Proceeding of ICSPHS 2026 Symposium: Critical Perspectives on Global Education and Psychological Development
DOI: 10.54254/2753-7048/2026.HT31088

Status Quo and Countermeasures of Personalized Mathematics Learning in the AI Era

Qianhui Ma

Normal School, Hubei University, Wuhan, China
1561993956@qq.com

Abstract. With the development of AI, intelligent teaching in China is playing an increasingly important role. However, the importance of personalized mathematics learning is widely acknowledged intelligence era, but traditional mathematics teaching can hardly cater to the differences in students' individual needs, which leads to a series of problems, such as the decline of students' interest in learning and the unbalanced development of students' abilities. This article aims to study the status quo, problems, and difficulties of implementing personalized mathematics learning in the AI era. This study proposes corresponding solutions to each problem. It is expected that these solutions can promote the development of personalized mathematics learning in the AI era and facilitate sustainable and sound development of the human-machine collaborative education paradigm, thereby creating a more inclusive and efficient educational ecosystem that balances technological innovation with student-centered pedagogy.

Keywords: AI, personalized learning, intelligent teaching

1. Introduction

Intelligent teaching has become one of the hotspots in academia over the past few decades. In the era we now inhabit, discussions about education cannot avoid mentioning artificial intelligence, which exerts a comprehensive influence across all domains, including educational objectives, content, teaching methods, and assessment systems [1]. With the rapid development of AI, more and more studies have begun to focus on the issue of personalized mathematics learning in the field of intelligent teaching. Despite some important achievements, the field of intelligent teaching still faces challenges such as algorithmic deviation, data silos, and a lack of emotional interaction.

The integration of AI in education marks a significant shift in teaching in modern times, especially in areas such as science, technology, engineering, and mathematics [2]. This paper is supposed to make an in-depth analysis of the status quo and trends of personalized mathematics learning in the AI era. It takes this as a starting point to explore challenges and related reasons in mathematical knowledge representation and contradictions in teaching adaptability from multiple perspectives. In this way, it can put forward targeted and feasible suggestions and countermeasures and thus promote optimization of teaching models. These suggestions and countermeasures will not only solve the urgent problems faced by the current education sector, but they will also be used to make long-term plans for the future development of the industry with a view to injecting new

DOI: 10.54254/2753-7048/2026.HT31088

impetus into education and promoting it to develop more stably and efficiently in the context of the new era. By conducting in-depth research on personalized mathematics learning in the intelligence era, new perspectives and solutions will be given to further promote the development of personalized mathematics learning and contribute to the development of the education industry.

2. Overview of the AI era and mathematics education

2.1. The intelligence era and intelligent teaching

New progress represented by the core technologies of AI, big data, and AI algorithms characterizes the AI era. Data-driven approaches, adaptive decision-making, and human-machine collaboration specifically include the technical dimension and the social dimension. AI refers to the replication of human cognitive functions in machines and enables machines to conduct tasks ranging from learning and reasoning to problem-solving and comprehension of languages. Artificial Intelligence in Higher Education: AI in higher education automates the literature review for students and researchers, assists in the analysis of large sums of data, grammatical and linguistic checking, enhances predictive research modeling, and finds the latest research topics through data analysis of vast amounts of data [3]. From a technical point of view, the AI era is underpinned by technologies of AI, big data analytics, and cloud computing that raise operational efficiency through enhanced capabilities for data analysis. From the social perspective, the traditional production model wherein the ability of human beings was the dominant force in production was transformed into a new mode characterized by collaborative work between humans and machines.

Intelligent teaching refers to the in-depth integration of modern information technology into education. It provides personalized and comprehensive learning methods, constructs a more intelligent teaching system, realizes a more efficient teaching model, and embodies the paradigm shift from "unified teaching" to "precise intervention". Intelligent teaching relies on the support of key technologies, such as learning analysis, knowledge graph, AI algorithms, and multimodal interaction technologies.

2.2. Mathematics education in the AI era

Mathematics is a discipline concerning concepts such as quantity, space, and structure, with a rigorous hierarchical structure of knowledge. It has many branches, including mathematical analysis, algebra, ordinary differential equations, and geometry. To master mathematics well, one must first cultivate mathematical thinking, acquire the abilities of logical reasoning and abstract modeling, and specialize in general things.

The rapid advancement of artificial intelligence technology is profoundly deconstructing and reconstructing the paradigm of mathematical practice. Algorithmic decision-making permeates the optimization of complex mathematical systems, automated proof tools are revolutionizing traditional discovery pathways, and big data modeling increasingly positions mathematics at the forefront of solving high-dimensional, real-time practical problems [4]. In the current society, many students face the problem that they can't learn mathematics well. Intelligent technologies have alleviated these issues in mathematics education to a certain extent. In the AI era, intelligent technologies can dynamically diagnose students' cognitive blind spots and conduct individual-specific analyses, transforming the one-size-fits-all mathematics education. At the same time, intelligent technologies also provide students with personalized mathematical resources AI, so that students can quickly and accurately obtain the mathematical resources they need.

DOI: 10.54254/2753-7048/2026.HT31088

3. Status quo and issues of personalized learning in mathematics in the intelligence era

3.1. Status quo of development

AI is put into application in higher education in many ways, relying on a series of technologies to elevate education and academic affairs, including intelligent tutoring systems and virtual simulation tools. Intelligent tutoring systems use AI to provide students with personalized teaching and feedback. For instance, Knewton and Onion Math can change course content based on the learning speed of students to present a personalized learning feeling. Students are helped by AI-based chatbots and virtual assistants that answer questions regarding courses, administrative procedures, and general campus facilities [5]. Virtual simulation tools like Geometer's Sketchpad AI Edition and 3D Function Visualization allow students to participate in the improvement of practical skills. According to the statistics from the Educational Information Technology Association in 2024, AI chatbots have cut down the response time for student inquiries by as much as 60%, which has greatly enhanced student satisfaction and independent learning.

Before the AI era, the teachers had to make subjective judgments on whether students encountered problems in learning. However, in the big data context, data can be used as a reference for teachers. For example, it shows how frequently students read certain chapters. Therefore, it would allow teachers to know at what pace they should conduct teaching based on the difficulties that students face while learning, making guidance more targeted and effective. Meanwhile, AI and large language model technologies facilitate the practical teaching process. In the past, teachers usually prepared detailed teaching content based on textbooks. Nowadays, by analyzing students' major-related data through AI, teachers can lead students to learn relevant skills more efficiently in an intuitively understandable way. Moreover, through big data analysis, teachers will be more precise in identifying materials that help raise teaching efficiency and exclude content that does not meet social needs [6].

3.2. Existing issues

Algorithmic bias poses significant risks to fairness in the intelligence era. It leads to unjust practices. In recent years, researchers have been focusing on existing cases of algorithmic bias in educational technology and the potential increase in bias and its harmful effects resulting from the adoption of AI and machine learning [7], for example, outcomes for certain groups in decision-making due to design flaws, biased data, or implementation context. Algorithms are often used to assess student abilities and predict potential. With bias, it can hamper some students' development opportunities. Furthermore, algorithmic bias causes excessive reliance on "quantitative indicators," ignoring individual differences and the complexity of student growth, thereby distorting educational goals.

Besides issues caused by algorithmic bias, educational practice also reveals many issues, due to the special nature of the subject, the complexity of the teaching process, and the diversity of students. The first challenge is the representation of mathematical knowledge, which needs to be expressed in multiple forms, such as symbols, graphics, and text. Different students have significantly different levels of acceptance of different forms. However, intelligent systems sometimes find it difficult to achieve flexible conversion and personalized adaptation. For example, if a student makes a mistake due to a "symbolic calculation error" rather than a "conceptual understanding error," and the system cannot distinguish between the two, it will incorrectly push conceptual explanations, resulting in ineffective feedback.

DOI: 10.54254/2753-7048/2026.HT31088

Another challenge is timely teaching adaptability. Intelligent systems dynamically adjust teaching strategies in line with the real-time learning status of students, while the particularity of mathematics teaching determines the difficulty in precise adaptation. For example, thinking is the core of mathematics education, but intelligent systems concentrate on the correctness of results and fail to provide targeted feedback concerning the development process of thinking.

It cannot sense the emotions of others, let alone understand the undistinguished trace of emotions in the situation [8]. In the face of constant setbacks and self-doubt, AI systems cannot recognize the negative emotions of students by observing their facial expressions and tone. They also cannot offer timely, sincere encouragement and comfort, like human teachers, and thus cannot help students regain their confidence. In addition, during collaborative learning, emotional interactions between students- things like competition and mutual aid-significantly impact the learning atmosphere and the effect of collaborative efforts. However, AI systems cannot perceive these emotional factors, and neither can it coordinate such elements effectively. It is hard to achieve emotional resonance by interacting with AI. Students also cannot fully adapt to this emotionless learning model, which hinders the improvement of learning outcomes.

4. Optimization strategies and recommendations

4.1. Transformation of mathematics education

The technical foundation of AI in education has evolved significantly through the integration of sophisticated machine-learning approaches [9]. It has been driving a transformation in education models, breaking the limitations of traditional classroom teaching. By analyzing multi-dimensional learning data such as student assignment completion and test scores, AI can accurately identify each student's learning style and customize a decently personalized learning path. However, to fully unlock the potential of personalized learning, targeted optimization strategies must be implemented to address key issues, with clear responsibilities for technical developers, schools, and teachers.

To ensure fairness and accuracy in personalized learning paths, technology developers should create explainable AI models for educational platforms that show the logic behind personalized recommendations, with teachers having the ability to adjust parameters to correct biases. On top of this, they should conduct quarterly audits for bias. By comparing recommended paths across students of different genders, academic backgrounds, and learning speeds, they can weed out biases driven by data. Simultaneously, schools should expand data collection beyond test scores to include classroom engagement, project-based outcomes, and student feedback on AI tools. Such a comprehensive dataset would let AI-driven personalized pathways actually reflect each student's actual strengths and areas of need.

In integrating mathematical knowledge in personalized learning, developers of technology need to create adaptive knowledge presentation systems that could switch between formats for specific mathematical content, using AI-identified student learning preferences: complex formulas paired with dynamic diagrams for visual learners, and abstract concepts embedded in real-life contexts with step-by-step textual explanations for verbal learners. In addition, they should provide features relating current topics to previously learned content in order to support continuity in personalized learning.

Timeliness is critical in personalized learning, and technology developers should design AI tools with real-time data feedback loops. For instance, when students solve math problems online, AI needs to analyze errors in real time and immediately adjust the next set of exercises. If a student makes three mistakes consecutively, AI can stop and suggest a 5-minute micro-lesson for

DOI: 10.54254/2753-7048/2026.HT31088

explanation before continuing practice. Developers must allow for teacher alerts: if AI detects that a student suddenly began struggling, it can alert the teacher in time for her to prevent widening gaps in learning. Teachers tap into these insights in real time to inform personalized interventions. Instructors can use AI reports to schedule one-on-one check-ins with students who need additional targeted support, rather than adopting a review approach meant for all students. This way, instructional adjustments can match individualized needs.

Emotional states directly affect personalized learning outcomes, and thus, developers of technologies should integrate emotion recognition technologies into AI platforms. From indirect cues or interaction frequencies, AI adjusts the learning content and pace and, therefore, the learning experiences. They should also develop an emotion feature that will be taken by a student to self-assess one's emotional state. From this, AI can compose what emotions are caused by particular subjects and use these data to optimize suggestions. Teachers can utilise AI sentiment analysis to develop better personalised interactions. For instance, if AI sends a message that a student is experiencing anxiety and feeling overwhelmed about concepts of geometry, educators can start informal conversations with them to identify the root cause and may adjust their manner of making materials more understandable. An emotional congruence makes students' learning pathways not only academically suitable but emotionally viable as well. Transformation of teachers from knowledge providers towards being facilitators of personalized learning could be further moulded by these optimized AI tools. AI-enabled adaptive platforms or intelligent course management systems have greatly enhanced students' engagement by personalizing both content and support for the needs of every individual student [10]. Today, teachers engage more in designing 'inspirational problem scenarios' aligned with the interests identified by AI in students, thereby provoking self-learning capabilities.

The evolving role of AI in enhancing collaboration, critical thinking, and interactive learning experiences will also be increasingly significant [11]. Guided by such optimization strategies, students are able to better take initiative for the adaptation of learning roles; through the use of AIs recommendation of personalized resources, together with reflection upon teachers' feedback, they can refine their learning pathways through practice and truly become their own leaders within education.

4.2. Implementation path

First, in the context of rapid social development and the continuous advancement of technology, school education can no longer be confined to educational activities conducted solely within the school setting. It must be in step with changes in society. Some schools are already implementing curriculum reform based on the new learning guidelines. They changed the logical starting point and emphasis of the generative AI course design from knowledge-oriented teaching to a student-centered approach that puts problem-solving awareness and capability enhancement in focus to practice "personalized learning" and "collaborative learning [12]." These schools firstly conducted in-depth studies in the new learning guidelines and organize teacher training for accurate understanding of the core requirements of the guidelines. The emphasis is on student agency, integration of interdisciplinary knowledge, and a link with social practice. In terms of the specific implementation of generative AI course reform, a transition from knowledge-oriented teaching logic to student-oriented approaches was manifested in a number of dimensions. In terms of teaching content, teachers shift from the simple teaching of basic principles and operation steps of generative AI to scenario-based learning task design in order to cultivate the problem-solving awareness of students in real life. In terms of teaching methods, "personalized learning" is implemented through intelligent

DOI: 10.54254/2753-7048/2026.HT31088

teaching platforms analyzing students' learning progress, mastery of knowledge, and interest preferences, and then pushing targeted learning resources and practice tasks. While "collaborative learning" is implemented in group projectbased learning, with students divided into groups to accomplish complex projects in AI applications in order to improve their abilities in collaborative communication and team cooperation.

Second, perfecting the teacher training system is very important to improve the teaching quality in order to respond to the emerging demands of education. Traditional models often lack practicality and fail to keep pace with industry and technological advancement, which creates a divide between teachers' skills and students' needs. To bridge this chasm, targeted programs-such as mandatory industry immersion or certification in AI pedagogy-would enhance instructional quality [13]. The addition of compulsory industry immersion into teacher training is required. Educators take part in working together with professionals from their respective fields to gain firsthand industry knowledge. In such a manner, educators are able to bring practical case studies and insights into their classrooms, which makes the curriculum relevant and interesting. Due to the impact brought about by AI in education, certification in AI pedagogy is highly recommended. Most educators cannot fully apply AI tools; thus, personalized instruction and efficiency improvements cannot be fully realized. Certification must cover basic operation of the tools and certain advanced features, such as use of data analytics in finding learning gaps. Through certification, teachers will transform into digital education facilitators and can better meet the demands of smart education.

Finally, it is clear that data silos, legacy systems, and resistance to change continue to cause bottlenecks in progress [14]. In light of these bottlenecks, stakeholders involved in mathematics education should put higher priority on the construction of technological platforms and resource ecosystem development. For example, educational institutions and technology partners could work together in the co-design of multi-module AI for mathematics education with, for example, modules on personalized problem generation, real-time learning analytics, or even interactive tutoring. Professional technical teams should be assigned to the daily maintenance of the platform, immediate patching of any security vulnerabilities, and periodic upgrading, which is needed to adapt to the evolution of instructional needs, such as to support new curriculum standards or to introduce advanced data visualization tools. In addition to developing these platforms, engaging in teaching resources co-design with mathematics educators, curriculum developers, and industry experts is also crucial. Resources could include video lectures, interactive simulations, practice question banks, among others. Next, introduce structured review and incentive mechanisms so that these resources are always relevant and highly qualified. For instance, seasoned educators can review accuracy and applicability quarterly, and those contributors whose materials receive high ratings or are highly used are rewarded with professional development opportunities or nominal grants. The more this is done, the greater the encouragement toward the updating of the repository of resources.

5. Conclusions

In the AI era, personalized learning in mathematics is reshaping the mathematics education ecosystem, and personalized learning has become an inevitable trend. In the future, we should further deepen the integration of AI technologies into mathematics teaching, leverage AI to more accurately analyze students' learning characteristics, and dynamically adjust personalized learning paths. Meanwhile, we should strengthen and ensure that every student can access high-quality, tailored mathematics educational resources. As intelligent technologies continue to evolve, personalized mathematics learning is poised to break through spatial and temporal constraints,

DOI: 10.54254/2753-7048/2026.HT31088

delivering more flexible and precise educational services and truly enabling every student to fully develop their potential in mathematics learning.

References

[1] Paek, S. and Kim, N. (2021) Analysis of worldwide research trends on the impact of artificial intelligence in education. Sustainability, 13(14), 7941.
[2] Kotsis, K.T. (2025) From Potential to Practice: Rethinking STEM Education through Artificial Intelligence. Deleted Journal, 5(5), 613–617.
[3] Choudhari, A.A., Chawla, N., Lenka, R., Gopalakrishnan, G., Crasto, C., Deshmukh, P.B. and Gaidhani, S. (2025) Artificial Intelligence Reshaping Research, Innovation, and Collaboration in Higher Education: A Data-Based Analysis. International Journal of Accounting and Economics Studies, 12(6), 89–99.
[4] Yang, M. (2025) Theoretical connotation and cultivation pathway of "Human-AI Collaborative Mathematical Literacy" in the context of Artificial Intelligence. Lecture Notes in Education Psychology and Public Media, 104(1), 188–195.
[5] Garima and Jain, D. (2025). Artificial intelligence and its impact on higher education. Retrieved from https: //anubooks.com/specialissues?url=-jgv-vol-xvispecial-issue-july-25
[6] Zhao, X. (2025) Online and offline teaching mode of art design based on big data environment and edge computing network. International Journal of Interdisciplinary Telecommunications and Networking, 17(1), 1–17.
[7] Baker, R.S. and Hawn, A. (2021) Algorithmic bias in education. International Journal of Artificial Intelligence in Education, 32(4), 1052–1092.
[8] Purohit, P.K. and Kochar, M.K. (2025) Empowering Educators: The Synergy between Emotional Intelligence and Artificial Intelligence in Teaching. International Journal for Multidisciplinary Research (IJFMR), e-ISSN: 2582-2160.
[9] Maddukuri, N. (2025) The Transformative impact of artificial intelligence in modern Education. International Research Journal of Modernization in Engineering Technology and Science, e-ISSN: 2582-5208.
[10] Ali, N.S., Khan, N.M.S., Faheem, N.M. and Fatima, N.I. (2025) The Transformative role of AI in university Education: Empowering educators, elevating students. The Critical Review of Social Sciences Studies, 3(3), 1485–1492.
[11] Mashagbeh, M.A., Alsharqawi, M., Tudevdagva, U. and Khasawneh, H.J. (2025) Student engagement with artificial intelligence tools in academia: a survey of Jordanian universities. Frontiers in Education, 10.
[12] Jia, Y. (2025) Experience with Generative Artificial Intelligence Educational Applications. Advances in Education, 15(03), 379–385.
[13] Zhang, H. (2025) The development status, challenges and future trends of China's vocational education in the digital transformation. Lecture Notes in Education Psychology and Public Media, 94(1), 16–20.
[14] Nuryanti, Y., Simorangkir, Y.N., Asbari, M., Ferdiyanto, Y.A. and Waruwu, H. (2025) Integrating big data and information systems in Higher Education: Implications for organizational productivity and efficiency. Indonesian Journal of Management and Economic Research, 2(01), 121–130.