

Changes in Elementary Mathematics Education in the Era of Artificial Intelligence: Current Situations, Challenges, and Coping Strategies for Teachers

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Abstract: Against the backdrop of the rapid development of artificial intelligence technology, primary school mathematics education is undergoing profound structural changes. Based on the technology empowerment logic of artificial intelligence in the educational field, this paper systematically analyzes the main changes in primary school mathematics education in three aspects: teaching resources, classroom models and evaluation systems: first, the transformation of teaching resources from traditional paper to intelligent and diversified; second, the evolution of classroom teaching from “teacher-centered” to “student-centered” personalized interactive mode; third, the expansion of the evaluation system from terminal result evaluation to process-based, data-based, and multi-dimensional evaluation. In response to the current difficulties faced by teachers in adapting to the integration of technical literacy, teaching concepts and practices, this article proposes coping strategies such as improving information technology capabilities, building a personalized teaching system, establishing a scientific and reasonable multi-evaluation mechanism, and strengthening the combination of theory and practice, emphasizing the important support of inter-school cooperation and educational ecological synergy for the sustainable advancement of reform. This article aims to provide theoretical support and practical inspiration for the transformation of primary school mathematics education in the context of the artificial intelligence era, and to help improve education quality and modernize basic education.

Keywords: Artificial intelligence; Primary school mathematics; Teaching reform; Personalized teaching

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1. Introduction

With the continuous advancement of global technology, artificial intelligence is profoundly reshaping the structures of various sectors in society. In recent years, the digitalization and intelligent transformation of education have become increasingly prominent, particularly in basic education ^[1]. Elementary mathematics, as

a crucial subject for cultivating students' logical thinking, spatial imagination, and problem-solving skills, is undergoing profound transformations in both teaching methods and content. Traditional teaching models have long relied on teacher-led board lectures and mechanical memorization by students, approaches that not only fail to stimulate learning interest but also fall short in meeting the individualized development needs of students at different levels ^[2].

Against this backdrop, the integration of artificial intelligence has injected fresh vitality into elementary mathematics education. By leveraging big data, machine learning, and virtual reality technologies, teachers can gain a more precise understanding of each student's learning condition and design instructional plans aligned with cognitive development patterns ^[3]. At the same time, the widespread application of smart devices, online education platforms, and interactive software has built convenient communication bridges between teachers and students, transforming the classroom from a rigid, traditional environment into a dynamic, interactive, and open space ^[4]. Additionally, AI plays an increasingly significant role in teaching evaluation, resource integration, and extracurricular tutoring, facilitating the comprehensive optimization and innovation of elementary mathematics education.

However, the rapid development of technology also poses challenges to the traditional education system and teachers' pedagogical methods. Teachers not only need to adapt to operating new technologies but must also shift their teaching philosophies. How to ensure the quality of knowledge transmission while simultaneously igniting students' learning interest and creative thinking has become an urgent problem requiring resolution ^[5]. Moreover, data-driven assessment methods and interactive classroom models introduced by intelligent technologies demand corresponding adjustments and investments in hardware, teacher training, and school management in order to truly achieve educational modernization.

2. Major changes in teaching

2.1. Digitalization and intelligent transformation of teaching resources

Artificial intelligence has driven a shift from traditional paper-based teaching materials to diversified, intelligent digital resources ^[6]. Powered by big data and cloud computing, personalized learning platforms can track students' learning trajectories, cognitive levels, and interests, recommending exercises, instructional videos, and interactive content tailored to their needs. This "teaching according to aptitude" approach not only addresses the shortcomings of traditional uniform teaching methods but also provides strong support for students' autonomous learning. In addition, the application of virtual reality (VR) and augmented reality (AR) technologies enables the visualization of abstract and difficult mathematical concepts. Through immersive experiences, students can grasp spatial structures and geometric relationships, significantly enhancing their understanding and memory of mathematical knowledge.

Moreover, the emergence of various online education platforms and micro-course videos has allowed teaching resources to transcend time and space barriers. Teachers can access the latest instructional cases and experimental data via online platforms, continuously updating and enriching their teaching content. The integration of information technology and artificial intelligence has created a vast, dynamic resource repository that not only meets the needs of basic knowledge instruction but also provides ample material for extracurricular exploration and interest development. As a result, the intelligent construction of teaching resources has become a key driving force behind current reforms in elementary mathematics education.

2.2. Transformation and upgrading of classroom models

The application of AI has led to a fundamental transformation in classroom instructional models. The traditional “lecture-note-taking-exercise” approach is gradually being replaced by interactive, cooperative, student-centered classroom models ^[7]. Smart devices and real-time data monitoring allow teachers to track students’ learning conditions in real time, detect individual differences, and adjust teaching content and pace accordingly. In-class use of voting systems, real-time quizzes, and instant feedback enables teachers to promptly understand student comprehension levels and guide class-wide discussions through targeted questioning, fostering deeper engagement.

Furthermore, flipped classrooms and project-based learning are becoming increasingly popular in elementary mathematics teaching. In a flipped classroom, students study fundamental knowledge through online platforms before class, while classroom time is dedicated to solving complex problems, group discussions, and project-based activities. This approach not only enhances classroom efficiency but also cultivates students’ independent learning ability and collaborative spirit. Project-based learning, by placing students in real-world problem scenarios, guides them to apply mathematical knowledge practically, fostering integrated and innovative thinking. These new teaching models effectively break the temporal and spatial limitations of traditional education, making mathematics classes more dynamic, flexible, and engaging.

2.3. Diversification and process orientation of assessment systems

Traditional assessment systems have primarily relied on final exam scores and assignment grades, making it difficult to comprehensively reflect students’ learning processes and overall capabilities. Today, driven by artificial intelligence, evaluation methods are evolving toward multi-dimensional, process-oriented, and dynamic systems. Using data collected from smart platforms, teachers can comprehensively assess students’ classroom participation, interactive performance, homework completion, online discussions, and group cooperation. Data-driven assessments allow teachers to identify students’ weaknesses in knowledge acquisition, logical thinking, and creativity promptly while providing scientific and quantifiable instructional feedback.

Additionally, dynamic evaluation systems incorporate self-assessment and peer-assessment components, encouraging students to engage actively in the evaluation process and cultivate self-reflection and self-improvement skills ^[8]. Personalized feedback reports help students clearly recognize their progress and shortcomings, enabling targeted adjustments in learning strategies. Such process-oriented assessment transforms evaluation from a mere terminal examination into a continuous driver of student learning motivation and growth. Overall, diversified assessment systems have injected new energy into elementary mathematics teaching, promoting comprehensive reforms in instructional methods and learning models.

In summary, elementary mathematics teaching in the era of artificial intelligence is undergoing profound changes in resource integration, classroom organization, and assessment methodologies. These transformations provide immense opportunities for educational innovation while presenting new challenges and expectations for traditional teaching models and the professional competencies of teachers. With ongoing technological advancements and deeper applications, this transformative trend is expected to accelerate, steering elementary mathematics education toward a future of greater intelligence, personalization, and efficiency.

3. Coping strategies for teachers

3.1. Enhancing proficiency in information technology and intelligent applications

In the face of rapid advancements in AI technology, teachers must proactively enhance their technological

literacy, mastering the principles and applications of big data, cloud computing, machine learning, and virtual reality in educational contexts ^[9]. Teachers can achieve this by participating in professional development programs, online courses, and academic seminars to continuously update their knowledge structures and improve their sensitivity to technological innovation. Only with a high level of digital literacy can teachers effectively incorporate smart tools into lesson design, optimize resource integration, and formulate targeted, differentiated instructional plans based on students' individual needs.

Educational institutions and administrative bodies should also establish robust training systems and practical platforms, offering teachers opportunities for hands-on engagement with new technologies. Through internal workshops, external collaborations, and expert consultations, teachers can share successful practices and collectively address challenges encountered in applying intelligent technologies in mathematics teaching. Furthermore, participation in educational technology research projects allows teachers to combine theory with practice, accumulating real-world cases and empirical data to support future reforms.

3.2. Building a student-centered personalized teaching system

In the context of continuous technological development, the traditional teacher-centered model no longer meets students' increasingly diverse and individualized learning needs ^[10]. Teachers should make full use of intelligent platforms and big data analysis to monitor each student's learning progress, interests, and cognitive levels in real time, thereby developing differentiated teaching plans tailored to individual characteristics. By implementing stratified teaching, group collaboration, and individualized tutoring, teachers can ensure that each student receives adequate attention and develops at their own pace.

Furthermore, teachers should encourage students to utilize online resources, mathematical games, and virtual laboratories to foster autonomous exploration and inquiry-based learning. The application of the flipped classroom model serves as a key approach to achieving personalized teaching. By engaging in pre-class online learning, students can acquire basic knowledge in advance, allowing classroom time to focus on discussion, application, and problem-solving, thus promoting the internalization of knowledge and the simultaneous development of practical skills.

In addition, teachers should guide students in self-assessment and peer assessment, helping them cultivate reflection and self-regulation skills. Personalized feedback and regular progress tracking reports allow students to identify their strengths and weaknesses, enabling targeted improvements in learning strategies ^[11]. A data-driven, student-centered teaching system not only increases classroom efficiency but also stimulates students' intrinsic motivation, creativity, and innovative thinking, fostering well-rounded development in both academic and personal competencies.

3.3. Establishing a scientific and comprehensive multi-dimensional evaluation system

The reform of evaluation systems is a cornerstone in achieving educational transformation ^[12]. Teachers must move beyond single-score assessments based solely on final exams and instead build multi-dimensional, dynamic, and process-oriented evaluation mechanisms with the support of AI technologies. Through smart platforms, teachers can collect and analyze data from various learning behaviors, including classroom participation, homework performance, online interactions, and group collaboration, offering a more holistic assessment of students' knowledge mastery, logical thinking, practical ability, and cooperative skills.

Moreover, integrating formative assessment, process evaluation, and summative assessment enhances students' intrinsic learning motivation ^[13]. Continuous feedback, personalized learning reports, and peer

assessments allow students to track their growth trajectories, adjust learning strategies in a timely manner, and foster a sense of achievement. In designing evaluation criteria, teachers should consider not only academic knowledge but also skills, emotional development, and values, thereby creating a system that encourages holistic student development.

3.4. Strengthening the integration of theory and practice and promoting inter-school and multi-stakeholder collaboration

In the face of new technological challenges, teachers should emphasize the integration of theoretical learning and practical exploration. Teachers are encouraged to document their experiences in applying intelligent technologies in mathematics classrooms through case studies and research papers, contributing to professional growth and pedagogical innovation. Schools should enhance horizontal collaboration by organizing demonstration lessons, academic seminars, and educational technology projects, creating cross-school and cross-regional exchange platforms to jointly discuss cutting-edge applications and emerging challenges in intelligent education ^[14].

At the same time, teachers should actively engage with parents, community organizations, and research institutions to establish collaborative ecosystems. Home-school collaboration, school-enterprise partnerships, and community resource sharing can provide students with broader learning opportunities and real-world application experiences.

In conclusion, the era of artificial intelligence presents both unprecedented opportunities and formidable challenges for elementary mathematics education. Teachers must continuously update their teaching philosophies, enhance their professional competencies, and actively construct personalized, student-centered instructional frameworks supported by intelligent technologies. By establishing multi-dimensional, data-driven evaluation systems and fostering strong connections between theory and practice, teachers can harness the advantages of AI to promote profound instructional transformation ^[15].

Furthermore, through active collaboration across schools, communities, and industries, a supportive educational ecosystem can be formed, facilitating the integration of cutting-edge technologies into classroom teaching. Ultimately, only by fully leveraging the potential of AI can elementary mathematics education achieve higher levels of teaching quality, educational equity, and personalized development. This endeavor not only addresses current pedagogical challenges but also lays a solid foundation for the modernization of basic education, paving the way for an intelligent, efficient, and innovative future in elementary mathematics teaching.

4. Conclusion

Elementary mathematics education is currently at the forefront of digital and intelligent transformation. The integration of artificial intelligence has not only enriched teaching resources and diversified classroom models but also driven the reform of assessment systems. These changes collectively highlight a paradigm shift from teacher-centered to student-centered education, from uniform instruction to personalized learning, and from terminal evaluation to process-oriented assessment. Such transformations provide unprecedented opportunities for improving teaching quality, stimulating students' curiosity, and cultivating their logical reasoning and problem-solving abilities.

Nevertheless, the transition toward intelligent education also raises critical challenges. Teachers are required to adapt rapidly to technological innovations, reconstruct their pedagogical philosophies, and maintain a delicate balance between knowledge transmission and competence cultivation. At the same time, ensuring educational

equity, preventing excessive dependence on technology, and addressing infrastructure gaps remain pressing concerns.

To fully harness the potential of AI, it is essential to strengthen teachers' digital literacy, build personalized instructional systems, and construct multi-dimensional evaluation frameworks supported by intelligent technologies. Equally important is fostering collaboration across schools, families, and communities, thereby creating an inclusive and sustainable educational ecosystem. Looking forward, the modernization of elementary mathematics education will depend not only on the advancement of technology itself but also on the integration of humanistic values, professional expertise, and institutional support.

In short, artificial intelligence should be regarded as both a tool and a catalyst for educational reform. When combined with thoughtful pedagogy and collaborative governance, it has the potential to significantly elevate the quality and equity of elementary mathematics education, laying a solid foundation for the cultivation of innovative talents in the era of intelligence.

Disclosure statement

The author declares no conflict of interest.

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