

# New Roles and Teacher Competencies in the Artificial Intelligence Era\*\*

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## A B S T R A C T

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The integration of artificial intelligence into educational technologies has fundamentally transformed traditional pedagogical paradigms and teacher roles. This research indicates that the successful implementation of artificial intelligence in education constitutes a complementary rather than substitutive process, requiring a nuanced balance between technological innovations, valid pedagogical principles, and teacher activities. The analysis results indicate that the teacher's position in the educational process is being transformed from a knowledge transmitter to collaborator, designer, and facilitator in digital environments supported by artificial intelligence technology, while necessitating the development of a new set of competencies beyond existing digital ones: data literacy, algorithmic thinking, and ethical and critical evaluation. The article concludes that successfully harnessing the potential of artificial intelligence in education necessitates a holistic approach that integrates technological, pedagogical, ethical, and socio-cultural dimensions, supported by a systematic transformation of initial teacher education and mechanisms for continuous professional development and improvement.

**Keywords:** *artificial intelligence, educational technology, teacher, competencies.*

## Introduction

The integration and implementation of artificial intelligence (AI) into educational technologies has considerably expanded over the past decade. This evolutionary trajectory has been influenced by several key factors, including the increased availability of digitized educational data, the advancement and sophistication of AI algorithms, and the broader paradigm shift toward personalized and adaptive learning (Hwang et al., 2020). As previously noted, one of the primary drivers of this ascent has been the exponential growth of educational data volume (Romero & Ventura, 2020). The widespread adoption of learning management systems, online learning platforms, and various educational applications initiated the generation of vast quantities of data pertaining learner interactions, performance outcomes, and behavioral patterns. These

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data are commonly referred to as the “Big Data”, constituting a rich resource from which AI algorithms can train, derive learning and produce meaningful decisions (Namoun & Alshantiti, 2020). By leveraging Big Data from educational contexts, intelligent software systems gain substantive insight into learners' knowledge levels, learning dispositions, and potential misconceptions, thereby enabling the development of personalized and adaptive learning experiences (Chaudhry & Kazim, 2022). The globally expanding learner population and the imperative for lifelong learning have compelled traditional educational systems to seek new, scalable, and efficient educational technologies and solutions without compromising instructional quality (Schiff, 2022). Artificial intelligence, at its current level of development, enables the automation of certain instructional tasks such as assessment and feedback provision, thereby liberating teachers to concentrate more of their time on higher-order tasks and individualized learning support (Cope & Kalantzis, 2019). The potential impact of AI on the teacher–learner relationship warrants careful and sustained consideration (Guilherme, 2017). Although AI augments instruction, it should not be regarded as a substitute for human teachers, as they contribute unique qualities to the learning process including empathy, creativity, and contextual understanding (Luckin & Cukurova, 2019). However, as AI-based technology becomes increasingly embedded in educational practice, it is essential to approach its implementation with critical and reflective rigor. Through the responsible deployment of digital technology and its alignment with the established evidence-based pedagogical principles, contemporary educational technologies are clearly transforming teaching and learning by enabling personalized, adaptive, and inclusive educational experiences for all participants in the process.

As AI-based systems gradually assume more responsible roles for specific instructional tasks such as content delivery, assessment, and feedback provision, teachers will adapt their instructional methodologies and develop new competencies to effectively engage with these systems and emerging educational environments (Cox, 2021). Over time, teachers will increasingly assume roles as mentors and learning experience designers, thereby devoting greater attention to the creation of meaningful learning experiences that integrate AI tools. Teachers will obviously be required to develop competencies in data literacy, AI ethics, and learning analytics in order to interpret and act upon the insights generated by the emerging intelligent educational systems (Tsai et al., 2019). In order to effectively engage with advanced learning environments, learners will invariably need to cultivate skills in self-regulated learning, metacognitive strategies, and digital literacy (Anthonysamy et al., 2020). Nevertheless, the evolving roles of both teachers and learners raise fundamental questions regarding the potential impact on the human dimension of education – specifically the importance of social interaction, emotional support, and the development of soft skills. It is imperative to establish a balance between the affordances of artificial intelligence and the intrinsic value of human connectedness and interaction within educational environments (Humble & Mozelius, 2022). The potential impact of AI on education is far-reaching and multifaceted, presenting innovative opportunities for personalized learning,

intelligent assessment, equity and accessibility, and consequently the transformation of teacher and learner roles.

## **The Artificial Intelligence Pedagogical Paradigm**

AI-driven educational technologies have the potential to revolutionize teaching and learning processes by enabling new personalized and adaptive digital learning opportunities. However, it is essential to examine the pedagogical implications and future developmental trajectories of these technologies in order for this implementation to be both effective and responsible. Intelligent tutoring systems (Zhu et al., 2024), adaptive learning platforms (Du Plooy et al., 2024), educational robots (Yüksel et al., 2025), chatbots (Namesztovszk et al., 2024), and related tools have all demonstrated considerable potential for improving learning outcome achievement, increasing learner engagement, and providing individualized support. The aforementioned technologies employ machine learning algorithms, natural language processing, and computer vision to analyze learner data, model individual profiles, and deliver targeted interventions. By adapting to the individual needs, preferences, and learning pace of each student, educational technologies facilitate the creation of inclusive and equitable learning environments. However, AI integration also introduces considerable challenges and raises important questions regarding the transformation of teacher roles, pedagogical impact, and ethical considerations associated with its application in educational settings. As algorithms progressively assume certain instructional functions, such as the assessment of student work and feedback provision, teachers must redefine their professional engagement and develop new competencies to effectively collaborate with and complement the emerging educational systems and instructional methodologies. These changes necessitate a critical examination of pedagogical implications and the development of new instructional strategies that harness the complementary strengths of both human and artificial intelligence.

The integration of artificial intelligence into education should be observed not merely as a technical advancement, but as a catalyst for a fundamental transformation in the way teaching and learning are conceptualized. As AI-based systems, including intelligent tutoring systems, adaptive learning platforms, and educational data mining tools, become increasingly sophisticated and widely adopted, traditional pedagogical concepts, methodologies, and established roles of teachers and learners are continuously being challenged. These systems employ machine learning algorithms and learning analytics to create personalized learning experiences that are dynamically adapted to the individual needs, preferences, and abilities of each learner. By providing tailored guidance, timely feedback, and responsive support, AI-based systems can empower learners to engage in autonomous, experiential, and inquiry-based learning, cultivating a sense of agency over their own educational trajectory. This transformation demands a critical examination and analysis of pedagogical implications and the development of new frameworks and strategies for leveraging technology while preserving essential human dimensions and roles in educational process. One of the

pivotal paradigm shifts introduced by AI is the transition toward personalized and adaptive learning experiences (Strielkowski et al., 2024). Contemporary educational technologies have enabled the conceptualization, development, and construction of dynamic learner profiles that encompass individual strengths, weaknesses, preferences, and learning styles, thereby facilitating the creation of tailored recommendations and individualized learning pathways. The orientation toward personalization is consistent with constructivist learning theory, emphasizing the active role of learners in the construction and development of their own knowledge and underscores the importance of adapting instruction to individual needs. This shift is also characterized by an enhanced emphasis on active learning, collaboration, problem-solving, and independent inquiry. The realization of personalized and adaptive learning experiences requires reconsideration of traditional teacher and learner roles, as well as the development of new pedagogical approaches that leverage AI capabilities while maintaining meaningful human oversight. Teachers will increasingly assume the role of learning process organizers, orchestrators, and facilitators, guiding students through their interactions with digital systems and providing the socio-emotional support and motivational guidance that computational algorithms cannot replicate (Marienko et al., 2020). The transition to an AI-supported competency-based learning model enables learners to advance at their own pace and receive recognition for their achievements, thereby promoting personalized and efficient learning experiences (Majeed et al., 2025). This approach underscores the importance of attaining a high level of understanding and proficiency within a given domain before progressing to more advanced content. By employing AI algorithms and tools for the continuous assessment of learner competencies and the delivery of targeted support, educational technologies can better assist learners in developing deep conceptual understanding and acquiring transferable skills. However, the learner-centered learning paradigm carries its own distinct implementation challenges. A critical concern is ensuring that AI systems are designed to promote meaningful learning and to foster the development of higher-order thinking and understanding, rather than simply optimizing performance on narrowly defined tasks or assessments.

The roles of human and artificial intelligence within educational environments must be thoughtfully balanced. Although digital systems are capable of automating certain tasks, such as grading assignments and providing feedback, they can also offer valuable insights into learner behavior and performance. However, they should not be construed as replacements for human teachers, as teachers fulfill a vital function in the creation of meaningful learning experiences, in nurturing the social and emotional development of learners, and in providing empathy. While technology can automate certain tasks and generate personalized recommendations, it cannot fully replicate the complex social interactions and emotional intelligence that teachers bring into the learning process. Therefore, it is essential to primarily regard AI as a tool that can assist and empower teachers, enabling them to concentrate on higher-order tasks, such as fostering critical thinking, creativity, and social skills, rather than as a substitute for

their professional expertise and judgment. The emergent synergy between human and artificial intelligence necessitates the development of new collaborative models and cultivation of AI literacy among educators (Casal-Otero et al., 2023). One of the key domains of technological application is the automation of routine administrative tasks (e.g., grading and record-keeping), which are often time-intensive and mainly administrative in nature. Beyond the assessment tasks automation, educational technology can assist teachers in monitoring learner progress and engagement, providing data-informed insights upon which teachers can base decisions and implement targeted interventions (Istenič Starčič, 2019). Learning analytics and educational data mining techniques are employed to process large volumes of learner data, including interaction logs, performance records, and demographic information, in order to identify patterns and trends that are frequently not immediately discernible to human observers. By generating early warning signals and personalized recommendations, these systems can assist teachers in proactively intervening and providing targeted support to learners experiencing difficulties. However, in order to make effective use of the insights generated by AI algorithms, teachers must develop the following new competencies and skills:

- Data literacy – defined as the ability to collect, analyze, interpret, and effectively communicate data, enabling teachers to make evidence-based decisions and evaluate the validity and reliability of AI-generated recommendations (Olari & Romeike, 2021);

- Algorithmic thinking – referring to an understanding of the manner in which software algorithms process data and arrive at decisions, which is essential for teachers to critically evaluate the outputs of AI-based systems and to identify potential biases or limitations (Nazaretsky et al., 2022);

- AI ethics – encompassing the consideration of ethical principles and values in the design, development, and deployment of AI-based tools and technologies in educational settings, ensuring that these technologies are transparent, accountable, and aligned with educational objectives and learner well-being (Song & Ko, 2024).

In order to support teachers in acquiring the aforementioned competencies, professional development programs should focus on providing training and support in the areas of digital literacy and AI integration into educational practice.

The integration of AI carries significant implications for instructional design and curriculum development (Türkmen & Sözen Özdoğan, 2025). As new technologies enable increasingly flexible and adaptive learning experiences, traditional linear and fixed curricula are progressively losing their relevance. There is a growing need to develop modular and adaptable content that can be dynamically assembled and sequenced in accordance with the learner needs and preferences, as well as data regarding learner performance. The learning environment design should be grounded in evidence-based learning theories and practices, ensuring that technology serves pedagogical objectives rather than driving them. The key lies in adopting a multidisciplinary approach that

integrates expertise from the fields of education, psychology, computer science, and related disciplines. Adaptive learning systems powered by AI algorithms can analyze learner data to construct personalized learning experiences that optimize engagement and achievement outcomes. In order to design effective adaptive learning pathways, instructional designers must take into consideration factors such as learner profiles, prior knowledge, learning objectives, and assessment strategies. Furthermore, they must collaborate closely with specialists in AI development to ensure that adaptive algorithms are pedagogically sound and aligned with validated learning theories and educational practices. AI integration provides instructional designers with opportunities to incorporate interactive and immersive elements that enhance learner engagement and motivation. Natural language processing, speech recognition, and computer vision technologies enable intuitive interactions between learners and educational systems. For example, virtual and augmented reality technologies, combined with advanced AI algorithms, can create highly realistic simulations and contextualized learning experiences that promote active learning and knowledge transfer. The investigation of pedagogical implications should integrate the cognitive and affective dimensions of AI-enhanced learning, the examination of social and cultural factors influencing the adoption and efficacy of educational technologies, and address the ethical and societal implications of their deployment.

### **Emerging Teacher Roles and Competencies**

The integration of AI into education has fundamentally transformed the roles and responsibilities of educational practitioners, requiring them to adapt and to develop new competencies in order to effectively leverage educational technologies and to support learning in contemporary and sometimes new educational environments. As AI progressively assumes a range of instructional tasks, including content delivery, assessment, and personalized learning support, the teacher's role as the primary source of knowledge is transitioning toward that of facilitator, designer, and collaborative partner in learning. This shift from knowledge transmitter to learning facilitator and designer is grounded in constructivist and sociocultural theories of learning, emphasizing the active role of learners in constructing their own knowledge through social interaction and authentic problem-solving experiences. The emerging responsibilities of teachers include the creation of meaningful learning experiences that harness the capabilities of AI systems while providing the essential guidance, support, and social connectedness that technology is still unable to offer (Uzunboylyu, 2024). As learning facilitators, teachers focus on stimulating learner engagement, critical thinking, and collaboration, employing AI-based digital tools to personalize learning experiences, provide targeted feedback, and adapt instruction to the individual needs of each learner. The new role of teachers as learning designers manifests in the curriculum development, the design of learning activities, and the development of appropriate assessment strategies that are aligned with educational objectives and pedagogical principles. It is expected that contemporary educators design authentic, project-based

learning experiences in order to enable learners to apply their knowledge and skills in real-world contexts utilizing AI tools for support, collaboration, communication, and innovation. Teachers can design AI-enhanced computational simulations and digital virtual environments that provide learners with immersive realistic scenario experiences, enabling them to practice decision-making, critical thinking, and problem-solving skills within safe and controlled environments. This entails collaboration between software development experts, instructional designers, and subject matter specialists in order to create learning experiences that effectively integrate AI technologies and promote deep, meaningful learning. Teachers must design and manage learning environments that foster the development of diverse competencies, including problem-solving, creativity, and digital literacy, which are essential for success in an increasingly AI-driven world.

In order to effectively embrace their emerging roles and to realize the potential of contemporary educational technologies, teachers must develop (in addition to existing digital competencies), a range of AI-specific competencies (Moorhouse et al., 2024). AI literacy refers to the knowledge, skills, and dispositions required to understand, employ, and critically evaluate AI technologies in educational contexts. The development of AI literacy and competencies is essential for several reasons. First, it enables teachers to understand the fundamental concepts, techniques, and applications of AI in education, including machine learning, natural language processing, and adaptive learning systems. This knowledge, along with the requisite skills and dispositions, is indispensable for teachers to critically assess the potential benefits and limitations of these technologies, as well as to identify appropriate opportunities for their integration into instructional practice. Second, AI literacy empowers educational practitioners to make informed decisions regarding the selection, design, and implementation of new educational technologies, ensuring that these tools are aligned with pedagogical objectives, validated learning theories, and evidence-based practice. Teachers who have developed strong data literacy skills can leverage learning analytics and AI-generated insights to personalize learning experiences, provide targeted feedback, and identify learners who may require additional support. Third, algorithmic thinking competencies enable teachers to interpret and evaluate the outputs of AI-based systems, identify potential biases or limitations, and make informed assessments of the validity and reliability of intelligent system recommendations. This competency is particularly important for ensuring that AI technologies are employed in a fair, transparent, and responsible manner, thereby mitigating the risks of perpetuating or amplifying existing educational inequities. Fourth, given that AI systems collect, process, and analyze vast quantities of learner data, teachers must be cognizant of the potential privacy and security concerns associated with these practices. The development of ethical competencies enables teachers to critically examine the social and moral dimensions of using AI in education, ensuring that these technologies are deployed in ways that promote equity, inclusion, and student well-being.

A key aspect of teachers' emerging roles in the AI era is their collaboration with intelligent educational systems and technologies. Collaborative partnerships between teachers and AI systems may assume various forms and serve diverse purposes. A common approach involves employing AI systems to automate routine tasks, such as grading, feedback provision, and learner progress monitoring. A second form of collaborative partnership involves utilizing AI systems to provide data-driven insights into learner development through learning analytics and educational data mining, drawing upon interaction logs, academic performance data, and demographic information. AI-based systems can also be engaged in the collaborative conceptualization and delivery of learning experiences that integrate the capabilities of both human and machine intelligence. For instance, intelligent tutoring systems can provide learners with personalized guidance, feedback, and support as they engage with complex problems or tasks, while teachers monitor learner progress, provide additional support as needed, and facilitate social interaction and collaborative learning. Collaborative partnerships should be continuously evaluated and refined to ensure effectiveness and accountability in response to the perpetually evolving needs of teachers and learners. This necessitates the development of robust evaluation frameworks and methodologies that are capable of assessing the impact of AI systems on learning outcomes, student engagement and well-being, and the alignment of instructional activities with the educational objectives and values.

The initial and continuing education of teachers for AI-driven education requires a holistic approach encompassing the diverse technical, pedagogical, and ethical dimensions of AI integration. Educational ecosystems must position and invest towards the development of technological infrastructure and resources, as well as professional development programs that empower the integration of new technologies into instructional practice. Teacher education programs must adapt their curricula to incorporate AI-related content and competencies, preparing prospective teachers for working in educational environments that are hybrid or AI-mediated. Teacher education should also be oriented toward cultivating a culture of innovation, experimentation, and continuous professional growth. This includes actively seeking new approaches to the AI technologies integration into instructional practice, exploring the potential benefits and limitations of emerging tools, and collaborating with colleagues, researchers, and developers in the co-design and evaluation of AI-enhanced learning solutions. Teachers should engage in ongoing professional development and reflective practice, continuously updating their AI-related knowledge and skills and adapting their instructional strategies to the evolving needs of their students.

### **Concluding remarks**

The integration of AI into educational processes and technologies represents a fundamental transformation that transcends the mere technological upgrade of existing pedagogical practices. It demands a substantive re-examination of teacher roles and competencies, a redefinition of pedagogical paradigms, and a reconstruction

of educational ecosystems. In fact, the rise of AI-based educational technologies is not a direct consequence of technological progress per se, but rather a response to the inherent challenges of contemporary instruction, including the need for greater personalization of learning, analytical monitoring of learner progress, the empowerment of self-regulated learning models, and the enhancement of educational inclusivity. The exponential growth of available educational data in digital form has enabled the development of sophisticated adaptive systems capable of offering personalized educational content and experiences tailored to the individual needs, pace, and preferences of each learner. The application of AI in education has initiated and effected a significant pedagogical and methodological shift away from the traditional transmissive model of instruction toward a model of personalized, adaptive learning. However, the central contribution of this article lies precisely in its emphasis on the fact that the successful implementation of a new AI-based pedagogical paradigm requires a nuanced balance of technological capabilities with foundational, traditional, and validated pedagogical principles. The technological innovation in question should not supplant the human capacities of teachers, but rather assume the role of a complementary element that enables teachers to focus more effectively on those essential aspects of the educational process that demand empathy, creativity, and contextual understanding.

The teacher's role transformation from knowledge transmitter to collaborator, designer, and facilitator of the learning process is arguably the most significant shift in educational practice of the past two decades, and has been catalyzed precisely by the integration of e-learning and AI into the instructional process. The successful enactment of these roles demands the development and consolidation of new teacher competencies that extend well beyond traditional pedagogical skills. Data literacy, algorithmic thinking, ethical awareness, and the capacity to create and manage the synergy between human and artificial (machine/digital) intelligence are becoming essential competencies for teachers in contemporary schools and other educational environments. It is concluded that the successful implementation of educational technologies requires a holistic approach that encompasses the technological, pedagogical, ethical, and socio-cultural dimensions of educational practice. Paradoxically, despite the growing automation and digitalization of certain aspects of the educational process, the human factor is also gaining in significance: teachers are becoming ever more indispensable in domains that require emotional intelligence, ethical judgment, and contextual understanding, thereby further underscoring the necessity of a complementary relationship between human and artificial intelligence in education. This multidimensional perspective must be integrated into both formal initial teacher education programs and non-formal and informal programs of professional development and individual professional growth. Teacher education should evolve toward the formation of reflective practitioners capable of critically evaluating the potential and limitations of AI and of creatively integrating such capacities into pedagogical practice (Zhang & Zhang, 2024). The implementation of AI in education also carries significant ethical implications that demand the sustained attention of educational practitioners. Issues of data privacy, algorithmic bias, the digital divide, and the potential dehumanization of the

educational process must be addressed through the systemically supported development of ethical frameworks and policies. Teachers occupy a pivotal role in ensuring that the implementation of AI in education serves the well-being of learners and advances the principles of equity and inclusion.

Finally, the transformation of education through AI integration demands a systemic approach encompassing all levels of the educational system. There is a pressing need to innovate and implement coherent educational policies that recognize the emerging roles of teachers, support the development of the requisite competencies, and create a stimulating environment for innovation. Only through the synergy of technological innovation, pedagogical wisdom, and ethical reflection can we realize the full potential of artificial intelligence in the ongoing transformation of education.

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