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SURVEY ON THE INTEGRATION OF ARTIFICAL INTELLIGENCE IN CHINESE MIDDLE SCHOOL MATHEMATICS TEACHING AND LEARNING

[1]Weishuo Wang, [1*]Bo Yu, [1]Yixin Gan, [1]Yazhuo Li, [2]Jing Ma, [3]Haiyan Wu

[1]School of Science, Hunan University of Technology

[2]Jian Ning Middle School

[3]Zhuzhou No. 2 Middle School

(* the corresponding author, boyu_hut@126.com)

Abstract: Against the backdrop of the rapid development of artificial intelligence (AI), a survey was conducted aiming at middle school mathematics teachers integrating AI into their teaching and the students learning under such instruction. Data was collected through questionnaires and interviews, and corresponding statistical analysis was conducted to evaluate the attitudes of teachers and students toward AI-integrated teaching from several different dimensions. Based on the survey results, a targeted analysis was performed, as well as feasible suggestions were proposed to address the challenges faced by teachers and students in AI-integrated mathematics teaching.

***Key-words*:** Artificial intelligence; Middle school; Mathematics teaching; t-test;

Introduction

The Chinese Ministry of Education released the Education Informatization 2.0 Action Plan in 2018, highlighting the transformative power of informatization in education. This initiative aims to support and guide the modernization of education by updating educational philosophies, promoting reform in teaching models, and reconstructing educational systems. The new era assigns a historical mission to informatized education, particularly when integrated with artificial intelligence (AI), which has become a crucial indicator and component of educational modernization (Jiménez, 2024). AI-enhanced education is also a distinctive feature and an integral part of the Education Modernization 2035 blueprint (Li et.al, 2024).

Against the backdrop of China’s informatization era, many middle schools have adopted a hybrid teaching model combining "online + offline" methods. This fusion of traditional and modern network-based teaching has become a key direction for the development of contemporary education in an internet-driven environment (Wang, 2013). Mathematics, a core subject for middle school students, particularly requires modern teaching tools to empower students for future interdisciplinary learning in areas such as biochemistry, physics, and medicine. These interdisciplinary endeavors often give rise to emerging fields and technologies.

However, current practices in blended learning face significant challenges, including limited teaching resources, insufficient student autonomy, and a lack of organic integration between classroom teaching and online learning (Karan & Angadi, 2023). Moreover, the foundational knowledge required for AI technology is extensive, and given that middle school students primarily focus on preparing for the College Entrance Examination (CEE), introducing professional AI concepts (such as neural networks, machine learning, and affective computing) in detail is impractical and overly complex for this stage of education. Therefore, effectively integrating AI technology into middle school mathematics instruction without adding extra burdens for teachers

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and students is vital in practices. Such integration can promote the evolution of middle school mathematics education toward a more learner-centered, personalized, precise, and intelligent approach (Dai et. al, 2018).

This paper investigates the current use of AI applications and related technologies in middle school mathematics teaching. A survey was designed to assess the current status of AI-integrated teaching and learning in middle school mathematics" among both teachers and students. The study aims to identify the existing state of AI-based teaching and learning, uncover challenges and deficiencies, and analyze areas for improvement in the informatized teaching of middle school mathematics. Based on these findings, practical suggestions are proposed to enhance the teaching and learning of mathematics in middle schools through the effective integration of AI technologies.

Research Methodology

Study tool

We employed Likert-scale questionnaires (Nemoto, Beglar, 2014) and face-to face investigations to collect data and information. Two questionnaires were specifically designed—one targeting students and the other targeting teachers.

The student questionnaire focused on the following aspects:

- Basic Information**:** Demographic and educational background of students.

- Attitudes Toward AI-Integrated Mathematics Teaching**:** How students perceive the integration of AI in mathematics education.

- Impact of AI-Integrated Education**:** The influence of AI-powered learning tools on students' learning experiences and outcomes.

The teacher questionnaire explored four key areas:

- Teachers' Skills in Designing and Implementing AI-Integrated Mathematics Courses**:** Their capability and readiness to incorporate AI into teaching.

- Comparison of AI-Based and Traditional Teaching Models**:** Teachers' perspectives on the differences and advantages between AI-enhanced and conventional teaching methods.

- Impact of AI-Integrated Mathematics Education on Teaching Quality: Insights into how AI affects the overall effectiveness of mathematics instruction.

- Suggestions and Outlook for the Future Development of AI-Integrated Mathematics Education**:** Recommendations and future expectations for leveraging AI in mathematics teaching.

Research objects

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Questionnaires were distributed across three middle schools in Zhuzhou City: Jianning Middle School**,** Zhuzhou No. 1 Middle School**,** and Zhuzhou No. 2 Middle School. A total of 200 questionnaires were distributed to students and teachers.

- Student Questionnaires: 91 responses were returned, with 89 deemed valid.

- Teacher Questionnaires: 95 responses were returned, with 93 deemed valid.

Additionally, field investigations were conducted in other middle schools within Zhuzhou City to gather complementary qualitative insights.

Data processing

A school-based survey was conducted on the factors influencing performance in the questionnaires. After all questionnaires were collected from the spot and on-line App, 186 sample quantification tables were obtained but only 182 are valid. The software EXCEL was employed to count the sample data and SPSS was utilized to assess the reliability and validity of the questionnaires, as well as through a single-sample T-test (Zhu, 2012).

Results Analysis and Discussion

General Attitudes Toward AI-Integrated Mathematics Education

Analysis of the student questionnaire revealed that 41.6% of students preferred AI-integrated online teaching, while 38.5% were neutral, and 19.9% favored traditional offline teaching. Most students acknowledged certain drawbacks of AI-integrated online education, such as poor class performance due to internet issues, insufficient class hours leading to academic pressure, negative effects on vision and physical health, and limited interaction with teachers and peers. Only a small number of students felt there were no disadvantages. On the other hand, a majority highlighted its advantages, including greater flexibility in learning location and time, the ability to review class content repeatedly for better revision, and improved learning efficiency through internet-based tools. A minority of students believed that AI-integrated teaching had no advantages.

Teacher responses showed that 63.5% strongly supported AI-integrated online teaching, 22.8% held a neutral stance, and 13.7% opposed it. Most teachers expressed a positive view of online education but also pointed out challenges such as resource and technological limitations affecting classroom effectiveness, lack of interaction, difficulty monitoring student attentiveness, and slow teaching pace. Only a small number of teachers considered AI integration to be entirely free of drawbacks. Nevertheless, the majority noted its strengths, such as offering flexibility in choosing the teaching environment and being well-suited for students with strong time management skills. However, a few teachers argued that students preparing for major exams, like the College Entrance Examination, would not benefit from AI-integrated teaching.

Statistical Analysis

The survey data was analyzed using SPSS software to assess the reliability and validity of the questionnaires (Basch & Gold, 1985), as well as through a single-sample T-test. The results met expectations and are summarized in Table 1.

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Table 1
Results of the survey data

	Dimensions	Alpha
Teachers	Design and Implementation Capabilities in AI-Integrated Mathematics Teaching	0.754
	Comparison Between AI-Integrated and Traditional Teaching Models**:**	0.802
	Impact on Teaching Quality	0.811
	Likert Scale	0.798
	Validity Assessment	0.805
	Total Scale	0.805
Students	Changes in Attitudes After Exposure to AI-Integrated Teaching	0.814
	Effects of AI-Integrated Courses on Learning Outcomes**:**	0.799
	Awareness and Understanding of AI-Integrated Courses	0.861
	Likert Scale	0.847
	Validity Assessment	0.833
	Total Scale	0.833

(1)Single-Sample T-Test Analysis of Student Gender

In the analysis of single-sample T-tests for student gender, the Sig. values for all items were less than 0.05, indicating statistically significant differences. This suggests that gender plays a significant role in the responses. The results are presented in Table 2.

Table 2
Single-Sample T-Test Analysis of Gender

	t value	Sig. (two tailed)	Mean Difference	95% Confidence Interval	
				Lower bound	Upper bound
Gender	9.825	0.001	0.452	0.31	0.49

The data highlights meaningful variations in attitudes and responses to AI-integrated mathematics education between different genders. Further discussion is needed to explore how gender-related factors influence perceptions, preferences, and learning outcomes in this context.

(2) Gender Differences in Attention Levels in AI-integrated Learning

The analysis revealed significant differences in attitudes toward AI-integrated learning between male and female students. In terms of course engagement, female students demonstrated significantly higher levels of attention and focus compared to their male counterparts. This finding is supported by the independent sample t-test results, as shown in Table 3.

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Table 3
Group Statistics in Independent Sample T-Test for Gender and Attention Levels

	Gender	Numbers	Mean	Standard Deviation	Standard Error Mean
Attention level during AI-integrated Learning	Male	51	2.97	1.124	0.137
	Female	38	3.45	1.027	0.128

(3) Single-Sample T-Test Analysis of Academic Performance Changes After AI-integrated Learning

A single-sample t-test was conducted to analyze changes in student academic performance following AI-integrated learning. The results in Table 4 indicate that students generally hold a neutral attitude toward whether their grades improved or declined. The Sig. value of 0.071 is noticeably greater than 0.05, suggesting no statistically significant change in academic performance. Furthermore, the mean score from the single-sample statistics is 2.90, which is close to the test value of 3, reinforcing the finding that the performance changes after engaging in AI-integrated learning were not substantial.

Table 4
Single-Sample T-Test Analysis of Academic Performance Changes

	t value	Sig. (two tailed)	Mean Difference	95% Confidence Interval Lower bound	Upper bound
AI-integrated learning improved your grades	-1.653	0.071	-0.131	-0.29	0.03

This data suggests that while AI-integrated learning introduces innovative methods, its immediate impact on academic performance may be limited, warranting further investigation into how such tools can better support student achievement

Analysis of the Advantages and Disadvantages of Current AI-integrated Education

•Student Attitudes Toward AI-Integrated Mathematics Learning

Among the 89 surveyed students, 66.2% found AI-integrated learning more engaging, citing the flexibility of learning schedules and the simplicity of accessing courses through AI-powered software and Apps. This mode of education allows students to learn in any network-connected environment, free from constraints of time and location. Additionally, 70.8% of students reported that AI-integrated learning supports post-class review, enabling them to revisit lessons through cloud-stored videos and ask questions anytime, thus reinforcing classroom knowledge. However, 58.2% of students noted that poor network quality often led to suboptimal learning experiences and hindered academic progress. Furthermore, 66.2% of students admitted struggling with self-discipline during AI-based review and Q&A sessions, with distractions such as chatting with the AI app. Prolonged use of AI-integrated learning tools also raised concerns about health, with 69.4% of students reporting negative effects on eyesight and potential harm to posture and neck health from extended screen time.

•Teacher Attitudes Toward AI-Integrated Mathematics Teaching

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While AI-integrated teaching offers many conveniences, it is not without flaws. Variations in students' adaptability to AI-based courses result in inconsistent learning outcomes, placing greater demands on students' independent learning abilities. Among the 93 surveyed teachers, some, particularly those new to AI-integrated mathematics, encountered difficulties operating related software and apps due to a lack of familiarity. Additionally, 38.8% of teachers observed reduced interaction and communication with students compared to traditional teaching, as students transitioned from passive recipients of knowledge to active participants in their learning. This shift weakened the teacher's control in the classroom, negatively impacting students with lower levels of self-discipline.

For older teachers, technical challenges posed a particular difficulty. Some expressed resistance to AI integration during interviews, citing the prioritization of college entrance exam preparation and feeling compelled to slow the pace of teaching. Moreover, due to national conditions and limitations in available network resources, certain advanced apps and specialized tools could not be directly implemented, creating barriers to the seamless integration of AI into mathematics instruction.

These findings highlight that while AI-integrated teaching holds promise, it faces significant challenges under current conditions. Substantial effort is required to overcome these obstacles and promote the broader adoption of AI in education.

Results & Discussion

As technology advances and society evolves, education methods and models are also expected to change. Traditional education, once limited to in-person instruction, is now increasingly influenced by the integration of artificial intelligence and the internet, creating a trend toward blending online and offline teaching. However, for the foreseeable future, online AI-enhanced teaching and traditional offline education are likely to remain complementary rather than substitutive, with both being indispensable. Under the backdrop of big data, the combination of online and offline education—with offline learning as the primary mode and online learning as a supplementary tool—has the potential to achieve the highest educational goals. Key to this integration are seamless platforms, high-quality digital resources, and suitable teaching software and Apps. AI-integrated platforms provide the foundation for this fusion, while reforms in school administration and teaching practices are critical to its success. Building a new system for AI-integrated mathematics teaching will require addressing the fundamental needs of both students and teachers, creating platforms that facilitate the seamless integration of in-person instruction and online reinforcement.

Schools should actively support teachers and students by collaborating with external, high-quality internet platforms to design comprehensive teaching systems. These systems could extend modules that are difficult to cover in traditional classrooms through AI-enabled online tools. Simultaneously, schools must stay attuned to technological trends, continuously reforming and adapting their educational systems to meet the demands of the fast-evolving big data era.

With the support of advanced technology and networks, learning pathways in the future will undoubtedly become more diverse. However, the focus should remain on emphasizing the central role of the learner. By leveraging the advantages of AI-driven online tools, education can shift from passive knowledge transmission to empowering students to actively construct their learning methods. This approach would result in a hybrid model of online and offline learning, combining classroom instruction with self-directed study. It also opens the door to innovative teaching models, such as flipped classrooms and dual-teacher systems, where online resources like cloud platforms or micro-lessons provide core knowledge, and in-person teachers focus on addressing students' individualized needs.

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Strengthening collaboration and communication between dual-teacher systems is essential to improving the effectiveness of AI-integrated teaching. This learner-centered approach supports holistic education. Beyond using AI in classrooms, integrating AI into students' self-directed learning after class can reduce teachers' workload and enhance students' interest in exploring subjects further. By fostering students' autonomous learning abilities, online education becomes a valuable supplement to offline teaching, achieving a seamless connection between the two. However, whether this model can be effectively implemented in underdeveloped regions remains an open question, warranting further exploration and consideration.

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References

1. Jiménez A. F. (2024) *Integration of AI helping teachers in traditional teaching roles[J]*. European Public & Social Innovation Review, 9: 1-17.
2. S. Li, Z.-T. Liu, & S.-J. Chen (2024). *The Chinese path to building a higher education power.* Higher Education Management. 18(1):1-23.
3. Wang F. (2013). *Analysis of the current status of artificial intelligence application in secondary education,* China Medical Education Technology, 27(4):4.
4. Dai Y.-H., Xu B. & Chen H.-J. (2018). *Artificial intelligence on the promotion of blending learning and the construction of its ecological chain,* Modern Distance Education Research, (2):24-31.
5. Karan B., Angadi G. R. (2023) *Potential risks of artificial intelligence integration into school education: A systematic review.* Bulletin of Science, Technology & Society, 43(3-4): 67-85.
6. Zhu J. (2012). *Applied multivariate statistical analysis (2nd Edition).* Science Press, 2012.
7. Nemoto T, Beglar D. (2014). *Likert-scale questionnaires,* JALT 2013 conference proceedings. 108(1): 1-6.
8. Basch C. E, Gold R. S. (1985) *The validity of reliability assessments*. Journal of School Health, 55(5): 191-195.

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