

Comparative Analysis of Hot Spots on Teachers' Digital Competence at Home and Abroad Based on Domestic and International Core Databases from 2006 to 2025

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Abstract: With the fourth industrial revolution, the digital transformation of education has become an important trend in many countries in the digital era. The general quality of teachers is the foundation of educational development in a nation. Teachers' digital competence has become a prerequisite for the digital transformation of education in China. To grasp the current status of teachers' digital competence studies and help improve it in China in the future, this study conducted bibliometric and visualization analyses of literature from domestic and international core databases from 2006 to 2025 using CiteSpace software. It was found that both domestic and international studies on this topic have been growing in recent years, but there are significant differences in the keywords and their emergence time points. This study also summarizes the research hot spots: domestic studies focus on model construction and strategy development to improve teachers' digital competence, while international studies focus on empirical research related to teachers' digital competence. Based on this, this study proposes several research insights for future studies on teachers' digital competence in China, so as to help Chinese teachers adapt to the new expectations and requirements of the digital era.

Keywords: Teachers, Digital Competence, Bibliometrics, Hot Spots, Digital Transformation of Education

1. Introduction

In 2006, the EU first proposed “digital competence” in its *Key Competences for Lifelong Learning* report. Ferrari (2012) ^[1] defined it as the knowledge, skills, attitudes, abilities and awareness needed to use information and communication technologies and digital media to complete tasks or solve problems. In 2013, the EU's Digital Competence Framework divided it into five components: information, communication, content creation, safety and problem-solving.^[2]

With the development of digital and intelligent technologies and the Fourth Industrial Revolution, the core value of digital competence in education has become increasingly prominent. Educational digitalization has become a core topic in global education. In 2020, the EU released the *Digital Education Action Plan (2021-2027)*, elevating it to a strategic priority at the European level. In recent years, China has issued key documents including the *Action Outline for Upgrading Digital Literacy and Skills* and the *14th Five-Year Plan for National Informatization*. These aim to deepen ICT-education integration, develop lifelong digital education, build new-era teaching models, and advance educational digital transformation and Digital China. Accelerating this transformation is critical to deepening educational reform, boosting high-quality education, and building China into a leading country in education. To build a strong nation, education comes first; to strengthen education, teachers must be empowered first. Teachers bear the core mission of nurturing talents for the country and the Party. Their digital competence is thus a critical prerequisite for national educational digital transformation.

To boost teachers' digital competence, many international and domestic policy documents have been issued. The 2017 EU DigCompEdu framework defined six core areas, namely Professional Engagement, Digital Resources, Teaching and Learning, Assessment, Empowering Learners, and Facilitating Learners' Digital Competence, along with 22 specific competences, providing a systematic framework ^[3]. The 2018 U.S. *ISTE Standards for Educators* set new requirements for K-12 teachers and defined seven digital era

roles^[4]. China's 2022 Education Industry Standard of *Digital Literacy of Teachers*, though digital literacy and competence differ in connotation, defined five dimensions to guide assessment and targeted training^[5]. These documents emphasized the critical importance of fostering teacher digital competence. Moreover, reviewing relevant international and domestic research can guide future domestic studies, improve China's digital era teaching workforce, and advance the building of a leading country in education and Digital China.

This study draws on high-quality domestic and international literature, focusing on teachers' digital competence across primary, secondary and higher education. International literature is sourced primarily from Web of Science, while domestic literature comes from the China National Knowledge Infrastructure (CNKI), including authoritative sources from CSSCI, PKU Core and AMI databases. Through systematic literature review and analysis, this study uses visualization to map overall research trends and high-frequency keywords in domestic and international teachers' digital competence research. Complemented by textual analysis, it identifies key research focuses and cross-national differences to clarify the field's research trajectory. Finally, it proposes refined future directions and suggestions for domestic research.

2. Research Methods and Data Sources

2.1 Research Methods

This study primarily employs the bibliometric method, that is, it mainly adopts a quantitative approach to analyze various characteristics of the academic literature and, relying on the quantitative external features of the literature, applies mathematical and statistical techniques to describe, evaluate, and predict the current research status and development trends^[6]. Developed in 2003, CiteSpace is a Java-based software for visualizing and analyzing academic literature. Through network visualization and cluster analysis within specific knowledge domains, it illustrates the evolution, research trends, and current hot topics of the field^[7]. This study will use CiteSpace 6.1 R6 to conduct systematic visualization analysis of relevant domestic and international literature to demonstrate keyword distribution, development trajectories, and trends in the number of publications over time in existing literature on teachers' digital competence, thereby laying a preliminary foundation for subsequent analysis of research hotspots and comparative studies between domestic and international research.

2.2 Data Sources

Domestic literature was retrieved from the China National Knowledge Infrastructure (CNKI) database, with a focus on high-quality literature indexed in the PKU Core, CSSCI, and AMI databases. Due to the limited number of policy documents specifically targeting teachers' digital competence in China, existing research on this topic is mostly in its nascent stage. Moreover, many Chinese scholars tend to use "digital competence" and "digital literacy" interchangeably to express similar concepts^[8]. Therefore, when screening target literature in the Chinese database, this study conducted a topic search using three keywords: "teachers' information literacy", "teachers' digital literacy", and "teachers' digital competence". In contrast, since several policy documents related to digital competence have been issued internationally, research on digital competence has flourished and has clearer conceptual boundaries with related concepts such as "digital literacy" and "information literacy". Thus, when retrieving literature from the Web of Science database, "Digital Competence of Teachers" or "Teachers' digital competence" was used as the topic keyword for screening. Given that the term "digital competence" first appeared in 2006, this study selected the time span from January 1, 2006, to December 31, 2025, as the retrieval period, and set the time slice value in CiteSpace to 1 year for literature organization. To further ensure the accuracy of the results, literature with low relevance was excluded based on titles and abstracts, resulting in a final sample of 329 domestic articles and 497 international articles.

3. Results of Literature Status Analysis and Comparison of Domestic and International Research Hot Spots

3.1 Results of the Status Analysis of Domestic and International Literature on Teachers' Digital Competence

First, based on the annual publication volume trend chart generated by CiteSpace, this study conducted a preliminary analysis of publication trends of all selected domestic and international literature.

For domestic literature, the number of relevant publications showed a stable development trend from 2006 to 2022, maintaining an average annual publication volume of approximately 10 articles with no significant increase or decrease, but saw a sharp increase in 2022; for international literature, the publication volume was relatively small from 2006 to 2016, showing a slow growth trend, experienced a moderate increase in 2016, and showed a sharp upward trend after 2018. After a brief decline in 2023, it reached its peak in 2025. Overall, literature related to teachers' digital competence both domestically and internationally has generally shown a growth trend in the past five years. It can be predicted that relevant research in this field is highly likely to continue to grow in the next few years, and the importance and research value of teachers' digital competence research have been preliminarily confirmed.

By importing 329 domestic and 497 international articles into CiteSpace, this study analyzed high-frequency keywords and generated knowledge maps of teachers' digital competence research hot spots internationally and domestically. Keyword font and node size represent occurrence frequency: higher frequency corresponds to larger nodes. High-frequency keywords include information literacy, digital literacy, teachers, university teachers, information technology, training mode, and educational technology. Notably, "teachers' digital competence" was absent from the domestic map. Cluster labels were extracted and a domestic keyword cluster timeline map based on publication time and keyword frequency was generated using CiteSpace's keyword function and the LLR algorithm to show high-frequency keyword trends. From 2006 to 2021, most domestic literature related to teachers' digital competence adopted the term "information literacy". After the 2022 release of *Digital Literacy of Teachers*, studies focused on "digital literacy" surged. Thus, while teachers' digital competence research has emerged, it remains non-mainstream in China. Most domestic scholars use "information literacy" or "digital literacy" instead of the internationally standard "digital competence" to describe teachers' digital teaching knowledge, skills, and attitudes. International literature shows distinct keyword profiles and trends. High-frequency keywords include digital competence, education, ICT, higher education, teacher education, digital literacy, information literacy, and other terms. While "information literacy" and "digital literacy" are prevalent both domestically and internationally, "teachers' digital competence", which remains non-mainstream domestically, is the top global keyword, confirming its widespread international attention and significant research value. The international timeline map shows that before 2013 research also used "digital literacy" and "information literacy". After the release of the EU's *A Framework for Developing and Understanding Digital Competence in Europe* in 2013, most studies shifted to "digital competence", focusing on teacher professional development and training via targeted programs to meet digital-intelligence era demands.

3.2 Summary of Domestic and International Research Hot Spots on Teachers' Digital Competence

Given that although CiteSpace is capable of visually analyzing and displaying the target literature, its extraction of the focal themes of articles may contain errors and may not accurately capture the core content addressed in the literature. Moreover, to ensure the readability of the visualization maps and the feasibility of literature organization, restrictive conditions were applied to the literature subjected to visual display (such as core journal articles in CNKI and literature indexed in the Web of Science database). Consequently, some important studies may have been overlooked. This study intends to conduct an in-depth reading of the literature on teachers' digital competence both domestically and internationally and, in conjunction with the above-mentioned visualization maps, to identify the research hot spots in this field. By sorting through and reading the domestic literature indexed in the CNKI database that has mentioned the concept of "teachers' digital competence," the domestic literature can be broadly categorized into two main research hot spots: (1) the construction of models related to teachers' digital competence; (2) strategies or pathways for enhancing teachers' digital competence.

3.2.1 Domestic Research Hot Spot 1: Construction of Models Related to Teachers' Digital Competence

Research on teachers' digital competence in the domestic context is still at a nascent stage. Eighteen existing studies have been devoted to the construction of models related to teachers' digital competence, aiming to explore the constituent elements of teachers' digital competence and provide a theoretical foundation for cultivating their digital competence.

Wang Xiaodan and Wang Jun (2023) ^[9] constructed a digital competence model for university teachers through methods such as interviews, questionnaire surveys, and literature research, comprising five dimensions: digital technology application, teaching ability, collaboration ability, academic innovation ability, and digital literacy. With reference to globally popular digital competence frameworks and the industry standard *Digital Literacy of Teachers* released by China in 2022, Song Xiaohuan (2024) ^[10] developed a theoretical model of digital competence for teachers in private higher education

institutions, which includes five components: technology integration and intelligent application, digital teaching ability, digital social responsibility, digital professional development, and teachers' personal characteristics. Wang Jianliang and Mei Hui (2024) ^[11] built a digital competence model for vocational college teachers, encompassing four first-level dimensions: basic digital competence, digital application competence, digital innovation competence, and digital development competence, and 16 second-level dimensions. Based on grounded theory, Chen Lei and Liu Jinfu (2024) ^[12] interviewed 15 teachers from three domestic higher vocational colleges and attempted to construct a teachers' digital competence model comprising six main components, namely digital awareness, digital thinking, digital responsibility, digital application, digital teaching, and digital management.

Thus, domestic research on teachers' digital competence models in universities and higher vocational colleges has made preliminary progress. However, most relevant literature dates to 2023 and 2024, indicating this research remains in its initial exploratory stage. Scholars have built distinctive models from diverse perspectives, offering key references for cultivating and evaluating university teachers' digital competence. Due to varying reference frameworks and study subjects, their constituent elements and hierarchical structures differ. Future research should integrate and refine these models to develop a more unified, systematic framework to guide university teacher digital competence training.

3.2.2 Domestic Research Hot Spot 2: Strategies/Pathways for Enhancing Teachers' Digital Competence

As evidenced by keywords such as “training”, “teacher training”, “teacher development”, and “development strategies” extracted from the keyword map of domestic research, another hot spot of domestic studies lies in proposing appropriate training or enhancement strategies and pathways to address the challenges faced by Chinese teachers in developing their digital competence, with the aim of offering feasible measures and suggestions for cultivating the digital competence of teachers in Chinese universities and primary and secondary schools.

Du Zhiqin (2024) ^[13] identified the current challenges confronting vocational college teachers in developing digital competence and proposed practical pathways for cultivating their digital competence from three different levels: national, institutional, and individual teacher levels. Ji Yanan, Jin Ming, and Chen Xiaomei (2024) ^[14] focused on the role orientation of open universities, emphasizing their importance as a cradle for cultivating digital talent. Against this background, they constructed a digital competence model for open university teachers encompassing five core dimensions—digital awareness, digital knowledge and skills, digital teaching, facilitating learners' digital competence development, and change and development—and concurrently proposed a series of targeted development and enhancement strategies. Lin Tao and Ye Yiqing (2024) ^[15] started from the practical dilemmas of digital competence existing among primary and secondary school teachers and proposed four main improvement strategies: enhancing digital awareness, optimizing evaluation standards, integrating digital resources, and coordinating multi-stakeholder participation, to help domestic primary and secondary school teachers develop digital competence. Wen Hui (2024) ^[16] combined China's policy orientation for promoting teachers' digital competence with the actual situation of teachers' professional development, and suggested starting from three levels: establishing firm concepts, optimizing resource allocation, and improving mechanisms, to comprehensively improve the digital competence level of primary and secondary school teachers. Zhou Yang (2024) ^[17] similarly began with the practical dilemmas of Chinese teachers' digital competence, explored the influencing factors of teachers' digital competence, and proposed practical pathways, such as optimizing the framework for teachers' digital competence, enhancing awareness of improving teachers' digital competence, carrying out teachers' digital competence training, and enriching digital teaching practices to promote the enhancement of teachers' digital competence.

Domestic research hot spots show that in the digital era, scholars recognize digital competence's key role in educational digital transformation and teaching quality improvement. To address challenges in developing teachers' digital competence, they have proposed enhancement strategies and practical pathways to advance teachers' digital competence across levels.

While existing international studies also focus on constructing teachers' digital competence models and school teacher cultivation pathways, these topics are not mainstream international hot spots. Unlike domestic research, which centers on theoretical model building and enhancement strategy design, international research prioritizes empirical studies to propose actionable recommendations for improving teachers' digital competence.

3.2.3 International Research Hot Spot: Development and Validation of Measurement Instruments for Teachers' Digital Competence

Domestic research tends to explore the constituent elements of teachers' digital competence through model construction, whereas international research is more inclined to conduct empirical studies involving scale development, thereby exploring the sub-dimensions of teachers' digital competence while providing measurement instruments for capturing the current state of teachers' digital competence. The term "Validation" also appears in the keyword map of international research, which corroborates that empirical research on measurement instruments occupies an important position in the relevant international studies.

Ghomi and Redecker (2019) ^[18] created a self-assessment tool strictly following the DigCompEdu framework to measure teachers' digital competence. Their study selected 335 German teachers as participants and verified the reliability and validity of the tool. Lucas et al. (2021) ^[19] validated a measurement scale based on the DigCompEdu framework in a sample of 1,071 primary and secondary school teachers in Portugal; their findings also explored the influencing factors of teachers' digital competence, revealing significant gender and age differences. Tzafilkou et al. (2023) ^[20] developed a measurement tool for primary and secondary school teachers comprising 20 items that cover six domains: teaching preparation, teaching delivery and student support, teaching evaluation, teaching revision, professional development, school development, and innovative education. Gümüş and Kukul (2023) ^[21] also designed a scale based on the European Framework for Digital Competence of Citizens and added a new dimension called digital ethics on the basis of the five dimensions originally proposed by the EU. Aydin, Yildirim, and Kus (2024) ^[22] surveyed 271 primary and secondary school teachers from Sweden and Turkey and developed a teachers' digital competence scale consisting of 36 items, dividing teachers' digital competence into four dimensions: teachers' digital teaching competence, teachers' use of teaching and communication tools, teachers' use of hardware tools, and teachers' digital development.

Drawing on different theoretical frameworks, international scholars have developed and validated teachers' digital competence scales covering various sub-dimensions, enriching the international repository of empirical research instruments while providing new ideas and directions for future domestic empirical research.

4. Research Implications

As mentioned above, teachers' digital competence has not yet become a systematic, mature, or mainstream research field in domestic studies. Therefore, drawing on the research hot spots and high-frequency keywords of international research on teachers' digital competence, this study intends to provide further insights for future domestic research on teachers' digital competence.

4.1 Pay Attention to the Dynamic Development of the Concept of Digital Competence and Update Research Directions with the Times

With the advancement of modern science and technology and the changes of the times, the content and definition of the concept of digital competence have undergone a continuous process of development, updating, and transformation. Terms such as digital literacy and information literacy, as predecessor concepts of digital competence, are prone to causing confusion when used, and it is common to see the indiscriminate use of digital literacy, digital ability, and digital competence in the domestic academic community. However, Zheng Xudong, Ma Yunfei, and Yue Tingyan (2021) ^[23] have pointed out that digital literacy and digital competence are two distinct concepts, with the former serving as the foundation for the latter. Digital literacy focuses on an individual's skills and abilities in using digital-related technologies and is typically defined as the capacity to correctly use and evaluate digital resources, tools, and services and to apply them to the lifelong learning process. In contrast, digital competence not only integrates digital skills and knowledge but also encompasses factors such as ethics, digital citizenship, well-being, security, and collaborative elements in digital environments. International scholars have stated that the view that merely focuses on teachers' ability to use digital technology in the current era should be abandoned, and that the more complex and comprehensive concept of digital competence should be adopted to summarize teachers' holistic qualities and capabilities in the digital intelligence era.

The international education field is increasingly replacing terms like digital literacy and digital skills with digital competence, and competence standards are emerging as a key global talent quality metric.

The 2024 World Digital Education Conference reaffirmed the international consensus on digital education and emphasized the value of enhancing teachers' digital competence. While most domestic scholars still use digital literacy, digital competence has richer comparative and competitive connotations. Unlike digital literacy, which only measures individual digital skills, it embodies ongoing pursuit of excellence in the digital-intelligence era. As a specific professional group, teachers derive greater value from digital competence in practicing the lifelong learning philosophy.

Future domestic research should clearly define, distinguish, and clarify the relationship between the two terms, recognize digital competence's profound significance for teacher education, and prioritize this internationally recognized term to expand and refine domestic research on teachers' digital competence.

4.2 Conduct Localized Empirical Research on Scale Development to Closely Integrate Theory and Practice

Although there is still limited domestic research focusing on digital competence, as mentioned earlier, a number of scholars have conducted studies on this topic. A considerable proportion of these studies focus on constructing theoretical models of teachers' digital competence. Such research is typically based on a certain theory and employs methods such as literature research, interviews, and expert consultation to build the basic framework of the model. Moreover, the dimensions encompassed in most of these teachers' digital competence models do not reflect the distinctive localized characteristics of Chinese education, and are relatively similar to the sub-dimensions of the teachers' digital competence framework proposed by the EU according to its localized educational conditions. As a result, the existing teachers' digital competence models still suffer from deficiencies in their guiding value and operational feasibility within the domestic educational context.

At the same time, there is a dearth of empirical research on teachers' digital competence at home, with only a few scholars, such as Hu Jingmei and Li Yubin (2022) ^[24], having carried out relevant empirical studies attempting to investigate the current state of digital competence among specific groups of teachers. In contrast, international research tends to conduct empirical studies involving scale development to identify the possible dimensions subsumed under teachers' digital competence and to ascertain the overall level of teachers' digital competence in a particular region or educational stage. To formulate more effective, feasible, and China-specific strategies and paths for improving teachers' digital competence, domestic scholars first need to attempt to develop more localized teachers' digital competence scales suited to China's context in order to comprehensively and deeply capture the current state of digital competence among specific target groups of teachers in China. Based on China's localized requirements for teachers and students at the relevant educational stage and the relevant policy orientations, they should also form a foundational understanding of the various sub-dimensions that teachers' digital competence should cover. Therefore, future domestic research can undertake more empirical studies of this kind involving scale development, devote efforts to the development and validation of localized Chinese instruments for measuring teachers' digital competence, explore the possible elements and dimensions that teachers' digital competence should encompass in the Chinese cultural context, and, with the support of empirical data to corroborate research assertions, construct more systematic, refined, and practical theoretical frameworks and models. Then, as Feng Bang and Liang Yanping (2024) ^[25] suggest, future research can propose targeted and reasonable strategies and suggestions for enhancing the digital competence of teachers at different educational stages in China.

5. Conclusion

Adopting the unique perspective of bibliometrics, this study conducted a comprehensive, systematic review and in-depth analysis of the extensive domestic and international literature on teachers' digital competence published between 2006 and 2025. First, this study preliminarily elucidated the current research status and development trends of this topic both domestically and internationally. Specifically, although teachers' digital competence has not yet become a mainstream research field in domestic academic circles, related research has begun to show a growth trend in recent years, while international research on teachers' digital competence has generally exhibited a steady growth trend since the EU released the *Digital Competence Framework for Educators* in 2017.

This study also summarized the main research hot spots in the field of teachers' digital competence in domestic and international academia in recent years. That is, domestic research focuses more on the construction of teachers' digital competence models and the exploration of improvement strategies, while international research tends to conduct empirical studies such as scale development and validation and

the exploration of influencing factors.

Finally, drawing on the advanced hot spots and trends in international research, this study offers novel and targeted suggestions and ideas for future domestic research from two distinct perspectives. It aims to provide useful references and guidance for subsequent domestic research, thereby promoting the effective improvement of teachers' digital competence and contributing to the construction of a high-quality teaching workforce and the advancement of Digital China and a leading country in education.

Acknowledgments

This paper was funded by Hebei Provincial Project for Supporting the Introduction of Overseas-Educated Talents (No.C20230104) and supported by The 2024 Teaching Reform Project of Tianjin Normal University (JG01224041).

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