

The Focus and Tendency of Studies on Pre-Service Teachers' Information Communication Technology Teaching Competency in China

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Abstract

Information communication technology (ICT) teaching competency is a key competency for Pre-service teachers. This study uses CiteSpace, analyzing 332 studies on “pre-service teachers’ ICT teaching competency” in China over the period from 2004 to 2024 in the database of CNKI. The findings indicate that the research on pre-service teachers’ ICT teaching competency can be divided into the initial development period and a subsequent growth period. A key author group for the research on pre-service teachers’ ICT teaching competency has not yet been formed, and the cooperation between authors and research institutions needs to be strengthened. The research mainly focuses on six major themes: student teachers, teaching competency, information technology, information literacy, pre-service teachers, and influencing factors. It is believed that there are three directions of deepening the research of pre-service teachers’ ICT teaching competency which are strengthening interdisciplinary cooperation and cross-field integration, integrating evidence-based evaluation and intelligent technology, and optimizing methods and simulating problem-driven approach.

Key words: Pre-service teachers; ICT teaching competency; Focus; Tendency

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The pre-service teachers’ ICT teaching competency directly bears upon the overall proficiency of the future teaching workforce. As a strategic fulcrum of the digital transformation of education, the research on pre-service teachers’ ICT teaching competency has been conducted for two decades, having established a multi-dimensional cognitive framework that encompasses technological integration, literacy models, and ecological evaluation. However, there is still considerable room for improvement in the field, particularly regarding academic community cooperation and the relevance to the times. Building on this foundation, a systematic review of the research trajectory and themes in this field, coupled with an exploration of its future research tendency, can provide theoretical support and a strategic framework for the cultivation of pre-service teachers in the new era.

1. RESEARCH DESIGN

1.1 Research Sample

This paper adopts a thematic retrieval method, using China National Knowledge Infrastructure (CNKI) as its data source to conduct a literature search on the theme of “pre-service teachers’ ICT teaching competency,” with a time span from January 1, 2004, to December 31, 2024. After an initial screening, 367 studies were identified, and 35 non-research studies were excluded, resulting in a final effective sample size of 332 studies.

1.2 Research Method

This paper uses CiteSpace 6.3.R1 for the visualization analysis of the literature, constructing knowledge maps from two dimensions: keywords and authors, to explore the research trajectory and clarify the overall tendency of the study on pre-service teachers’ ICT teaching competency.

2. ANALYSIS OF RESEARCH OUTCOMES

2.1 Period Division

The annual publication volume (see Figure 1) shows that after the implementation of the program for educational

modernization in China, there has been a rapid increase in the number of publications on pre-service teachers' ICT teaching competency, indicating the future prospects of research in this field.

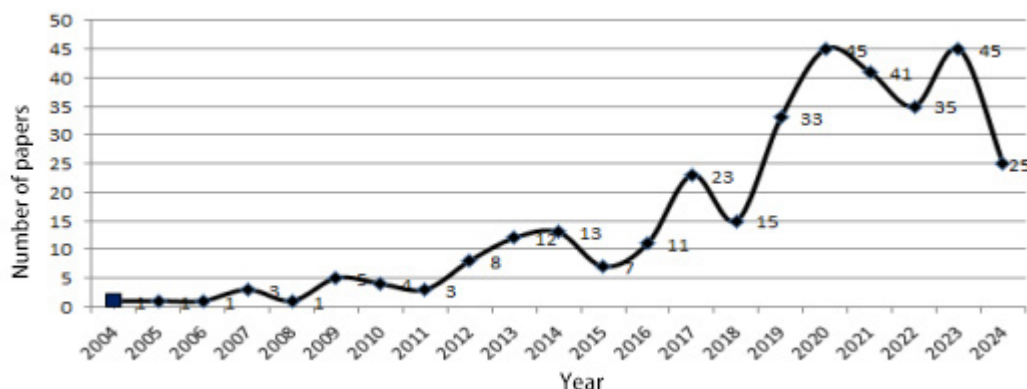


Figure 1
Number of publications on pre-service teachers' ICT teaching competency (2004-2024)

2.1.1 The Initial Development Period (2004-2017)

In 1999, Ren and Qu published the paper "On the Cultivation of Modern Educational Technology Competence in Teachers", which marked the beginning of the research on pre-service teachers' ICT teaching competency. The period from 1978 to 1999 represented the infancy stage of educational information technology in China, with only one paper published. Due to the continuous advancement of educational information technology reform, it has entered the stage of driven development (2000-2010). During this period, the number of papers published increased slightly in some years, but it was mostly one or two each year. In terms of research methods, theoretical discussion was predominant, with only one empirical research paper. The research subjects are relatively homogeneous. As China's educational informatization enters the phase of application-driven development (2011-2017), scholars gradually paid more attention to pre-service teachers' ICT teaching competency. In 2017, the number of publications reached more than 20, and the research subjects showed a diversification trend. In terms of research content, the research on the training mode and strategies of pre-service teachers' ICT teaching competency began to increase, and some scholars also started to focus on evaluating pre-service teachers' ICT teaching competency.

2.1.2 A Subsequent Growth Period (Since 2018)

The release and implementation of the "Education Informatization 2.0 Action Plan" in 2018 marked the beginning of a new era in educational information technology. During this period, information technology and education have been deeply integrated, and education has become characterized by networking, digitalization, intelligence, personalization, and lifelong learning. This

has placed new demands and challenges on primary and secondary school teachers, also catalyzing a higher stage of research on pre-service teachers' ICT teaching competency. In this stage, the number of publications has surged, exceeding 34 articles each year. In February 2018, the "Action Plan for the Revitalization of Teacher Education (2018-2022)" further emphasized the research on pre-service teachers' ICT teaching competency. The number of publications on this theme reached 45 annually in 2020 and 2023, with significant differences in research perspectives, research subjects, and research methods compared to the previous studies. The "The Outline for Building an Advanced Country in Education (2024-2035)", released in January 2025, emphasizes the development of a learning-oriented society, utilizing digital education to open new development tracks and shape new competitive advantages. Consequently, studies on pre-service teachers' ICT teaching competency will continue to increase.

2.2 Statistical Analysis of the Researchers

Based on the publication analysis, Liu, Yin and Zheng (2015) emerges as a prolific researcher in this field, having published four articles. Among the authors who have published two or more papers, there are 36 individuals, accounting for 10% of the total number of authors in this field. It is noteworthy that a few of these authors have collaborative efforts, indicating that the research on pre-service teachers' ICT teaching competency lacks a stable core author group, with contributors being scattered and the majority having published only a single paper.

2.3 Conditions of Research Institutions

The results of the statistical analysis indicate that the top ten research institutions, in terms of the number of

published papers, are all normal universities. Central China Normal University and Qufu Normal University have the most publications, with 11 each, followed by East China Normal University with 10 publications. This demonstrates that normal universities place a particularly high emphasis on the study of pre-service teachers' ICT teaching competency, which is related to the national educational policies, the talent cultivation objectives of normal universities, and the graduation requirements.

3. DISCUSSION ON RESEARCH THEMES

The keywords identified through CiteSpace 6.3.R1 calculations are indicative of the research themes and focal points of this field. The keywords derived from the research samples encompass "student teachers," "teaching competency," "information technology," "information literacy," "pre-service teachers," and "influencing factors," highlighting a focus on the influencing factors and student teachers related to pre-service teachers' ICT teaching competency. The terms "influencing factors," "information technology," and "teaching competency" have emerged as key focal points in recent studies concerning pre-service teachers' ICT teaching competency.

Based on the analysis of research themes, this paper further reviews relevant literature, systematically identifying the shifting focus of cognitive attention in the research on pre-service teachers' ICT teaching competency since the reform of educational information technology in China. The specific findings are as follows:

The first strand of research primarily focuses on the conceptualization of pre-service teachers' ICT teaching competency. The scholars have conducted research on the connotations and constituent elements of pre-service teachers' ICT teaching competency, proposing that it encompasses ICT teaching concepts, information technology skills, and the abilities to design, implement, and evaluate ICT teaching (Liu et al., 2015). In such studies, the divergence in scholarly perspectives primarily lies in whether ICT teaching competency includes ethical awareness and a capacity for professional growth.

The second strand of research examines the current state of pre-service teachers' ICT teaching competency. Early research predominantly used a utilitarian research paradigm, focusing on investigating how pre-service teachers were using available technical tools. However, the analysis of pre-service teachers' specific behaviors in technology-integrated teaching allows for a better understanding of the current level of their ICT teaching competency. The application of technology in teaching has gradually gained more attention. The results from the current status survey indicate that the overall level of pre-service teachers' ICT teaching competency is still not high, and their competencies in ICT teaching design,

implementation, and evaluation still need improvement (Shen & Yang, 2020; Zhou, Kuang, Yu, & Tang, 2017).

The third strand of research focuses on the factors influencing pre-service teachers' ICT teaching competency. The research primarily focuses on two aspects: the influencing factors of pre-service teachers' willingness to adopt ICT teaching and the factors affecting the level of pre-service teachers' TPACK knowledge (Huang, 2017; Zhang, Xiao, Wang, & Fan, 2015). The scholars have drawn on research frameworks, such as the technology acceptance model (TAM), to conduct quantitative studies. It is identified that perceived usefulness, perceived ease of use, social influence, facilitating conditions, and performance expectancy are common influencing factors (Zhang, 2019).

The fourth strand of research focuses on the evaluation of pre-service teachers' ICT teaching competency. Based on the TPACK framework, the scholars have constructed an evaluative structure and a corresponding index system for pre-service teachers' ICT teaching competency. The resulting assessment tool enables the measurement of pre-service teachers' ICT teaching competency levels, thereby facilitating the development of targeted strategies for enhancing their ICT teaching competency (Yan, Li, & You, 2018; Ren, Yan, & Li, 2018).

4. FUTURE RESEARCH TENDENCY

The research on pre-service teachers' ICT teaching competency is a complex systematic project. Future studies should focus on the following three aspects:

4.1 Strengthening Interdisciplinary Cooperation and Cross-Field Integration

The study of pre-service teachers' ICT teaching competency mainly focuses on experiential summaries. The scholars have conducted studies on the pre-service teachers' ICT teaching design and cultivation of pre-service teachers' ICT teaching competency based on constructivism, activity theory, and deep learning theory. It is shown that the theoretical research is abundant while the empirical studies are scarce. Future research should integrate findings from disciplines such as philosophy, psychology, information technology, and artificial intelligence, focusing on the integration of technology in authentic teaching contexts and the transfer of competencies, thereby fostering a development ecosystem that harmonizes theory and practice. The researchers should adopt an open-minded and innovative approach. It is essential to learn from outstanding international cases and successful experiences. Meanwhile, they should innovatively develop representative samples that reflect the unique characteristics of their local schools and regions. To translate practices into tangible, actionable results, it is essential to integrate theory with practice

through structured research. This involves fostering collaboration among research institutes, universities, governments, primary and secondary schools, and enterprises, promoting interdisciplinary synergy, and building blended online-offline communities for cross-disciplinary collaboration. Such efforts will pioneer new fields for enhancing pre-service teachers' ICT teaching competency.

4.2 Integrating Evidence-Based Evaluation and Intelligent Technology

The pre-service teachers' ICT teaching competency possesses characteristics of the times. In today's era empowered by intelligence, both the connotation and denotation of pre-service teachers' ICT teaching competency have undergone significant transformation, necessitating further deep exploration in research. Firstly, it is essential to conduct in-depth research on relevant policies, such as the national teacher education, to conduct top-level design of the relevant systems and mechanisms for pre-service teachers' ICT teaching competency, promote the institutionalization and scientization of the cultivation of pre-service teachers' ICT teaching competency, and better grasp the direction of the cultivation of pre-service teachers' ICT teaching competency. Secondly, with the rapid development of artificial intelligence and data science technology and the theoretical evolution of evidence-based education, the existing standards related to pre-service teachers' ICT teaching competency require continuous optimization (Li & Liu, 2024; Mou, Liu, & Chen, 2019). Finally, the curriculum system for pre-service teacher education must be restructured, and it is imperative to integrate emerging technologies, such as artificial intelligence, to meet the demands of the new era. The research on pre-service teachers' ICT teaching competency should be based on a broad educational perspective, to achieve a seamless integration of pre-service teachers' ICT teaching competency with the requirements of primary and secondary school education.

4.3 Innovating Research Methods and Simulating Problem-Driven Approach

The research on pre-service teachers' ICT teaching competency demands methodological diversity to enhance the scientific rigor and validity of findings. Future studies should incorporate a wider range of research approaches, such as experimental research, comparative research, the Delphi method, the analytic hierarchy process, and narrative research. Furthermore, the application of advanced technologies and analytical methods, including structural equation modeling, regression analysis, big data mining, and artificial intelligence, is critical. These methods should be used to examine key dimensions of pre-service teachers' ICT teaching competency which

are the influencing factors, evaluation systems, and enhancement strategies. The research focus must center on authentic teaching scenarios, analyzing and comparing the causes and correlations between different scenarios. To deepen the understanding of the underlying mechanisms and causal pathways of pre-service teachers' ICT teaching competency, the research subjects should be refined, and the integration of general research on pre-service teachers and research on the disciplinary characteristics of pre-service teachers should be emphasized. This integrated approach will provide evidence-based support for the in-depth study of pre-service teachers' ICT teaching competency.

5. CONCLUSION

Through a systematic review of literature on pre-service teachers' ICT teaching competency in the CNKI full-text database from 2004 to 2024, combined with bibliometric and knowledge map analysis methods, this paper reveals the dynamic developmental characteristics of the field. In the future, it is imperative to expand diversified methodological approaches, strengthen empirical research and localized theoretical innovation, enhance technological empowerment, promote interdisciplinary collaboration, and deepen the research on the enhancement system and evaluation of pre-service teachers' ICT teaching competency, thereby providing theoretical support for the construction of a stronger education system.

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