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Hotspots of the Research on Digital Campus and Policy Implementation-Visualization Based on Citespace and a Study Based on the Smith Policy Implementation Process Model

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Abstract: This study examines the development of digital campuses in China, contributing to both theoretical and policy discussions in higher education. Using CiteSpace, 468 academic papers were analysed, alongside 68 policy documents based on the Smith Policy Implementation Process Model. Drawing on data from the China Higher Education Informatisation Development Report (2021), the study identifies key challenges, including student dissatisfaction, low engagement, weak feedback mechanisms, regional disparities, insufficient funding, and cybersecurity gaps. To address these issues, it proposes strengthening investment and infrastructure, improving feedback and collaboration mechanisms, enhancing smart learning environments, and reinforcing data security. The findings provide practical insights for advancing digital campus development in diverse international contexts.

1. Introduction

Education informatisation refers to the extensive integration of modern information technology into education, aiming to optimise resources, improve processes, enhance students' information literacy, and promote educational modernisation.[1] Digital campuses emerged as a transitional stage, transforming traditional campuses through technological means,[2] while smart campuses represent a more advanced form by integrating physical and digital spaces to enable ubiquitous access to resources and services.[3]

Distance education plays a crucial role in enabling students who are unable to attend in-person classes to access and participate in formal education.[4] Consequently, education informatisation is often associated with social equity[5] because it assists individual students in overcoming educational disparities related to opportunities, participation, and outcomes across diverse formal learning environments.[6]

The development of digital campuses provides institutions with new approaches to personalised learning and flexible education models. In this context, China launched the Education Informatisation 2.0 Action Plan in 2018 to promote the integration of information technology with teaching and improve infrastructure and application levels in higher education.[7]

2. Initial Review

This study used the China National Knowledge Infrastructure (CNKI) database to conduct a literature review on "Digital Campus Construction." The search, conducted on 20 January 2026, covered publications from 2010 to 2025, yielding 3,671 documents, of which 468 valid studies were selected for analysis.

2.1. Distribution of Publications

Figure 1 illustrates the publication status of research on digital campuses in China indexed in the CNKI. From 2010 to 2025, annual publications on digital campuses in China consistently exceeded 50, peaking at 263 in 2013. After 2018, the number declined and stabilised below 200, suggesting that foundational infrastructure had largely matured and research focus was shifting toward application and smart learning scenarios.

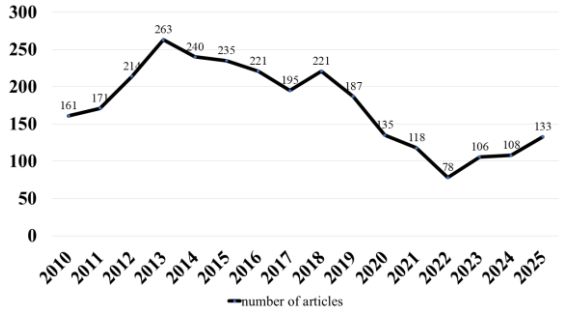


Figure 1: Number of Publications per Year.

2.2. Literature Themes and Hotspots

Keywords represent the core content and research focus of academic articles. By analysing keyword frequency and co-occurrence relationships, it is possible to identify research characteristics, hotspots, and development trends.[8] Using CiteSpace, this study conducted a co-occurrence analysis of keywords in the collected literature. A total of 45 clusters were identified using the log-likelihood ratio (LLR) algorithm. The largest clusters included digital campus, collaboration theory, smart campus, digital textbooks, vocational education, big data, digital twin, smart education, campus football, and data integration, reflecting the main research hotspots in China's digital campus construction field. Based on these clusters, an overlay analysis combining co-occurrence networks and emerging terms further identified high-frequency thematic trends.

An association analysis of the co-occurrence keyword clustering map in Table 1 revealed that research on digital campus construction in China primarily focused on the following three areas.

1) System Planning and Architecture: This theme includes clusters such as smart campus, architecture, and information portal, focusing on theoretical frameworks and structural design. The release of the national standard General Framework of Smart Campus marked a key milestone. Subsequent studies proposed different architectural models, such as the "four-horizontal and two-vertical" framework [9] and the "five-horizontal and two-vertical" model [10], enriching the theoretical foundation of digital campus construction.

2) Intelligent Information Technology: This area involves clusters such as big data, IoT, data fusion, and virtual simulation. Research highlights the application of technologies including cloud computing, RFID, and digital twins in supporting data integration, intelligent operations, and campus transformation, thereby improving resource allocation and educational quality.

3) Smart Application Scenarios: Clusters such as smart education, smart classrooms, flipped classrooms, and smart services fall under this category. Studies emphasise the practical application of intelligent technologies in teaching, learning, and campus management, including personalised learning environments, smart operations, and integrated service platforms connecting campus and home.

Table 1: Keyword Co-occurrence Network Clustering Table (Limited by space, only the top 5 clusters are presented).

Cluster ID	Size	Silhouette	Mean (Year)	Top Terms (TF*IDF)	Top Terms (LLR)	Top Terms (MI)
0	65	1	2014	Digital Campus; Collaboration; Archives; Collaboration Theory; Social Network	Digital Campus; Collaboration Theory; Primary and Secondary Schools; Relationship Mining; Smart Campus; Application Components; Systems Thinking; Information Collaboration; Infrastructure; Peking University Library	Application Components; Systems Thinking; Information Collaboration; Infrastructure
1	30	0.957	2017	Vocational Colleges; Teaching Model; Teaching; Digitalization; Flipped Classroom	Vocational Colleges; Teaching Model; Flipped Classroom; Online Information; Industry-Education Integration; Archives; Data Governance; Internet; Teaching Resources; Educational Technology	Flipped Classroom; Online Information; Industry-Education Integration; Archives
2	27	0.98	2016	Smart Campus; Architecture; Information Portal; Educational Informatization; Education	Smart Campus; Architecture; Information Portal; Smart Operations; SSO; Education Network; Smart Services; Integration Model; Overall Framework; Evaluation Indicators	Smart Operations; SSO; Education Network; Smart Services; Integration Model
3	21	0.983	2016	Textbook; Teaching Environment; Teaching; Digital Textbook; Smart Teaching Environment	Informatization; Digital Textbook; Information Technology; Textbook; Teaching Reform; Smart Teaching Environment; Instructional Design; Online Learning; Teaching; Risk	Digital Textbook; Information Technology; Textbook; Teaching Reform; Smart
4	19	0.973	2016	Vocational Education; Construction; Education; Digital Campus; Digital Campus Policy	Vocational Education; Construction; Digital Campus Policy; Germany; Value Analysis; Digital Competence; Campus Culture; Community Education; Lifelong Education; Open Education	Digital Campus Policy; Germany; Value Analysis; Digital Competence; Campus

2.3. Literature Review Conclusions and Characteristics

CiteSpace software was used to extract and identify burst terms to understand cutting-edge research areas, shifts in research focus, and the latest research hotspots, as well as to predict future development trends in the field (See Figure 2 and Figure 3). It was found that:

1) From 2010 to 2015, research centred on foundational concepts such as informatisation and big data, with emphasis on infrastructure construction and initial IT integration in education.

2) From 2015 to 2020, the focus shifted to smart campus, smart education, and educational technology, reflecting a transition toward integrated and intelligent environments. Research increasingly emphasised smart services, system integration, and emerging technologies.

3) From 2020 to 2025, recent studies highlight digitalisation, data governance, vocational education, and digital twins, indicating a move toward data-driven management and sector-specific applications. The continued prominence of digital twin and digital governance suggests future research will prioritise data integration, high-fidelity simulation, and governance frameworks for sustainable smart campus development.

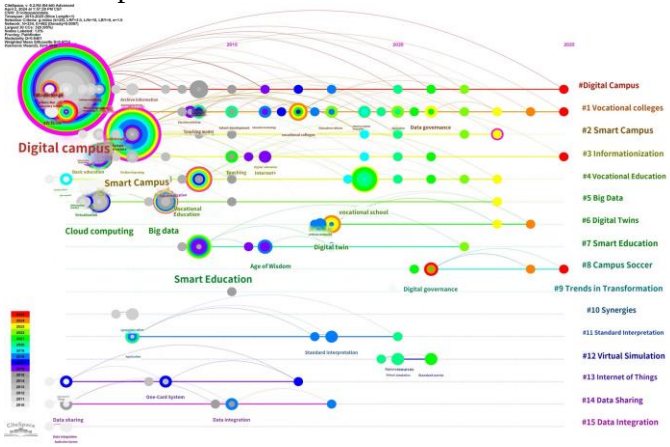
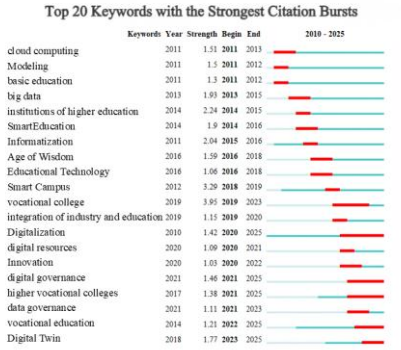


Figure 2: Keyword Timeline Chart.



Top 20 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2010 - 2025
cloud computing	2011	1.51	2011	2013	
Modeling	2011	1.5	2011	2012	
basic education	2011	1.3	2011	2012	
big data	2013	1.93	2013	2015	
institutions of higher education	2014	2.24	2014	2015	
SmartEducation	2014	1.9	2014	2016	
Informatization	2011	2.04	2015	2016	
Age of Wisdom	2016	1.59	2016	2018	
Educational Technology	2016	1.06	2016	2018	
Smart Campus	2012	3.29	2018	2019	
vocational college	2019	3.95	2019	2023	
integration of industry and education	2019	1.15	2019	2020	
Digitalization	2010	1.42	2020	2025	
digital resources	2020	1.09	2020	2021	
Innovation	2020	1.03	2020	2022	
digital governance	2021	1.46	2021	2025	
higher vocational colleges	2017	1.38	2021	2025	
data governance	2021	1.11	2021	2023	
vocational education	2014	1.21	2022	2025	
Digital Twin	2018	1.77	2023	2025	

Figure 3: Top 20 Keywords.

3. Methodology and Research Design

This study adopts the Smith Policy Implementation Process Model as its analytical framework, which emphasises that policy effectiveness depends not only on formulation but also on implementation capacity. The model identifies four key components: idealised policy, implementing agencies, target groups, and environmental factors.[11] In the context of digital campus construction, effective implementation requires actionable policies, capable institutions, adequate resources, responsiveness to stakeholder needs (especially faculty and students), and alignment with broader socio-economic and technological conditions.

Based on this framework, 68 policy documents related to educational informatisation were collected from the Ministry of Education. Policy evolution was analysed alongside implementation practices in universities. To further examine target groups and external conditions, stakeholder theory and the PEST framework were incorporated. This integrated approach enables a systematic analysis of policy implementation, key challenges, and improvement pathways in digital campus development.

4. Results and Discussion

4.1. Policy Dimension: Evolution and Implementation of Digital Campus

Based on an analysis of 68 policy documents retrieved from the Ministry of Education, the development of digital campus policies in China demonstrates a clear stage-based evolution, reflecting the progressive deepening of educational informatisation.

1) Infrastructure Construction Stage: This phase emphasised comprehensive network coverage and the establishment of digital resource systems.[12] The 2010 National Medium- and Long-Term Education Reform and Development Plan Outline initiated educational informatisation by promoting resource platforms and national databases.[13] The 2012 Ten-Year Development Plan for Education Informatisation further advanced initiatives such as 'Three Links and Two Platforms' and 'Internet Plus', strengthening digital campus infrastructure.[14]

2) Technology Application Expansion Stage: This stage focused on resource sharing and the widespread integration of IT in teaching.[12] The 13th Five-Year Plan (2017) promoted the application of big data, artificial intelligence, and virtual reality to support new teaching models and online resource development.[15]

3) Integration and Innovation Stage: Beginning with the 2018 Education Informatisation 2.0 Action Plan, this phase emphasised deep integration of IT and education, encouraging intelligent learning environments, 5G-based systems, and reforms in teaching and talent cultivation.[7] Subsequent policies, including Education Modernisation 2035, further highlighted digital governance and smart campus development.[15]

In terms of policy implementation, universities have made notable progress. According to the China University Informatization Development Report (2021), universities have made significant progress in policy implementation. In 2021, 98% of institutions had leadership overseeing informatisation, and 83.2% established dedicated departments. Overall, universities have strengthened organisational structures, standardised management mechanisms, and improved compliance with established standards, supported by regular planning and specialised meetings.

Infrastructure has also improved markedly. Total network bandwidth reached 13,263 Mbps, with per capita bandwidth of 0.79 Mbps. Wireless access points, data centre capacity, and virtual servers increased significantly, while IPv6 applications grew by approximately 50%.

These trends indicate continuous expansion of network capacity, increased adoption of virtualisation technologies, and rapid advancement of IPv6, supporting the development of IoT and improving overall service quality.

4.2. Problem Analysis

Despite significant progress in digital campus construction, several structural challenges continue to constrain its development.

First, insufficient funding for information technology construction remains a fundamental limitation. Although national initiatives such as the Double First-Class Initiative and the Double High-Level Plan aim to promote high-quality development, the proportion of funding allocated to informatisation is relatively low—only 1.5% in Double First-Class universities and 5.1% in Double High-Level institutions.[16] With government funding accounting for merely 30%–40%, universities rely heavily on self-financing and social contributions, resulting in unstable funding sources that restrict sustained investment in infrastructure, teaching, and management innovation.

Second, the lack of effective feedback mechanisms undermines the continuous optimisation of digital campuses. Limited feedback channels, delayed responses, and insufficient data analysis lead

to reactive rather than proactive improvements. Low transparency in the feedback process further weakens student trust and reduces participation in system optimisation.

Third, low student satisfaction and engagement reflect deficiencies in system design and functionality. Problems such as complex interfaces, poor usability, and system instability negatively affect user experience. At the same time, inadequate resource integration and limited personalised services fail to meet diverse learning needs, while insufficient interactive features constrain communication between students and faculty.

Fourth, significant regional disparities in digital resource systems hinder balanced development. High-quality resources are concentrated in economically developed regions, whereas underdeveloped areas face shortages and outdated technologies. The absence of effective resource-sharing mechanisms further exacerbates these inequalities and reduces overall efficiency.

Finally, gaps in cybersecurity systems pose increasing risks in the context of rapid digitalisation. Although progress has been made in network and application security, many universities lack dedicated cybersecurity departments and comprehensive data protection policies. Incomplete lifecycle data management and insufficient personal information protection continue to threaten data security and system reliability.

4.3. Target Group Analysis for Digital Campus Construction in Higher Education

Universities, as nonprofit stakeholder organisations, involve multiple actors jointly influencing digital campus construction. Among them, university leaders, administrative staff, faculty, and students constitute the primary stakeholders, while educational authorities, partner enterprises, parents, alumni, and the broader community serve as secondary stakeholders.

University leadership plays a decisive role in policy formulation and implementation; however, insufficient attention to students' actual needs often leads to weak user experience and low engagement. Administrative staff face challenges in process optimisation and information management, resulting in inefficient service delivery and limited accessibility. Support staff encounter constraints in system maintenance, with issues such as instability and slow response times negatively affecting user satisfaction. Financial personnel also face challenges in allocating limited resources effectively, which restricts project implementation.

Faculty members, as key facilitators of digital teaching, often lack sufficient technological proficiency or time investment, thereby limiting their engagement and reducing teaching effectiveness. Students, as primary users, report low satisfaction due to poor interface design, system instability, limited resource integration, and lack of personalised services. The absence of efficient feedback mechanisms further prevents timely problem resolution.

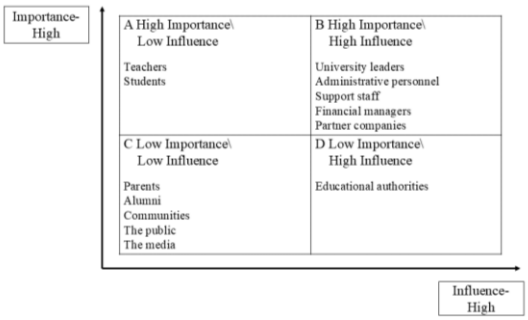


Figure 4: Stakeholder Matrix Diagram.

Digital campus construction involves multiple stakeholders, including university leaders, administrators, faculty, and students as core participants, as well as external actors such as educational authorities, enterprises, and communities. These stakeholders differ in influence and

participation, and their roles can be evaluated based on importance and impact., as illustrated in Figure 4.

4.4. Environmental Factors in Digital Campus Construction in Higher Education

The development of digital campuses is shaped by political, economic, social, and technological (PEST) factors.

From a political perspective, national policies such as the Education Informatization 2.0 Action Plan and the 14th Five-Year National Informatization Plan provide strong macro-level guidance for digital transformation. However, policy support at the institutional level remains insufficient, limiting in-depth implementation.

Economically, although government investment provides essential support, funding disparities persist across regions and institution types. Double First-Class universities receive significantly higher funding than other institutions, while vocational colleges remain underfunded. The reliance on mixed funding sources introduces uncertainty and constrains long-term development.

Socially, increasing demand for digital education, driven by the rise of a learning society and changing student expectations, promotes digital transformation. Nevertheless, digital inequality remains a concern, particularly in less developed regions where access to resources and technologies is limited.

Technologically, advances in artificial intelligence and big data enable personalised learning, data-driven evaluation, and intelligent campus management. However, shortages of skilled personnel and insufficient digital literacy among educators and administrators hinder effective adoption. Additionally, rapid technological development raises challenges related to data security and privacy protection, requiring more robust governance systems.

5. Conclusion

This study analysed 468 articles using CiteSpace to identify research trends in digital campus construction in Chinese universities, revealing a strong focus on emerging technologies and intelligent application scenarios. Building on this foundation, the Smith Policy Implementation Process Model was applied to examine policy-driven development. Based on an analysis of 68 policy documents, educational informatisation in China has evolved through three stages—from infrastructure construction to technology application and, ultimately, to integration and innovation—reflecting a deepening convergence between information technology and educational reform.

Drawing on data from the China Higher Education Informatisation Development Report (2021), this study further evaluated policy implementation effectiveness. Combined with stakeholder theory and the PEST framework, the findings indicate that although universities have made progress in organisational structures, infrastructure, and standardisation, several constraints remain, including insufficient funding, weak feedback mechanisms, low student satisfaction, regional disparities, and gaps in cybersecurity systems. These results suggest that digital campus development is not driven by a single factor but depends on the coordinated interaction of institutional arrangements, technological capacity, and external environments.

Based on these findings, several policy implications can be derived. First, strengthening funding support and improving infrastructure are essential to ensure sustainable development. Second, enhancing feedback mechanisms and stakeholder collaboration can improve system responsiveness and user engagement. Third, universities should promote smart learning environments through technological optimisation and student-centred design to improve learning outcomes. Finally,

reducing regional disparities and strengthening data security systems are critical to achieving equitable and secure digital campus development.

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References

[1] Nan, Guonong. 2002. "Several Theoretical and Practical Issues in the Construction of Education informatization (Part 1)." Journal of Educational Technology Research (12): 3–6.

[2] Li, You Zeng, Zhou Quan, and Zhao Jian. 2018. "Some Reflections on the Construction of Smart Campuses in Higher Education Institutions." China Educational Technology (1): 112–117.

[3] Ministry of Education. 2021. "Specification for the Construction of Digital Campus of Higher Education Institutions (for Trial Implementation)." Ministry of Education of the People's Republic of China. Accessed March 16, 2025. http://www.moe.gov.cn/srcsite/A16/s3342/202103/t20210322_521675.html.

[4] Gunawardena, Charlotte N., and Marina S. McIsaac. 2004. "Distance Education." In Handbook of Research in Educational Communications and Technology, edited by D. H. Jonassen, 355–395. Mahwah, NJ: Lawrence Erlbaum Associates.

[5] Bates, A. W. (Tony). 2005. Technology, e-learning and Distance Education. London: Routledge.

[6] Willems, Julie, and Carina Bossu. 2012. "Equity Considerations for Open Educational Resources in the Glocalization of Education." Distance Education, 33(2), 185–199. https://doi.org/10.1080/01587919.2012.692051

[7] Ministry of Education. 2018. "Education Informatisation 2.0 Action Plan." Ministry of Education of the People's Republic of China. Accessed April 18, 2025. http://www.moe.gov.cn/srcsite/A16/s3342/201804/t20180425_334188.html.

[8] Zhao, Xinjiang, and Zhang Yanyong. 2015. "The Status, Hotspots, and Trends of U.S. Higher Education Research in the Past Decade: A Visualization Analysis Based on Five SSCI Higher Education Journals in the United States." China Higher Education Research (10): 63–69. DOI: 10.16298/j.cnki.1004-3667.2015.10.12.

[9] Zhang, Fang. 2022, "The Practice and Innovative Application of Smart Campus Construction in Higher Education: A Case Study of Central University of Finance and Economics." Modern Educational Technology 32(04): 113–125.

[10] Qian, Xiaolong, Song Ziyun, and Huang Beibei. 2023. "The Comprehensive Realization of an Immersive University Smart Campus: Theoretical Construction and Practical Exploration." Chongqing Higher Education Research 11 (05): 49–61. DOI: 10.15998/j.cnki.issn1673-8012.2023.05.005.

[11] Deng, Datong, and Xu Fang. 2012. "The Policy Implementation Process of Community Health Education in China: An Analysis Based on the Smith Model." Journal of Wuhan University (Philosophy and Social Sciences Edition) 65 (4): 5–12.

[12] Wu, Di, Yu Liqin, Li Congdon, et al. 2017. "The Promotion Path of Education informatization Policies in Developed Countries and Its Implications." Journal of Educational Technology Research 38(09): 5–13. DOI: 10.13811/j.cnki.eer.2017.09.001.

[13] Ministry of Education. 2010. "The Outline of Medium and Long-Term Education Reform and Development Planning (2010–2020)." Ministry of Education of the People's Republic of China. Accessed August 16, 2025. http://www.moe.gov.cn/srcsite/A01/s7048/201007/t20100729_171904.html

[14] Ministry of Education. 2012. "Ten-year Development Plan for Education Informatisation (2011–2020)." Ministry of Education of the People's Republic of China. Accessed March 13, 2025. http://www.moe.gov.cn/srcsite/A16/s3342/201203/t20120313_133322.html.

[15] State Council (PRC). 2019. "Implementation Programme for Accelerating Modernisation of Education (2018—2022)." State Council of the People's Republic of China. Accessed February 23, 2025. https://www.gov.cn/xinwen/2019-02/23/content_5367988.htm.

[16] Ministry of Education. 2023. "Report on the Development of Informatisation in Chinese Universities (2021)." Ministry of Education of the People's Republic of China. Accessed July 14, 2024. https://itc.jnmc.edu.cn/2023/0715/c1949a148516/page.htm