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Artificial Intelligence in Education: A Brief Narrative Review

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ABSTRACT

Artificial intelligence (AI) has shifted from a peripheral research interest to a central concern in contemporary education, a movement greatly accelerated by the public release of generative AI tools after 2022. This brief narrative review synthesises empirical and conceptual literature on artificial intelligence in education (AIEd), tracing its development from early intelligent tutoring systems to present-day large language models, and organising the field around its principal application areas: intelligent tutoring and personalised instruction, adaptive learning and learning analytics, automated assessment and feedback, conversational and generative tools, and support for teachers and administration. Evidence from several meta-analyses indicates that well-designed intelligent tutoring systems produce moderate positive effects on learning, though they remain less effective than expert human tutoring; evidence on generative AI is more recent and mixed. Across the literature, recurring challenges concern academic integrity, data privacy, algorithmic bias, equity and the digital divide, and over-reliance. The review argues that AI is most defensibly understood as an augmentation of skilled teaching rather than a substitute for it, and that realising its benefits depends less on the technology itself than on pedagogy, governance, and investment in human capabilities.

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1. INTRODUCTION

Artificial intelligence in education (AIEd) is widely described as one of the fastest-growing areas of educational technology, even though research applying AI to teaching and learning stretches back roughly three decades (Zawacki-Richter et al., 2019). The field rests on the premise that systems able to make inferences, judgements, and predictions can offer learners personalised guidance and support while assisting teachers and policymakers in their decisions (Hwang et al., 2020). What was once a specialised pursuit has become a matter of mainstream institutional strategy, with reviews documenting two decades of accumulating research across instruction, learning, and administration (Chen et al., 2022). The public release of large language models (LLMs), most prominently ChatGPT in late 2022, intensified both enthusiasm and anxiety, prompting what several scholars characterise as a fundamental disruption to teaching, assessment, and scholarship (Kasneci et al., 2023; Eke, 2023). This disruption sharpened a long-standing question: does AI actually improve learning, and at what social and ethical cost? Proponents emphasise personalised instruction at scale, immediate feedback, and the automation of routine work; critics warn of compromised integrity, opaque algorithms, and the risk of deepening existing inequalities (Selwyn, 2019).

Scholars have proposed frameworks to make sense of this diversity, including a three-paradigm account distinguishing AI-directed, AI-supported, and AI-empowered approaches to learning (Ouyang & Jiao, 2021). A narrative review is well suited to mapping such a heterogeneous and fast-moving field, because it can integrate evidence across methods and disciplines while foregrounding interpretation and synthesis. This paper therefore aims to (1) outline the main forms AI takes in education and how they have evolved; (2) summarise the evidence on their impact on teaching, learning, and assessment; and (3) identify the principal challenges and the conditions under which AI is most likely to serve genuinely educational ends.

2. LITERATURE REVIEW

2.1. The Evolution and Conceptual Landscape of AIEd

The intellectual roots of AIEd lie in efforts to approximate one-to-one tutoring through software, an ambition articulated in influential overviews that argued AI could unlock more personalised and engaging learning (Luckin et al., 2016; Holmes et al., 2019). Reviews of the field commonly distinguish three broad clusters of application—learning, teaching, and administration—each supported by different techniques such as machine learning, natural language processing, and knowledge modelling (Chen et al., 2020).

Conceptually, the field has matured from a narrow focus on automating instruction toward richer models of the human–machine relationship. The three-paradigm framework situates AI on a spectrum from directing the learner, through supporting the learner, to empowering learners as agents in their own learning (Ouyang & Jiao, 2021). Parallel critical scholarship has examined how datafication and automation reshape educational institutions and raise governance questions that purely technical accounts overlook (Williamson & Eynon, 2020). A recurring concern across these analyses is that AIEd research has often been driven by computer scientists with limited engagement from educators, weakening its connection to pedagogical theory (Zawacki-Richter et al., 2019).

2.2. Principal Application Areas

2.2.1. Intelligent tutoring and personalised instruction

Intelligent tutoring systems (ITS) remain the most thoroughly evaluated AIEd application. They model a learner's knowledge state, deliver targeted feedback, and adjust difficulty in response to performance, aiming to give each student something closer to individual attention (Ma et al., 2014). This personalisation ambition continues to anchor newer systems and motivates much of the optimism surrounding adaptive and generative tools.

2.2.2. Adaptive learning and learning analytics

Adaptive platforms customise learning paths to learners' strengths and progress, while analytics surface patterns that help teachers intervene earlier. Systematic reviews of empirical work document rapid growth in such applications across online and blended higher education (Ouyang et al., 2022). Related meta-analytic work on technology-enhanced approaches, such as simulation-based learning, suggests that carefully designed digital environments can produce substantial learning gains when aligned with instructional goals (Chernikova et al., 2020).

2.2.3. Automated assessment and feedback

AI tools can score certain tasks, generate practice items, and provide immediate formative feedback, narrowing the gap between performance and correction. Advances in machine learning have made automated scoring of complex constructed responses, including science writing, increasingly feasible (Latif & Zhai, 2023). Such efficiencies are frequently cited among the principal practical benefits of AIEd, alongside corresponding concerns about reliability and fairness (Owoc et al., 2019).

2.2.4. Conversational and generative tools

Conversational agents and generative chatbots offer on-demand explanation, brainstorming, language practice, and tutoring-style dialogue. Earlier work explored rule-based and machine-learning chatbots, particularly in language learning (Kim et al., 2019), and systematic reviews have examined how conversational AI can complement, rather than replace, human teachers (Ji et al., 2023). The arrival of LLMs broadened these possibilities dramatically: such models can support personalised learning, generate explanations and code, and improve accessibility, while also raising distinctive risks (Kasneci et al., 2023). Rapid reviews of ChatGPT's educational impact report both substantial promise and significant concern (Lo, 2023), and commentators have highlighted the technology's potential to transform pedagogy when integrated thoughtfully (Adiguzel et al., 2023). Empirical studies have begun to document how learners actually use LLM-based tools—for instance, how novices employ code generators in self-paced programming courses (Kazemitabaar et al., 2023), how chatbots can be designed to support student success (Chen et al., 2023),

how generative AI performs on demanding professional examinations such as the USMLE (Kung et al., 2023), and how such tools may support communication training in intercultural contexts (Dai et al., 2024).

2.2.5. Support for teachers and administration

A recurring theme is that AI's clearest near-term value may lie in relieving teachers of routine work—drafting materials, generating items, and summarising student data—so that they can concentrate on instruction and mentorship (Holmes et al., 2019). Reviews of the field's current state emphasise that this support role, rather than wholesale replacement, dominates documented practice (Crompton & Burke, 2023). The quality of the teacher–student relationship remains central, and several scholars caution that technical capability cannot substitute for the relational dimension of education (Guilherme, 2019).

2.3. Evidence on Learning Outcomes

The strongest quantitative evidence concerns ITS. A large meta-analysis drawing on 107 effect sizes and more than 14,000 participants found that ITS outperformed teacher-led classroom instruction and non-ITS computer-based instruction, with positive effects across education levels and most subject domains (Ma et al., 2014). Focusing on college students, a second meta-analysis reported a moderate positive effect ($g \approx 0.32–0.37$); ITS surpassed most conventional methods but remained less effective than one-to-one human tutoring (Steenbergen-Hu & Cooper, 2014). A review of 50 controlled evaluations similarly found that students using ITS outperformed conventionally taught peers in the large majority of studies, with a median effect in the moderate-to-strong range—though effects on standardised tests were considerably weaker than on locally aligned assessments (Kulik & Fletcher, 2016). Reframing expectations, comparative work showed that the gap between human and computer tutoring is smaller than the long-assumed "two-sigma" benchmark, with human tutoring raising scores by an effect size near 0.79 relative to no tutoring (VanLehn, 2011). Two cautions follow. First, apparent effects depend heavily on what is measured: alignment between assessment and instruction strongly shapes outcomes (Kulik & Fletcher, 2016). Second, technology alone does not guarantee gains; teachers, pedagogy, and learners' self-regulation mediate whether tools translate into durable learning (Steenbergen-Hu & Cooper, 2014). Evidence on generative AI is younger and more mixed: such tools can increase engagement and personalise explanations, but reliability problems and the ease of shortcut-taking complicate claims about learning, and rigorous outcome studies remain comparatively scarce (Kasneci et al., 2023; Lo, 2023).

3. RESEARCH METHOD

This is a narrative (non-systematic) review. Peer-reviewed articles, scholarly books, review papers, and meta-analyses were identified through database and web searches combining terms such as "artificial intelligence in education," "intelligent tutoring systems," "adaptive learning," "learning analytics," "generative AI," "ChatGPT," and "academic integrity." Priority was given to influential reviews and meta-analyses, foundational conceptual works, and recent literature from the generative-AI era (2022–2026). Sources were selected for relevance and representativeness rather than through exhaustive or pre-registered criteria, and the synthesis is interpretive. This approach affords breadth and conceptual integration but, unlike a systematic review, does not catalogue the literature exhaustively and is more susceptible to selection bias—a limitation revisited in Section 8. It can be seen in the figure:

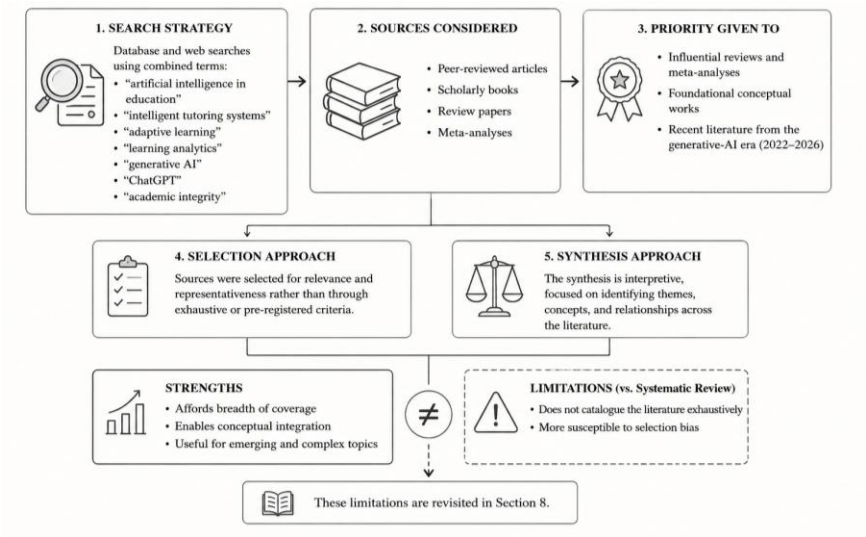

Figure 1. Narrative (Non-Systematic) Review: Literature Identification and Synthesis

4. RESULTS AND DISCUSSION

4.1. Challenges and Risks

4.1.1. Academic integrity

The most immediate concern raised by generative AI is academic integrity. LLMs can produce essays, solve problem sets, and complete take-home tasks, blurring the line between student and machine work (Eke, 2023). Empirical research suggests that even "authentic" assessment designs are neither a reliable shield against nor a complete solution to this challenge, and that detection grows harder as models improve (Kofinas et al., 2025). Systematic reviews converge on the need to rethink assessment and develop clear institutional policies rather than rely on bans or detection alone (Bittle & El-Gayar, 2025).

4.1.2. Data privacy and security

AIEd systems depend on large volumes of learner data, raising questions about consent, storage, and downstream use that are especially acute where minors are involved (Kasneci et al., 2023). International guidance has stressed that data protection must be built into AIEd governance from the outset rather than addressed retrospectively (UNESCO, 2021).

4.1.3. Algorithmic bias

Models trained on biased data can reproduce or amplify those biases, producing discriminatory outcomes that disadvantage already marginalised students (Akgun & Greenhow, 2022). Reviews of ethical and regulatory challenges identify transparency in how systems reach decisions as a precondition for responsible deployment (García-López & Trujillo-Liñán, 2025).

4.1.4. Equity and the digital divide

AI's benefits are unevenly distributed. In well-resourced settings it personalises learning and automates tasks; in under-resourced contexts, limited infrastructure, cost, and shortages of skilled personnel constrain adoption (Selwyn, 2019). Systematic reviews of K-12 settings document both the affordances and these structural constraints (Crompton et al., 2024). Whether AI narrows or widens disparities depends on policy and investment, a concern central to international guidance on generative AI (UNESCO, 2023).

4.1.5. Over-reliance and the human role

A subtler risk is that learners outsource thinking to AI, weakening the effortful processing that learning requires. Across the literature a human-centred framing recurs: AI should augment, not replace, educators, because empathy, motivation, and mentorship remain irreducibly human (Seldon & Abidoye, 2018; Guilherme, 2019). This concern extends into ethics and citizenship, where scholars have examined the moral implications of delegating educational and social functions to machines (Peters, 2020).

4.2. Dicussion

Taken together, the literature supports a measured optimism. AIEd has a credible evidence base for improving certain outcomes—clearest for intelligent tutoring, more provisional for generative tools—while posing risks that are social and institutional as much as technical. Three implications stand out.

First, pedagogy leads and technology follows. The systems that work do so because they embody sound instructional principles—targeted feedback, appropriate challenge, alignment with assessment—rather than because they are "intelligent" in the abstract (Kulik & Fletcher, 2016). The persistent observation that AIEd has too often been developed without educators underscores the cost of neglecting pedagogy (Zawacki-Richter et al., 2019).

Second, governance is decisive. Privacy, bias, integrity, and equity are addressed through policy, transparency, and design choices, and a human-centred orientation offers a useful organising principle for such governance (Yang et al., 2021; UNESCO, 2023). Institutions that treat generative AI as a constitutive feature of the scholarly environment, governed proactively, are likelier to benefit than those that ignore or simply prohibit it.

Third, capability-building matters. The benefits of AI are contingent on educators' AI literacy and learners' self-regulation, and conceptual accounts of how AI reshapes knowledge and assessment suggest that curricula themselves may need rethinking (Cope & Kalantzis, 2019). Future research should prioritise rigorous outcome studies of generative AI, longitudinal evidence on over-reliance and skill development, work in non-STEM and under-resourced settings, and the continued elaboration of the field's research agenda (Hwang et al., 2020).

4.3. Limitations

This review is limited by its narrative method: source selection was purposive rather than exhaustive, raising the possibility of selection bias, and the rapid evolution of generative AI means that specific claims

about tool capabilities date quickly. The synthesis should therefore be read as an orienting map rather than a definitive account, and quantitative claims drawn from individual meta-analyses should be interpreted in light of their respective inclusion criteria and comparison conditions.

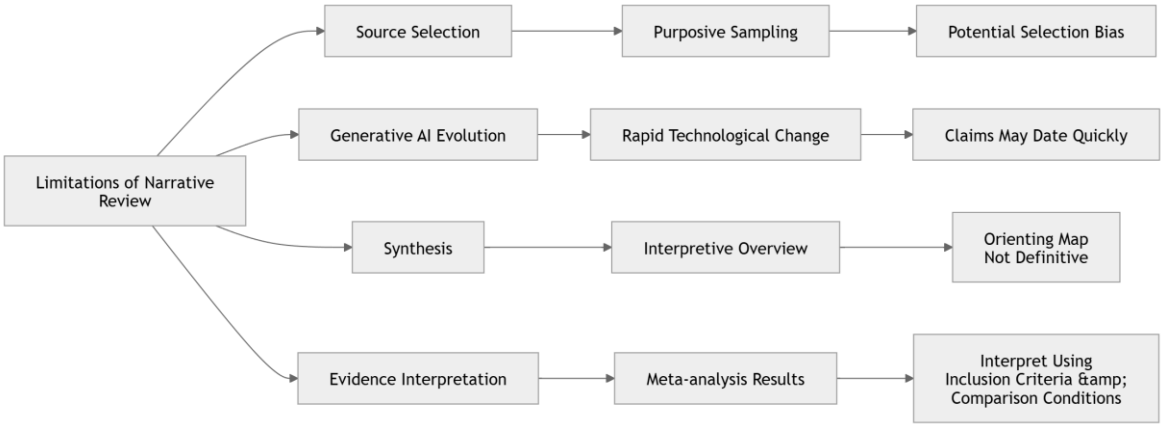

Figure 8. Key Limitations and Interpretation Considerations in the Narrative Review

5. CONCLUSION

Artificial intelligence is reshaping education, but it is not rewriting its fundamentals. The evidence suggests that AI can personalise instruction, broaden access, and lighten teachers' workloads, with intelligent tutoring systems offering the most robust track record and generative tools offering broad but less reliable promise. Whether these affordances improve education depends on choices that lie largely outside the technology—on pedagogy, governance, equity, and the cultivation of human judgement. Understood as an augmentation of skilled teaching rather than a substitute for it, AI can serve genuinely educational ends; mistaken for a replacement, it risks undermining them.

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