

A Visual Analysis of the Hotspots, Processes and Prospects of Digitalization Research on Rural Teachers in China over the Past 10 Years

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Abstract: Over the past decade, research on rural teachers' digitization in China has gradually become a hot social issue of great concern. Using CiteSpace to visualize and analyze the high-quality literature on rural teacher digitization-related research in the CNKI database in the past 10 years, the timeline shows a clear research trend during the decade, including three stages of sustained growth (2014-2019), a brief decline (2020), and a rapid rebound (2021-2024), which is in line with the changes in the national education tactic, the rural revitalization strategy, and the rise of online education in the wake of the COVID-19 epidemic and the global trend of digital transformation. The research power of rural teachers' digitalization is mainly concentrated in teacher training colleges and education academies, and the authors and research institutes are characterized by small concentration and large dispersion, and the cooperation network has not yet been widely formed. The three core themes of "rural teachers", "rural education" and "rural revitalization" are highlighted in the cited keywords, reflecting the close connection between the research content and national tactic and social needs. In light of the regional and special characteristics of rural education, research that is detached from the reality of the countryside and based on a single methodology will gradually change to a diversified research model based on the localized characteristics of the countryside.

Keywords: CiteSpace; Knowledge Mapping; Rural Teachers; Digitization

1. Introduction

1.1 Background and Significance of the Research

The issue of rural education has always been a crucial topic in the development of education both in China and globally. With the advent of the digital age, technology has empowered education, and the digital transformation of education has become a hot topic in contemporary educational research. The long-standing imbalance between urban economic development and rural development has resulted in a significant urban-rural educational gap, making rural education a weak link in China's educational system. The rapid development of digital technology has become an important means to improve the level of rural education, promote educational equity, and reduce the educational divide^[1]. This study aims to review the research focus and progress of rural teachers' digitalization in China over the past decade, providing theoretical and practical support for improving the quality of rural education and enhancing the digital literacy of rural teachers.

1.2 Data Source

In this study, CNKI was selected as the data source, and the search terms of "rural teachers' TPACK", "rural teachers' informationized teaching", "rural teachers' information literacy", "rural teachers' technology", "rural teachers' digital literacy", and "rural teachers' digitalization" were selected as the starting point of the literature source search. "rural teachers' technology", "rural teachers' digital literacy" and "rural teachers' digitization" as search terms, and selected 2014 and 2024 as the starting and ending points of the literature source search time. and the end point. In order

to focus on the research of rural teachers' digitalization and reduce the influence of irrelevant data, the disciplines related to rural education and rural teachers' digitalization, such as educational theory and educational management, computer software and computer application, secondary education, higher education, primary education, adult education and special education, library information and digital library, were selected as the disciplines for the search of literature sources.

Using "subject" as the search keyword, and selecting core journals with high recognition and influence, CSSCI, CSCD as the journal source categories, a total of 275 journal documents were obtained by eliminating duplicates, book reviews, news reports and other non-research documents, and then stored in txt text in the format of refworks, and then exported to CiteSpace V to export the above documents. CiteSpace V was used to export the keywords, authors, issuing organizations and other valid information of the above literature.

1.3 Research Methods

CiteSpace V is a professional literature analysis software, mainly used for the visual analysis of scientific literature and knowledge domain exploration^[2,3]. CiteSpace V is a professional literature analysis software, which is mainly used for the visualization of scientific literature and knowledge domain exploration. It helps researchers to sort out the research development and trends by analyzing the data of co-citation and keyword co-occurrence, and helps to explore the dynamic changes and hot research trends of scientific research. CiteSpace utilizes the knowledge mapping technology to realize the visual presentation of the data of citation analysis and keyword co-occurrence. With the help of this knowledge map, researchers are able to visually reveal the research focuses and evolutionary trends of rural teachers' digitalization in recent years.

2. Rural Teachers' Knowledge Mapping

2.1 Temporal Distribution of the Literature

Preliminary statistical analysis of the collected data yielded that the distribution of articles during the period 2014-2024 can be roughly divided into three phases, as shown in Figure 1:

the first period is a sustained growth phase (2014-2019), with an increase in the number of articles year by year starting from 2014, and reaching a peak of 35 articles in 2019; the second is a one-year fallback period (2020), which dropped to 9 articles; the third period is a period of rapid rebound (2021-2024), reaching a peak of 54 articles in 2024. The review found that the "Notice on Providing Living Allowances to Rural Teachers Working in Contiguous Destitute Areas," issued by the Ministry of Education and the Ministry of Finance in 2013, implemented provisions for living allowances for rural teachers. This initiative sparked a wave of research on rural teachers in 2014. In 2018, China recommended continuing to focus the development of national social undertakings on rural areas, promoting the allocation of resources such as public education towards rural regions. This opinion promotes the steady growth of research on rural teachers and the direction of rural teacher digitization. The brief decline of related research in 2020 may be attributed to the outbreak of the COVID-19 epidemic and the resulting shift in research focus, the reallocation of resources, and the restriction of field research, among other reasons. Taking the COVID-19 outbreak as an opportunity, the development of online courses and the full-scale implementation of online classes ushered in a rapid rebound in rural teachers' digitalization research in the following year, coupled with the "Strong Teachers Program" in 2022 and "Promoting the Digitalization of Education", which were respectively proposed, universities and research institutes attached great importance to the digitalization of education. In addition to the "Strong Teachers Plan" and "Promoting Education Digitization" in 2022, Universities and research institutes have increasingly emphasized and conducted related research, leading to a steady rise in the number of publications year by year.

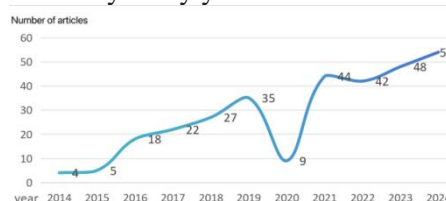


Figure 1. Statistics of Digitalized Research Publications on Rural Teachers, 2014-2024

2.2 Distribution of Authors in the Literature

As the data in Table 1 shows, based on the statistical criterion of the first author, Prof. Tang Songlin of Hunan University became the most prolific author by publishing six papers. Among the 11 authors who have published more than three papers, except for Prof. Tang

Songlin, the other 10 authors are from teacher training colleges and universities, and their research is concentrated in the field of education. This phenomenon indicates that teacher training colleges and the education sector have paid high attention to the field of rural teachers' digitalization research and have achieved fruitful research results in this field.

Table 1. Author Posting Statistics of Rural Teacher Digitization Research in China, 2014-2024

No.	Number of articles	Authors	Year of first publication	issuing organization
1	6	Tang Songlin	2014	Hunan University
2	4	Xiao Zhengde	2014	Hangzhou Normal University
3	4	Liujia	2017	Huzhou University
4	4	Zhouye	2022	Northwest Normal University
5	4	Fu Weidong	2018	East China Normal University
6	3	Wu Zhihui	2019	Northeast Normal University
7	3	Gao Panwang	2014	Shandong Normal University
8	3	Zhang Haizhu	2018	Shanxi Normal University
9	3	Zhang Ligu	2023	Shaanxi Normal University
10	3	Li Hua	2021	Tianshui Normal University
11	3	Liu Shanhuai	2019	Northeast Normal University

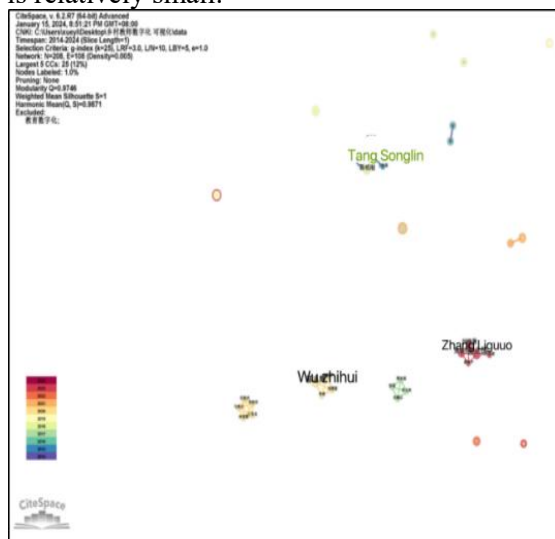
The posting authors can reflect the core authors and their research teams in the research field. As shown in Figure 2a, a total of 208 nodes were formed in the authors' cooperative network analysis, and only 108 interactive links were formed, showing that the density of the network was only 0.005. This low-density indicator suggests that the cooperative network in this field is relatively sparse. From Figure 2b-2d, it is clear that teamwork research is combined with individual solo work, and teamwork presents a three-pronged situation, with Tang Songlin, Zhang Ligu, and Wu Zhihui forming the core of the three main research teams. Although the links within each team are strong, there is a lack of sufficient cross-collaboration between these teams and with external organizations. This situation suggests that there is limited communication between the teams and less interdisciplinary and cross-disciplinary integration of research. Less interdisciplinary integration may affect the breadth and depth of integrative research.

2.3 Distribution of Issuing Organizations

Institutional distribution of articles as shown in Figure 3, the distribution of institutional charts appeared obvious clustering effect, the

formation of the five major centers of rural teacher digital research in China: the Department of Education of Southwest University, the Department of Education of Northeast Normal University and the Northeast Normal University China Rural Education Development Research Institute, the Department of Education of Beijing Normal University, the Department of Education of Guangxi Normal University, as well as the College of Educational Sciences of Hunan University. Among them, Southwest University topped the list with 13 articles. Institutions with more than 10 articles include the Department of Education of Southwest University, the Department of Education of Beijing Normal University, and the China Rural Education Development Research Center of Northeast Normal University. Northeast Normal University, Department of Education and Northeast Normal University, China Rural Education Development Research Center became according to the amount of articles ranked found that China's six teacher training colleges directly under the Ministry of Education are at the forefront of the rest of the institutions are also a book of colleges and universities. Similar to the findings of scholars Du Zhiqiang and Chen Yifan, high-level

research on rural teachers is mainly concentrated in the ministry as well as other well-known one-book teacher training colleges and universities, and the number of high-level papers on digitalization of rural teachers in comprehensive colleges and universities and local new two-book colleges and universities is relatively small.



a. Co-occurrence Mapping of Authors of Research on Digitization of Rural Teachers in China, 2014-2024



b. Core Team 1



c. Core Team 2



d. Core Team 3

Figure 2. Co-occurrence Mapping of Authors of Research on Digitization of Rural Teachers in China, 2014-2024 and Core Team Mapping

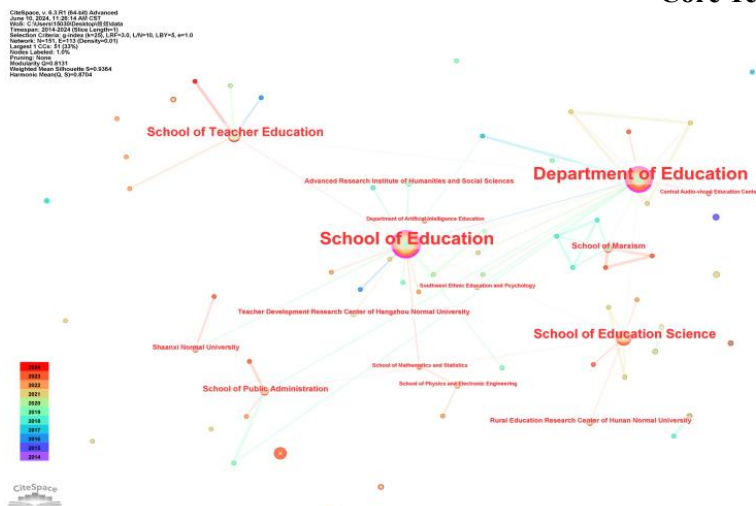


Figure 3. Co-occurrence Mapping of Institutions Issuing Research on Rural Teachers in China, 2014-2024

2.4 Keywords Co-occurrence

Keywords are highly condensed and summarized in the content of the author's article, which can reveal the research theme and direction and reflect the core content of the paper. Figure 4 will be the keywords as network nodes, set a year as a time slice, to each time slice of the top 25 highly cited

keywords to draw a common line word spectrum, keyword co-occurrence mapping relationship line color with the advancement of time from orange-yellow to rosy-red transition, each node represents a keyword, node size characterizes the frequency of the keyword, the larger the node the higher the frequency of the keyword appears. The connecting line indicates the frequency of two keywords

appearing together in the literature, the thickness of the connecting line indicates the strength of the degree of connection between the keywords and the number of co-occurrences, the thicker the line, the higher the frequency of co-occurrences. There are 276 keyword nodes, 498 links, and a density of 0.0131 in Figure 4. Among them, rural teachers, rural education, and rural revitalization become the highest centrality keywords, which have been the hot topics in the research in this field, and on November 30, 2022, China's Ministry of Education released the document "Teachers' Digital Literacy", and the high-quality development and teachers' digitization are undoubtedly the hottest 2024 Topic. The mapping shows that the five largest connected subgraphs in the literature contain a total of 240 keywords, and the most frequently co-occurring keywords account for 86% of the total, indicating a strong co-occurrence relationship between these keywords.

The top 10 high-frequency keywords were extracted according to the order of keyword citation frequency, and the research hotspots of rural teachers, rural schools, and teachers' professional development appeared earlier, rural revitalization, and rural education followed, and rural teachers' professional development, high-quality development, and teachers' team building were the research hotspots in the past two years. As can be seen from Figure 5, the centrality of the above three terms of rural teachers (127,1.02), rural

education (35,0.23) and village teacher (31,0.22) is high, and they are the three major themes that can not be bypassed in the study of rural teachers' digitization. The promulgation of the Opinions of China on Comprehensively Promoting Rural Revitalization and Accelerating Modernization of Agriculture and Rural Areas in 2021 marked China's focus on modernization of agriculture and rural areas, which explicitly set out the goal of achieving significant progress in modernizing agriculture and rural areas by 2025. Against this backdrop, the research field focuses mainly on applied and developmental research, especially the digital management practices of rural education and the technological training and professional development of rural teachers have become the focus of research. Rural education, as a key component of the whole education system, plays an indispensable role in improving the overall quality of the rural population. Rural teachers are not only the backbone of rural education development, but also play a crucial role in improving the quality of rural population and promoting rural revitalization. The role of rural teachers is crucial to the future quality of rural population in China. Therefore, enhancing the digital literacy of rural teachers is not only crucial to promoting the digital reform and high-quality development of rural education, but also of great significance in bridging the shortcomings of education and promoting the digital transformation of society.

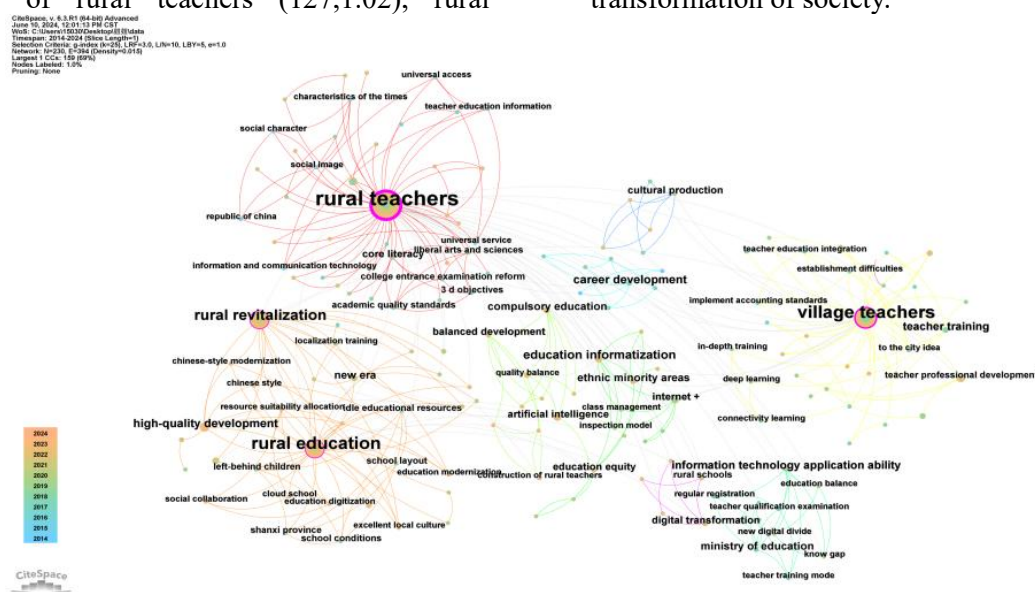


Figure 4. Co-occurrence Mapping of Keywords in China's Rural Teacher Digitization Research, 2014-2024

2.5 Knowledge Graph Analysis of Co-citation Clustering

The co-citation clustering map can reveal the different research focus areas within this field. By visualizing the co-cited references, we obtained Figure 5. As shown in Figure 5, there are nine differently colored labels representing nine clusters. The clustering numbers used in this system represent the number of keywords in each cluster: larger numbers correspond to clusters with fewer keywords, while smaller numbers indicate clusters with more keywords. Within the map, connections only exist within the clusters for #0 "rural teachers" and #2 "village teachers." Other clusters, such as #1 "rural revitalization," #3 "balanced development," #4 "educational equity," #5 "information technology application ability," #6 "tactics implementation," #7 "cultural capital," and #10 "digital transformation," show cross-cluster connections. This indicates a higher degree of co-citation and close relevance between these research directions.

In the keyword co-occurrence analysis, LLR (Log-Likelihood Ratio) is used to assess whether the co-occurrence probability of two keywords is significantly higher than their random co-occurrence probability. According to Figure 5, with the theme of rural teachers' digitalization, cluster #0 "rural teachers" and "TPACK" show a high MI (Mutual Information) value. In the field of rural education, the TPACK framework is widely used to optimize teachers' digital teaching abilities, aiming to improve teaching quality and enhance teachers' digital literacy. This might indicate a current research trend or literature focus on how to apply the TPACK framework in rural teachers' teaching practices or how rural teachers can improve their teaching effectiveness through TPACK.

Cluster #1 "rural revitalization" and "70 years of New China" have a high MI value, possibly indicating that many scholars combine rural education with national social, political, and economic changes from a historical perspective, thus often discussing these two themes together in academic papers. The theme of rural teachers and equal opportunity in cluster #2 shows a high MI value, possibly indicating that ensuring equal development opportunities for all people is key in the process of achieving rural revitalization.

Most notably, cluster #3 "balanced development" corresponds to "Shanxi Province's impoverished areas." The construction of the teaching workforce, initially a national issue involving nationwide participation, is not limited to Shanxi Province. The focus of this work is to improve the quality and capability of teachers nationwide, ensuring the uniformity and improvement of education quality. As one of China's key poverty alleviation provinces, Shanxi particularly focuses on the education of its impoverished school-age population. The Shanxi Provincial Committee and Provincial Government prioritize enhancing education levels in impoverished areas, implementing tactic measures such as funding and project inclination and establishing educational assistance accounts. Through the Special Post Teacher Program, National Training Program, and various special programs, Shanxi prioritizes the training and enrollment of students from impoverished areas while fully utilizing university resources to support industrial upgrading and self-development capabilities in impoverished regions, reflecting a comprehensive and long-term educational poverty alleviation plan^[4].

2.6 Keyword Timeline Chart

Figure 6 shows 13 clusters, each labeled with keywords from the co-occurrence network, which are spread across the clusters to which they belong according to the year in which they appeared in the corresponding time period, showing the development of the keywords in each cluster.

The figure 6 shows that hot research keywords appear at scale between 2014 and 2024, with rural teachers, rural education, rural revitalization, digitalization of education, and high-quality development being particularly prominent, which are inseparable from the national tactic's emphasis on rural education and rural teachers. In 2018, Prof. Tang Songlin and Prof. Zeng Xin respectively published the paper Empowerment and Empowerment: The Road of Rural Small-Scale School Teacher Team Construction in the Context of Rural Revitalization, "Teachers' Missions, Challenges, and Choices in the Rural Revitalization Strategy", which triggered the scholars to explore the professional development of teachers, professional

construction of teacher teams, and the development of education based on rural revitalization context. Digitalization, digital transformation, strong teacher program and other topics. open AI came out in November 2022, which triggered heated discussions on the topic of artificial intelligence in all walks

of life, and the Ministry of Education of China released a document on "Teachers' Digital Literacy" on November 30, 2022. 2022 So far, AI and digitalization have become the hottest keywords in the study of rural education and rural teachers.

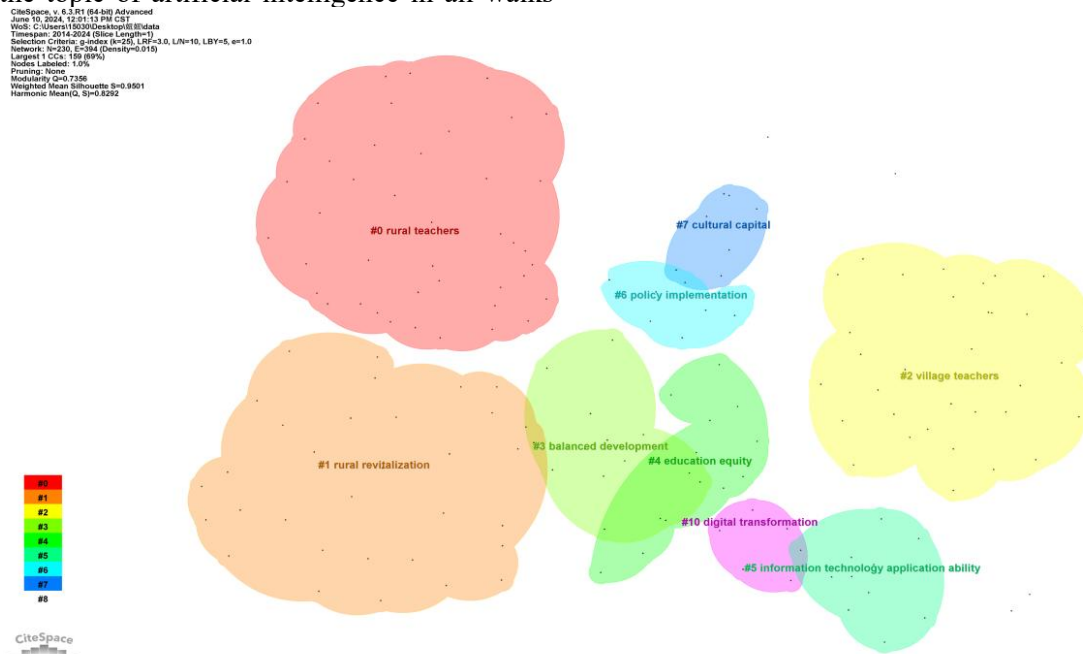


Figure 5. Clustered Knowledge Graph of Co-Cited Literature on Digitization of Rural Teachers (LLR), 2014-2024

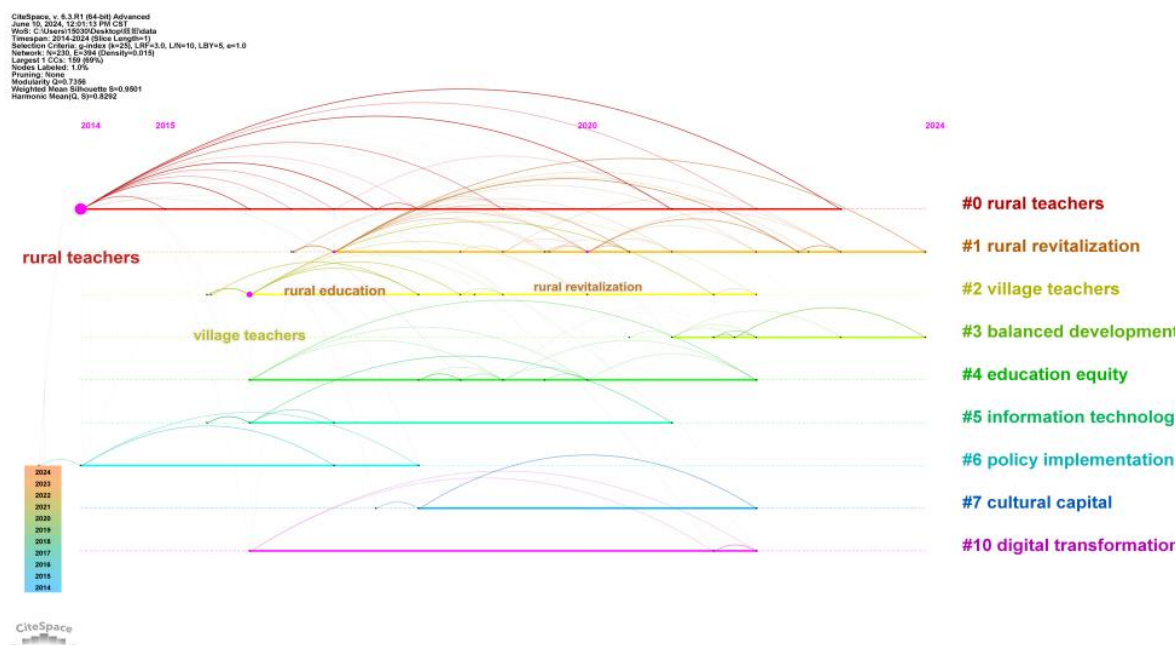


Figure 6. Co-occurrence Timeline of Keywords for Rural Teacher Digitization Research, 2014-2024

2.7 Keyword Mutation

According to the keyword mutation during the

period 2014-2023, in Figure 7. From 2014-2017, the cited high-frequency words are mainly career development, teacher training,

ministry of education, most of which are related to tactic support and tactic orientation; in 2018-2019, people expanded to internet+, knowledge gap, teacher professional development; In 2020, there was a brief gap in research due to the impact of the COVID-19 epidemic, and in 2021, there was a brief emergence of research on the construction of the teacher team and the professional development of rural teachers; from 2022 to the present, we have continued to pay attention to the themes of rural education, high-quality development, digitization, and the digitization of education, which is closely related to the introduction of OPEN AI in November 2022, the technological empowerment of education, and the digital transformation of education. trend is inextricably linked.

Top 19 Keywords with the Strongest Citation Bursts

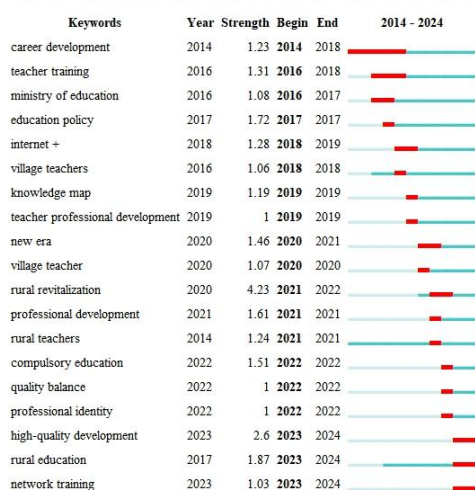


Figure 7: Distribution of Keyword Mutations for Rural Teacher Digitization Research, 2014-2024

3 Conclusions

3.1 Conclusions of the Study

3.1.1 Rural Education and Teacher Digitization Processes Led by National Tactics

This study uses the CiteSpace document visualization tool to conduct an in-depth analysis of the digital transformation of rural teachers, coupled with a coupling analysis of rural education and rural teachers. It is found that the digital transformation of rural education and teachers is not only consistent with the overall goal of the country to promote the digital transformation of society, but also crucial to the realization of the grand blueprint of building a strong educational country. The

improvement of rural education informatization level is closely related to national tactic support. Country inputs have a significant positive effect on resource allocation, education quality improvement, and rural teacher training, and Shanxi Province has achieved excellent results in the digital transformation of rural education and rural teachers, and in narrowing the urban-rural gap^[4]. Through this study, we can gain a clearer understanding of the central role of rural education informatization in the national education strategy and provide strong support for the formulation and implementation of related plans.

3.1.2 It is difficult to implement rural digitalization reforms that are divorced from reality

Rural education has the characteristic of localization, and it is difficult to integrate the digital reform of rural education and rural teachers into the local culture, traditions and social realities if they are detached from the reality^[5]. Localized education has a positive effect on enhancing the identity, cultural heritage and development of students in rural schools.

Existing teacher training is disconnected from teaching content and lacks consideration of the actual situation, resulting in the training and work in two different ways, training is training, teaching is still the same old style, and it is difficult to realize the deep integration of technology and teaching^[6,7]. This reflects the structural imbalance between the supply of traditional teacher training services and the individualized needs of teachers in the new era^[7].

3.1.3 Research methodology is relatively homogenous

Current research frameworks focus on quantitative methods, drawing on statistical models to explore the multiple influences on rural teachers' digitization, their level of competence development, and the assessment of teaching effectiveness. These studies are usually based on large-scale data collection, with numerical and statistical analyses, and provide a macro perspective on rural teachers' digitalization level and influencing factors. However, rural education has obvious regional characteristics and localized differences. Cultural backgrounds, economic conditions, educational resources, and individual teachers'

teaching styles and experiences vary from region to region. This complexity and diversity means that a single quantitative approach may not be able to fully capture and understand the deeper issues and nuances of rural teachers' digitization practices.

3.2 Research Implications

3.2.1 Focusing on the Digitalization of Rural Education to Contribute to the Strategy of a Strong Education Nation

The research priorities and processes of the past decade have shown that close integration with national tactic is crucial for research. National tactic can reflect the urgent needs of society and thus guide the direction of research, and research results can, in turn, help realize the goals of national tactic and feed back into tactic formulation and adjustment. As China strives to become an education powerhouse, research by the Chinese Academy of Educational Sciences (CAES) reveals that the key to becoming an education powerhouse lies in grasping the new trends and strong dynamics. Having gone through the stages of popularization, scientificization and internationalization of the education track, the country is currently focusing on education informatization and occupying the digital high ground as a way to promote the overall development of education. Education informatization is relatively lagging behind in rural areas, in which rural teachers are the key force in promoting this process. Their digital skills directly affect the digital literacy of rural residents and the overall education level. Emphasizing the digital transformation of rural education and rural teachers, the digital research on rural teachers needs to be in-depth, not only at the level of theoretical discussion, but also close to the actual situation, serving the strategy and highlighting the value of rural education research.

3.2.2 Transformation of TPACK Training for Rural Teachers Strengthened by Regional, Localized Characteristics

Existing digital training for rural teachers is independent of the curriculum taught by the teachers, and lacks actual investigation of rural resource allocation, educational facilities, teacher quality, etc., wasting resources while taking up rural teachers' time^[8]. While highlighting the regional differences and localized characteristics of rural education, the

digital training of rural teachers has evolved from a single technical skill (TK) to an organic integration of subject teaching with integrated technology (TPACK)^[9]. Emphasizing the key role of the TPACK framework in enhancing the digital competence of rural teachers, it must be clear that the technical content knowledge (TCK), pedagogical content knowledge (PCK), and technological pedagogical knowledge (TPK) in the TAPCK framework are not simply additive, but are organically integrated. Based on the local and specific digital pain points of rural teachers, precise training and technical support will be given to meet the differentiated needs of teachers.

3.2.3 Enrichment of Research Methods, Combining Quantitative and Qualitative Research

Introducing qualitative research methods has become an important way to complement and improve digital research on rural teachers. Focusing on in-depth understanding of rural teachers' individual experiences, feelings and perspectives, qualitative research is able to reveal specific practices, challenges and successes in the process of digital teaching and learning through methods such as interviews, observations and case studies. This approach helps to uncover the individual needs of teachers in the process of digital transformation and how they interact with their students and communities to achieve an effective integration of teaching content with rural realities^[10]. The combined use of quantitative and qualitative research methods can not only provide an in-depth understanding of the whole picture of rural teachers' digitalization at both the macro and micro levels, but also provide more precise and practical guidance and recommendations for tactic making and educational practice.

3.3 The Limitation

The limitation of this study is that it only collected data from the China Knowledge Network (CNKI) database, which limits the amount of data. In addition, it was not analyzed in comparison with relevant foreign literature in Web of Science, which limits the depth and breadth of the study.

Acknowledgments

This paper was supported by Shaanxi Province

Philosophy and Social Science Research Special Youth Project: "Research on the Path of Enhancing the Digital Application Ability of Rural Teachers in Shaanxi Province", Project No. (2024QN322); Shaanxi Society of Higher Education 2023 Special Project for Private Colleges and Universities: "Practical Research on Enhancing Teachers' Informatization Teaching Ability in Shaanxi Colleges and Universities Based on TPACK Theory", Project No.: (XGHZ2308);

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