Analysis of the Development Trends and Hotspots of Digital Transformation in China's Vocational Education

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Abstract: In recent years, with the rapid development of next-generation digital technologies, the vigorous growth of the digital economy, and the continuous deepening of the strategy to build a strong education nation, the digital transformation of vocational education has increasingly become a focal point. This trend has prompted researchers to delve into the background of digital transformation in vocational education, the current challenges and difficulties it faces, and actively seek effective pathways to enhance vocational education quality through digital transformation. It also explores how to better leverage the potential of digital technologies in educational services. Against this backdrop, this paper employs CiteSpace software to conduct a visual analysis of research literature related to digital transformation and vocational education, aiming to outline the research hotspots and evolutionary trends in this field. Based on the analysis results, the paper further proposes constructive suggestions and prospects for the future development direction of vocational education digital transformation.

Keywords: Digital transformation; Vocational education; Development insights

1. Introduction

In recent years, with the expansion of China's digital economy and the innovative development of next-generation information technologies such as cloud computing, the Internet of Things, and high-performance integrated circuits, digital technology has injected strong momentum into the high-quality development of vocational education. Currently, the digital transformation of vocational education has become an endogenous need to promote its high-quality development, a key link in building China's modern education system, and is related to the strategic overall situation of "digital China" construction [1]. In March 2021, the *Outline of the 14th Five-Year Plan for National Economic and Social Development of the People's Republic of China and the Long-Range Objectives Through 2035* clearly stated, "Accelerate digital development, build digital China, embrace the digital era, unleash the potential of data elements, and advance the construction of a cyber power"

[2]. In February 2022, the *Key Points of the Ministry of Education's Work in 2022* explicitly proposed, "Implement the strategic action of educational digitalization, actively develop 'Internet + Education,' and accelerate the digital transformation and intelligent upgrading of education" [3]. From this series of policies, it can be seen that under the background of the educational digitalization strategy, vocational education, as an important component of China's national education system and human resource development, should be placed in a more prominent position in educational reform and innovation and national development, using digital transformation as an internal driving force to promote the high-quality development of vocational education [4]. Under this background, the digital transformation of vocational education has become a new hot topic in the field of education.

This paper utilizes the visualization knowledge graph analysis software CiteSpace to conduct a visual metrics analysis of literature related to digital transformation in vocational education research in the China National Knowledge Infrastructure (CNKI) database, studying its hotspots, evolutionary trends, and cutting-edge developments, contributing to the exploration of the development path of China's distinctive digital vocational education.

2. Research methods and samples

The data for this study were sourced from the CNKI academic journal database. A search was conducted using the keywords "digital transformation + vocational education," with the source category limited to "academic journals." Non-research materials such as notices, advertisements, and book reviews were manually excluded, along with duplicate publications, resulting in an initial set of 1,094 valid articles that formed the full sample dataset. To enhance the depth and accuracy of the research, the literature sources were further narrowed down to "Peking University Core" and "CSSCI" (Nanjing University Core) journals, ultimately yielding 255 high-quality articles that constituted the high-quality core dataset for subsequent in-depth knowledge graph analysis.

In terms of analytical methodology, this study integrates macro-trend analysis with micro-level knowledge structure mining. First, we utilize the built-in "visualization" feature of the CNKI database to conduct an overall trend analysis of the full-sample dataset, capturing the macroscopic development trends of the field. Subsequently, we employ the CiteSpace Scientific Knowledge Graph Tool (version 6.4.R1) to perform in-depth analysis on high-quality core datasets. In CiteSpace analysis, the time span is set from 2014 to 2025, with 1-year intervals as time slices, node types selected as "keywords," and the Pathfinder algorithm applied for network pruning. The analysis not only focuses on keyword frequency to identify hotspots but also calculates intermediary centrality (typically considered significant when > 0.1) to identify key hubs connecting different research themes. This approach enhances the persuasiveness of research conclusions and provides deeper insights into the domain's knowledge structure.

3. Research results and analysis

3.1. Article publication analysis

The annual publication volume of academic papers serves as a crucial indicator for gauging the attention and developmental trends in specific research fields. Its fluctuation patterns can intuitively reveal whether a field is becoming a hot topic in academia [5]. According to the search results shown in **Figure 1**, the total publication volume (blue bar) demonstrates a clear "initial stagnation followed by explosive growth" pattern in this field. From 2014 to 2020, annual publications remained at a very low level, indicating that the topic had not yet

attracted widespread academic attention at that time. However, since 2021, the total publication volume has shown exponential growth, peaking at 401 papers in 2024. This steep growth curve clearly demonstrates that the integration of digital transformation and vocational education has rapidly become a hot research area in recent years.
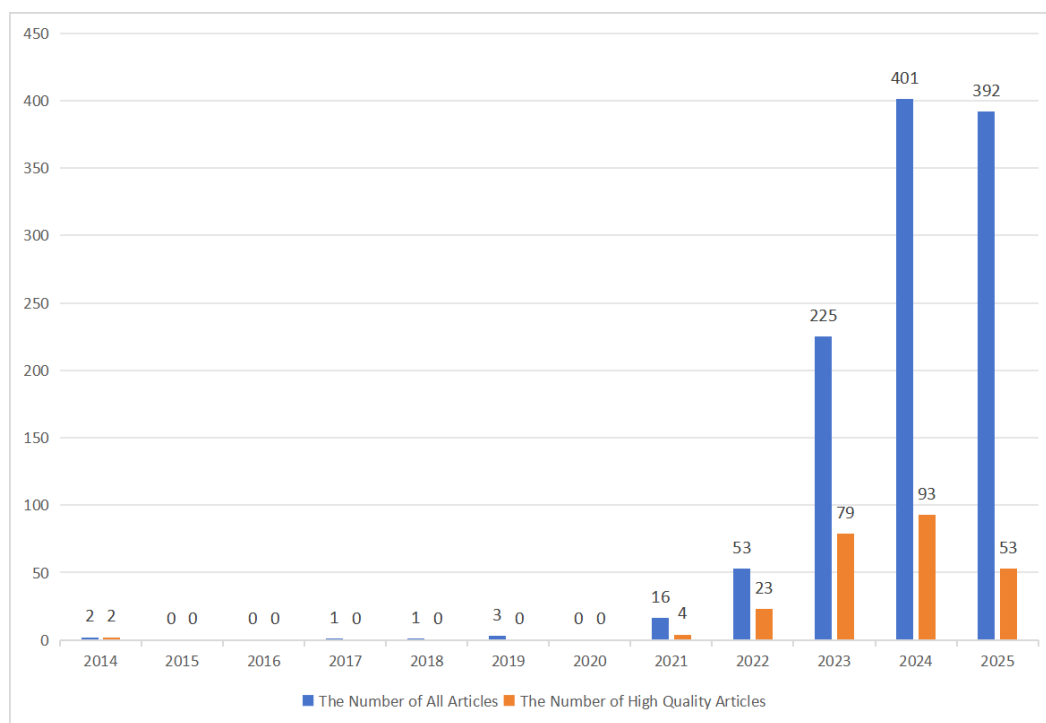
Figure 1. Graph of annual publications related to digital transformation and vocational education in China

Similar to the trend in total publications, the number of high-quality articles (orange bars) has shown significant growth since 2021, peaking at 93 in 2024, reflecting improved research quality in the field during this period. However, a key detail emerges: while the total number of publications (392) in 2025 remains near its peak, the count of high-quality articles has dropped sharply to 53. This "scissors gap" phenomenon indicates that although research enthusiasm persists, the proportion of core achievements published through rigorous peer review in top-tier journals is declining, suggesting fluctuations or divergence in overall research quality.

In summary, the chart reflects that while China's digital transformation and vocational education research have achieved large-scale prosperity, profound problems also lurk beneath the surface. The core issue lies in the divergence between the quality and quantity of research, with the sustainability of academic growth facing challenges. The surge in quantity in the early stage (especially in 2024) may have been an immediate response to policy hotspots, but many studies may lack sufficient theoretical depth and innovation, leading to their failure to translate into sustained high-quality output in 2025. This phenomenon warns us that the research ecosystem in this field may be at risk of "bubbling." If we fail to shift from pursuing "quantitative growth" to "quality-based development," the current prosperity will be unsustainable and unable to provide truly valuable guidance for practice.

The concept of digitalization was first proposed in the United States in the 1990s and gradually faded into obscurity until the International Business Machines Corporation (IBM) introduced the concept of digital transformation in 2012, undergoing an evolutionary process from "digital conversion" to "digitalization" and then to "digital transformation." The digital transformation of vocational education is one of the strategic needs

for building a "digital China." From the proposal of "education informatization" in 2014, the rise of "Internet + education" in 2015, to the official implementation of the newly revised *Vocational Education Law of the People's Republic of China* in May 2022, which explicitly states the need to "support the use of information technology and other modern teaching methods to develop online courses and other learning resources for vocational education, innovate teaching methods and school management approaches, and promote the informatization and integrated application of vocational education" [6]. It can be said that the relationship between "education" and "digitalization" has become an important focus in the construction of China's modern education system, with vocational education being one of the key areas of transformation. The research trajectory also reveals this significant era change. However, in the field of vocational education, how digital transformation should develop, be applied, and play a greater role still requires in-depth exploration by scholars.

3.2. Research characteristics analysis

The visualization, created using CiteSpace Scientific Atlas (version 6.4.R1), presents a keyword co-occurrence network to analyze knowledge structures and trending topics in China's interdisciplinary research field of 'vocational education' and 'digital transformation.' With a g-index (k = 25) and Pathfinder algorithm pruning, the network yields a 216-node maximal connected subgraph (98% of total nodes), demonstrating strong internal connections and a well-defined knowledge community within this research domain.

The keyword co-occurrence graph counts the frequency of keywords appearing in the field, and the higher the frequency, the larger the node of the keyword [7]. As shown in **Figure 2** and **Table 1**, High-quality development, Digital technology, Digitalization, Higher vocational colleges, Integration of industry and education, Digital literacy, Digital transformation of education, A nation with strong education, Digitalization of education, New-quality productive forces, Artificial intelligence, and Digital economy have drawn significant attention.
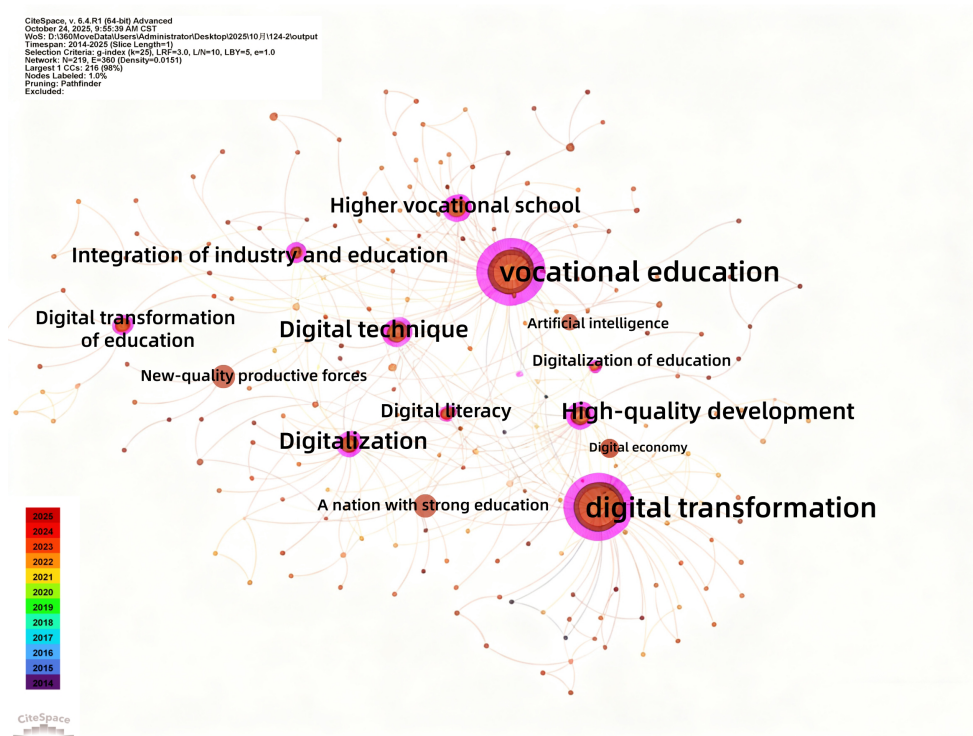
Figure 2. Digital transformation and vocational education keyword co-occurrence map

Table 1. High-frequency keywords in the field of digital transformation and vocational education research

Serial number	Keyword	Year	Frequency	Centrality
1	High-quality development	2022	25	0.34
2	Digital technique	2022	25	0.29
3	Digitalization	2021	21	0.38
4	Higher vocational school	2023	19	0.31
5	Integration of industry and education	2021	14	0.25
6	Digital literacy	2023	11	0.11
7	Digital transformation of education	2023	10	0.12
8	A nation with strong education	2023	9	0.06
9	Digitalization of education	2022	8	0.12
10	New-quality productive forces	2024	7	0.07
11	Artificial intelligence	2024	7	0.04
12	Digital economy	2022	6	0.02

The co-occurrence network of this keyword clearly reveals the tightly-knit knowledge structure in the field of vocational education digital transformation, with "vocational education" as the core and multiple hotspots surrounding it. Notably, nodes like "high-quality development" and "digitalization" exhibit both high frequency of occurrence and centrality, indicating they are not only research hotspots but also key hubs connecting different research themes. The network demonstrates a clear hierarchical structure: the core layer consists of "vocational education" and "digital transformation"; the strategic guidance layer includes macro-level propositions such as "high-quality development" and "a nation with strong education"; the implementation path layer features representatives like "higher vocational colleges" and "Integration of industry and education"; while the technology application layer highlights specific topics such as "digital technology" and "artificial intelligence." The dense connections between nodes form a maximum connected subgraph accounting for 98%, confirming that this research field has established an internally cohesive knowledge network.

While the research map reveals a rich landscape of studies, quantitative analysis still uncovers several fundamental issues. First, the centrality distribution of key nodes shows unevenness, with strategic concepts like "high-quality development" demonstrating significantly higher centrality than individual development-related terms such as "digital literacy." This reflects a tendency in research to emphasize macro-level strategic guidance over micro-level implementation, with insufficient exploration of digital transformation mechanisms in specific teaching scenarios. Second, technical nodes like "artificial intelligence" (seven occurrences) exhibit low centrality (0.04), indicating weak connections to core educational issues. Research often remains at the surface level of technology application rather than achieving deep integration. Additionally, emerging concepts like "new-quality productive forces" show both low frequency and centrality, revealing room for improvement in responsiveness and depth regarding cutting-edge topics. Overall, the research perspective urgently requires expansion and deepening.

4. Conclusion and prospects

4.1. Conclusion

To comprehensively review the development trajectory of digital transformation research in China's vocational education sector, this paper conducts a systematic analysis of relevant papers using bibliometric methods. Meanwhile, the CiteSpace platform is employed for statistical analysis to examine the progress of related research, hot topics, and their evolution through statistical and knowledge graph visualization analysis, leading to the following conclusions:

First, the research trajectory demonstrates pronounced policy dependence, with academic autonomy requiring reinforcement. The explosive growth of academic publications closely aligns with the introduction of key policy milestones, indicating that current research momentum primarily stems from external policy guidance rather than the logical progression of disciplinary knowledge accumulation. While this development model can rapidly achieve scale effects, it may lead to research topics chasing fleeting trends and remaining superficial. This approach lacks in-depth, sustained exploration of the intrinsic patterns, core contradictions, and long-term pathways of vocational education's digital transformation, ultimately compromising the independence and foresight of academic research.

Second, there exists a significant gap between "macro vision" and "micro practice" in research content. While existing studies predominantly emphasize the strategic value and development direction of digital transformation at the macro level, there is a notable lack of in-depth empirical research on how this transformation concretely manifests at meso-level (institutional governance, program development) and micro-level (curriculum restructuring, classroom innovation, teacher-student interaction) dimensions. The driving mechanisms, implementation pathways, and effectiveness evaluation of these processes remain underexplored. This disconnect results in many research findings appearing directionally correct but failing to translate into actionable, implementable solutions for vocational schools, thereby diminishing the practical feedback loop between research and real-world application.

Third, current research predominantly focuses on the application of technological tools while neglecting a return to the essence of education. Most studies view "digitalization" as a tool to empower vocational education, emphasizing how technology is "used effectively," yet they lack critical reflection on how technological applications can profoundly reshape the core values, paradigms, and educational objectives of vocational education—essentially addressing how to "use it well" and "apply it skillfully." Core issues concerning educational equity and quality, such as the digital divide in digital transformation, data ethics, teacher role transformation, and students' holistic development, have not received sufficient attention. Research should shift from a "technology-centric" approach to a "human-centered" perspective, placing greater emphasis on the growth and development of individuals during digital transformation.

4.2. Prospects

To advance the research and practical implementation of digital transformation in vocational education, breakthroughs should be pursued at three key levels.

First, establishing a bridge between macro and micro perspectives: Research should shift from macro-level strategic frameworks to exploring practical pathways at meso and micro levels. Specifically, we should actively develop digital teaching and management platforms tailored for secondary and higher vocational institutions, along with actionable guidelines for professional development and curriculum digital transformation. This will translate top-level designs into concrete action plans at the institutional level.

Second, strengthen the support system centered on faculty development: The success of digital transformation hinges on "people." It is essential to establish systematic and regular mechanisms for enhancing teachers' digital literacy and skills training. This includes designing tiered and discipline-specific training programs, creating certification standards for digital competencies, and integrating digital teaching capabilities into faculty evaluation systems. These measures will provide a solid talent foundation for the transformation process.

Third, broaden interdisciplinary critical and forward-looking perspectives: Research should transcend mere technical application approaches by actively integrating theories from pedagogy, sociology, ethics, and related disciplines to systematically examine the profound transformations brought by digital transformation. For instance, in-depth studies should address critical issues such as the digital divide, data ethics, and teacher-student relationships in human-machine collaborative teaching models. This ensures that vocational education's digital transformation progresses healthily toward equitable, inclusive, and education-centered development.

Of course, this study also has certain limitations. First, in terms of the selection of research scope, this paper mainly focuses on artificial intelligence issues in the field of vocational education in China, failing to include related research on vocational education abroad in the discussion scope, and also lacking a comparative analysis of China's research progress in this field with other countries. Second, in terms of research methods, although bibliometric tools such as CNKI visualization and CiteSpace were adopted, bibliometrics itself encompasses various research methodological approaches. If other methods could be combined for cross-validation and complementary analysis, it might lead to more diverse or in-depth research findings.

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The authors declare no conflict of interest.

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