



The Application of Artificial Intelligence in Teacher Education in China

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Abstract. In recent years, the application of artificial intelligence in the field of education has become increasingly profound, injecting enormous potential into the development of teaching and learning. This trend is also evident in teacher education. In the context of China, how is artificial intelligence technology applied in teacher education? Following the PRISMA guidelines, this study selected 12 relevant research articles related to teacher education to provide teachers and educational authorities with information on effectively utilizing AI technology to support teacher education.

Keywords: artificial intelligence, teacher education, pre-service, in-service

1 Introduction

In recent years, research on the application of artificial intelligence in various fields of education has been growing, and teacher education is no exception. Teachers around the world have experienced to some extent the challenges brought by the era of artificial intelligence. Analyzing and studying these challenges and exploring the key qualities that teachers need to successfully address these challenges are not only important for teacher development and school education reform but also have significant and far-reaching implications for the future development of human society [1]. How to transform the practice wisdom of teacher education and move towards intelligent teacher education has become an urgent issue for our time [2].

2 Teacher Education and Artificial Intelligence in Teacher Education

2.1 Teacher Education

Teacher education is defined as the practice, strategies, and policies that equip teachers with the professional knowledge, teaching skills, assessment techniques, and moral orientation required to effectively carry out their instructional activities and contribute

to societal development. Teacher education is typically recognized as having two stages: pre-service and in-service, both of which are part of a continuous process. Therefore, teacher education refers to education aimed at pre-service teachers as well as ongoing professional development training for in-service teachers. Regarding the use of technology, most teachers now recognize the importance of technology in instructional activities. As a result, teacher education activities can take place in classrooms or through continuous online courses in various ways. However, due to factors such as school philosophies, the effectiveness of resources, and teachers' attitudes, knowledge, and skills, effectively integrating technology throughout the entire process of teacher education remains challenging. In 2017, the State Council of China, in its publication of the "Next Generation Artificial Intelligence Development Plan," explicitly stated the need to utilize intelligent technologies to accelerate the transformation of talent training models and teaching methods, construct a new education system incorporating intelligent learning and interactive learning, establish intelligent campuses to apply artificial intelligence in teaching, management, and resource development throughout the entire process, and develop intelligent educational assistants and comprehensive education analysis systems [3]. These policies have become essential components of the education system. Therefore, technology, especially artificial intelligence, will play an increasingly important role in teacher education aimed at fostering teachers.

2.2 Artificial Intelligence in Education

Artificial intelligence (AI) encompasses various branches and sub-branches. In the field of education, commonly utilized AI technologies include machine learning (ML), which employs algorithms to recognize patterns through continuous training on educational data; deep learning, which utilizes algorithms to simulate and predict educational outcomes using datasets; and natural language processing (NLP), which employs language recognition algorithms to extract and analyze textual meaning. In the context of education, AI supports and enhances learning environments through intelligent tutoring systems, intelligent agents, and intelligent collaborative learning systems. As AI technology continues to advance, interdisciplinary integration, including computer science, image processing, linguistics, psychology, and neuroscience, provides broader application scenarios for AI in the field of education, leading to ongoing transformations in educational systems. In this regard, this study aims to provide an overview of AI research in teacher education. By summarizing the latest research in this field in our country, the study aims to understand how AI influences teacher education. The findings will help guide teachers, practitioners, and decision-makers in understanding the potential of AI technology in supporting teacher education. This study adopts a literature review method to explore the relevant literature on utilizing artificial intelligence and AI technologies to improve teacher education. Specifically, it introduces the research methodology, presents the research findings and insights for the future development of teacher education, and concludes with the study's findings.

This study addresses the following questions:

What are the primary objectives of using AI in teacher education? (Objectives)

How is AI employed to support teacher education? (Technological pathways)

Who are the subjects of research on artificial intelligence in teacher education?
(Participants)

3 Methodology

The purpose of this study is to provide up-to-date information on AI in teacher education in China. A systematic review will be conducted to extract and synthesize knowledge obtained from the literature to address the three research questions mentioned above. This study follows the PRISMA guidelines. The CNKI database will be used as the primary search database, as it comprehensively covers the majority of educational journals in China and provides access to academic literature from Chinese experts and scholars. The following search terms were used: ("teacher education") and ("artificial intelligence" "teacher education"). During the search settings, content containing the search terms in the title, abstract, and keywords were included. According to the PRISMA guidelines, the following criteria were used to determine which articles to include in the study: (a) articles published from January 2018 to December 2022; (b) published in Chinese core journals; (c) articles related to pre-service and in-service teacher education; (d) articles that include specific technological pathways (Table 1). According to the Bradford's law of literature dispersion, most key literature is usually concentrated in a few core journals. Core journals are important carriers of scientific research findings [4]. Therefore, this study considers publication in Chinese core journals as an important criterion for inclusion and exclusion, as shown in Table 1.

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Articles published between January 2018 and December 2022.	Articles published before January 2018.
Articles published in Chinese core journals.	Articles published in non-core journals.
Articles related to pre-service and in-service teacher education.	Articles not related to pre-service and in-service teacher education.
Articles that include specific technological pathways.	Articles that do not include specific technological pathways.

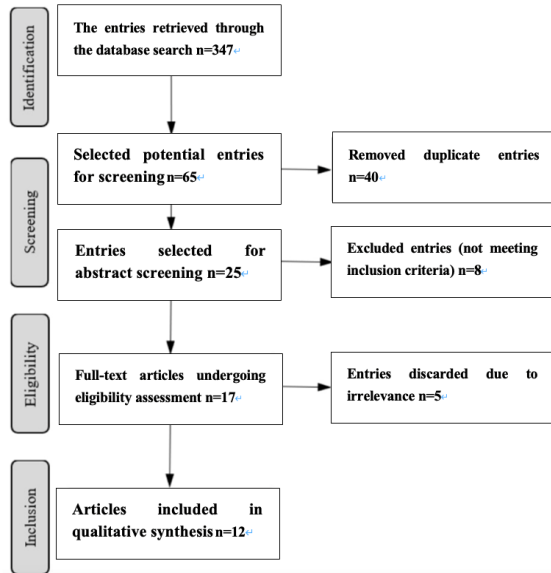


Fig. 1. PRISMA Flowchart

This study ultimately selected 12 eligible research articles [2] [3] [5] [6] [7] [8] [9] [10] [11] [12] [13] [14] for investigation. The selection process is as shown in Fig.1.

4 Results

This review encompasses 12 studies on AI in teacher education, all of which are articles from Chinese core journals, aiming to understand the research status of teacher education in China using AI-based technologies. The analysis conducted under the research questions provides insights into the impact of AI on teacher education in China. The analysis and statistics of the selected literature references are presented in Table 2.

Table 2. Analysis and statistics of selected literature references

Participants	Sample quantity	Objectives and Goals		Technological Pathways	
		New practices	New theories	Enhancement of literacy skills	Reform models
In-service teachers	6	5	1	2	4
Didn't strictly differentiate	6	5	1	1	5

4.1 Objectives and Goals

What are the main objectives of the reviewed studies on the use of AI in teacher education?

The results indicate that the selected studies primarily focus on the objectives and goals of using AI in teacher education. For instance, some studies [4][5][6] demonstrate that AI contributes to the effectiveness of teacher education learning activities. Gu Xiaoqing et al. [7] emphasize the relationship between teachers' behavioral intentions regarding new technologies and their actual use of these technologies in the classroom. Improving digital competence is also a major research focus in terms of objectives and goals, which is often defined as a set of knowledge, skills, and attitudes needed to create, communicate, and solve problems using new technologies in an efficient and effective manner, as well as enhancing the teaching process through technology use [8]. For example, in our findings, some studies emphasize the measurement of digital competence [9][10]. These studies suggest that digital competence should be considered as a skill that requires particular enhancement in teacher education.

4.2 Technological Pathways

How is AI used to support teacher education?

Chen Lei [3] proposes the use of technologies such as the Internet of Things, cloud computing, big data, virtual reality, and artificial intelligence to construct an integrated system that combines teacher education, management, research and training, trajectory tracking, and personalized recommendations. This system aims to achieve instructional integration, deep understanding, effective collaboration, interactive inquiry, and personalized teaching in the process of teacher development. Liu Qingtang et al. [11] obtain data from training image libraries, testing image libraries, or video databases to analyze classroom behaviors and explore the occurrence and developmental patterns of teaching behaviors. This analysis enhances teachers' and students' self-awareness in teaching, improves the efficiency of teaching behaviors, promotes the objectivity of teaching evaluation, and develops teachers' practical knowledge. Li Yang et al. [6] utilize artificial intelligence technologies such as optical character recognition (OCR), speech recognition, body recognition, face recognition, and location recognition. Their intelligent and precise teaching research system automatically collects and analyzes teachers' teaching behavior data and teaching evaluation data. It generates visualized classroom teaching analysis reports, providing a foundation for teachers to conduct teaching research anytime and anywhere. Furthermore, some studies [12][8][10][13] propose the support of AI in teacher education through specific competencies, such as digital literacy, core competencies for teachers in the AI era, cultivation pathways, and monitoring and evaluation.

4.3 Participants

Regarding the participants involved in the reviewed studies, we found that 6 studies [6][8][11][12][13][14] focused on in-service teachers, while 6 studies

[2][3][5][7][9][10] did not strictly differentiate between pre-service and in-service teachers. These findings indicate that researchers are concerned with in-service teachers utilizing advanced AI technologies to update their knowledge, practices, and digital competencies, all of which ultimately benefit students. It is also noteworthy that many scholars [4][14][3][15] have mentioned the importance of continuous professional development in technology for both pre-service and in-service teachers, enhancing their knowledge and skills.

5 Discussion

In general, this study provides important insights into the current research status of AI in teacher education, summarized as follows:

First, teacher education is continuously adapting and gradually incorporating the use of new technologies among pre-service and in-service teachers. The application of digital technologies in education brings both opportunities and challenges. Technology can offer benefits in teacher education, but it is also essential to emphasize the importance of integrating technology into education for pre-service teachers.

Second, this study provides examples of AI's impact on various teaching activities, such as teacher behavior analysis and adaptive teaching, advancing the improvement of the educational process through AI. However, there is a need to develop the digital competence of in-service teachers, which is a fundamental requirement for using advanced technologies in teaching education. Additionally, Zhao Leilei et al. [8] point out that teachers need to acquire relevant competencies through appropriate training to be prepared for AI, meaning they should know how to leverage AI to enhance their teaching abilities and professional knowledge. Third, our findings indicate the importance of obtaining participants' willingness to engage in research on teacher education, particularly when using AI technologies and tools.

This study has certain limitations. Firstly, it focuses primarily on in-service teacher education, with relatively fewer studies specifically addressing pre-service teacher education. Future research can expand the scope to include pre-service teacher education. Additionally, this study mainly focuses on understanding the development of AI in teacher education within China. Future research can explore the development of AI in other countries and make comparisons with domestic research to benefit from each other's strengths. Secondly, this review broadly covers AI-related technologies, and further research can provide more specific insights by delving into individual technologies, enhancing the reproducibility of the studies. Lastly, it is not guaranteed that all relevant articles were found, and the number of included literature was relatively limited. Nevertheless, this study contributes to analyzing the research status of AI in teacher education in China.

6 Conclusion

This study provides a systematic review of how AI is used in teacher education, as AI technologies are gradually adopted to support teaching activities across different edu-

ational levels. However, compared to other fields such as medicine, industry, and finance, the application of AI in education is developing at a slower pace. This study offers evidence-based educational innovations through the application of AI in teacher education. These applications serve various purposes, such as visualizing teacher behavior and interactions, automated scoring of video-based oral presentations, and enhancing teachers' AI literacy. Importantly, Finally, this study reveals that an increasing number of researchers are exploring the opportunities and challenges that artificial intelligence technologies bring to teacher education. This will greatly contribute to the advancement of teacher education.

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