

Effective Use of Artificial Intelligence Capabilities in The Educational Process

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Received: 27 July 2026; **Accepted:** 24 August 2026; **Published:** 19 September 2026

Abstract: The rapid development of artificial intelligence (AI), particularly generative AI and large language models, has changed the conditions under which teaching, learning, assessment, and educational management are organized. The purpose of this study is to identify pedagogically effective ways of using AI in the educational process and to determine the conditions under which its benefits can be realized without weakening learner autonomy, academic integrity, or the professional role of the teacher. The study applies a structured integrative literature review and comparative document analysis. Peer-reviewed studies on artificial intelligence in education, intelligent tutoring systems, generative AI, and AI-supported teaching were analyzed together with policy guidance from UNESCO, the OECD, and the European Commission. The findings show that AI is most effective when it is used to support personalized learning, formative feedback, instructional design, differentiated practice, and data-informed teaching rather than to replace human judgment or learner effort. The analysis also demonstrates that educational effectiveness depends on teacher AI literacy, transparent rules for use, verification of machine-generated content, protection of personal data, and assessment designs that require reasoning and authentic performance. The article concludes that the educational value of AI is determined less by the novelty of a particular tool than by the quality of its pedagogical integration. Human oversight, critical thinking, and clearly defined learning objectives should therefore remain central to AI-enhanced education.

Keywords: Artificial intelligence, education, generative AI, personalized learning, formative assessment, intelligent tutoring systems, digital pedagogy, academic integrity, AI literacy.

Introduction: Artificial intelligence has moved from a specialized technological field into everyday educational practice. Machine-learning systems, intelligent tutoring platforms, automated feedback tools, learning analytics, recommender systems, and generative AI applications are now capable of supporting a wide range of educational activities. Earlier research on artificial intelligence in higher education concentrated largely on profiling and prediction, assessment and evaluation, adaptive systems, and intelligent tutoring, while also revealing that pedagogical and educator-centered perspectives were not always sufficiently represented [1]. The recent spread of generative AI has expanded the discussion because teachers and learners can now interact with

systems that generate explanations, examples, questions, summaries, images, code, and other forms of content through natural-language prompts.

The growing availability of AI creates significant opportunities for improving access to support and increasing the responsiveness of teaching. Evidence from research on intelligent tutoring systems has long suggested that adaptive computer-based guidance can produce meaningful learning gains when it is aligned with clearly defined instructional goals [2; 3]. More recent reviews show that AI applications increasingly influence learning, teaching, assessment, and administration, while generative systems add new possibilities for content creation, dialogue, idea generation, and individualized assistance [4; 5]. These

developments make AI attractive to educational institutions seeking to improve quality, efficiency, personalization, and digital accessibility.

At the same time, educational effectiveness cannot be assumed simply because an AI tool is technically advanced. Large language models can generate fluent but inaccurate information, reproduce biases contained in training data, produce fabricated references, and encourage excessive dependence if students use generated answers instead of engaging in cognitive work [6–8]. Questions of academic integrity, copyright, privacy, data security, unequal access, and transparency further complicate adoption. International organizations therefore emphasize a human-centered approach in which AI supports educational goals while human agency and professional responsibility are preserved [12–14].

The central problem is not whether AI should be used in education, but how it can be used in a way that improves learning without displacing the intellectual activity through which learning occurs. Effective integration requires a distinction between productive cognitive support and unproductive cognitive substitution. When AI provides hints, alternative explanations, formative feedback, simulations, practice opportunities, or scaffolding, it can extend the learner's capacity. When it performs the whole task without requiring understanding, evaluation, or revision, it may reduce the educational value of the activity. Accordingly, the purpose of this study is to synthesize research evidence and policy guidance in order to clarify the main conditions for effective AI use in the educational process.

The study was designed as a structured integrative literature review combined with comparative document analysis. This approach was selected because the research question concerns not one specific AI application but the pedagogical conditions under which different forms of AI can contribute to teaching and learning. The analytical corpus included peer-reviewed meta-analyses, systematic reviews, empirical and conceptual studies, and authoritative international policy documents published primarily between 2014 and 2024. Sources were selected when they directly addressed educational applications of AI, intelligent tutoring, generative AI, teacher practice, learning outcomes, assessment, or ethical governance.

The analysis was conducted in three stages. First, the selected literature was examined to identify recurring educational functions of AI and evidence concerning their effects on learning and teaching. Second, findings were compared across studies in order to distinguish established uses, such as intelligent tutoring and adaptive feedback, from newer generative applications whose evidence base is still developing. Third, recommendations from UNESCO, the OECD, and the European Commission were compared with the research literature to identify conditions related to human oversight, privacy, transparency, fairness, teacher competence, and learner responsibility [12–14].

The synthesis used four analytical categories: pedagogical value, teacher role, learner activity, and governance. Pedagogical value referred to the degree to which AI supported meaningful learning objectives. Teacher role covered instructional design, interpretation of AI outputs, feedback, and professional judgment. Learner activity focused on reasoning, self-regulation, active practice, and verification. Governance included academic integrity, data protection, equitable access, explainability, and institutional rules. The review was not intended as a statistical meta-analysis; rather, it aimed to integrate reliable findings into a coherent framework for effective educational practice.

The analysis shows that personalization is one of the most consistently supported educational functions of AI. Intelligent tutoring systems can adapt task difficulty, feedback, sequencing, and explanations to learner performance. A meta-analysis by Ma et al. found that intelligent tutoring systems were generally associated with better achievement than large-group teacher-led instruction, non-intelligent computer-based instruction, and textbook or workbook conditions [2]. Kulik and Fletcher similarly reported a substantial overall advantage for intelligent tutoring systems across controlled evaluations, while also warning that outcomes depended on implementation quality and the alignment between instruction and assessment [3]. These findings indicate that personalization is effective not because AI is autonomous, but because it can increase the frequency and precision of instructional responses.

A second major contribution is formative feedback. In conventional classrooms, teachers often face practical

limitations in providing immediate individual feedback to every learner. AI systems can analyze responses, identify common errors, suggest revisions, generate additional practice, and provide alternative explanations. This function is particularly useful when feedback is low-stakes and iterative. AI can help learners identify gaps before final assessment and can give teachers information about patterns that require intervention. However, the educational value of automated feedback depends on whether students are required to interpret and act on it. Feedback that merely supplies a corrected answer may reduce productive struggle, whereas feedback that prompts explanation, comparison, or revision can support deeper learning.

The literature also identifies significant value in teacher support. AI can assist with drafting lesson materials, generating examples at different levels of difficulty, adapting texts, producing question variants, designing rubrics, and suggesting alternative instructional activities. Research on generative AI in teacher education shows that such tools can support lesson planning and widen access to teaching resources, but generated materials still require critical evaluation for accuracy, contextual relevance, bias, and pedagogical suitability [10]. Thus, AI can reduce some routine preparation time, yet responsibility for curriculum alignment and instructional quality remains with the educator.

Generative AI expands the possibilities for dialogic learning. Students can use conversational systems to ask follow-up questions, request explanations in different forms, test ideas, simulate debates, rehearse language, or receive guided practice. Studies published after the public release of ChatGPT describe potential benefits for engagement, tutoring, content generation, and collaboration, but they also consistently report risks related to fabricated information, overconfidence in outputs, and misuse in assessed work [6–9]. These findings suggest that conversational AI is most valuable when prompts and tasks require learners to question, compare, verify, and improve generated responses rather than accept them as authoritative.

The review further shows that AI can support assessment, but this area requires careful redesign. Automated scoring and analytics can help with diagnostic and formative assessment, especially when

large volumes of responses must be processed. Generative AI can also assist teachers in creating parallel tasks or feedback prompts. Nevertheless, traditional take-home assignments that mainly require information reproduction are increasingly vulnerable to outsourcing. Effective assessment in an AI-rich environment therefore needs to emphasize reasoning processes, oral explanation, application to local or personal contexts, drafts and revision history, practical performance, and the ability to evaluate evidence. In this sense, AI does not simply create an integrity problem; it exposes weaknesses in assessment designs that measure product more than learning process.

Finally, the evidence indicates that effective use depends on institutional and ethical conditions. UNESCO recommends a human-centered and age-appropriate approach to generative AI, with strong attention to data privacy, validation, and human agency [12]. OECD analysis similarly emphasizes system-level governance, equitable access, teacher capacity, and guardrails for trustworthy use [13]. European guidance stresses critical and ethical engagement with AI and data, even for educators without advanced technical expertise [14]. Across these sources, a common conclusion emerges: AI becomes educationally useful when institutions define what the technology may do, what learners must still do themselves, how outputs should be checked, and where human judgment is mandatory.

The findings demonstrate that artificial intelligence should be understood as a pedagogical amplifier rather than an independent educational agent. It can amplify good instructional design by increasing responsiveness, widening access to practice, accelerating feedback, and supporting differentiation. It can also amplify weak instructional design by making superficial tasks easier to complete without understanding. This distinction explains why the same technology can produce very different educational outcomes across contexts. The decisive variable is not access to AI itself but the learning architecture in which it is embedded.

This interpretation is consistent with broader systematic reviews. Chiu et al. identified multiple roles for AI across learning, teaching, assessment, and administration while also documenting challenges that require further pedagogical and ethical attention [4]. Crompton and Burke's review of higher education

research similarly shows that AI has become relevant to diverse academic functions rather than a single specialized application [5]. A later systematic review by Wang et al. confirms the expansion of AI-supported personalization, tutoring, assessment, management, profiling, and prediction and highlights the multidisciplinary character of the field [11]. Taken together, the literature suggests that the next stage of AI in education should focus less on proving that AI can perform educational tasks and more on determining which task distributions between humans and machines produce the strongest learning outcomes.

Teacher competence is central to this task distribution. The teacher's role does not disappear when AI is introduced; instead, it becomes more complex. Teachers must be able to formulate learning objectives, choose suitable uses of AI, design prompts and activities, recognize unreliable outputs, protect learner data, and decide when human feedback is educationally preferable. They also need to make expectations transparent. If students are permitted to use AI for brainstorming but not for producing a final response, that distinction should be explicit. If AI-assisted writing is allowed, students can be required to disclose how the tool was used and to justify revisions. Such practices shift the focus from policing technology to developing responsible academic behavior.

Learner AI literacy is equally important. Effective use requires more than the ability to enter prompts. Students need to understand that generative AI outputs are probabilistic rather than inherently factual, that confident language does not guarantee accuracy, and that sources must be checked independently. They should learn to compare AI responses with authoritative materials, identify unsupported claims, improve prompts when necessary, and decide when not to use AI. These abilities connect AI literacy with information literacy, critical thinking, metacognition, and academic integrity. Kasneci et al. emphasize precisely this need for competencies that allow teachers and learners to understand both the capabilities and the limitations of large language models [6].

The issue of cognitive dependence deserves special attention. Educational technologies are beneficial when they scaffold performance while gradually increasing learner independence. Generative AI can undermine this principle if it supplies complete solutions before

students have attempted a task. A more effective design is to structure AI use in stages. Learners may first formulate their own interpretation, solution, or draft, then use AI to obtain critique, alternative reasoning, or counterarguments, and finally revise their work with justification. In this model, AI becomes a source of comparison and feedback rather than a substitute author. Such a process preserves effort while still taking advantage of machine-supported dialogue.

Equity also shapes effectiveness. AI may expand access to explanations and language support, but unequal access to devices, paid models, reliable internet, and digital competence can create new disparities. Moreover, systems trained on large-scale data may respond unevenly across languages, cultures, disciplines, or underrepresented contexts. Educational institutions should therefore evaluate tools for accessibility and local relevance rather than assuming that global availability guarantees educational fairness. OECD and UNESCO guidance places this issue within the broader responsibility to ensure that digital transformation remains inclusive and human-centered [12; 13].

A sustainable model of implementation should therefore be based on alignment. AI use should align with curriculum goals, the cognitive level of the task, the age and needs of learners, assessment criteria, privacy requirements, and institutional ethics. It should also remain auditable: teachers and students should be able to explain why AI was used and how its output influenced the final work. When these conditions are present, AI can increase educational capacity without weakening human responsibility. When they are absent, efficiency may increase while the quality of learning decreases.

Artificial intelligence offers substantial opportunities to improve the educational process, but its effectiveness depends on pedagogical design and responsible governance. The most productive applications are those that strengthen personalization, formative feedback, differentiated practice, instructional planning, and reflective dialogue. AI should support the learner's reasoning and the teacher's professional judgment rather than replace either of them.

The literature also demonstrates that meaningful integration requires AI literacy, verification of

generated content, transparent academic rules, data protection, equitable access, and assessment methods that value reasoning and authentic performance. These requirements transform AI from a convenient content generator into a controlled educational resource. Consequently, institutions should evaluate AI tools not primarily by speed, novelty, or automation capacity, but by their contribution to clearly defined learning outcomes. The effective use of artificial intelligence in education is therefore best understood as a human-centered partnership in which technology expands instructional possibilities while educators and learners retain responsibility for judgment, meaning, and knowledge construction.

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