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Feedback and Improvement Measures for Digital Teaching from the Student Perspective

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Abstract: *With the ongoing advancement of educational digital transformation strategies, AI-enhanced teaching has emerged as a pivotal topic in the education sector, making digital transformation a core focus of China's educational reforms. As AI applications in education remain in their early stages, teachers' understanding and awareness of AI technologies remain limited. This study conducted a questionnaire survey among nearly 180 students across three educational levels in Chongqing, analyzing the factors influencing teachers 'adoption of AI in instruction. Results indicate generally positive student feedback on digital teaching, though variations exist in feedback patterns across different educational stages and school populations. The study further examines underlying causes and proposes measures to enhance teachers' digital literacy, aligning with critical trends in teacher training for the digital education era.*

Keywords: *Digital teaching, Artificial intelligence, Current situation, Students, Improvement measures*

1. Introduction

Since the concept of "artificial intelligence" [1] was first introduced at the Dartmouth Conference in 1956, the emergence of generative AI systems like DeepSeek and ChatGPT has made AI a major focus in China. AI has permeated all sectors of society, including education, where generative AI significantly enhances classroom instruction - trend driven by both technological evolution and the intrinsic need for high-quality educational development [2].

To empower teachers to cope with the rapid iteration and upgrading of technology, governments worldwide have actively promoted the integration of artificial intelligence into higher education teaching reforms at the policy level, emphasizing the enhancement of teachers 'digital literacy and technical proficiency [3,4]. For example, China's officially issued "China Education Modernization 2035" explicitly states that teachers should possess the ability to apply intelligent educational technologies to meet the demands of educational modernization [5]. To achieve digital transformation in education, it is essential to improve teachers 'digital application capabilities, as emphasized in the "New Era Basic Education Strong Teacher Plan" [6]: "We must strengthen the development of teaching and learning competencies and information technology application skills, and leverage teachers' roles in integrating artificial intelligence with education." The educational industry standard "Teacher Digital Literacy" released by the Ministry of Education also outlines the essential competencies required of teachers in the digital age, providing theoretical support for enhancing their digital skills and guiding the development and cultivation of their digital literacy.

However, current demands for teacher digital literacy training are complex and diverse, with significant variations in AI awareness, acceptance, and application capabilities among teachers across different educational stages, subjects, and experience levels [7,8]. As artificial intelligence integrates with education, teachers are evolving from "sages on the podium" to "guides at their students' side" [9]. It is essential to thoroughly examine the actual practices of teachers using AI in instruction, identify emerging challenges, and implement corresponding measures to enhance their AI teaching competencies and advance the intelligent transformation of education.

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2. Current Research Status

Using "teacher digital literacy" as the keyword, relevant literature was searched in the China National Knowledge Infrastructure (CNKI) database. After excluding studies unrelated to the target keywords, a total of 370 effective articles were identified. A detailed visual analysis of the annual distribution of these 370 articles was conducted using CNKI, resulting in Trend Line Chart 1. As shown in Figure 1, during the period from 2002 to 2011, virtually no related research publications were published; it was not until 2012 that initial research findings on digital education began to emerge, with this trend subsequently showing a sustained upward trajectory. Against the backdrop of rapid advancements in intelligent technologies and strong policy support from national authorities, numerous challenges and pressing needs in this field have been progressively identified, leading to a steady increase in the number of published research papers. Overall, the momentum in digital education research in China exhibits an optimistic and positive trend, indicating that future studies in this area will become more profound and extensive.

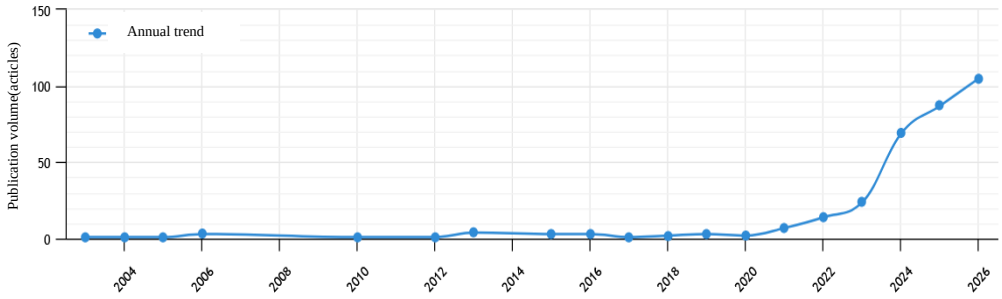

Figure 1: Visualization of annual publication volume of literature on "Digital Education".

By conducting statistical analysis of keyword frequency using citespace and selecting representative keywords (as shown in Table 1), the results indicate that highly ranked keywords such as "digitalization," "universities," and "talent cultivation" highlight these as key research focuses in teacher digital literacy. However, most existing studies approach this from an educator's perspective, with limited research examining digital education from the student' s viewpoint. Therefore, this research direction warrants particular attention.

Table 1: Selected Keywords.

frequency	*First occurrence year*	*Keywords*
20	*2017*	*digitalize*
8	*2016*	*colleges and universities*
14	*2019*	*personnel training*
10	*2019*	*model of instruction*
13	*2024*	*transformation of education*
9	*2023*	*artificial intelligence*
6	*2023*	*Digital Literacy*
5	*2022*	*basic education*
5	*2024*	*Curriculum-based Ideological and Political Education*

3. Research Design

3.1. Research Sample

The study focused on students within Chongqing Municipality, employing random sampling. The sample demonstrated broad coverage across school types, grade levels, and age groups, including middle school students, university students, and master's degree candidates, thereby ensuring strong representativeness and a solid analytical foundation. Statistical analysis was conducted on 181 valid questionnaires collected through the formal survey, with the sample characteristics summarized in Table 2.

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Table 2: Basic Sample Characteristics.

demographic variables		*Proportion(%)*
sex	*woman student*	*53.90*
	man student	*46.10*
phase of studying	*junior middle school*	*24.40*
	senior middle school	*21.80*
	junior college	*1.70*
	undergraduate college	*44.80*
	Graduate level or above	*7.30*
School Type	*Higher Vocational and Technical Colleges*	*1.70*
	Higher Vocational College Degree	*0.50*
	Undergraduate degree	*44.30*
	Double First-Class Universities	*7.30*
	Municipal Key School	*16.80*
	Key secondary schools at the county and district levels	*18.70*
	ordinary high school	*10.70*

3.2. Research Tools

The study employed a questionnaire-based approach for data collection, aiming to assess the current status of teachers in Chongqing utilizing artificial intelligence in teaching and to gain deeper insights into their needs for enhancing AI-related teaching skills. The questionnaire was designed and developed with reference to relevant research findings by domestic scholars [10–12], with questions unrelated to the study objectives removed. A pilot survey was conducted, and based on its results, the questionnaire was revised to address issues such as unclear phrasing, poorly designed options, and insufficient coverage of key research aspects, ensuring more accurate data collection on university teachers' AI usage in teaching and their associated needs. The final version of the questionnaire contained 11 items, two of which were administered using a Likert scale for respondent selection.

3.3. Data Collection and Analysis Methods

A questionnaire was created using Wenjuanxing and distributed for an online pilot survey. The identified issues were revised and refined before the final official questionnaire was distributed, resulting in the collection of 181 student responses. After screening out non-compliant samples - such as those with excessively short response times or identical answers - the final response rate reached 97.24%. The collected data were analyzed using IBM SPSS Statistics 27 and Excel to assess the current status and challenges of artificial intelligence applications in teaching practices among educators.

3.4. Validity and Reliability Testing

This study employed the Cronbach's α coefficient as an indicator for assessing the internal consistency reliability of the questionnaire. The Cronbach's α for the student questionnaire was 0.923, indicating good reliability. Its validity test yielded a KMO value of 0.791 ($P<0.001$), demonstrating strong and statistically significant validity. Both the questionnaire design and its validity and reliability tests met scientific and rational standards, enabling effective measurement of the target dimension's validity and reliability indicators and providing robust support for the research.

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4. Analysis of Survey Results

4.1. There are differences in digital literacy among different teacher groups

According to the questionnaire survey results, artificial intelligence has been adopted to some extent in teaching across all educational stages, but there are significant differences in the frequency of AI usage among teachers at different levels. As shown in Figure 2, teachers at the higher education level (particularly at the college level) use AI more frequently, while the graduate and above levels exhibit a "high-frequency distribution" pattern - the proportions of teachers who "never use AI" (15.3%) and those who "always use AI" (23%) are the highest among all stages, reflecting considerable variation in AI acceptance within this group. In contrast, its application in basic education (especially at the junior high school level) remains relatively limited.

Across all educational stages, the proportion of respondents who "never" use artificial intelligence remains low, indicating that AI has a solid foundation for broader adoption in educational settings.

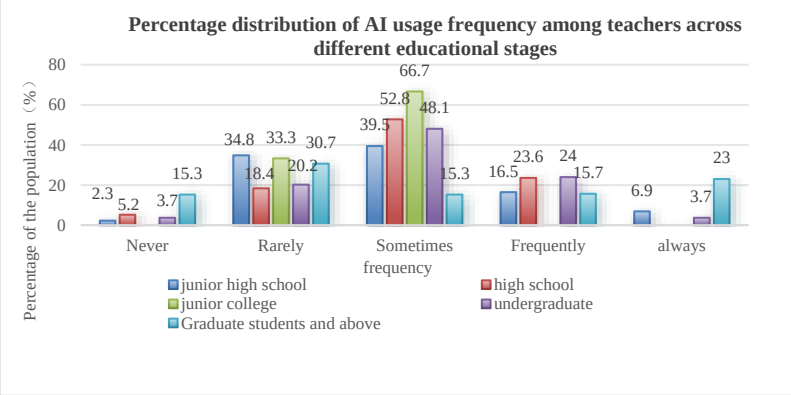

Figure 2: Statistical chart showing the percentage distribution of artificial intelligence usage frequency among teachers across different educational stages.

4.2. Artificial intelligence has wide applications, but its practical capabilities still require further enhancement

Figure 3 (left) illustrates the proportion of teachers utilizing artificial intelligence across various scenarios, highlighting its core applications in education. "Course content design" (59.40%) and "teaching plan optimization" (58.80%) account for the highest shares, both approaching 60%, demonstrating AI's most recognized value in enhancing lesson preparation efficiency and quality. "Teaching material generation" (45.30%) and "intelligent Q&A assistance" (43.50%) each exceed 40%, indicating these are the most frequently used AI tools by educators. "Virtual experiment demonstrations" and "teaching effectiveness analysis" each reach 50.60%, reflecting AI's widespread application in teaching practice and outcome evaluation—and its role in addressing resource limitations and optimizing instructional feedback.

There are relatively few AI applications specifically for exams, likely due to the stringent and standardized requirements for exam question design, as well as teachers' lingering concerns about the quality of AI-generated content.

Figure 3 (right) shows the percentage of teaching activities students perceive as where teachers might use artificial intelligence technology. It is evident that "collecting teaching materials" (74.40%) is the activity most likely to involve AI according to students, reflecting a widespread belief in AI's exceptional efficiency for information retrieval and material integration, making it an ideal tool for lesson preparation. Over 60% of students expect AI to be used in "learning analysis and progress tracking" and "classroom interaction and questioning," indicating recognition of AI's capabilities in data processing and personalized analysis, as well as expectations for its role in enhancing classroom engagement and providing immediate feedback.

The proportions of "homework grading and feedback" (48.90%) and "post-class tutoring and Q&A" (40.30%) were relatively low, indicating that students perceive post-class tutoring as involving extensive personalized and emotional interactions - areas where AI struggles to fully meet expectations.

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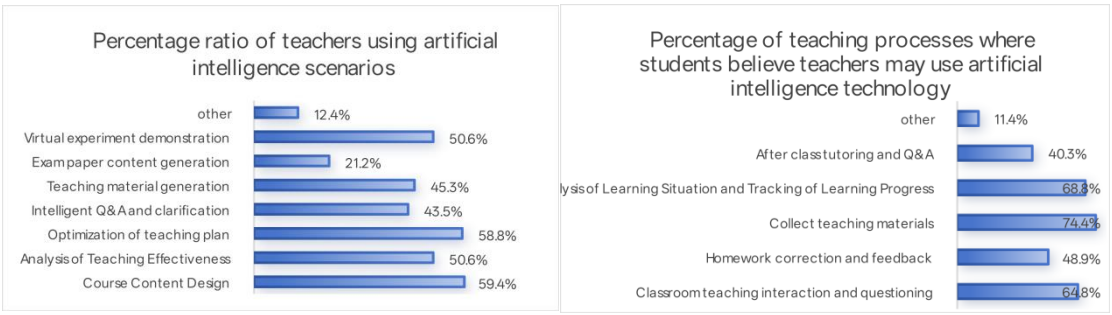

Figure 3: Scenarios of teachers using artificial intelligence (left) versus teaching segments where students perceive potential AI usage by teachers (right) – statistical chart.

4.3. Digital teaching possesses dual attributes

As shown in Figure 4 (left), students exhibit varying levels of acceptance toward teachers' use of artificial intelligence technologies in the teaching process. However, overall recognition remains exceptionally high, with the proportions of respondents stating "disagree" or "strongly disagree" generally below 5%, indicating that resistance among students toward teachers employing AI technologies is exceedingly rare.

Among these aspects, over 80% of students endorsed both "improved teaching efficiency" and "enriched teaching content" when teachers implemented this model. This clearly demonstrates that students directly experience the role of artificial intelligence technology in enhancing teaching efficiency and expanding classroom content. Across the three dimensions, the proportion selecting "average" ranged from 14.7% to 18.2%, indicating that a minority of students held a wait-and-see or uncertain attitude toward the effectiveness of AI technology applications.

Figure 4 (right) illustrates the obstacles students perceive when teachers employ artificial intelligence technology in instruction. The most prominent issue is "the belief that AI cannot fully replace teachers' emotional support and humanistic care" (74.40%), reflecting a widespread view among students that teaching involves not merely knowledge transmission but also emotional interaction and humanistic engagement—areas where AI technology falls short. Meanwhile, concerns such as "easy distraction" (32.40%) and "too much content to remember" (21.60%) suggest that some students believe overly complex AI-based teaching methods may impair classroom focus and learning outcomes.

Students' concerns about AI-assisted teaching are not directed at the technology itself, but rather focus on the fact that "technology cannot replace human warmth." They also worry about potential issues with user experience arising from technological applications. These findings suggest that in advancing AI-powered education, it is essential to strike a balance between technical efficiency and humanistic considerations while optimizing instructional approaches.

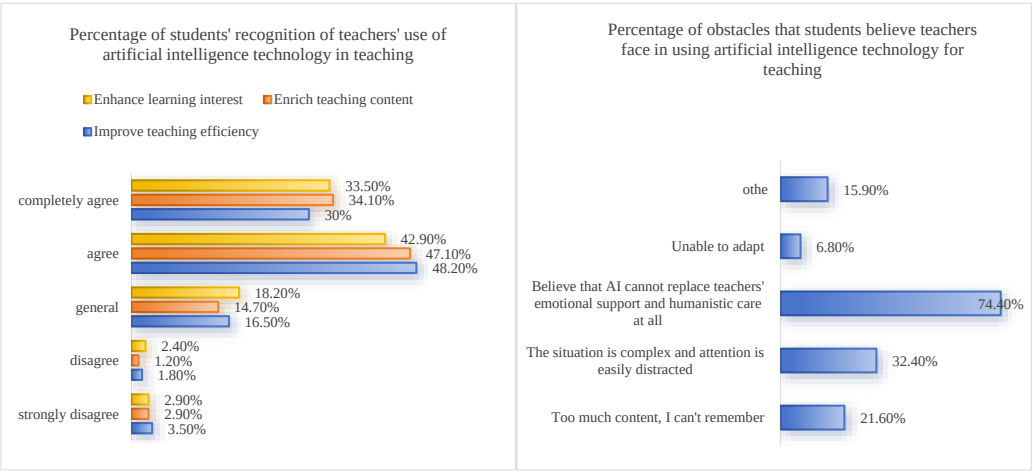

Figure 4: Statistical 1chart showing students 'percentage rates of recognition (left) and obstacles (right) regarding teachers' use of artificial intelligence technology in teaching.

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4.4. Students have positive experiences and high expectations regarding digital teaching

Table 3 presents the descriptive statistical analysis of students 'perceptions regarding the application prospects of AI technologies in teaching and their satisfaction with related experiences. The data indicate that the mean values of both indicators fall within the high-score range of the scale, reflecting a predominantly positive feedback—both regarding current AI teaching experiences and expectations for its future potential. Moreover, the standard deviations of these indicators are moderate, suggesting that while there are some variations in students' views on AI teaching, consensus outweighs dissent. The majority of students express positive and optimistic sentiments, demonstrating strong recognition and anticipation of AI's role in enhancing education.

Table 3: Descriptive Statistics of Students 'Opinions on Teachers' Use of Artificial Intelligence.

title	*N*	*least value*	*crest value*	*average value*	*standard deviation*
Viewpoints on the future application prospects of artificial intelligence technology in teaching by educators	*176*	*1*	*5*	*4.01*	*0.929*
The degree of preference among teachers for using artificial intelligence technologies in teaching	*176*	*1*	*5*	*3.97*	*0.874*

Table 4 presents a Pearson correlation analysis of students 'preferences for teachers' use of artificial intelligence technology in teaching and their views on its future prospects. The results show r = 0.802 with P <0.001, indicating a strong positive correlation between "students 'preference for AI teaching" and "their outlook on its future prospects" —a statistically significant relationship that is not accidental and demonstrates high reliability. This suggests that the more positive students' current experience with AI teaching is, the more optimistic they are about its future development.

Table 4: Correlation 1Analysis of Students' Views and Favorability towards the Application Prospects of Teachers Using Artificial Intelligence Technologies in Teaching.

title	*metric*	*Students' preference for teachers using artificial intelligence technology in teaching*	*Students' views on the prospects of teachers using artificial intelligence technology in future teaching*
Students' preference for teachers using artificial intelligence technology in teaching	*Pearson correlation coefficient*	*1*	*.802***
	Significance (two-tailed)		*<0.001*
	Number of cases	*176*	*176*
Students' views on the prospects of teachers using artificial intelligence technology in future teaching	*Pearson correlation coefficient*	*.802***	*1*
	Significance (two-tailed)	*<0.001*	
	Number of cases	*176*	*176*

At the 0.01 level (two-tailed), the correlation is significant.

5. Cause Analysis and Countermeasures

The reasons for this disparity lie in the following aspects:

(1) Teachers lack practical experience

The survey results indicate that teachers in Chongqing urban areas exhibit a high adoption rate of artificial intelligence, yet there are disparities in its utilization across different school levels and educational stages. This may be attributed to some teachers' lack of practical experience, making it challenging for them to effectively integrate AI technologies into teaching practices.

(2) Artificial intelligence technology updates rapidly

With the continuous advancement of artificial intelligence technology, new digital and intelligent tools as well as teaching software are emerging one after another. These AI tools, leveraging their

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powerful storage capabilities and high operational efficiency, are reshaping the role and norms of teachers, posing a threat to the traditional authority of educators [13]. This may stem from teachers 'inability to keep pace with these technological developments, resulting in insufficient proficiency in applying AI during actual teaching practices; or it could be due to some teachers' fear of the unknown or excessive reliance on traditional teaching methods, leading them to resist adopting new technologies.

(3) The system for enhancing teachers' digital literacy is incomplete.

As the core driving force behind educational digital transformation, artificial intelligence is profoundly reshaping teaching and learning methodologies. Although the concept of teachers 'digital literacy has been widely recognized in education, both the necessity of cultivating such literacy and practical implementation pathways remain inadequately defined [14]. Current teacher training systems exhibit significant shortcomings in addressing educators' needs for AI competency enhancement: training content often remains overly theoretical, lacking hands-on practice and case studies, making it difficult for teachers to apply acquired knowledge in real-world instruction [15]; insufficient training opportunities and limited access channels further hinder professional development. Under the pressures of performance management and quantitative evaluations, teachers typically face dual workloads from teaching and research alongside intensified academic competition [16], leaving little time for systematic learning.

In summary, the current application of artificial intelligence in university education still faces numerous practical challenges. These challenges stem from both teachers 'reliance on traditional teaching paradigms and their perceived risks associated with new technologies [17], as well as inadequate alignment between institutional hardware infrastructure, technological capabilities, and disciplinary teaching requirements. However, enhancing teachers' digital literacy is a long-term process that cannot yield immediate results through short-term skill training alone [18].

Therefore, the following countermeasures and recommendations are proposed to address the difficulties teachers encounter in applying AI:

(1) Strengthen digital teaching to enhance students' overall literacy

Enhancing students 'digital literacy is a practical necessity for advancing the development of a digital powerhouse. Amid the trend of artificial intelligence empowering education, it is even more crucial to cultivate students with high digital literacy who can comprehensively assess educational outcomes during AI-based teaching and propose corresponding optimization suggestions. To strengthen digital education, it is essential to offer general digital literacy courses, deepen students' understanding of the current state of the digital industry, guide them in developing digital awareness and digital thinking, and accelerate the deep integration and innovative development of digital information and digital literacy education [19].

(2) Establishing a Tiered and Categorized Training System

A tiered and categorized teacher training system should be established based on different age groups, academic backgrounds, and technical competencies. Young teachers can participate in workshops on applying artificial intelligence tools to explore the integration of technology with teaching, while experienced teachers focus on discussions about updating pedagogical concepts and transforming teaching practices. To address the uneven distribution of learning resources across different levels, a technical support program can be implemented—such as stationing teachers from less developed regions in urban areas for on-the-job training or providing remote mentoring by renowned urban educators—to cultivate key AI teaching professionals at the county level [20]. Additionally, cross-school online classrooms can be established to enable teachers from various institutions to share high-quality instructional resources, overcoming geographical barriers. Simultaneously, a cloud-based teaching research platform should be developed to facilitate inter-school collaboration and joint teaching research projects, thereby enhancing overall teaching quality.

(3) Establish relevant support mechanisms to encourage teachers' self-directed learning

Establish an Artificial Intelligence Teaching Innovation Fund to support teachers in exploring and implementing relevant research projects. Additionally, local education administrative departments develop modules such as micro-courses, operational guides, and case libraries incorporating AI technologies to enable teachers to engage in self-directed learning during their spare time. Implement a teacher learning points system to motivate continuous learning and participation.

(4) Expand diverse learning channels and establish a peer-assisted learning mechanism among

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teachers

Teachers should ground their practice in an open and integrated digital-intelligence culture, achieving mutual development through collaborative cooperation, observation, and critique [21]. It is recommended that teachers seek guidance from colleagues, friends, and professionals, or join digital literacy-related communities or forums for exchange. Furthermore, teachers should be encouraged to form mutual learning groups to share resources and jointly address challenges in technology application.

(5) Development of Government Resource Platforms

By leveraging free digital literacy enhancement resources provided by governments or institutions and implementing relevant government policies, educators can access greater opportunities to improve digital literacy. It is recommended that education authorities lead the establishment of a free digital literacy resource platform to offer teachers one-stop learning services. Educational stakeholders should actively communicate and coordinate with relevant government departments to facilitate the issuance of policy documents aimed at enhancing teachers' digital literacy. This will enable securing more dedicated funding, clear pathways for digital literacy development, and allocated training quotas, thereby creating more opportunities for teachers to improve their skills. Examples include organizing participation in national and provincial-level digital literacy training programs and encouraging involvement in academic exchanges related to digital technologies, thereby broadening their digital perspectives and acquiring cutting-edge knowledge.

6. Conclusion

This study assessed teachers' digital literacy from the students' perspective within the Chongqing urban area, revealing their strengths and weaknesses in applying artificial intelligence. A systematic analysis of the survey results showed that while most teachers possess a solid understanding of AI, their practical operational abilities vary significantly. Accordingly, this study puts forward a series of countermeasures and suggestions to solve such practical problems, so as to promote the intelligent development of education.

Acknowledgments

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