

# Strategies for AI-Empowered Mathematics Teaching

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**Abstract:** Artificial Intelligence (AI) technology serves as a significant driving force in advancing the development of mathematics classroom instruction in primary schools. Against the backdrop of educational digitalization, AI is entering the field of basic education as a collaborative "partner," not only transforming the key elements of mathematics teaching but also reshaping the instructional models in primary school classrooms. This paper begins by examining how digitalization propels the high-quality development of current mathematics teaching practices at the primary level. It then analyzes the aspects of change and continuity in mathematics instruction facilitated by AI technology. Subsequently, the study reviews the current state of mathematics classroom teaching in primary schools. Finally, it proposes strategies for empowering mathematics instruction through AI, aiming to enhance the quality and efficiency of classroom teaching in primary school mathematics under AI enablement.

**Keywords:** Educational digitalization; Mathematics teaching practices; AI technology

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## 1. Introduction

In February 2023, at the basic education sub-forum of the World Digital Education Conference, the theme was titled "Deepening the Implementation of Strategic Actions for Educational Digitalization to Empower High-Quality Development of Basic Education with Digital Technologies." The forum collectively explored ways to transform the static potential of digital resources into a powerful driving force for the reform and high-quality development of basic education, emphasizing the need to leverage digitalization to enable high-quality advancement in basic education<sup>[1]</sup>. As Artificial Intelligence (AI) technology serves as a major driver of the new round of technological revolution and industrial transformation, educational digitalization can only promote innovation and development in education by actively adapting to and engaging with these changes.

## 2. Materials and method

In 2022, China fully implemented the national strategy for educational digitalization, advancing the "3C" principle—Connection, Content, and Cooperation—to unleash the amplifying, superimposing, multiplying, and sustained spillover effects of digital technology on high-quality educational development. Digital education has bolstered basic education, turning high-quality resources into tangible outcomes and magnifying the value of education<sup>[2]</sup>.

In February 2024, the Ministry of Education announced a list of 184 "Artificial Intelligence Education Bases for Primary and Secondary Schools." These pilot bases aim to explore new concepts, models, and solutions for AI-based education, generating replicable exemplary cases and advanced experiences to deepen the integration of artificial intelligence in elementary and secondary schooling. Since the 21st century, information technologies such as the internet, big data, and cloud computing have undergone continuous innovation and developed at an unprecedented pace. Governments around the world have introduced relevant policies to align with these trends and promote digital transformation in education.

However, AI-generated content also poses challenges and limitations. The goals of AI development—safety, reliability, trustworthiness, and usability—are also paramount considerations for its integration into education. Due to technical constraints, AI may fail to accurately capture the author's intent or cultural context, resulting in generated content that is rigid, inaccurate, or difficult to distinguish between truth and falsehood. Moreover, the rise of AI may lead to increased exposure of students' personal privacy and the marginalization of teachers' educational roles. Therefore, it is essential to adhere to the student-centered educational philosophy, strengthen the awareness of "AI for Good," and foster a supportive teaching and learning environment for the development of artificial intelligence<sup>[3-4]</sup>.

Currently, research on the application of AI technology in primary school mathematics classroom instruction remains relatively underdeveloped. Major challenges include the lack of flexibility in teaching models, insufficient digital literacy among teachers, and a shortage of AI-trained educational professionals, all of which hinder the effective integration of AI into mathematics teaching.

With each advancement in educational technology, teachers are required—willingly or not—to adapt to these changes. The rapid evolution of digital intelligence technologies poses particular challenges. The increasing integration of AI in education means that smart teaching tools now possess certain human-like cognitive capabilities, placing additional pressure on educators. First, most primary school mathematics teachers have not received systematic training in AI, making it difficult for them to intuitively and effectively incorporate AI into instructional practices. Second, some teachers lack proficiency in applying information technologies, including limited mastery of basic tools, an inability to record or edit lessons, and difficulties in interacting on online teaching platforms—all of which undermine instructional fluency. Third, many teachers struggle to effectively identify and utilize digital resources from the vast amount of material available online, hindering their capacity to enrich teaching with appropriate multimedia content.

There is a critical scarcity of professionals specializing in AI education who are willing to teach in primary schools. According to incomplete statistics, by the end of 2023, around 500 higher education institutions in China offered programs in artificial intelligence, yet very few provided teacher preparation programs specializing in AI education. Moreover, AI is a complex and interdisciplinary field that integrates knowledge and methodologies from multiple domains. Graduates in this area are highly sought-after talents, most of whom tend to concentrate in developed regions and are generally reluctant to pursue teaching careers in primary schools within third- or fourth-tier cities. This imbalance further restricts the promotion and implementation of AI education.

Explore modern teaching approaches based on AI technology to achieve personalized, precise, interactive, and dynamic instructional goals. On one hand, student-centered teaching should be promoted by integrating diverse and individualized methods that encourage independent inquiry and active thinking, thereby creating a vibrant classroom atmosphere. With the rapid development of information technology, virtual reality offers new possibilities for primary science education. Using AI, teachers can design authentic communication scenarios, role-playing activities, and animated videos to situate learning in practical contexts and help students grasp knowledge effectively. AI can also be used to connect related knowledge points, enabling interdisciplinary instructional design. For example, when teaching the perimeter of polygons, an AI visualization module can be incorporated. Through graphical programming and intelligent manipulation of framework teaching tools—such as disassembly, recombination, and transformation—students can actively discover the relationship between side length and perimeter, thereby deepening their conceptual understanding.

On the other hand, teaching should extend beyond traditional spatial and temporal constraints. Mathematics instruction can evolve from static to dynamic, from physical to virtual, and from museums, science centers, and research bases into digital cyberspace. By breaking away from rigid class schedules, teaching duration can be adjusted flexibly according to content, allowing sufficient time for students to explore and investigate problems. This approach supports diverse developmental needs and promotes broader and deeper transformation in primary mathematics learning.

Improving teachers' digital literacy and AI-integrated teaching capabilities is essential. External factors function through internal agency; only by continuously updating teachers' educational philosophies and actively engaging them in digital teaching reform can the shortage of AI-specialized educators be fundamentally addressed. First, primary school mathematics teachers should be empowered through rights to learn AI technology and recognition of their self-development capabilities, granting them greater flexibility and initiative in applying AI. Second, high-level teaching-research activities on AI technology should be organized for early- and mid-career backbone teachers, cultivating curriculum leaders. Meanwhile, regional teacher-led learning communities in AI technology education should be established in collaboration with normal universities, research institutions, and AI enterprises to develop teaching and learning resources for AI education in primary schools. Third, AI-related content should be incorporated into pre-service training and professional development programs, with enhanced digital skills training to ensure teachers can flexibly integrate AI elements into mathematics teaching.

By 2024, many higher education institutions domestically and internationally have incorporated AI technology into classroom teaching, reshaping talent development models to align with contemporary needs. East China Normal University implemented a campus-wide "Digital Intelligence Leap" plan to help students master AI tools and develop critical thinking skills; Shanghai Normal University introduced general AI and education courses for teacher trainees, simultaneously instructing both students and in-service teachers. This parallel training model aims to help subject pedagogy instructors integrate their teaching knowledge with AI proactively.

At the same time, to better serve the essence of teacher education and cultivate educational talents that meet the demands of the new era, the connection between AI and education must be further explored through teaching practice. The higher education and research sector should also intensify the depth and breadth of research on AI-related technologies and expand educational applications of AI. In the future, AI will become a tool for the development of teacher education. While embracing the convenience brought by technology, the core values of teacher education must be upheld. Teacher trainees should keep pace with the times, prepare proactively, learn AI knowledge, improve AI-related skills, and enhance their social competitiveness to meet future challenges.

### 3. Conclusions

The AI era has placed higher, more far-reaching, deeper, and broader demands on mathematics classroom teaching in primary schools. The integration of AI technology enhances the perception, collection, analysis, and monitoring of dynamic data in elementary mathematics instruction. It also enables multidimensional teaching approaches within the classroom, providing important support for achieving the goal of fostering virtue through education. Furthermore, AI contributes to the accelerated realization of quality and efficiency improvements in primary school mathematics teaching.

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