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THE APPROPRIATE USE OF ARTIFICIAL INTELLIGENCE IN STUDENT LEARNING

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Summary. The global expansion of artificial intelligence (AI) and its increasing availability in educational settings present both unprecedented opportunities and major pedagogical challenges. The performance and learning outcomes enabled by AI raise fundamental questions about its meaningful, ethically responsible, and pedagogically justified integration into student learning processes. This article explores the possibilities and limitations of effectively incorporating AI into the educational environment from didactic, psychological, and ethical perspectives. It emphasizes how the use of AI tools can transform the dynamics of teaching and learning, redefining the roles of teacher and student in an increasingly technologized classroom.

The theoretical foundations are rooted in personalized and adaptive learning theories, constructivist approaches to knowledge acquisition, and cognitive psychology focused on information processing and metacognition. The article also draws from current research on human-machine interaction and self-regulated learning, examining how AI-driven platforms can support differentiated instruction and formative assessment. Furthermore, it discusses potential risks such as overreliance on algorithms, loss of critical thinking, and ethical dilemmas arising from data privacy, authorship, and transparency of automated decisions.

From a practical standpoint, the analysis reveals that while AI has the potential to strengthen inclusivity, enhance learner motivation, and optimize instructional efficiency, its educational effectiveness depends on the teacher's pedagogical autonomy and digital competence. The authors propose a balanced approach that integrates AI as a supportive – not substitutive – partner in education, preserving the humanistic dimension of learning and the social-emotional interaction between teacher and student.

The article concludes with theoretically and empirically informed recommendations for school practice, addressing the conditions necessary for responsible AI implementation. These include teacher training, curriculum adaptation, ethical policies for AI use, and strategies for maintaining equal access to technology. The paper is aimed at the professional community of educators, psychologists, and policymakers seeking evidence-based guidelines for making artificial intelligence a truly pedagogically meaningful element of contemporary education.

Keywords: artificial intelligence, education, pedagogy, psychology of learning, personalization, didactics, adaptive learning.

1. Introduction

Education today stands at the threshold of a profound transformation, driven in large part by the rapid advancement of artificial intelligence (AI). Its application in teaching provokes pressing questions: How can AI foster individualized learning? In what ways might it enhance student motivation and autonomy? And what ethical and professional challenges accompany its adoption? The answers cannot be sought within the technology alone, but rather in the ways AI is embedded into the pedagogical framework of instruction.

The use of AI in schools is not merely a technical intervention; it represents a fundamental shift in the very didactic design of teaching. AI has the potential to support differentiation, self-regulation, and formative assessment, while at the same time posing risks of depersonalization if deployed without sensitivity and a thorough understanding of educational processes.

A pedagogical perspective requires that teachers remain the central agents and facilitators of learning, while AI should serve as a complementary tool –capable of analyzing data, identifying student needs, and extending opportunities for both direct and indirect instruction. From a psychological standpoint, the integration of AI highlights the importance of motivation, cognitive load, and metacognitive strategies, all of which can be strengthened through thoughtful application.

The purpose of this article is to provide a systematic overview of the theoretical foundations for incorporating AI into student learning, to classify pedagogically appropriate uses of AI in school contexts, and to analyse the psychodidactic and inclusive implications of such practices. The discussion builds on contemporary research that bridges technological possibilities with pedagogical needs and psychological processes of learning. Particular emphasis is placed on the safe, ethical, and professional implementation of AI in education, aligned with current curricular frameworks and value orientations.

2. Theoretical Foundations of Using AI in Education

The meaningful integration of artificial intelligence (AI) into student learning requires a robust theoretical foundation. Such grounding ensures that implementation is not only technologically feasible but also pedagogically justified and psychologically informed. AI should not be regarded merely as a technical tool, but as a transformative element that reshapes the educational process itself –redefining the teacher's role, the structure of the curriculum, and the learner's engagement with knowledge. Several theoretical perspectives provide the framework for understanding why and how AI can be effectively applied in educational contexts: personalized and adaptive learning, constructivism, metacognitive approaches, and pedagogical scaffolding within a technological environment.

Personalized and Adaptive Learning

A central contribution of AI to education lies in its capacity to address the individual needs of learners. Personalized learning is grounded in the conviction that effective instruction must be tailored to cognitive abilities, learning pace, and personal preferences. AI systems enable the real-time collection and analysis of learning data, allowing instructional content, levels of difficulty, and modes of presentation to be dynamically adjusted to the learner's current stage of development (Pane et al., 2017).

From a pedagogical perspective, this approach connects to the concept of the Zone of Proximal Development (ZPD), which delineates the range within which learners can attain higher levels of competence with appropriate support. Although originally formulated in the early twentieth century, this concept has been further developed within contemporary theories of digitally mediated scaffolding, where the supportive role of the teacher is complemented – and in some contexts extended – by intelligent tutoring systems (Luckin, 2010).

Constructivism and the Facilitation of Learning

The didactic significance of AI can also be understood through the lens of constructivism, which emphasizes the active role of learners in building knowledge. In the constructivist view, learning is not a passive reception of information but a process of creating meaning based on prior experiences, contextual factors, and interaction with the environment. In this context, AI functions as a facilitator of knowledge – a tool that helps learners organize and structure new information, establish connections, and formulate questions that lead to deeper understanding (Luckin et al., 2016).

From a pedagogical perspective, it is crucial that AI does not merely generate mechanical responses or prescriptive recommendations but instead fosters open-mindedness, flexibility, and independence. In doing so, AI broadens the space for learner engagement in the instructional process and strengthens their active participation in the construction of knowledge.

Cognitive Psychology and Metacognitive Strategies

From the standpoint of learning psychology, AI carries the potential to support not only the acquisition of information but also the development of metacognitive strategies. These strategies are essential for enabling learners to regulate their own learning through planning, monitoring, and evaluating their study processes. Modern AI-based learning systems can, for instance, provide continuous feedback, suggest subsequent steps, or visualize a learner's progress. Such features enhance autonomy and self-regulation, which are particularly important in the context of lifelong learning and the competence to learn (Holmes et al., 2019).

AI is especially valuable for learners who require individualized support or who progress at a different pace than their peers. For these students, AI can provide a personalized framework that strengthens self-confidence and increases the overall effectiveness of their learning.

Ethical and Professional Anchoring of AI in Educational Practice

The theoretical grounding of AI cannot be separated from its ethical and professional dimensions. Teacher autonomy together with the ability to interpret the outputs of AI systems and to make informed decisions about their integration into instruction – remains central. AI must not replace the teacher; instead, it should complement and enhance the teacher's capacity for differentiation, individualization, and reflective practice (Selwyn, 2019).

Equally critical are the protection of student privacy, the transparency of algorithms, and the assurance of equal access. AI must be implemented in ways that reinforce fairness and justice in education, rather than undermine them.

3. Typologies of AI Use in Student Learning

The introduction of artificial intelligence (AI) into education does not follow a uniform or universal trajectory. Its implementation varies depending on the type of school, pedagogical objectives, technological infrastructure, and learner characteristics. From a pedagogical standpoint, it is essential to classify different types of AI use in order to evaluate their didactic potential, their psychological impact on learners, and the extent to which they support formative, active, and reflective learning. Typologies of AI use demonstrate that AI is not a one-dimensional tool, but rather a collection of distinct functions, each influencing different aspects of instruction. For teachers, it is crucial to understand when and why a particular application should be chosen – whether for diagnosis, instructional design, individualization, or reflection. Psychologically, it is equally important that AI fosters not only performance but also intrinsic motivation, metacognitive awareness, and learner self-efficacy.

3.1. AI as a Tool for Personalized Education

AI can act as a "silent partner" to the teacher, providing learners with personalized instructional content based on their performance, learning style, error patterns, and progress over time. These applications are often realized in the form of Intelligent Tutoring Systems (ITS), which adapt the pace, difficulty, and mode of instruction to the needs of each individual student (VanLehn, 2011).

From a pedagogical perspective, this approach supports the principles of individualization and differentiation, which are particularly valuable in heterogeneous classrooms. For students with specific educational needs, AI can serve as a tool to ensure equal access to education.

3.2. AI as a Medium for Feedback and Assessment

AI also plays a critical role in formative assessment. AI-driven systems are capable of analyzing student responses not only in terms of correctness, but also in relation to error types, response time, problem-solving strategies, and levels of uncertainty. This enables teachers to gain deeper diagnostic insights into student competencies and to provide more targeted and timely support (Holmes et al., 2022).

From a pedagogical and psychological perspective, high-quality feedback is essential for strengthening learners' metacognitive awareness, fostering autonomy, and sustaining long-term motivation. Research confirms that a combination of human and machine analysis can achieve an optimal balance between accuracy and pedagogical empathy.

3.3. AI as a Partner in Dialogic Learning

Contemporary AI systems are increasingly capable of engaging in dialogue with learners answering questions, posing counter-questions, administering checks, offering additional explanations, or suggesting alternative directions of thought. This approach aligns with the tradition of Socratic dialogue, in which students learn through active reasoning, argumentation, and reflection.

Pedagogically, dialogically oriented AI holds particular potential in developing critical thinking, creativity, and reflective learning. Rather than providing direct answers, AI models ways of searching for solutions, which is consistent with the constructivist conception of education (Luckin et al., 2016).

3.4. AI as a Creative and Collaborative Element

Certain forms of AI can be applied in collaborative and creative tasks. Typical examples include generating texts, designing presentations, producing visual elements, formulating project hypotheses, or simulating scenarios. In such contexts, AI not only stimulates student curiosity, motivation, and learning-by-doing, but also enables teachers to design multi-layered tasks that promote higher-order cognitive operations (Anderson & Rainie, 2023).

Psychologically, this fosters intrinsic motivation, as learners become co-creators of the learning situation. Here, AI functions not as a evaluator but as a partner in creation, thereby supporting what can be termed participatory learning.

4. Didactic Principles and Methodologies for Implementing AI in Student Learning

The integration of artificial intelligence (AI) into school environments requires a carefully designed didactic framework that ensures technology supports pedagogical aims rather than replaces them. Such a framework must be grounded in the principles of effective instruction, taking into account both individual learner characteristics and the dynamic nature of learning situations. This chapter identifies key principles that should guide the use of AI in the classroom. The didactic application of AI must always rest on a deep pedagogical understanding of the learning context. AI is not an end in itself but a means, and its effectiveness depends less on technical parameters than on the teacher's ability to use it in creating meaningful, motivating, and safe learning environments. Only under these conditions can AI genuinely enhance student learning and contribute to the goals of contemporary education.

4.1. The Principle of Pedagogical Intent

Any use of AI must be based on a clearly defined pedagogical objective, such as fostering comprehension, supporting autonomy, strengthening metacognition, or enhancing creativity. AI should never be introduced as an end in itself; it must operate as a tool that advances specific instructional strategies. Research confirms that when AI is not aligned with the teacher's goals, it can reduce both students' cognitive engagement and motivation (McLaren et al., 2010).

4.2. The Principle of Active Learning

AI implementation should always promote active learner engagement in the learning process. This includes asking questions, formulating hypotheses, analyzing errors, exploring alternative solutions, and stimulating discussion. Cognitive science has consistently shown that active learning is more effective than passive reception of information (Chi & Wylie, 2014). From a psychological perspective, AI should create constructive cognitive conflict that triggers deeper processing strategies and supports metacognitive growth (D'Mello & Graesser, 2012).

4.3. The Principle of Transparency and Algorithmic Understanding

Effective AI integration requires that both teachers and learners understand the basic principles of how algorithms operate. It is critical to clarify how AI analyzes inputs, evaluates performance, provides feedback, and collects data. Transparency increases trust and fosters a more open relationship with technology, which in turn supports the development of positive attitudes toward teach (Holmes et al., 2022).

4.4. The Principle of Methodological Guidance and Reflection

AI cannot substitute for the human dimension of teaching. Teachers must provide methodological guidance, helping students interpret AI outputs, reflect on results, correct errors, and set future learning goals. This reflects the principle of scaffolding: while technology provides a structure, genuine progress is made possible through expert human guidance. Research on adaptive scaffolding confirms that the combination of human support and digital structure creates optimal conditions for the development of self-regulated learning (Munshi et al., 2022). In this role, the teacher is not merely a data interpreter but a guide who helps student's articulate goals, think strategically about their performance, and critically evaluate AI-generated feedback. Psychologically, this form of support strengthens student autonomy, self-regulation, and the learner's perception of the teacher as a facilitator of thought.

4.5. The Principle of Ethical Anchoring in AI-Based Teaching

The introduction of AI into education should not be understood solely as a technological innovation. It must be firmly grounded in ethical values and the pedagogical mission of the school. AI should promote equality in access to education, protect student privacy, and respect cultural and individual diversity. In practice, this requires not only secure data management but also critical scrutiny of algorithmic decisions – for example, assessing whether they produce hidden forms of discrimination or disadvantage certain groups of learners.

Teachers play a pivotal role in shaping students' responsible engagement with AI. Learners must develop an understanding of how AI functions, what its capabilities are, and where its limitations lie.

This process fosters digital literacy, the ability to reflect on the ethical implications of technology, and civic competence in a data-driven world. Ethically anchored AI use is therefore not only a matter of school climate but also an essential component of preparing students for responsible participation in digital society (Zawacki-Richter et al., 2019).

5. Psychological Aspects of Student–AI Interaction

The interaction between students and artificial intelligence in educational contexts presents both a significant challenge and a unique opportunity for contemporary pedagogy and psychology. From a psychological perspective, complex mechanisms of perception, learning, motivation, self-regulation, and identity come into play. AI is not merely a tool; it becomes an interactive partner that model's behaviour, shapes thinking processes, and either strengthens or weakens intrinsic motivation.

5.1. Perceiving AI as an Actor in Education

With the rise of personalized technologies, students increasingly encounter AI systems that not only deliver instructional content but also interact in ways resembling human teachers. Psychological research confirms that learners tend to perceive AI as a "social actor", with the degree of anthropomorphism human-like features in AI communication significantly influencing trust, engagement, and learning performance.

From a pedagogical standpoint, moderate "humanization" of AI can foster emotional connection to learning, while excessive anthropomorphism may provoke discomfort, reduce trust, or create cognitive dissonance. Recent studies demonstrate that the optimal design of AI tools, in terms of perceived humanness, strongly affects not only technology acceptance but also the quality of learners' intrinsic motivation and self-regulation (Pitts & Motamedi, 2025; Shahini, 2025). The teacher thus plays a crucial role in maintaining balance between human guidance and technological mediation.

5.2. Impact on Student Motivation and Self-Regulation

Supporting autonomy is a fundamental psychological prerequisite for effective learning. When AI enables students to independently choose the pace, type of tasks, or form of feedback, it enhances their sense of control over the learning process. This, in turn, fosters intrinsic motivation, self-efficacy, and the use of metacognitive strategies. Importantly, AI can also detect signs of frustration or cognitive overload in real time and adapt task difficulty accordingly, thereby supporting learners' psychological needs (Holstein et al., 2020).

5.3. Emotional Responses to AI-Supported Learning

AI-mediated educational interactions evoke diverse emotional responses, ranging from curiosity and enthusiasm to anxiety, resistance, or uncertainty. Since emotions play a decisive role in shaping learning outcomes, it is critical to monitor how students experience AI in the classroom. Research shows that positive emotions increase cognitive engagement and openness to learning, whereas negative emotions may hinder concentration and weaken students' relationship to schooling (D'Mello & Graesser, 2014). Teachers should therefore approach AI not only as a cognitive tool but also as an emotional factor, actively shaping the classroom climate in digitally assisted learning environments.

6. Transformation of the Teacher–Student Relationship in AI-Supported Learning

The introduction of AI into education reshapes the traditional model of interaction between teachers and students. The classical paradigm, in which the teacher is the primary source of knowledge and evaluator of student performance, is shifting toward a model of horizontal collaboration. In the presence of AI, the interaction becomes triangular: student–AI–teacher. Within this framework, the teacher remains the central guarantor of values, interpretation, and higher-order competencies, while AI assumes partial functions such as adaptive task allocation or performance evaluation.

This transformation requires new didactic and psychological competencies. Teachers must not only master technological tools but also preserve the human dimension of education. This includes understanding student behaviour in interaction with AI, accurately interpreting emotional feedback, and actively sustaining trust in the teacher's role. Research confirms that students' trust in AI is significantly influenced by how teachers present and mediate it. When AI is framed as a technical support that is complemented by the teacher's interpretation and personal approach, students are more likely to perceive the technology as useful and trustworthy (Nazaretsky et al., 2025).

Beyond trust, a sense of autonomy is also crucial. If AI functions in an excessively authoritarian or rigid manner, there is a risk of undermining students' intrinsic motivation and their willingness to take responsibility for their own learning. Here, the teacher acts as a mediator by framing AI as a tool rather than an authority. Evidence suggests that the optimal scenario is one in which AI provides recommendations while leaving the final decision to the student. This approach fosters both independence and responsibility (Wu et al., 2024).

7. Supporting Student Autonomy in Hybrid Learning with AI

Hybrid learning, which combines in-person and digital forms of education, places considerable demands on students' ability to manage their own learning processes. In this context, autonomy emerges as a central educational competence, encompassing planning, decision-making, self-assessment, and the adaptation of learning strategies. Artificial intelligence can play a pivotal role in developing these skills – provided it is integrated into instruction with a clear pedagogical rationale and under the guidance of a skilled teacher.

AI tools – such as intelligent learning platforms, adaptive systems, or virtual assistants – enable learners to make choices regarding pace, task sequence, and forms of feedback. This personalization enhances students' responsibility for their own learning and strengthens their engagement in the educational process (Kim & Hannafin, 2011). Autonomy, however, should not be seen as an end in itself. Its true value lies in fostering deeper understanding, critical thinking, and active learning.

From the perspective of learning psychology, autonomy is closely linked to intrinsic motivation, a sense of competence, and the ability to regulate one's own performance. AI can support these processes by providing clear and timely feedback, allowing learners to adjust task difficulty, and visualizing their progress. Nonetheless, the teacher remains central-guiding students in interpreting AI outputs, helping them set meaningful goals, and fostering reflective engagement with learning outcomes. Without this human mediation, autonomy risks being reduced to the pursuit of the easiest path rather than the development of genuine learning competencies.

The successful use of AI to cultivate autonomy therefore requires a balanced approach: technological flexibility must be integrated within a pedagogical framework that provides structure, guidance, and meaningful orientation. Only within such an environment can student autonomy be developed as a genuine competence rather than as a nominal expression of freedom.

8. Limitations and Risks of Using AI in Education

Although artificial intelligence offers many advantages for education, its implementation also introduces risks that must be systematically addressed. When AI is applied in teaching without appropriate pedagogical and ethical sensitivity, it may disrupt educational balance, foster growing dependence on automated systems, or marginalize the teacher's role.

One of the most significant risks is the loss of transparency. Many AI systems used in education rely on algorithms whose decision-making logic cannot be fully understood or verified by either teachers or students. This lack of clarity undermines trust in AI-driven decisions and can lead to passive acceptance of outputs without critical reflection (Selwyn, 2019).

Another limitation lies in the potential reproduction or amplification of existing inequalities. If the "training data" of AI systems is grounded in historical patterns, it may perpetuate unconscious biases or stereotypical judgments of learners (Williamson & Eynon, 2020). Instead of promoting equity, AI may unintentionally reinforce disparities in access, assessment, or recommended learning pathways.

A fundamental pedagogical risk is reductionism the attempt to translate complex learning processes into measurable variables. Yet learning is a dynamic, context-dependent, and socially constructed process that cannot be fully captured by data or algorithms. If AI is treated as an objective instrument, there is a danger that it will exert control over curriculum or assessment without regard to pedagogical values and learner diversity.

Risks also emerge when teacher autonomy is diminished. When schools adopt external AI systems without options for pedagogical customization, decision-making shifts to the technology and its providers. In such cases, teachers risk becoming implementers of system-generated recommendations rather than creators of educational environments.

For these reasons, AI must be understood as a tool, not as an authority. Its implementation should always be accompanied by professional reflection, teacher training, transparent design, and adherence to the principles of equity, safety, and pedagogical autonomy.

9. Implementation Frameworks and Teacher Professional Development in the Integration of AI into Education

The introduction of artificial intelligence (AI) into schools is not merely a technological initiative but a transformative process requiring teachers' professional readiness, clearly defined institutional frameworks, and curricular integration.

From the perspective of professional preparation, it is essential that teachers acquire not only technical skills for working with AI but also an understanding of its pedagogical aims and limitations. Research indicates that in the absence of adequate support, teacher uncertainty increases, often resulting in resistance to innovation (Cheah, Lu, & Kim, 2025).

At the institutional level, systematic planning is critical. This includes methodological guidance, ethical frameworks, and mechanisms for reflecting on the impact of AI in teaching. Schools that articulate strategic objectives for AI and actively invest in professional development achieve stronger pedagogical outcomes and higher adoption rates of these technologies (Cukurova, Miao, & Brooker, 2023).

Curricular integration of AI should be driven by aims related to the development of digital literacy, self-reflection, and critical thinking, rather than being treated as a mere technological add-on. Classroom teaching must remain aligned with the values of quality, autonomy, and pedagogical ethics, with AI serving as a means to advance these priorities (Casal-Otero, 2023).

Professional development for teachers must therefore be continuous, grounded in the sharing of practice, guided reflection, and authentic applications. Only under these conditions can AI genuinely enhance student engagement, foster authenticity in teaching, and support the development of core educational competencies.

10. Supporting Student Autonomy in Hybrid Learning with AI

The development of student autonomy has long been regarded as one of the fundamental aims of modern pedagogy. In the context of hybrid learning where face-to-face and online forms of education are combined autonomy becomes even more significant. AI can play a central role as a tool that enables personalized instruction, individualized feedback, and the enhancement of metacognitive skills, namely learners' ability to regulate their own learning processes (Kochmar et al., 2020).

Artificial intelligence is capable of analysing data on students' learning progress and adapting instructional content not only to their level of knowledge but also to their working style, pace, and preferences. Such targeted adaptive environments allow learners to work within their optimal developmental zone while simultaneously acquiring competencies necessary for independent learning. An additional benefit is the increase in motivation, as students perceive instruction as "tailored" to their needs, making it more relevant and meaningful (Suraworachet et al., 2022).

From a psychological perspective, this process strengthens intrinsic motivation, a sense of competence, and the ability to plan, make decisions, and evaluate one's own learning. Cognitive autonomy is closely linked to learners' emotional orientation, their confidence in their abilities, and the perceived support of the environment. AI can function as a tool that provides real-time formative feedback, offers suggestions for improvement, enables progress tracking, and thus contributes to the stable development of self-regulation (Holmes, Bialik, & Fadel, 2022).

The teacher's role in such an environment change substantially, becoming more that of a mentor and guide who monitors learning processes, analyses data provided by AI, assists in interpreting results, and creates conditions for deeper understanding. Teachers bear the key responsibility of ensuring that technology does not replace pedagogical interaction but instead enriches and enhances it. They determine the degree of autonomy granted to learners while ensuring a meaningful framework and a safe environment for experimentation and error.

The student–AI relationship is also shaped by dynamics of trust in technology. Research demonstrates that learners' trust in AI-supported educational tools increases significantly when algorithms are transparent and recommendations are clearly explained (Pitts & Motamedi, 2025). This type of trust–distinct from the traditional "human–machine" model is essential for the effective integration of AI into educational practice. It also heightens student engagement and fosters their ability to make autonomous decisions in relation to learning (Nazaretsky, 2025).

Thus, student autonomy in hybrid learning with AI does not depend solely on the choice of appropriate tools but primarily on pedagogical guidance, ethical sensitivity, and carefully considered didactic strategies. Technology alone cannot guarantee competencies its value arises only through synergy with high-quality instructional design.

11. Evaluating the Impact and Effectiveness of AI in School Education

The evaluation of AI in education cannot be limited to technological performance indicators; it must primarily address its contributions to student learning, competence development, and the transformation of pedagogical practice. Effective evaluation therefore examines not only learning outcomes but also psychodidactic processes and professional implications.

Quantitative studies confirm that personalized feedback generated by AI can significantly improve learning outcomes. For example, in intelligent tutoring systems, targeted data-driven instruction has been shown to lead to greater knowledge acquisition and higher student satisfaction with the learning experience (Kochmar et al., 2020). Their benefit lies in adapting the learning process to individual student needs, thereby increasing the relevance and effectiveness of instruction.

Qualitative interventions, such as combining human and AI-based analytical feedback on reflective writing tasks, have demonstrated positive effects on motivation, work consistency, and performance. Research indicates that students with lower levels of self-regulation become more engaged and perform better when supported by blended feedback (Suraworachet et al., 2022).

Another crucial dimension of evaluation concerns the transformation of the teacher's role. The most effective uses of AI have emerged when teachers employed technology as a complement to their didactic strategies rather than as a replacement. In such cases, AI functions as a tool for diagnosis, individualization, and reflection, thereby extending pedagogical potential (Munshi et al., 2022).

From a broader perspective, long-term classroom use of AI has been shown to foster intrinsic motivation, enhance digital competencies, and strengthen readiness for lifelong learning. These aspects can be considered elements of broader school effectiveness, which encompasses not only academic results but also the development of competencies and attitudes (Holmes, Bialik, & Fadel, 2022).

A critical condition for effectiveness remains pedagogical integration, supported by meaningful feedback and reflection cycles based on real data. Frameworks such as Universal Design for Learning (UDL) and Technological Pedagogical Content Knowledge (TPACK) provide guiding structures that align technology with learning objectives and pedagogical design (Mishra & Koehler, 2006).

12. Discussion

The integration of artificial intelligence into school education represents a major paradigmatic shift in conceptions of teaching, the role of the teacher, and student learning. The preceding chapters have demonstrated that AI holds the potential to significantly enhance personalization, learner autonomy, metacognition, and instructional effectiveness. At the same time, however, it places increased demands on ethical sensitivity, pedagogical deliberation, and teachers' professional readiness.

This discussion must take into account not only the benefits but also the limitations of the concepts examined. Personalization through AI can foster higher student engagement and learning effectiveness (Holmes, Bialik, & Fadel, 2022; Suraworachet et al., 2022). Yet it also carries the risk of reducing education to customized content delivery without deeper pedagogical reflection. Critics further warn against excessive confidence in the ability of algorithms to predict student performance without considering contextual, cultural, or emotional factors (Williamson & Eynon, 2020; Selwyn, 2019).

From a psychological perspective, interactions with AI can enhance students' intrinsic motivation and self-regulation when systems are designed with transparency, adaptability, and formative feedback in mind (Holstein et al., 2020; Nazaretsky, 2025). Nonetheless, significant differences remain in how students perceive the trustworthiness and authority of AI, depending on factors such as age, prior experience, and levels of digital literacy (Pitts & Motamedi, 2025).

With regard to teachers' professional preparedness, evidence suggests that without sufficient support, the implementation of AI can be more burdensome than beneficial (Cukurova, Miao, & Brooker, 2023). In the absence of methodological guidance and pedagogical framing, teachers may perceive AI as a tool of external control rather than as an aid to professional growth.

The ethical dimensions of AI use are particularly tied to issues of equity, data protection, autonomy, and algorithmic bias. AI must not create inequities or reproduce hidden biases embedded in its training data. Pedagogical responsibility therefore remains indispensable even in technology-enhanced education.

Taken together, these findings suggest that the use of AI in teaching is not primarily a technical issue but a complex pedagogical challenge requiring cultivated, deliberate, and critically reflective integration. The task is to seek balance among student autonomy, teacher professionalism, and technological functionality without prioritizing one at the expense of the others.

13. Conclusion

The use of artificial intelligence in student learning represents a significant shift in how the educational process is understood, organized, and enacted. This article has demonstrated that AI does not replace the role of the teacher but can complement it as a tool for personalization, differentiation, and the promotion of learner autonomy. At the same time, however, new challenges emerge concerning teacher professional preparation, ethical responsibility, and the necessity of thorough curricular integration.

Based on the analysis of current theoretical and empirical findings, several key conclusions can be drawn:

AI must be understood as a means of reinforcing pedagogical goals rather than as a technological imperative.

Successful implementation of AI depends on the integration of pedagogical expertise with teachers' digital competence.

The learner must remain an active subject of the educational process AI can support self-regulation, metacognition, and intrinsic motivation only under conditions of meaningful pedagogical guidance.

Transparency of algorithms, protection of privacy, and the guarantee of equitable access to educational technologies are essential prerequisites.

Professional development for teachers remains a critical challenge; it must be continuous, reflective, and grounded in the values of pedagogical autonomy.

The future of AI in school education therefore depends not on the technology itself but on the ability of teachers, researchers, and institutions to harness its potential in a responsible, professional, and critically reflective manner.

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