Asia Pacific Science Press

*Journal of Educational Theory and Practice*
*ISSN(O):3005-9313*
*ISSN(P):3005-9305*
*Vol. 2 No.4 (2025)*

# Research Hotspots and Trends in the Digital Transformation of Global Vocational Education

**Lei Xie [1], Huayang Zhang[2]***

1.The Open University of China, Beijing, 100039, China

2.Shenzhen Polytechnic University, Shenzhen, 518055, China

***Corresponding author: Huayang Zhang, zhanghuay@szpu.edu.cn***



**Abstract:** The digital transformation has provided an era of opportunity for the high-quality development of China's vocational education. How to seize the opportunities of the times and further promote the innovative development of vocational education digitalization on the basis of existing research has become an urgent problem to be solved. In order to systematically and objectively analyze the global characteristics of vocational education digital transformation research, this study uses CiteSpace software to visualize and analyze 604 relevant papers worldwide. The results show that the number of Chinese articles is generally higher than the international ones, the transformation of higher vocational colleges and digital teaching are the common focus of the world, and China is in a leading position in the research of industry-education integration. In the future, we should promote the sustainable development of digital transformation with resource supply-side reform.

**Keywords:** Educational Digitalization; Vocational Education; Global Trend; Bibliometrics

**Published:** Oct 26, 2025

**DOI:** https://doi.org/10.62177/jetp.v2i4.754

## 1.Introduction

In 2022, China's National Education Work Conference proposed implementing the national strategy for educational digitalization as a key agenda item, while the report of the 20th National Congress explicitly set forth the strategic direction to "advance educational digitalization". This signifies that digital transformation in education has become the core mission of China's educational reform—both currently and in the foreseeable future—and represents an essential path toward achieving high-quality development in education. As an integral component of China's high-quality education system, the digital transformation of vocational education (VE) has emerged as both an undeniable reality and an urgent imperative. Indeed, numerous scholars worldwide have conducted extensive research on this topic. Internationally, many studies focus on digital teaching and learning practices encompassing areas such as teachers' digital competencies [1], blended learning models [2], and self-directed learning based on e-portfolios [3]. In China, researchers tend to prioritize the development of digital resources and institutional mechanism innovations—including construction of digital textbooks [4] and resource allocation systems [5]. However, existing studies either concentrate on isolated scenarios within VE or employ non-empirical methodologies, lacking systematic rigor and objectivity. To comprehensively analyze the global characteristics of VE digitalization, this study utilizes bibliometric methods to systematically review relevant literature from both domestic and international sources. From a macro perspective, it explores strategic entry points for advancing VE digital transformation, aiming to provide insightful guidance

for current research and practice while driving deeper, higher-level progress in China's vocational education digitalization initiatives.

# 2.Study design

## 2.1 Data

This study focused on literature concerning educational digitalization within vocational education from both domestic and international sources. Academic papers were retrieved from the CNKI and Web of Science databases. For the Web of Science database, searches targeted articles indexed in SSCI/SCI journals using the topic string: "vocational education" AND ("digital" OR "smart" OR "intelligent" OR "artificial intelligence" OR "online"). In CNKI, Peking University Core Collection and CSSCI-indexed publications were selected with the Chinese search terms combining " vocational education" alongside any of "digitalization", " smart", or " online". The temporal scope was limited to publications dated between 2020–2024, coinciding with when major international organizations formally introduced the concept of educational digital transformation—including UNESCO's report Digital Transformation in Education: Connecting Schools, Empowering Learners [6] and EDUCAUSE's Top Ten IT Issues 2020: Accelerating Digital Transformation [7]. Non-relevant materials such as conference proceedings, commentaries, duplicate entries, and studies not specifically focused on vocational education contexts were excluded. After screening, the final dataset comprised 198 English articles and 406 Chinese articles.

## 2.2 Method

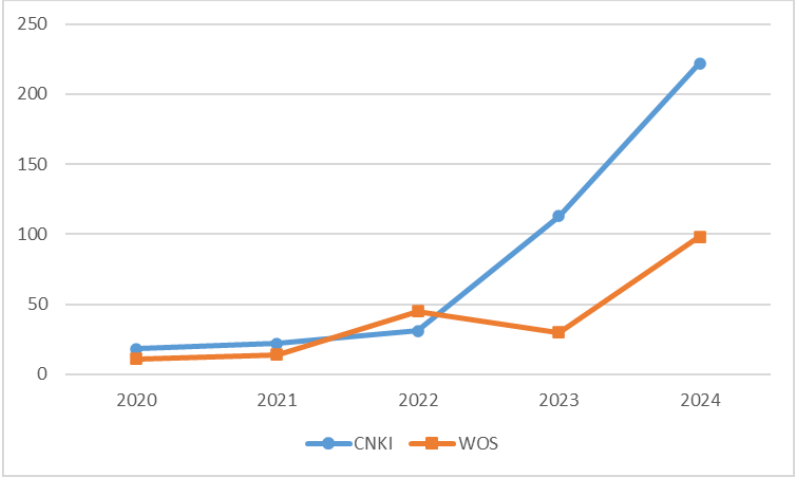
This study employed CiteSpace analytical software to conduct statistical analyses of the 604 documents based on publication year, authorship, country/region, and research topics. The software parameters were configured as follows: Years per slice = 1; selected node types included keywords, authors, countries, and institutions; all other settings remained at their default values.

# 3.Result

## 3.1 Annual number of published articles

Figure 1 illustrates temporal trends in publication volume within the field of vocational education digitalization across domestic and international contexts over recent years. Domestically, China demonstrated an overall upward trajectory, with output in 2024 significantly surpassing both 2023 and 2022 levels. As shown in the figure, domestic research activity grew gradually during 2020–2022 before accelerating rapidly from 2022 to 2024—indicating heightened scholarly attention likely driven by dual policy impacts: China's national strategy for educational digitalization and revisions to the Vocational Education Law of the People's Republic of China. Internationally, global publications exhibited a steady ascendant pattern: moderate growth occurred between 2020–2022, followed by a slight contraction post-2022, then resumed robust expansion during 2023–2024.

*Figure 1 The number of published documents in the field of global vocational education digitalization from 2020 to 2024*




## 3.2 The distribution of countries that have issued documents

After importing Web of Science (WOS)-indexed publication records into the analysis software with parameters configured

as country for node type and 1 year per slice for temporal segmentation, we generated a co-occurrence map of countries contributing to global research on vocational education digitalization (Figure 2). A total of 31 nations produced relevant publications, with China leading at 54 articles, followed by Germany (n=12) and Malaysia (n=5). All other countries contributed fewer than five papers each, while over half published only a single article. This quantitative dominance demonstrates China's pioneering position in this research domain.

*Figure 2 Map of co-occurrence of the issuing countries*


## 3.3 Distribution of Publishing Institutions and Collaboration Status

Figure 3 displayed a co-authorship network map generated from Web of Science publications, revealing institutional contributions to research on vocational education digitalization. The highest-producing institution was Taiwan Tech University, with five published articles. This was followed by UCSI University and University of Management and Technology, each contributing three papers. Institutions publishing two articles included Abo Akademi University, University of Eastern Finland, University of Granada, University of Helsinki, and University of Zurich. Notably, the inter-institutional collaboration pattern exhibits scattered global distribution with localized clusters—indicating both fragmented and regionally concentrated research efforts across countries.

Figure 4 presents an institutional co-occurrence map based on CNKI, mapping contributors to research on vocational education digitalization in China. Guangxi Normal University emerged as the most prolific institution with 15 relevant articles published. Subsequent high-contributing institutions included Tianjin University (n=11), Beijing Normal University (n=8), National Institute of Education Sciences (n=8), and Tianjin University of Technology and Education (n=8). An additional 36 institutions each contributed two or more papers. Notably, inter-institutional linkages appear relatively sparse across this network.

*Figure 3 The co-occurrence map of international publishing institutions*

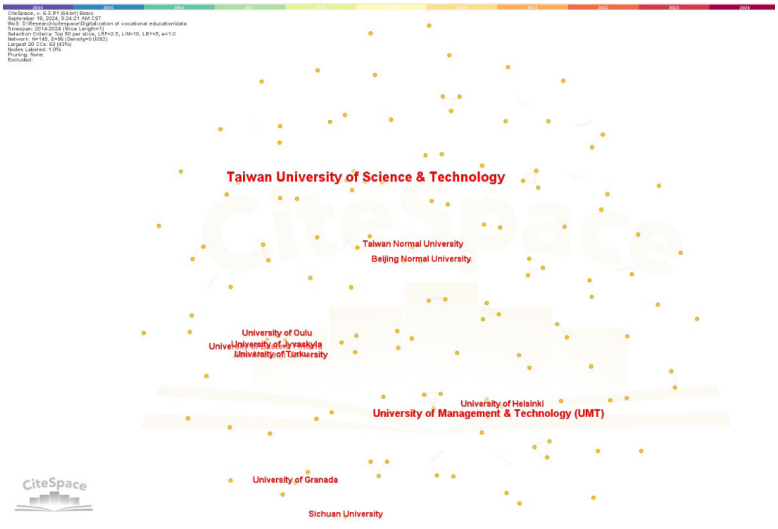


*Figure 4 A map of the co-occurrence of Chinese issuing institutions*

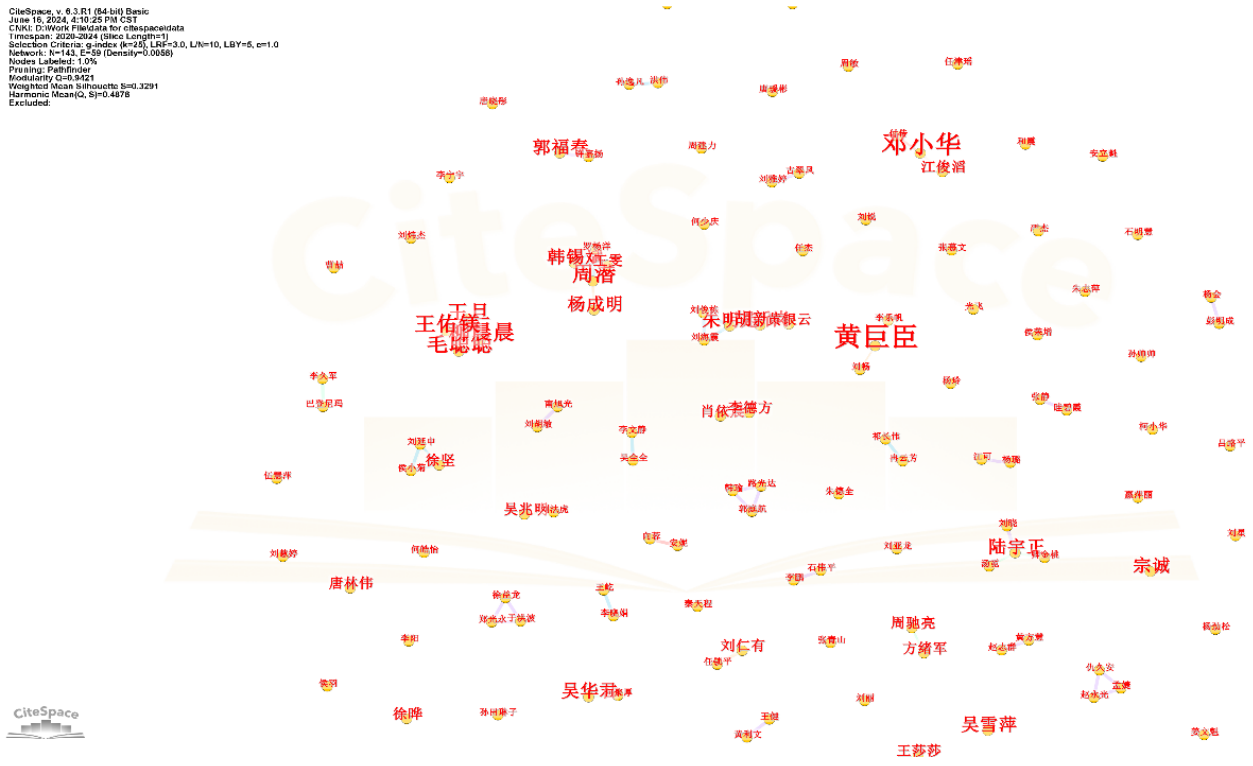

## 3.4 The distribution of authors who have published articles

Figure 5 illustrated an author co-occurrence network derived from WOS, revealing patterns among researchers in vocational education digitalization studies. The most productive author was Liping Jiang (3 papers), followed by fourteen scholars who each contributed two papers. Notably, the collaboration structure exhibits fragmented connectivity overall but demonstrates localized clustering in specific research communities.

Figure 6 displayed an author co-occurrence map generated from CNKI, mapping scholarly contributions to vocational education digitalization research. Huang Jucheng from Lanzhou University emerged as the highest-publishing author with seven relevant articles. This was followed by Deng Xiaohua (Guangxi Normal University, n=6), Wang Youmei (Wenzhou University, n=4), and Zhou Qian (Tsinghua University, n=4). A total of 31 authors each contributed two or more papers. The collaboration network among these scholars exhibits scattered global distribution with localized clusters—indicating both fragmented and regionally concentrated research efforts.

*Figure 5 The co-occurrence map of international publishing authors*

*Figure 6 The co-occurrence map of Chinese publishing authors*




## 3.5 Research hotspot

As shown in Figure 7, a keyword co-occurrence map was constructed using papers indexed by the WOS. Excluding background keywords such as “education” and “vocational education”, the most frequently co-occurring keywords included satisfaction (9 times), blended learning (7 times), self-efficacy (6 times), artificial intelligence (6 times), and higher education (5 times). This indicates that international research on digitalization in vocational education predominantly focuses on themes related to higher vocational education stages, intelligent technologies, blended learning models, students’ self-efficacy, attitudes toward digital technologies, and instructional design. Applying K-clustering analysis, these keywords could be grouped into ten categories: learning adaptability, vocational education, neural network, higher education, work characteristics, mobile apps, 21st-century abilities, e-learning readiness, in-service teachers, and augmented reality. These findings suggest that global studies emphasize leveraging digital technologies—particularly mobile applications and augmented reality—to support student learning and facilitate professional development among teachers within higher vocational education contexts.

As illustrated in Figure 8, a keyword co-occurrence network was generated based on publications indexed in CNKI. Excluding background terms such as vocational education, digitization, and intelligent era, the most frequent keywords included higher vocational institutions (23 times), artificial intelligence (22 times), talent cultivation (12 times), industry-education integration (9 times), digital literacy (8 times), and online teaching (7 times). Through K-clustering analysis, these keywords clustered into ten categories: vocational education, artificial intelligence, digital technology, metaverse, higher vocational institutions, industry-education integration, online teaching, higher vocational education, instructional design, and educational reform. This pattern indicates that Chinese research on digital transformation in vocational education predominantly concentrates on institutional settings—specifically at the higher vocational level—with particular emphasis on leveraging artificial intelligence to enhance talent development and pedagogical practices within school contexts. Notably, the top three keywords by centrality degree were artificial intelligence, talent cultivation, and industry-education integration, signifying their core roles in China’s related research landscape.

*Figure 7 International research keyword clustering map*

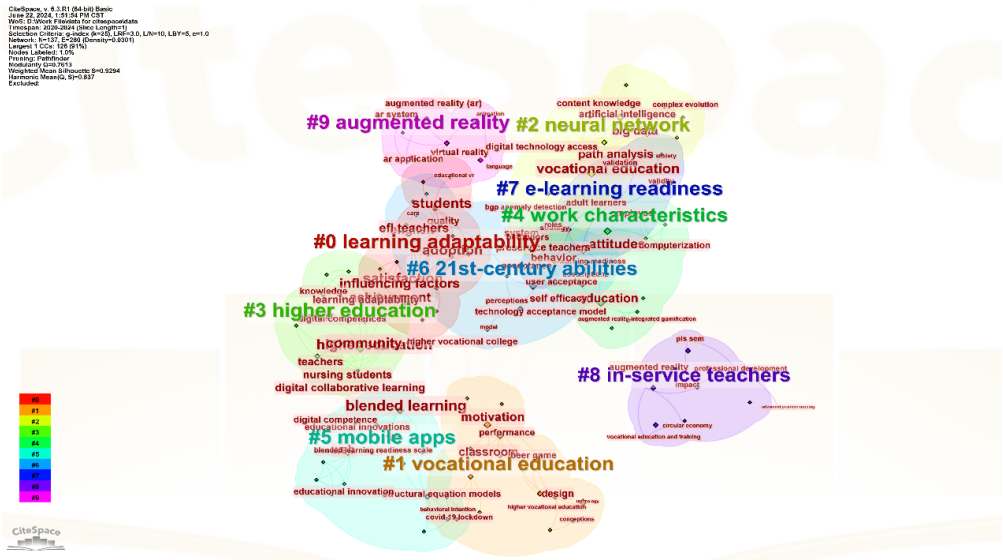
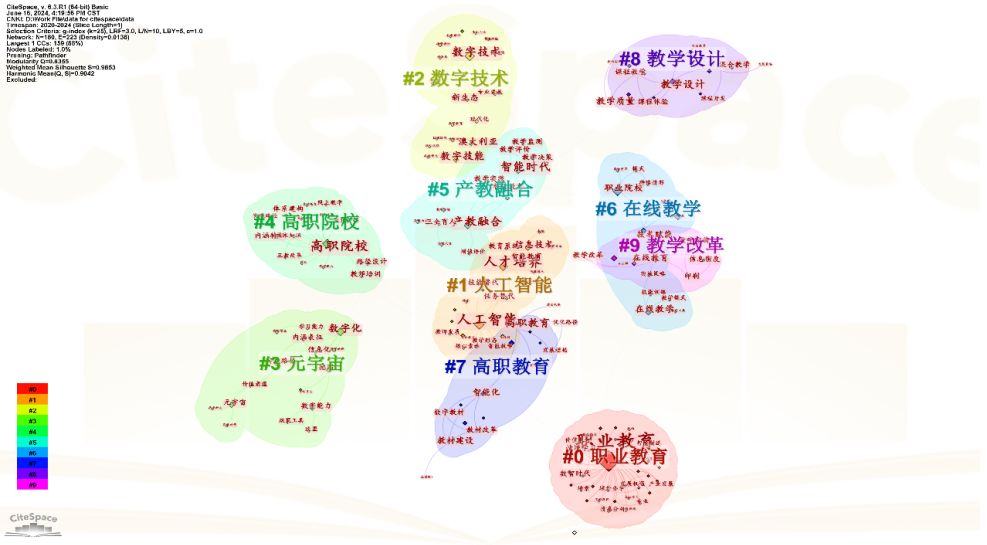



*Figure 8 Chinese research Keyword clustering map*




## 3.6 The evolving trends of research hotspots

Building upon the analysis of research hotspots, a temporal clustering map was developed to visualize the evolutionary trajectory of core themes in vocational education digitalization over the past five years. Internationally, since 2020, digital transformation within higher education-oriented vocational education and blended learning has emerged as a prominent research focus. Starting in 2021, investigations into technologies such as big data and artificial intelligence began gaining traction in this field. Following initial experimental phases, scholars shifted their focus toward practical efficacy from 2022 onward, marked by studies examining performance metrics and satisfaction levels. As research and implementation deepened, the scope expanded to incorporate emerging keywords, including 5G networks, game-based learning, and content knowledge (as depicted in Figure 9).

In China, since 2020, higher vocational institutions, industry-education integration, and instructional design have constituted major research hotspots in the field of vocational education. By 2021, studies related to information technology, digital skills, and digitization surged dramatically. Subsequently, from 2021 onward, research on digital transformation deepened with focused attention on topics such as digital textbooks, teaching assessment, learning analytics, and professional development. Entering 2024, keywords including “three-track education reform”, “skill substitution”, and “optimization

pathways" experienced rapid growth—signaling an emerging emphasis on systemic approaches within vocational education digitalization. Concurrently, interoperability across educational modalities and implementation frameworks has become central theme (as illustrated in Figure 10).

*Figure 9 International research keyword timeline clustering map*

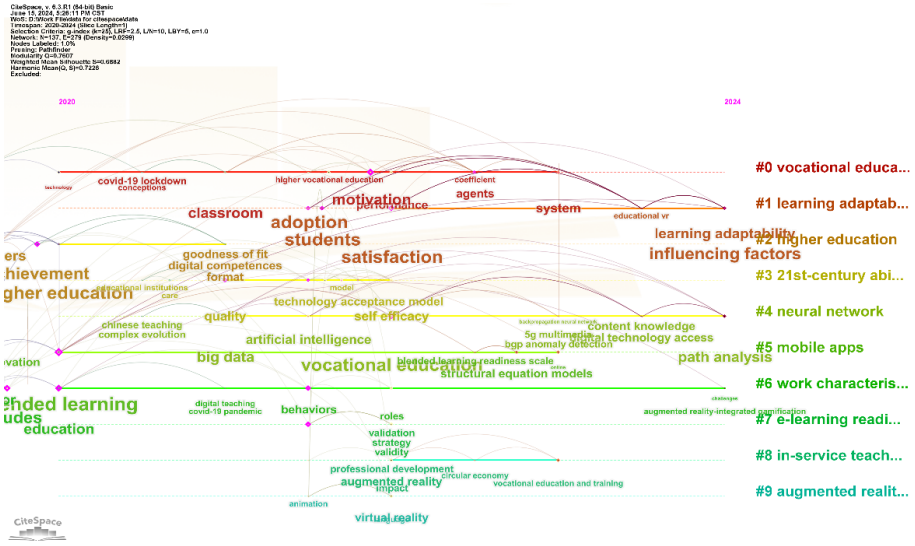
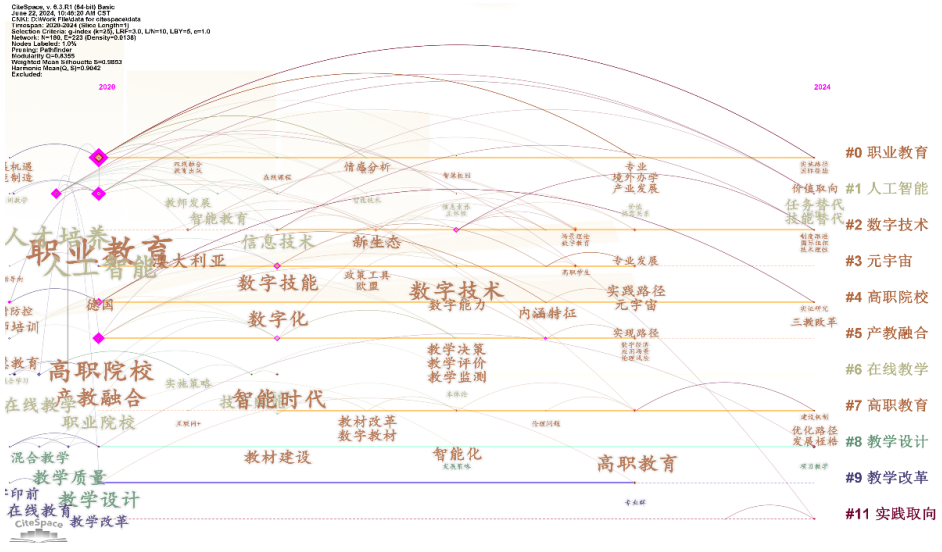



*Figure 10 Chinese research keyword timeline clustering map*




## 4.Discussion

### 4.1 The overall number of documents issued by China is higher than that issued internationally

Annual publication statistics reveal that China consistently produced more papers than the international community in 2020, 2021, 2023, and 2024. Notably, among WOS-indexed publications, China also held the highest output volume. This underscores China's comparatively greater emphasis on research in vocational education digitalization relative to other nations globally. Several factors explain this trend: national strategic planning and policy initiatives have significantly propelled such studies. Within China's broader educational context, its current advancement in educational digitalization represents an extension and innovation built upon prior achievements in educational informatization, long deemed a cornerstone strategy. Key milestones include the Ministry of Education's Action Plan for Education Informatization 2.0 (issued in 2020) and subsequent guidelines on developing high-quality supportive systems through new infrastructure construction (2021). At the 2022 National Education Conference, the Minister explicitly called for implementing a digital strategy in education. Concurrently, revised regulations took effect under China's newly amended Vocational Education Law (2022),

mandating "promoting IT application and integrated use of information resources in vocational education" [8]. The same year, the Party's 20th National Congress emphasized coordinating collaborative innovation across vocational, higher, and continuing education sectors [9], reinforcing vocational education's strategic importance. Guided by these policies, Chinese researchers intensified their focus on digitalization research, directly contributing to the surge in publications observed during 2023.

## 4.2 The transformation of higher vocational colleges and digital teaching are the common focus of the world

The statistical results and clustering results of research keywords show that the digital transformation of higher vocational colleges and digital teaching are the focus of global attention. In terms of higher vocational colleges, the keyword "higher education" co-occurred 5 times internationally, ranking ninth in frequency; in China, the keyword "vocational college" co-occurred 23 times, ranking first in frequency. At the same time, the keyword clustering results show that "higher education" and "vocational college" are each a separate category. This indicates that higher vocational colleges are both the focus of research in global digitalization research on vocational education. The reason for this phenomenon may be that the authors of articles mainly come from institutions of higher education, which makes it easier to focus on higher education research.

Regarding digital teaching practices, international clusters included distinct categories such as learning adaptability and e-learning readiness, while Chinese counterparts formed separate groups around instructional design, online teaching, and educational reform. This convergence highlights that technology-mediated instruction remains a central focus globally. Analysis of sampled papers reveals key research trajectories: innovations in pedagogical approaches—including blended online/offline hybrid models [10] and data-driven precision teaching [11]; alongside novel assessment methodologies like formative evaluation based on granular teacher-student profiles [12], and value-added assessment leveraging longitudinal student data [13]. Both streams demonstrate sustained scholarly attention to classroom dynamics within institutional settings across national contexts.

## 4.3 China has a first-mover advantage in the research of industry-education integration

The clustering analysis and temporal trends of research keywords reveal that industry-education integration emerges as a distinctive hotspot in China's scholarship, whereas these dimensions remain underexplored internationally. Notably, the term "industry-education integration" forms an independent cluster exclusively in Chinese publications—contrasted by the absence of industry-related keywords (e.g., enterprises, corporations) in global literature—indicating China's unique emphasis on leveraging industrial capabilities to advance vocational education development. National strategic prioritization dates back to 2017, when the Report of the 19th CPC National Congress explicitly advocated "deepening industry-education integration". Concurrently, the State Council issued Guidelines on Promoting Industry-Education Integration [14]. By 2023, eight ministries jointly launched the Action Plan for Enhancing Vocational Education Through Industry Collaboration (2023–2025) [15], further solidifying its policy centrality. Practical implementation demonstrates deep synergy between industries and schools in digital domains: iFLYTEK's intelligent speech evaluation technology now scales across nearly 100 Chinese cities for junior high school English listening assessments [16]; during the pandemic era, corporate platforms like Tencent Meeting and DingTalk provided critical infrastructure supporting nationwide online education surge—while firms established dedicated edtech ecosystems delivering curriculum resources to teachers and students. Driven by dual forces of top-down policy mandates and grassroots adoption, achieving substantive industry-academia convergence has become a consensus among policymakers and scholars. Given vocational education's inherent proximity to industrial sectors, such collaboration yields mutual benefits: institutions gain real-time insights into workforce demands, enabling curriculum alignment with job market skillsets and enhancing graduate employability; conversely, industries access tailored talent pipelines meeting their specialized needs. Consequently, industry-education integration constitutes a defining research priority within China's vocational digitalization agenda.

## 4.4 Promote digital transformation through supply-side reform of resources

Originally an economic concept, supply-side reform targets equilibrium between demand and supply by enhancing quality, optimizing delivery mechanisms, and refining outcomes [17]. In recent years, this framework has gained traction in education research, which emphasizes collaborative innovation across three stakeholder groups—governments, institutions, and

enterprises—through institutional restructuring, service model transformation, and platform resource integration [18]. Within China's vocational education sector, studies predominantly focus on resource provision dynamics. Longitudinal keyword clustering reveals sustained emphasis on digital textbook development over multiple years. Specifically, structural reforms address four dimensions: architecture of resource allocation, tiered resource hierarchies, evaluative metrics for resource efficacy, and modalities of resource distribution [19]. Practical implementations include: (1) Diversified contributors now encompass academic experts, industry specialists, and frontline educators in content curation[20]; (2) Expansion from discipline-specific materials to general knowledge repositories[21]; (3) Evolution of assessment protocols incorporating student feedback alongside expert reviews and third-party validations[20]; and (4) Leveraging data analytics with knowledge graph technologies to deliver interactive, personalized digital learning resources[22]. These initiatives collectively advance the modernization of vocational education resource ecosystems through systemic supply-chain optimization.

Looking ahead, advancing the digital transformation of vocational education requires deeper refinement in resource granularity across supply tiers. First, resources should be disaggregated to address contextualized scenarios—currently, comprehensive digital textbooks covering entire courses present limitations due to their scale, multi-stakeholder development processes, extended creation cycles, substantial funding requirements, and predominant focus on generic student needs. To bridge this gap, governments and institutions are encouraged to support educators in developing supplementary micro-lectures or targeted video clips addressing specific knowledge gaps or exercise challenges. Furthermore, beyond course videos, teachers may create auxiliary materials such as guided study handbooks and enrichment activities catering to diverse learner proficiency levels. These complementary resources enable personalized learning pathways while maintaining alignment with core curriculum standards.

## 5.Conclusion

China's advancement in educational digitalization represents an innovative evolution built upon prior achievements in educational informatization, constituting a comprehensive paradigm shift within the education sector. Amid emerging developmental imperatives, substantial research foundations have already been established in vocational education. To accelerate its digital transformation trajectory, we must leverage accumulated experience to implement demand-driven resource provision and institutional mechanism innovation—ensuring educational resources achieve enhanced efficiency and precision in serving educators and learners. Moreover, capitalizing on China's first-mover advantage in vocational education digitalization calls for proactive dissemination of research outcomes while strengthening international collaboration. This strategic approach will elevate China's global standing and influence in the field. Through sustained commitment to innovation, we can contribute Chinese insights and solutions to advance worldwide vocational education development, jointly propelling progress in global educational endeavors.

## Funding

This work was supported by the [The Open University of China Youth Project] under Grant [number Q23C0026]; the [Guangdong Province Philosophy and Social Sciences Planning Co-construction Project] under Grant [number GD24XJY44]; and the [Shenzhen Education Science 14th Five-Year Plan Special Topic on Artificial Intelligence] under Grant [number rgzn23005].

## Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

## Reference

[1] Cattaneo, A. A., Antonietti, C., & Rauseo, M. (2022). How digitalised are vocational teachers? Assessing digital competence in vocational education and looking at its underlying factors. Computers & education, 176, 104358. 10.1016/j.compedu.2021.104358

[2] Asghar, M. Z., Afzaal, M. N., Iqbal, J., Waqar, Y., & Seitamaa-Hakkarainen, P. (2022). Evaluation of in-service vocational teacher training program: A blend of face-to-face, online and offline learning approaches. Sustainability, 14(21), 13906. https://doi.org/10.3390/su142113906

[3] Hj. Ebil, S., Salleh, S. M., & Shahrill, M. (2020). The use of E-portfolio for self-reflection to promote learning: A case of TVET students. Education and Information Technologies, 25(6), 5797-5814. https://doi.org/10.1007/s10639-020-10248-7

[4] Zhang, Z. X. (2022). Thoughts on the Construction of Intelligent Digital Textbooks for Vocational Education. Chinese Editors Journal, (06):67-70+75.

[5] Shao, M. Y., Yang, L. H., & Ren, S. H. (2023). The Institutional Empowerment of Digital Transformation in Vocational Education: Contents, Characteristics and Reflections on Issues. Chinese Vocational and Technical Education, (36):45-51.

[6] Sepúlveda, A. (2020). The digital transformation of education: connecting schools, empowering learners. TIC EDUCAÇÃO, 249.

[7] Grajek, S. (2020). Top 10 IT issues, 2020: The drive to digital transformation begins. EDUCAUSE Review (Online).

[8] National People's Congress. (2022). Vocational Education Law of the People's Republic of China. http://www.moe.gov.cn/jyb_sjzl/sjzl_zcfg/zcfg_jyfl/202204/t20220421_620064.html

[9] Xi, J. P. (2022). Hold High the Great Banner of Socialism with Chinese Characteristics and Unite in Striving for the Comprehensive Construction of a Modern Socialist Country - Report at the 20th National Congress of the Communist Party of China. http://www.qstheory.cn/yaowen/2022-10/25/c_1129079926.htm

[10] Lopez-Belmonte, J., Moreno-Guerrero, A. J., Pozo-Sanchez, S., & López-Núñez, J. A. (2020). Effect of digital teaching competence in the use of blended learning in Vocational Training. Investigación bibliotecológica, 34(83), 187-205.

[11] Wu, D. (2022). Application of digital media technology for teaching in higher vocational colleges using big data. Mobile Information Systems, 2022(1), 8974147. https://doi.org/10.1155/2022/8974147

[12] Gu, R. J., Ma, Y. F., & Zhou, K. (2022). Informatization of Teaching Management in Vocational Colleges in the Intelligent Age: Practical Dilemma and Path Breakthrough. Theory and Practice of Education, 42(24):17-22.

[13] Xiao, Y. C. & Li, D. F. (2024). Teaching Perspectives in Digital Era Vocational Education Programs: An Analysis Based on Embodied Cognition Theory. Journal of Vocational Education, 40(03):24-31.

[14] General Office of the State Council. (2017). Several Opinions on Deepening the Integration of Industry and Education. https://www.gov.cn/zhengce/content/2017-12/19/content_5248564.htm

[15] National Development and Reform Commission, Ministry of Education, Ministry of Industry and Information Technology, Ministry of Finance, Ministry of Human Resources and Social Security, Ministry of Natural Resources, People's Bank of China, State-owned Assets Supervision and Administration Commission of the State Council. (2023). Implementation Plan for the Empowerment and Enhancement Action of Industry-Education Integration in Vocational Education (2023-2025 year). https://www.gov.cn/zhengce/zhengceku/202306/content_6886061.htm

[16] iFLYTEK. (2024). AI Listening and Speaking Classroom. https://edu.iflytek.com/solution/school/listening-and-speaking

[17] Jia, K., Xu, L., Li, W. S., Yao, Y. D., Huang, J. H., Liu, P. L., & Li, H. J. (2013). Analysis of the Key Points of New Supply Economics in China's Reform. Review of Industrial Economics,（7）：7-13.

[18] Feng, X. Y., Wang, R. X., Cao, J. T., & Huang, L. Y. (2020). Trinity of Educational Supply-side Reform in the Era of "Internet +". e-Education Research, 41(04):42-48.

[19] Ren, Y. Q., Feng, X. Y., & He, C. (2022). Towards supply-side reform of professional development for basic education teacher in the digital age. Chinese Journal of Distance Education, (08):1-8+78.

[20] Tian, H., Zhang, M. M., & Liu, B. (2019). Exploration and Practice of Digital Textbook Construction in Secondary Vocational Education - Taking the Textbook Development of Shanghai Medical School as an Example. Chinese Vocational and Technical Education, (32):49-52.

[21] Zhang, Y. & Wu, Z. M. (2023). Research on the Development and Application of Digital Resources for Online Courses in Higher Vocational Colleges under the Background of Digital Transformation in Education. Education and Vocation, (23):87-94.

[22] Guo, J., Chi, X. W., & Liu, D. (2024). Construction of Interactive Digital Teaching Materials for Comprehensive Practical Training of Higher Vocational Nursing Based on Knowledge Map. Journal of Science and Education, (17):136-140.