multilevel linear models, and learning analytics. It advocates building cross-cultural and cross-economic collaborative experimental platforms to achieve equity and inclusivity, developing multidimensional ethical risk assessment scales and collaborative governance mechanisms to ensure technological evolution resonates with educational equity. We hope this review not only provides researchers with navigation guidance but also maps out a "blueprint" for policymakers, educators, and technology developers to jointly build trustworthy AI in Education.

The paper is structured as follows (Figure 1). Section 2 details the research methodology and literature selection employed in this study. Section 3 provides an overview and descriptive analysis of annual publications, country distribution, and journal distribution. Section 4 first summarizes six major research themes before listing eight application scenarios. Section 5 presents challenges from three dimensions: research paradigm, contextual context, and ethical risks, along with recommendations for future development. Finally, Section 6 summarizes the entire paper.

2 Methodology & Paper Selection

2.1 Sample Selection

We searched for the papers from the WoS core collection database. Despite other databases, such as Scopus, Google Software, Dimensions, Microsoft Academic, the WoS core collection database is more suitable for large-scale Bibliometric analysis with high reliability. Based on education, learning, teaching, and AI, we searched for articles in the Title, Author Keywords, and Keywords Plus (the search date was August 23, 2025). The search formula is: (TI=(educa* OR learn* OR teach*) OR AK=(educa* OR learn* OR teach*) OR KP=(educa* OR learn* OR teach*)) AND (TI=(AI) OR AK=(AI) OR KP=(AI)) .

2.2 Analysis

According to the literature review search process, a total of 13,839 documents were obtained with publication years ranging from 2012 to 2026. Based on the analysis, by screening WoS categories, we limited the types of documents to articles, and obtained 11,024 articles. This study focuses on the field of education, therefore selecting "Educational Research" under the Web of Science Categories to obtain 1,181 articles. Based on the collected 1,181 articles, a descriptive analysis was conducted, such as annual publications and citation analysis; country & publications analysis, and journal co-citation analysis.

A total of 1,181 articles on AI in education published between 2020 and 2025 were selected to analyze the research hotspots and applications in this field. The process of sample selection is illustrated in Figure 1.

3 Descriptive Analysis

3.1 Annual Publications & Citations

From 2020 to 2025, we selected 1,181 articles on AI in education in WoS. The publications and citations have increased annually (Figure 2). The annual publications of articles increased from 1

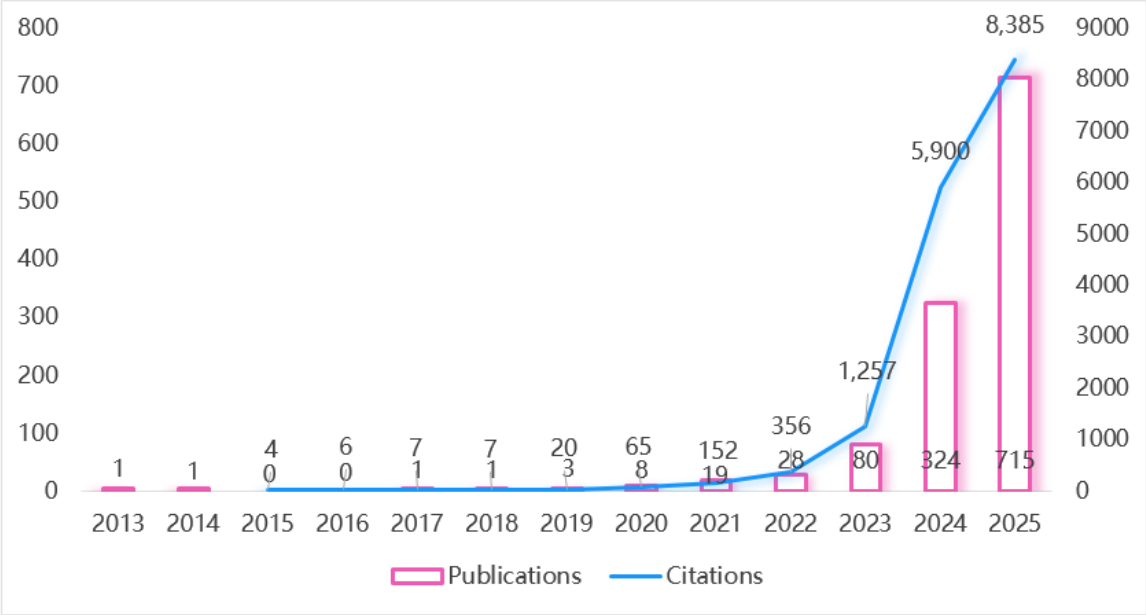

Figure 2: Analysis of Annual Publications & Citations (2013-2025)

Table 1: Country & Publications Analysis

Country	Year	Publications	Centrality
China	2018	428	0.23
USA	2013	216	0.10
Australia	2019	89	0.49
England	2019	77	0.79
Turkiye	2023	73	-
South Korea	2021	54	-
Malaysia	2022	32	0.06
Singapore	2017	32	0.27
Saudi Arabia	2023	32	0.17
Germany	2020	28	0.05

Notes: Limited to the top 10 countries by the number of publications

in 2013 to 715 in 2025, while the citations increased from 0 in 2013 to 8385 in 2025. Specifically, the publications and citations in 2020-2023 increased slowly, but since 2024, scholars' interest has improved qualitatively, and the annual publications and citations have maintained a high growth trend.

3.2 Country & Publications Analysis

This study conducted a systematic analysis of 1,181 articles published between 2013 and 2025. The data reveals that China, the United States, Australia, England, Turkey, South Korea, Malaysia, Singapore, Saudi Arabia, and Germany rank as the top ten countries (Table 1). Although China only began AI in education research in 2018, it has become the country with the most published papers and has engaged in extensive collaborations with other nations. The United States launched AI in education research as early as 2013, becoming the first country to initiate related work in this field and currently ranks second in paper output, while also collaborating with other countries. Australia and England followed suit in 2019, though their publication numbers lagged behind China and the U.S., they actively pursued international cooperation. Turkey (2023) and South Korea (2021), despite publishing over 50 papers each, leaned toward independent research with limited international collaboration. Malaysia (2022), Singapore (2017), Saudi Arabia (2023), and Germany (2020) also joined the research community, though their published paper counts remained relatively low.

3.3 Journal Analysis

Journal analysis employs statistical methods to identify the primary journals publishing relevant research findings. Through comprehensive analysis of 1,181 articles on AI in education published

Table 2: Journal Analysis

Journals	Publications
Education and Information Technologies	242
Interactive Learning Environments	60
BMC Medical Education	51
British Journal of Educational Technology	47
European Journal of Education	44
IEEE Transactions on Learning Technologies	41
Educational Technology & Society	40
International Journal of Educational Technology In Higher Education	33
System	30
Journal of Computer Assisted Learning	27
International Journal of Management Education	24
Computers & Education	24
Innovations In Education And Teaching International	21
British Educational Research Journal	20
International Review of Research In Open and Distributed Learning	20
Notes: Limited to journals with no less than 20 publications	

Table 3: Distribution of Topics

Topics	Year											
	2013	2014	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
Impact of AI on Education						3	7	3	19	69	139	240
AI-Student Interaction							2	8	10	64	117	201
AI in Learning Tools	1				1	1	1	1	10	37	67	119
AI in Teacher Development								2	4	22	75	103
AI Literacy & Ethics		1				1	1	2	11	21	47	84
AI in Education Evaluation								1	4	13	33	51
Application Scenarios			1	1	2	3	8	11	21	94	231	372
Other									1	4	6	11
Total	1	1	1	1	3	8	19	28	80	324	715	1181

between 2013 and 2025, we discovered that 15 journals (Table 2) each published over 20 articles. Notably, the journal ***Education and Information Technologies*** stood out with a staggering total of 242 publications.

4 Explore the Topics of the Literature

To explore the development of AI education literature, this study analyzed the 1,181 articles on AI in education published between 2013 and 2025. These articles covered six thematic areas (Table 3), namely: Impact of AI on Education, AI-Student Interaction, AI in Learning Tools, AI in Teacher Development, AI Literacy & Ethics, AI in Education Evaluation, Application Scenarios.

4.1 Themes Analyses

4.1.1 Impact of AI on Education. The impact of AI on education encompasses multiple dimensions: generative AI's comprehensive effects on students' academic performance and learning motivation; teachers 'role transitions, risk perceptions, and instructional design adjustments in AI-assisted collaboration; educational administrators' decision-making processes regarding AI adoption, ethical considerations, and policy formulation; as well as equity concerns and ethical dilemmas faced by diverse cultural backgrounds, genders, and marginalized groups in AI-powered education. Current research predominantly relies on single-dimensional cross-sectional data, lacking long-term tracking.

4.1.2 AI-Student Interaction. Existing research provides a comprehensive overview of student interactions with generative AI, spanning from elementary to university levels across various domains including writing, programming, speaking, reading, mathematics, and scientific inquiry. Studies reveal that AI's instant feedback enhances students' learning motivation and engagement, thereby improving academic performance.[1] Students perceive AI as partners, mentors, or even friends, where collaborative AI interactions stimulate critical thinking and creativity.

4.1.3 AI in Learning Tools. This study provides a comprehensive review of AI-powered learning tools spanning from kindergarten through university and vocational training. The analysis focuses on five key areas: Generative AI for automated creation of personalized learning materials, assessments, and feedback; Gamification,

tangible computing, multimodal approaches, and augmented reality technologies to enhance motivation, computational thinking, and subject-specific competencies; Real-time support from chatbots, intelligent agents, and adaptive platforms in oral communication, writing, programming, and scientific modeling; Validation of effectiveness in rural education and medical training contexts; Addressing concerns about tool interpretability, fairness, and ethics among educators, students, and parents.

4.1.4 AI in Teacher Development. This study focuses on how AI is reshaping teacher development pathways. Extensive research has measured and enhanced AI knowledge, attitudes, and self-efficacy among educators from kindergarten through university levels, developing various assessment tools while integrating AI-assisted pedagogy, reflective practice, and ethics training into pre-service programs and professional development.[2] The findings reveal that while teachers recognize AI's potential in lesson preparation, assessment, and personalized tutoring, they also express concerns about technological dependency, equity issues, and potential role displacement.

4.1.5 AI Literacy & Ethics. Current research on AI literacy and ethics focuses on teachers, students, parents, and educational administrators. Three key research areas emerge: how AI literacy impacts learning motivation, innovative behaviors, and academic performance; how ethical standards are translated into classroom practices and evaluation systems; and how technological power dynamics—such as AI monitoring and algorithmic biases—reshape educational equity[3].

4.1.6 AI in Education Evaluation. The research focuses on "AI in Educational Assessment," collecting and interpreting student learning evidence from both teaching and learning perspectives to evaluate students 'learning attitudes and mastery of knowledge and skills, thereby improving instruction. For instance, large language models can replace or assist teachers in grading assignments and exams. Through real-time analysis of emotional responses and knowledge graphs, they diagnose students' weaknesses and deliver personalized exercises. By continuously monitoring teaching deviations and reshaping the role of educators, AI enables teaching authentication, diagnostic support, and learning enhancement.[4]

4.2 Application Scenarios

4.2.1 Language Learning. In foreign language classrooms, AI is extensively utilized for writing assessment, oral practice, vocabulary and grammar training, automated generation of reading comprehension materials, as well as translation and cross-cultural competence development.[5] The system provides real-time personalized feedback based on student input, simulates native speaker interactions, delivers graded readers, and assists with post-editing tasks.

4.2.2 Early and Basic Education. In kindergarten and primary school stages, humanoid robots, intelligent toys, and storytelling systems are utilized to support literacy initiation, Chinese character acquisition, mathematical concept construction, and scientific inquiry.[6] Through gamified tasks and visual feedback, AI reduces the difficulty of abstract knowledge and enhances learning interest.

4.2.3 Higher Education and Professional Training. Disciplines including medicine, engineering, business, music, and art utilize AI as virtual patients, lab assistants, project consultants, and creative partners. AI systems can generate medical cases, simulate experimental environments, provide commercial case data, or assist in composing and arranging music, helping students complete complex projects.

4.2.4 Special Education. For students with autism, dyslexia, hearing or visual impairment, AI provides personalized intervention programs, emotional recognition and prompts, as well as barrier-free text and speech conversion, to help teachers and parents work together to set learning goals and track progress.

4.2.5 Teacher Development and Teaching Management. Teachers use AI to complete lesson preparation, automatically generate questions, analyze students 'learning status, manage classroom interaction, and plan professional growth.[7] The AI system can generate teaching plans, design tests, analyze students' homework data, and push improvement suggestions to teachers according to the teaching syllabus.

4.2.6 Learning Analysis and Precision Intervention. Through the continuous collection of learning behavior, emotion and achievement data, AI can identify high-risk students, provide personalized learning path, emotional adjustment prompts and resource recommendations, so as to realize early warning and accurate support.[8]

4.2.7 Immersive and Gamified Environments. In virtual reality, augmented reality or mixed reality scenarios, AI agents act as mentors, teammates or opponents, dynamically adjusting the difficulty of tasks according to learners' performance, maintaining learning motivation, and promoting knowledge transfer and collaboration ability.[9]

4.2.8 Lifelong Learning and Adult Education. Adults use AI-driven recommendation systems to obtain personalized learning paths in vocational training, micro-certificate courses and interest learning, and use chatbots for instant consultation and skill practice.[10]

5 Challenges and Prospects

5.1 Challenges

Through reviewing existing literature on AI in education, we identified several critical research gaps that require urgent attention. This paper systematically examines these key shortcomings from three dimensions: research paradigms, educational subjects and contexts, as well as ethical considerations and social impacts, aiming to provide directional guidance for future studies.

5.1.1 Research Paradigm and Evidence Base. Most current studies employ short-term experimental designs that lack long-term tracking of learners 'developmental trajectories.[8] Furthermore, they fail to adequately utilize methods like randomized controlled trials for causal inference. Consequently, conclusions about AI interventions' effects on learning outcomes, emotional attitudes, and behavioral patterns remain unreliable. The long-term sustainability of AI's impact on learners remains uncertain, making it difficult to establish sufficient evidence for policy formulation.

5.1.2 Education Object and Situation Coverage. Current research predominantly focuses on English and mainstream disciplines, with

insufficient attention given to low-resource languages, non-English cultural contexts, and special education settings. The individualized needs of learners with autism spectrum disorder, reading disabilities, and multisensory impairments remain inadequately addressed. Furthermore, rural and remote areas exhibit significant disparities compared to urban regions in infrastructure, teacher competency, and cultural adaptation, yet systematic comparative studies on these aspects are notably lacking.

5.1.3 Ethical Risks and Social Consequences. In educational AI systems, data collection processes, algorithmic decision-making mechanisms, and result presentations often operate in a "black box" environment. The data-gathering phase may inadvertently compromise student privacy, while AI algorithms could develop biased patterns influenced by input data.[11] Notably, some empirical research conclusions lack rigorous reliability and validity testing, compromising their credibility. Furthermore, AI integration into education risks exacerbating the digital divide, potentially creating new inequalities for students from lower socioeconomic backgrounds.

5.2 Prospects

In the face of these challenges, this paper believes that research should be carried out in three aspects: paradigm innovation, context expansion and ethical governance to promote the development of AI in education.

5.2.1 Paradigm Innovation and Causal Inference. Future research should strengthen longitudinal studies tracking the same cohort of students over multiple years. By establishing large-scale, cross-contextual, and multi-timepoint longitudinal databases, combined with randomized controlled trials, quasi-experimental designs, and causal mediation analysis, we can systematically examine the immediate and lagged effects of AI interventions on students 'cognitive, emotional, and behavioral variables.[8] Methodologically, incorporating paradigms such as learning analytics and educational data mining—integrating quantitative behavioral data with qualitative interview materials—will help reveal the complex mechanisms and individual differences in AI education's impact.

5.2.2 Contextual Expansion and Fairness and Inclusion. Research should delve into underserved contexts such as low-resource languages, special education, rural and remote areas, establishing a collaborative platform integrating "family-school-community" partnerships.[12] Through cross-cultural experimental designs, regional control groups, and socioeconomic stratified sampling, we can evaluate AI's effectiveness and sustainability across varying infrastructure levels, teaching quality, and cultural backgrounds. The study should also examine AI's potential and limitations in bridging urban-rural, gender, and socioeconomic disparities. Future efforts should focus on developing more equitable resource allocation strategies.

5.2.3 Ethical Governance and Risk Prevention and Control. Future research should prioritize protecting student data privacy and enhancing the fairness of AI algorithms. This can be achieved by strengthening data literacy education for educators and students through initiatives like data literacy courses, ethics-focused modules, and enhanced policy oversight to reduce privacy risks. Simultaneously, we need to develop a collaborative governance framework involving technology developers, educational administrators, teachers, and students. Establishing transparent, auditable, and accountable AI education frameworks will ensure technological progress aligns with educational equity and ethical responsibilities.[13]

6 Conclusion

This study systematically examines the evolution trajectory, hotspot distribution, and research gaps in the field of "AI in education" through a comprehensive analysis of 1,181 literature articles from the Web of Science core collection between 2013 and 2025, combining bibliometric methods with thematic content analysis. The findings reveal a significant "dual leap in quantity and quality" in the field post-2024: annual publications surged from 1 in 2013 to 715 in 2025, with citation counts reaching 8,385. China, the United States, and Australia form the primary knowledge production network, while 15 journals including *Education and Information Technologies* constitute core publishing platforms. Thematic analysis identifies six major research areas— "macro impacts of AI on education," "AI-student interaction," "AI learning tools," "AI teacher development," "AI literacy and ethics," and "AI in Education assessment" —which extend to eight application scenarios: language learning, basic education, higher education, special education, teacher development, learning analytics, immersive environments, and lifelong learning. However, current research predominantly relies on cross-sectional designs lacking longitudinal tracking and causal inference; samples are concentrated in English-speaking contexts and resource-rich regions, with insufficient attention to rural areas, low-resource languages, and special education settings; while ethical risks are widely discussed, there remains a lack of actionable and verifiable governance frameworks. In light of this, this paper proposes a three-dimensional research framework encompassing "paradigm innovation, contextual expansion, and ethical governance". Regarding research paradigms, it advocates for large-scale longitudinal data and multivariate causal inference. For contextual expansion, it calls for cross-cultural and cross-regional collaborative experimental platforms. In terms of ethical governance, it suggests developing multidimensional risk assessment tools and establishing multi-stakeholder collaborative regulatory mechanisms. This study aims to provide valuable recommendations for advancing AI in education research and informing policy implementation.

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References

[1] Adarkwah, M. A. (2025). The perceived relationship between self-directed learning, active learning, and critical thinking in using GenAI of adult learners in Ghana: An assessment of Gen Z, Millennials, GenX, and Baby Boomers. *International Journal of Educational Research*, 132, 102636.

[2] Almuhanna, M. A. (2025). Teachers' perspectives of integrating AI-powered technologies in K-12 education for creating customized learning materials and resources. *Education and Information Technologies*, 30(8), 10343-10371.

[3] Cai, C., Zhu, G. X., & Ma, M. (2025). A systemic review of AI for interdisciplinary learning: Application contexts, roles, and influences. *Education and Information Technologies*, 30(7), 9641-9687.

[4] Chen, C., Hu, W., & Wei, X. M. (2025). From anxiety to action: exploring the impact of artificial intelligence anxiety and artificial intelligence self-efficacy on motivated learning of undergraduate students. *Interactive Learning Environments*, 33(4), 3162-3177.

[5] Alshumaimeri, Y. A., & Alshememry, A. K. (2024). The Extent of AI Applications in EFL Learning and Teaching. *IEEE Transactions on Learning Technologies*, 17, 653-663.

[6] Su, J. H. (2024). Artificial Intelligence (AI) literacy in early childhood education: an intervention study in Hong Kong. *Interactive Learning Environments*, 32(9), 5494-5508.

[7] Kim, J. (2024). Types of teacher-AI collaboration in K-12 classroom instruction: Chinese teachers' perspective. *Education and Information Technologies*, 29(13), 17433-17465.

[8] Liu, X. H., Guo, B. X., He, W., & Hu, X. Y. (2025). Effects of Generative Artificial Intelligence on K-12 and Higher Education Students' Learning Outcomes: A Meta-Analysis. *Journal of Educational Computing Research*, 63(5), 1249-1291.

[9] Hsia, L. H., Lin, Y. N., Lin, C. H., & Hwang, G. J. (2021). Effect of an AI-based chatbot on students' learning performance in alternate reality game-based museum learning. *British Journal of Educational Technology*, 55(5), 2315-2338.

[10] Rawas, S. (2024). ChatGPT: Empowering lifelong learning in the digital age of higher education. *Education and Information Technologies*, 29(6), 6895-6908.

[11] Holmes, W., Iniesto, F., Anastopoulou, S., & Boticario, J. G. (2023). Stakeholder Perspectives on the Ethics of AI in Distance-Based Higher Education. *International Review of Research in Open and Distributed Learning*, 24(2), 96-117.

[12] Zheng, L. Q., Fan, Y. C., Chen, B. D., *et al.* (2025). Using AI-empowered assessments and personalized recommendations to promote online collaborative learning performance. *Journal of Research on Technology in Education*, 57(4), 727-753.

[13] Yang, L., Tao, Y., & Song, Y. J. (2025). Generative artificial intelligence in education: A topic-based bibliometric analysis. *Educational Technology & Society*, 28(2), 327-347.