

Education in the Intelligence Era: Challenges and Reorientation of Contemporary Educational Theories

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ABSTRACT

The emergence of artificial intelligence (AI) is transforming contemporary education and challenging established assumptions underlying educational theories. This study aims to examine the challenges posed by AI in the intelligence era and analyze the need for reorientation of contemporary educational theories in response to increasingly complex human-AI interactions. A qualitative systematic literature review was conducted using scholarly literature from Scopus, Web of Science, and Google Scholar, with emphasis on publications from 2019 to 2026. The literature was analyzed through thematic analysis and critical interpretive synthesis, guided by the PRISMA 2020 framework, focusing on knowledge construction, learning processes, assessment, teacher and learner agency, ethics, and educational purposes. The findings indicate that AI is reshaping education through personalized learning, adaptive instruction, automated feedback, and expanded knowledge exploration, while simultaneously creating challenges related to knowledge reliability, learner dependency, academic integrity, assessment validity, data privacy, and human agency. The review further shows that constructivism, experiential learning, social learning, connectivism, and humanistic education remain relevant but require critical reorientation to accommodate AI-mediated learning environments. The study proposes a human-centered, AI-augmented educational paradigm that integrates technological intelligence with critical thinking, learner autonomy, teacher agency, ethical reasoning, reflective judgment, and meaningful human interaction.

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1. INTRODUCTION

The rapid development of artificial intelligence (AI), generative artificial intelligence (GenAI), machine learning, learning analytics, and adaptive digital systems has moved education beyond conventional digital transformation toward what can increasingly be described as the intelligence era. Unlike earlier forms of educational digitalization, which primarily transferred teaching and learning activities into digital environments, contemporary AI technologies can generate content, process complex information, provide feedback, personalize learning experiences, and support

cognitive decision-making. Consequently, AI represents not merely another technological instrument but a transformation of the epistemological, pedagogical, and institutional foundations of education.

The OECD (2023) emphasizes that digital transformation should be understood in relation to fundamental changes in teaching, learning, assessment, and educational ecosystems. In this context, the intelligence era raises fundamental questions about how knowledge is constructed, how learning takes place, and how the roles of teachers and learners should be reconceptualized. Generative AI further intensifies these questions because activities traditionally associated with human cognitive work including writing, summarizing, translating, brainstorming, and problem-solving can increasingly be performed with machine assistance (Kasneci et al., 2023).

The emergence of AI also challenges several assumptions underlying contemporary educational theories. Constructivism, social learning, experiential learning, and humanistic education have traditionally emphasized learners' active participation, social interaction, experience, autonomy, and human development. However, when learners interact continuously with AI systems capable of generating explanations, providing feedback, producing alternative solutions, and supporting knowledge construction, the boundary between human cognition and technological mediation becomes increasingly fluid.

Wang et al. (2024), through a systematic review of AI in education, demonstrate that AI research has expanded across adaptive learning, intelligent tutoring, assessment, prediction, personalization, and other educational applications. At the same time, Zawacki-Richter et al. (2019) identify a persistent need for stronger pedagogical and theoretical engagement in AI-related educational research. These developments suggest that educational theory must move beyond viewing technology merely as an external learning tool and instead examine how machine intelligence participates in knowledge construction, learner agency, interaction, and decision-making. The central theoretical challenge is therefore to explain learning in an environment where human intelligence increasingly operates in interaction with artificial intelligence.

The transformation is particularly evident in assessment, teacher roles, learner agency, and educational purposes. Generative AI can perform many tasks traditionally used to assess students' knowledge, including producing essays, explanations, summaries, and solutions, thereby challenging assessment practices based primarily on the reproduction of information. Rather than responding only through technological restriction, education increasingly needs to cultivate critical AI literacy, epistemic judgment, creativity, complex problem-solving, ethical reasoning, and the capacity to evaluate and contextualize machine-generated outputs (OECD, 2023).

Similarly, AI should not reduce teachers to technological operators; instead, increasing machine capabilities may reinforce the importance of teachers in areas requiring contextual interpretation, ethical judgment, empathy, dialogue, motivation, and character development. UNESCO (2023) consequently advocates a human-centered approach in which AI supports rather than replaces human agency and educational purposes. This perspective requires contemporary educational theories to reconsider the relationship among human agency, machine intelligence, knowledge, pedagogy, and ethical responsibility, while preserving the fundamentally human dimensions of education.

Against this background, the reorientation of contemporary educational theories should not be understood as a rejection of established theoretical traditions but as their critical extension into an AI-mediated educational environment. The intelligence era requires educational theory to reconsider what constitutes meaningful learning when information can be generated instantaneously, what constitutes valid evidence of learning when cognitive production can be technologically assisted, and how teachers and learners should exercise agency within human-AI interaction. Holmes et al. (2019) argue that the development of AI requires education to reconsider

both what students should learn and how learning should be organized in technologically transformed environments.

Accordingly, the educational emphasis needs to move beyond knowledge acquisition toward critical thinking, creativity, collaboration, reflective judgment, ethical reasoning, AI literacy, and the responsible application of knowledge. This article therefore examines Education in the Intelligence Era by analyzing the challenges generated by AI integration and the consequent need to reorient contemporary educational theories. The central proposition is that the future of education should not be determined solely by the increasing intelligence of machines, but by how effectively educational systems integrate technological capabilities with human cognition, ethical responsibility, social interaction, and human development.

2. METHODS

This study employed a qualitative systematic literature review (SLR) to critically examine the challenges of artificial intelligence (AI) in contemporary education and analyze the need for reorientation of educational theories in the intelligence era. Relevant literature was identified through searches of Scopus, Web of Science, and Google Scholar using combinations of keywords such as “artificial intelligence in education,” “generative AI,” “AI in education,” “educational theory,” “learning theory,” “pedagogical transformation,” and “human–AI interaction,” with emphasis on scholarly publications published between 2019 and 2026. Studies were selected based on their relevance to AI-mediated education, theoretical or empirical contribution, scholarly credibility, and availability of sufficient information for analysis, while duplicate, irrelevant, and technically oriented studies without substantive educational implications were excluded. The selection and reporting process was guided by the PRISMA 2020 framework (Page et al., 2021). The selected literature was analyzed through thematic analysis and critical interpretive synthesis, focusing on recurring issues related to knowledge construction, learning processes, pedagogy, assessment, teacher and learner agency, ethics, and educational purposes. The identified themes were subsequently examined in relation to contemporary educational theories, particularly constructivism, social learning theory, experiential learning, connectivism, and humanistic education, to identify theoretical assumptions that remain applicable, require modification, or need conceptual extension within AI-mediated learning environments. The synthesis was ultimately organized into two analytical dimensions: (1) the challenges of education in the intelligence era, including epistemological, pedagogical, assessment, ethical, and human-agency challenges; and (2) the reorientation of contemporary educational theories, emphasizing the integration of human intelligence, machine intelligence, critical judgment, ethical responsibility, and meaningful learning. This approach enabled the study to move beyond a descriptive review of AI applications and develop a theoretically grounded interpretation of how educational theories may need to evolve in response to the increasing integration of AI into educational practice.

3. FINDINGS AND DISCUSSION

The systematic literature review indicates that the emergence of the intelligence era is transforming education across five interconnected dimensions: knowledge construction, learning and pedagogy, assessment, teacher and learner agency, and the broader purposes of education. The reviewed literature consistently demonstrates that AI has evolved from functioning primarily as a technological support tool into an increasingly active component of educational environments, particularly through generative AI, adaptive learning systems, intelligent tutoring systems, and automated feedback.

This transformation challenges the traditional assumption that knowledge is accessed, processed, and produced exclusively through human cognitive activity. AI can now generate explanations, synthesize information, provide alternative solutions, and support personalized learning pathways, thereby creating new forms of human AI interaction in knowledge construction. At the same time, the literature identifies persistent concerns regarding inaccurate or biased outputs, algorithmic dependence, data privacy, unequal access, and the potential weakening of learners' independent cognitive engagement (Kasneci et al., 2023; UNESCO, 2023; Wang et al., 2024).

These findings indicate that the central challenge of the intelligence era is not the presence of AI itself, but the development of educational practices that ensure AI enhances rather than diminishes human intellectual agency. A second major finding concerns the transformation of pedagogical relationships and learning processes. The literature suggests that AI-mediated learning environments increasingly support personalized, adaptive, interactive, and feedback-oriented learning experiences. These developments are broadly consistent with constructivist and experiential perspectives because learners can actively engage with information, test ideas, receive immediate feedback, and revise their understanding through iterative interaction.

However, the integration of AI introduces a dimension that is not fully addressed by traditional formulations of these theories: learning may increasingly occur through continuous interaction between human cognition and machine-generated responses. Consequently, learners are no longer interacting solely with teachers, peers, content, and physical or digital environments, but also with computational systems capable of responding dynamically to their individual needs. Wang et al. (2024) and Zawacki-Richter et al. (2019) document the expanding applications of AI in adaptive learning, intelligent tutoring, prediction, assessment, and personalization.

The findings therefore suggest that contemporary pedagogy needs to conceptualize AI not merely as a medium or instructional tool, but as a cognitive-mediating environment whose outputs require human interpretation, verification, and reflection. The third finding concerns assessment and the changing meaning of learning achievement. The reviewed literature indicates that generative AI poses substantial challenges to assessment practices that rely heavily on essays, written assignments, information retrieval, and standardized responses. Because AI systems can increasingly produce sophisticated textual and analytical outputs, the mere production of an answer is becoming a less reliable indicator of individual cognitive development.

This situation requires a shift toward assessment practices that emphasize higher-order cognitive processes, including reasoning, application, critical evaluation, creativity, problem-solving, and reflection. Rather than treating AI-generated outputs as direct evidence of learning achievement, assessment should examine how learners formulate questions, evaluate information, identify limitations, critically revise AI-generated responses, and apply knowledge to authentic contexts. The literature therefore suggests a transition from an output-oriented assessment paradigm toward a process- and reasoning-oriented paradigm, in which the quality of human judgment becomes more important than the quantity of information produced. This finding also reinforces the importance of AI literacy as an integral component of contemporary educational competence (OECD, 2023; UNESCO, 2023).

The fourth finding concerns the redefinition of teacher and learner agency. Existing research indicates that AI can automate or support various instructional and administrative activities, including content generation, feedback, assessment, learning analytics, and personalized instruction. However, the literature does not support interpreting these developments simply as the replacement of teachers by intelligent systems. Rather, AI appears to redistribute educational responsibilities and increase the importance of roles that depend on human judgment, contextual understanding, ethical reasoning, interpersonal relationships, and emotional engagement. Teachers increasingly function as learning designers, critical mediators, ethical guides, and facilitators of

meaningful human interaction, while learners are expected to become more autonomous, reflective, and capable of critically evaluating AI-generated knowledge.

This finding is consistent with the human-centered approach advocated by UNESCO (2023), which emphasizes that AI should augment human capabilities while preserving human agency. The emerging educational relationship can therefore be conceptualized as a human–AI partnership, in which technological intelligence supports educational processes without determining their ultimate goals or values. Finally, the synthesis identifies a broader theoretical finding concerning the reorientation of contemporary educational theories. The literature suggests that established theories remain relevant but require conceptual extension to accommodate AI-mediated learning environments. Constructivism needs to account for knowledge construction involving human–AI interaction; social learning theory needs to recognize technologically mediated forms of interaction and modeling; experiential learning needs to incorporate AI-supported simulations and feedback; connectivism becomes increasingly relevant as knowledge networks expand to include intelligent computational agents; and humanistic education becomes particularly important as a counterbalance to excessive technological instrumentalism. Across these theoretical perspectives, a common principle emerges: the increasing intelligence of educational technologies does not diminish the importance of human capacities but changes the conditions under which those capacities are exercised.

DISCUSSION

The findings demonstrate that the emergence of the intelligence era represents a fundamental transformation in the conditions under which education takes place. AI is no longer functioning merely as an instructional technology but is increasingly becoming part of the cognitive and pedagogical environment in which knowledge is produced, interpreted, and applied. This finding extends previous discussions of educational technology by suggesting that the central issue is not technological adoption but the changing relationship between human cognition and machine intelligence. Kasneci et al. (2023) identify substantial opportunities for large language models to support learning while also highlighting concerns related to reliability, dependency, and academic integrity.

Similarly, Wang et al. (2024) demonstrate the expanding scope of AI applications across learning, assessment, personalization, and educational decision-making. The present synthesis indicates that these developments require a conceptual shift from viewing AI as an external educational tool toward understanding it as a cognitive-mediating environment. Such a shift has important theoretical implications because knowledge construction can no longer be conceptualized exclusively as an interaction between learners and human or material environments. Instead, contemporary learning increasingly involves dynamic interactions among learners, educators, digital resources, and intelligent computational systems.

The educational challenge is therefore to ensure that technological mediation strengthens learners' epistemic agency rather than encouraging passive acceptance of machine-generated knowledge. This transformation also requires a critical reconsideration of constructivist and experiential approaches to learning. Constructivism emphasizes that learners actively construct knowledge through interaction, interpretation, and experience, while experiential learning emphasizes the relationship between concrete experience, reflection, conceptualization, and application. AI-mediated learning can potentially strengthen these processes by providing immediate feedback, generating alternative perspectives, simulating situations, and enabling learners to repeatedly test and revise their understanding.

However, the presence of AI also creates a theoretical tension: if learners delegate substantial cognitive activity to AI, technological assistance may facilitate task completion without necessarily producing meaningful knowledge construction. Therefore, the critical issue is not whether AI is compatible with constructivism, but under what pedagogical conditions AI-supported interaction produces genuine cognitive engagement. From this perspective, AI should function as a scaffold for inquiry and reflection rather than a substitute for thinking. Learners should be required to question AI-generated responses, compare them with independent reasoning and credible sources, identify limitations, and transform generated information into personally understood knowledge. This interpretation extends constructivist theory by positioning critical human–AI interaction as an increasingly important context for knowledge construction. The findings concerning assessment further indicate that the intelligence era challenges conventional definitions of educational achievement.

Traditional assessment frequently assumes that students' written products provide reasonable evidence of their individual knowledge and cognitive abilities. Generative AI complicates this assumption because sophisticated outputs can be produced with relatively limited direct cognitive effort from the learner. The implication is not that conventional assessment should be abandoned, but that its underlying epistemological assumptions need to be reconsidered. OECD (2023) and UNESCO (2023) emphasize the need for educational systems to respond to AI through responsible and pedagogically meaningful approaches rather than relying exclusively on technological restriction. In this context, assessment should increasingly examine process, reasoning, reflection, verification, and application, rather than focusing solely on final outputs. Learners can, for example, be evaluated on their ability to formulate meaningful questions, critique AI-generated information, justify revisions, document their reasoning, and apply knowledge to authentic and contextually complex problems.

Such an approach transforms AI from a perceived threat to assessment validity into an object and instrument of critical learning. Consequently, the intelligence era calls for an assessment paradigm in which demonstrating the capacity to think with, about, and beyond AI becomes an important component of educational achievement. Another important implication concerns the changing relationship between teacher agency and learner agency. The findings indicate that AI can automate several instructional functions, but automation does not eliminate the educational significance of teachers. Rather, it changes the nature of their responsibilities. Zawacki-Richter et al. (2019) already identified limited attention to educators in much of the earlier AI-in-higher-education literature. The present synthesis suggests that this issue becomes even more significant as generative and adaptive AI systems become increasingly capable.

Teachers remain essential for establishing educational purposes, interpreting learner needs, designing meaningful learning experiences, evaluating the appropriateness of AI use, and cultivating ethical and social dimensions of learning. At the same time, learners need greater agency because effective AI-mediated learning depends on their capacity to make informed decisions about when, why, and how AI should be used. UNESCO (2023) similarly emphasizes a human-centered orientation in which AI augments rather than replaces human capabilities. Accordingly, the emerging educational relationship is better conceptualized as distributed but human-directed agency, where computational systems contribute analytical and generative capabilities while teachers and learners retain responsibility for educational judgment, values, and goals. The findings also have significant implications for connectivism and humanistic educational theory.

Connectivism conceptualizes learning as the ability to establish and navigate networks of information, resources, and connections. The integration of AI expands these networks by introducing computational agents capable of generating, filtering, reorganizing, and communicating information. Consequently, the contemporary learner needs not only the ability to

access information networks but also the ability to evaluate the epistemic reliability of intelligent systems operating within those networks. At the same time, the increasing role of AI reinforces the importance of humanistic education. As machines become increasingly capable of generating information and performing cognitive tasks, education must place greater emphasis on dimensions that remain fundamentally connected to human development, including empathy, ethical reasoning, identity, responsibility, interpersonal relationships, creativity, and meaning-making.

The coexistence of these perspectives suggests that the future of educational theory should not be constructed around a binary opposition between human intelligence and artificial intelligence. Instead, it should address how technological intelligence can be integrated into educational systems while preserving the social, ethical, and developmental purposes of education. Taken together, these findings support the proposition that the intelligence era requires a reorientation rather than a replacement of contemporary educational theories. Constructivism can be extended toward AI-mediated knowledge construction; experiential learning can incorporate AI-supported simulation, experimentation, and feedback; social learning can account for technologically mediated interaction; connectivism can incorporate intelligent computational agents within knowledge networks; and humanistic education can provide the ethical and developmental foundation for ensuring that technological progress remains subordinate to human educational purposes.

The theoretical contribution of this study therefore lies in positioning AI not simply as an emerging educational technology but as a factor that changes the epistemic, pedagogical, and relational conditions of education. A human-centered, AI-augmented educational paradigm should consequently integrate technological capability, critical thinking, ethical judgment, learner autonomy, teacher agency, social interaction, and human development. Such reorientation enables educational theory to respond to the intelligence era without reducing education to technological efficiency, while ensuring that the increasing intelligence of machines contributes to, rather than displaces, the intellectual and human purposes of education.

4. CONCLUSION

The intelligence era is reshaping knowledge construction, learning, assessment, and educational interaction, requiring artificial intelligence (AI) to be understood as more than a technological tool. This review shows that AI presents challenges concerning knowledge reliability, learner dependency, academic integrity, assessment validity, privacy, and human agency, while also enabling personalized learning, adaptive instruction, feedback, and knowledge exploration. Contemporary educational theories therefore remain relevant but require critical reorientation rather than replacement, emphasizing critical AI literacy, higher-order thinking, learner autonomy, teacher agency, ethical reasoning, and reflective judgment. The study consequently proposes a human-centered, AI-augmented educational paradigm in which AI complements rather than replaces human cognition, creativity, ethical responsibility, and social interaction.

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