

# Empowering Teaching and Learning with Artificial Intelligence

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Teaching is the fundamental approach to realizing educational goals, integrating contents, methods, and tools in a systematic manner under the guidance of educational theories. It answers the three fundamental questions of “what to teach,” “how to teach,” and “what to use for teaching.” Teaching and learning unfold through a two-way interactive process between the instructor’s teaching and the student’s learning. This process not only transmits information but also encourages students to actively explore knowledge, and develop skills and competencies needed for adapting to the development of this era. The “New Generation Artificial Intelligence Development Plan” issued by the State Council of the People’s Republic of China (the State Council) explicitly proposes using intelligent technology to accelerate the reform of talent cultivation modes and teaching methods. This policy identifies artificial intelligence (AI) technology as a crucial strategic tool for advancing innovation in education and teaching, where technological innovation brings about the evolution of educational concepts and pedagogy.

The empowerment of teaching and learning with AI is a new trend in the development of the times. The society has entered a new era of intelligence as technology rapidly evolves, placing higher demands on the education sector and calling for comprehensive reforms in teaching concepts, technologies, and pedagogies. Introducing AI is not only a vital response to the challenges of the era but also a necessary approach to enhance educational quality and cultivate talents needed by future societies. The intelligent era has significantly altered the demands for workers’ knowledge, capabilities, and qualities. Simple memorization and mechanical skills no longer suffice; instead, proactive innovation, interdisciplinary collaboration, and human–machine cooperative thinking have become essential competencies. These new demands require us to re-evaluate traditional teaching models and consider how to cul-

tivate innovative talents more effectively in the future. AI offers new possibilities for achieving these goals, and exploring how to deeply integrate AI into the teaching process has become a key task in current educational reforms. Post-pandemic teaching practices have demonstrated AI’s great potential in updating innovative teaching models, such as blended learning and AI-supported human–machine collaborative teaching. These new models, leveraging AI technology, make learning more flexible and accessible. AI also supports immersive collaborative teaching practices, creating novel environments that support students in formal and informal learning beyond geographical and temporal boundaries, promoting efficient and equitable use of educational resources. AI not only fosters the innovation of teaching models but also transforms students’ learning methods, enhancing their motivation and creativity. With AI’s support, students can engage in personalized learning based on their interests and capabilities, while teachers can tailor learning tasks and plans to students’ habits, mastery levels, and styles, facilitating self-paced learning. AI’s empowerment shifts the teacher’s role from mere knowledge transmitters to learning partners and guides, assisting in tasks like grading, organizing information, and managing courses, thereby allowing teachers to focus more on interaction, guidance, and motivation. This transformation enhances learning outcomes and cultivates students’ initiative, creativity, and interdisciplinary collaboration skills, contributing to students’ holistic development.

The fundamental purpose of empowering teaching and learning with AI is to advance deep-seated educational reforms and establish a new paradigm that is interconnected, unifies theory and practice, and is flexible and adaptable. First, reimagining teaching design is crucial. Traditional teaching designs, often dominated by knowledge transmission, are slow to update contents and follow a preset, linear set of rules, significantly limiting the generativity and diversity of teaching. Driven by AI, teachers can update course content in real time, ensuring that students access the latest and most

practical knowledge. They can also break away from traditional teaching rules, making course organization more varied and flexible. For instance, through virtual reality technology, students can engage in immersive learning experience, completing their knowledge acquisition through vivid interactive processes. Second, gradually implementing personalized teaching is vital. Traditional “one-to-many” teaching models often overlook individual student differences. With AI and adaptive technologies, teachers can design more personalized, flexible, and appropriate learning paths and feedback mechanisms, enhancing students’ learning efficiency and fostering their autonomy and creativity. For example, intelligent tutoring systems can analyze students’ learning data to precisely identify their challenges and interests, offering tailored learning suggestions and resources. Third, comprehensively improving teaching quality is imperative. In the AI-reconstructed educational paradigm, teachers’ roles undergo profound changes. They are no longer just transmitters of knowledge but become organizers, guides, collaborators, and supervisors of learning activities, which requires higher levels of professional competences and skills. AI also offers more opportunities for teachers’ lifelong learning and professional development. For instance, teachers can analyze students’ learning data to understand their teaching effectiveness and shortcomings and adjust their strategies and methods accordingly. At this level, data and algorithms become core drivers of reform in education. Intelligent platforms can analyze and mine data from the entire teaching and learning process and all domains, generating customized teaching strategies based on teachers’ needs, making teaching more precise and efficient. Furthermore, highly intelligent learning process analyses provide precise teaching interventions and feedback, helping students discover and correct misunderstandings in a timely manner and offering data-based evidence to support teachers’ reflective practice and schools’ quality improvement.

AI brings unprecedented transformations to educational teaching, with its empowerment of teaching and learning reflected in three aspects.

First, *learning about AI*. As an interdisciplinary field, AI encompasses knowledge from computer science, psychology, mathematics, and more, emphasizing the integration and intersection of these disciplines. AI education is application-oriented and allows students to tackle “real problems” in practical activities, which fosters their creativity and exploration spirit. Introducing AI-related courses not only cultivates students’ computational thinking, allowing them to understand and apply algorithms and data structures for problem-solving, but also enhances their digital learning capabilities and complex problem-solving skills, better preparing them for the intelligent era. The intelligent era presents teachers with new opportunities as well as challenges.

Teachers must constantly improve their knowledge of AI technologies, master its basics, learn AI-related courses, and possess the ability to design AI-based teaching activities. Teachers must also utilize AI to improve their guiding capabilities, develop teaching resources, and apply educational data. In recent years, China has placed great importance on promoting teachers’ professional development with AI. In 2018, the Ministry of Education of the People’s Republic of China (MoE) initiated the pilot project for AI-assisted teacher-team construction, achieving significant results after three years of exploration. In 2021, the MoE launched the second batch of the AI-assisted teacher team construction pilot project, signaling a new phase in the application of AI in education. Additionally, leading universities like Peking University and Tsinghua University have established dozens of AI colleges and research institutes, setting up AI majors and promoting the construction of AI as a primary discipline, further enhancing the AI discipline system in Chinese universities.

Second, *teaching and learning by AI*. Empowered by AI technology and through extensive mining of data across the entire teaching and learning process, real-time monitoring of students’ implicit states and explicit behaviors, adaptive intelligent learning platforms can generate customized teaching strategies in a timely manner, creating creative, immersive, and appropriate classroom instruction. On the one hand, using AI, Big Data, cloud computing, and digital resource libraries, content is tagged and courses are automatically matched to students based on their completion status, achieving a two-way match between learners and learning resources to better meet learning needs. Subject knowledge graphs are established to automatically generate suitable questions and assignments for various students and perform automated grading, significantly reducing teachers’ workload and sparing more time for creative work. On the other hand, highly intelligent learning process analyses through data analysis and pattern recognition can accurately estimate students’ emotional states. This precise emotional recognition helps teachers better understand their students, leading to appropriate guidance, feedback, and teaching adjustment. It also provides precise teaching interventions and feedback, offering data support for students’ personalized development, teachers’ professional growth, and schools’ intrinsic development, reshaping personalized, precise, and scientific whole-process accompanying education evaluation and driving profound changes in classroom teaching and evaluation.

Third, *co-learning with AI*. This aspect emphasizes the importance of human-machine collaborative teaching. It involves working closely with intelligent teaching robots and other tools to seamlessly integrate physical space, resource space, and social space, thereby creating intelligent learning scenarios with multiple

participants. In these scenarios, teaching and learning break away from the traditional “one-to-many” teaching model, transitioning from the past “teacher–student” binary structure to a “teacher–machine–student” ternary structure. In human-machine “game” situations, co-teaching and mutual learning between humans and machines are realized. Specifically, every student receives personalized learning partners and assistant support, enjoying a learning experience with strong presence and interactivity. Each teacher can learn alongside AI, leveraging AI technology to enhance teaching effectiveness and provide students with more patient, accurate, and unique learning support services, achieving personalized education on a large scale. This increases students engagement and satisfaction and helps teachers deliver precise instruction based on actual needs, improving teaching quality and efficacy. The widespread application of large language models like Chat Generative Pre-trained Transformer (ChatGPT) will further innovate educational scenarios, offering more interactive teaching and learning experiences. Everyone can have a personal assistant and learning consultant, pushing the vision of “assistance for every teacher, companionship for every student,” aiding teachers in conducting precise teaching based on actual needs and bridging the “digital divide” in education. Overall, AI technology offers new pathways and possibilities for teaching and learning. Through practicing and exploring learning about AI, teaching and learning by AI, and co-learning with AI, a more intelligent, efficient, and personalized educational ecosystem can be built, cultivating more diverse and innovative talents.

The future has arrived, and facing the dual

challenges of improving overall educational quality and nurturing future talents, empowering teaching and learning with AI has become an essential path for educational reform and innovation. The report to the 20th National Congress of the Communist Party of China proposed “advancing the digitization of education” as a strategic direction, guiding the use of digital technology to promote high-quality educational development. Facing the opportunities of the intelligent era, we must recognize the challenges and issues, thoughtfully consider and balance efficiency and equity, speed and scale, and supply and demand. We cannot pursue efficiency at the expense of equity, nor can we chase speed while ignoring quality. While highly valuing the promotion of education through AI, we must also be wary of the “digital divide” that may arise from new technology applications. Promoting educational equity is a crucial goal of AI in education. We should fully utilize AI technology to optimize resource allocation, provide superior services, and powerfully and warmly extend quality resources to remote and impoverished areas, allowing technology to bridge gaps and narrow divides. Only by reforming and innovating, keeping pace with the times, focusing on equity, and enhancing quality can we achieve a comprehensive digital transformation of education.

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