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Digital and intelligent integration drives educational transformation: the path, challenges, and future prospects of digital transformation in China's higher education

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Abstract

The rapid development of digital technology is reshaping the global economic and social landscape with unprecedented depth and breadth. As a high ground for talent cultivation and technological innovation, the digital transformation of higher education has become an inevitable choice and a national strategy. This paper, based on a systematic review of the connotation and theoretical framework of digital transformation in higher education, comprehensively analyzes the current status and challenges faced by Chinese universities in terms of strategic planning, teaching models, governance systems, and teacher development. The study points out that the current transformation faces core bottlenecks such as fragmented top-level design, a disconnect between technology and education, insufficient digital literacy among teachers and students, and a lack of data governance systems. Drawing on the successful experiences of international organizations and universities at home and abroad, this paper proposes a systematic path for deepening the digital transformation of higher education in China from five dimensions: "concept reshaping—capability building—model innovation—governance reconstruction—ecological collaboration," aiming to provide theoretical reference and practical guidance for building a high-quality, sustainable new ecosystem of smart education.

Keywords

Higher education; Digital transformation; Artificial intelligence; Teaching innovation; Data governance; Collaborative pathways

1. Introduction

Entering the 14th Five-Year Plan period, breakthroughs in a new generation of digital technologies, represented by big data, cloud computing, the Internet of Things, and artificial intelligence, are propelling human society towards an intelligent era. This profound technological revolution is not only reshaping production and lifestyles but also posing urgent transformation requirements to the education sector, especially higher education, which bears the mission of supplying high-end talent and innovating knowledge. The report of the 20th National Congress of the Communist Party of China included "digitalization of education" for the first time, explicitly proposing to "promote the digitalization of education and build a learning society and a learning nation for lifelong learning," marking the rise of digitalization of education to a national strategic deployment. Minister of Education Huai Jinpeng has also repeatedly emphasized the need to vigorously implement the digitalization strategy for education, using digital transformation to drive high-quality development of higher education.

The digital transformation of higher education is not simply about overlaying digital technology onto traditional educational processes; it is a systemic and profound transformation involving educational philosophy, teaching models, governance structures, resource allocation, and cultural ecology. Its core lies in the deep integration of digital technology with all elements of education, shifting the educational paradigm from a "teacher-centered" to a "student-centered" approach, and driving the transformation of educational services from standardized supply to personalized, precise, and intelligent delivery. Currently, Chinese universities have made significant progress in the construction of information infrastructure, with smart classrooms, online platforms, and digital resource databases flourishing. However, how to bridge the gap between "technology application" and "model innovation," and overcome deep-seated challenges such as data silos, competency gaps, and

insufficient collaboration, to truly unleash the potential of digital technology for educational reform, remains a pressing issue of our time.[2][4]

This article aims to systematically review the current research status and practical progress of digital transformation in higher education in my country, analyze the key challenges and bottlenecks in the transformation process, and explore a path for deepening digital transformation in higher education that is in line with China's national conditions and oriented towards the future, by combining cutting-edge concepts from international organizations and typical experiences from domestic and foreign universities. The goal is to provide useful references for relevant policy formulation and institutional practice.[1][3][5][8]

2. The Connotation and Theoretical Framework of Digital Transformation in Higher Education

Accurately grasping the connotation of digital transformation in higher education is the logical starting point for scientifically advancing transformation practices. Scholars at home and abroad, as well as international organizations, have provided in-depth interpretations of this concept from different perspectives.

2.1 Definition of Digital Transformation

The Association for Higher Education Information Technology (EDUCAUSE) defines digital transformation as a process of optimizing and transforming an institution's operating model, strategic direction, and value proposition through deep, coordinated changes in culture, workforce, and technology. This definition emphasizes the holistic and systemic nature of transformation, rather than isolated technological upgrades. Chinese scholars generally believe that digital transformation in higher education, driven by digital technology, involves a comprehensive innovation and restructuring of the education system's educational philosophy, organizational structure, teaching paradigms, evaluation mechanisms, and governance models, aiming to build a more open, inclusive, flexible, and efficient new educational ecosystem. Scholars such as Zhu Zhitin point out that digital transformation will drive innovation in educational institutions at the paradigm, cultural, and organizational levels, ultimately forming an adaptive, resilient, and sustainable educational ecosystem.[9]

2.2 Dimensions and Theoretical Framework of Transformation

Based on existing research, the digital transformation of higher education can be analyzed from multiple dimensions.

The three-element model: Some studies suggest that transformation can focus on four core areas: "digital education, digital school management, digital administration, and digital support." Among them, education emphasizes the personalized growth of learners; school management focuses on the innovation of teaching and research models; administration focuses on the intelligentization of internal governance and external collaboration; and support involves the construction of support systems such as policies, funding, and human resources.

The Six-Pillar Framework: UNESCO's "Six Pillars for Digital Transformation in Education: A Common Framework" provides systematic guidance for countries, including: coordination and leadership, connectivity and infrastructure, cost and sustainability, capacity and culture, content and solutions, and data and evidence. This framework emphasizes the synergy between top-level design and bottom-level implementation, highlighting the central role of leadership, capacity building, and data-driven decision-making.

The PDCA cycle model: Some scholars have adopted the PDCA cycle from management science, viewing the digital transformation of universities as a dynamic iterative process. Plan (top-level planning) emphasizes strategic guidance; Do (implementation path) can be subdivided into a three-tiered progressive model: infrastructure construction, platform resource sharing, and digital literacy improvement; Check (evaluation and feedback) focuses on the scientific evaluation of the transformation's effectiveness; and Act (optimization and iteration) involves continuous improvement based on the evaluation results. This model provides universities with an actionable logic for action.[7]

The "Human-Technology" Symbiotic Perspective: Some studies, from a technological philosophy perspective, emphasize that transformation must adhere to a "human-centered" value orientation. The application of digital technology should serve the all-round development of people and avoid technological alienation. International organizations such as UNESCO, OECD, and the European Union have also repeatedly stressed that the digital transformation of education should safeguard human dignity, empower the growth of teachers and students, and promote educational equity and social well-being.[6]

3. The Current Status and Challenges of Digital Transformation in my country's Higher Education

Driven by policies and empowered by technology, my country's digital transformation of higher education has been fully launched, but it is still in a critical period of transition from the "exploration stage" to the "early implementation stage", presenting a complex situation of both opportunities and challenges.

3.1 Overview of the current status of transformation

At the strategic level: The digital education strategy has been incorporated into the national top-level design, and a series of related policy documents have been issued, such as "China's Education Modernization 2035" and the "14th Five-Year Plan for National Informatization," providing clear direction and policy guarantees for the transformation. More and more universities are incorporating digital transformation into their "14th Five-Year Plan," and some "Double First-Class" universities have taken the lead in launching systematic transformation explorations.

At the infrastructure level: the construction of smart campuses continues to advance. According to the "2023 China Higher Education Informatization Development Report," the proportion of smart classrooms in "Double First-Class" universities has reached 25.0 %, while that of ordinary universities is 11.6%. High-speed networks, cloud data centers, and IoT-based sensing environments are gradually being improved, providing fundamental support for teaching, research, and management.

In terms of teaching applications: Digital teaching resources, represented by MOOCs, SPOCs, and virtual simulation experiments, have been greatly enriched. The National Higher Education Smart Education Platform has gathered a vast amount of high-quality courses, and new teaching models such as blended learning and flipped classrooms have been promoted. For example, Nanjing University of Posts and Telecommunications' AI curriculum system based on knowledge graphs and Beijing Technology and Business University's AI-enabled digital business platform demonstrate the initial effectiveness of artificial intelligence technology in personalized learning path planning and teaching resource allocation.

At the management and service level: the construction of the integrated intelligent service platform has accelerated, connecting multiple business systems such as academic affairs, student affairs, human resources, and finance, initially realizing the goal of data traveling more and teachers and students traveling less. Big data analytics technology has begun to be applied to scenarios such as precise student profiling, academic early warning, and job recommendations, improving the scientific level of management decision-making.

3.2 Major Challenges and Dilemmas Faced

Despite some progress, current practices still face many deep challenges compared to the ambitious goals of digital transformation.

Fragmented top-level design and insufficient strategic coordination: Some universities' understanding of digital transformation remains at the level of information technology construction tools, lacking a systematic strategic plan from the perspective of the university's overall development. Departments often operate independently, building their own information systems, resulting in numerous "information silos" and "data silos," making cross-departmental and cross-level business collaboration and data sharing extremely difficult. As Yu Gang et al. (2025) pointed out, application-oriented universities generally suffer from problems such as fragmented organizational structures and rigid management processes that are incompatible with the requirements of transformation.

The phenomenon of a disconnect between deep integration of technology and education: The application of digital technology in teaching often remains at a superficial level, such as simply moving offline PowerPoint presentations online, failing to truly address the restructuring of teaching content, innovation in teaching methods, and transformation of teaching models. Many teachers lack the ability to deeply integrate technologies such as artificial intelligence and big data with subject knowledge, resulting in a disconnect between technology application and educational goals, and failing to effectively stimulate students' learning initiative and higher-order thinking skills.

The overall digital literacy level of teachers and students needs to be improved: Teaching in the digital age poses new requirements for both teachers and students. On the one hand, some teachers, especially older teachers, have a fear of technology, lack the ability to apply digital tools and design digital teaching, and find it difficult to effectively manage smart teaching environments. On the other hand, students' digital literacy varies greatly. Some students lack information discernment, critical thinking, and self-learning abilities, are prone to becoming addicted to the virtual world or over-relying on AI tools, and face new challenges in cultivating academic integrity and innovation capabilities. Liu Shunyu's (2026) survey of University C showed that digital literacy among special education teachers in universities is a significant weakness in their professional development competency model.

Lack of Data Governance Systems and Security Ethics: With the exponential growth of educational data, issues such as data ownership, standards, quality, security, and privacy protection are becoming increasingly prominent. Most universities have not yet established comprehensive data governance systems, and problems such as non-standard data collection, inefficient sharing, superficial analysis, and inadequate security protection are widespread. The application of generative AI further exacerbates risks such as academic misconduct, algorithmic bias, and information leakage, urgently requiring the establishment of corresponding ethical norms and

regulatory mechanisms.

Insufficient Sustainability of Continuous Investment and Collaborative Ecosystem: Digital transformation is a long-term, complex, and systematic project that requires continuous, stable, and sufficient financial investment. For many application-oriented universities and universities in the relatively resource-scarce central and western regions, the high costs of technology deployment, platform maintenance, and professional talent constitute a heavy burden. Furthermore, the collaborative mechanisms between universities and governments, enterprises, and research institutions are still inadequate, failing to form a strong synergy to drive transformation.

4. Practical Explorations and Lessons Learned from the Digital Transformation of Universities at Home and Abroad

Faced with challenges, numerous universities and international organizations both at home and abroad have carried out diverse practical explorations, and their experiences have important reference value for my country's deepening transformation.

4.1 The ideological guidance and policy framework of international organizations

International organizations such as UNESCO, OECD, and the European Union have played the roles of "idea advocates" and "framework setters" in promoting the digital transformation of global education.

Value Orientation: International organizations generally emphasize the core concepts of "people-centeredness," "equity and inclusion," "lifelong learning," and "collective action." For example, UNESCO clearly states in the Beijing Consensus that the development of artificial intelligence should be controlled by people and serve people; the EU's Digital Education Action Plan (2021-2027) takes improving digital skills and literacy as a core objective and has built a digital literacy framework for citizens and educators.

Action Frameworks: Systematic frameworks proposed by international organizations provide references for policy-making in various countries. For example, UNESCO's "Six Pillars" framework comprehensively covers key elements of transformation, from coordinating leadership, infrastructure, cost, capacity, content to data evidence. The OECD, on the other hand, focuses on providing data support for countries to optimize their digital education policies through big data surveys (such as PISA and TALIS) and evidence-based research.

Practical Path: International organizations translate their ideas into concrete actions by establishing special funds, building digital public platforms (such as the UNESCO Global Skills Academy and the European Digital Education Hub of the European Union), and developing self-reflection tools (such as SELFIE for Teachers), thereby promoting capacity building and resource sharing on a global scale.

4.2 Typical Practice Cases of Domestic Universities

Some top universities in China have taken the lead in systematically exploring digital transformation and have formed their own unique practice models.

Zhejiang University: Taking the construction of "Online Zhejiang University" as a starting point, it is comprehensively promoting digital transformation. By building integrated platforms such as "Learning at Zhejiang University," "Researching at Zhejiang University," and "Enjoying Life at Zhejiang University," it has created a smart campus ecosystem covering teaching, research, management, and services. Its core experience lies in adhering to the combination of top-level design and grassroots innovation, taking data-driven approaches as the core, and promoting profound changes in organizational structure and business processes.

Huazhong Normal University, Xi'an University of Electronic Science and Technology, and Wuhan University of Technology: These three universities represent representative of each other's transformation paths. Huazhong Normal University emphasizes "driving educational modernization through educational informatization" and has systematically constructed a smart teaching environment; Xi'an University of Electronic Science and Technology focuses on the deep integration of information technology and education, exploring a new model of "artificial intelligence + education" in the intelligent era; Wuhan University of Technology promotes data-driven precision management and services through the construction of a data platform. Professor Yang Zongkai summarized that the practices of the three universities outline the transformation and development pattern from "recognizing change, responding to change, to seeking change."

University C (Special Education): Liu Shunyu (2026)'s research reveals a professional development competency model for special education teachers in universities in the digital age, pointing out that special education ability, professional competence, digital literacy, teaching and research innovation, and social service ability are the core components. University C's practice shows that transformation in specific fields must accurately focus on the needs of teachers and students, especially addressing the shortcomings in digital literacy, and empowering teachers' professional growth by building personalized training systems and collaborative support mechanisms.

4.3 Lessons Learned

A review of domestic and international practices

yields the following insights: First, strategic guidance is a prerequisite. Successful transformation requires a clear top-level design, strong leadership support, and continuous resource investment. Second, capacity building is the core. Improving the digital literacy of managers, teachers, and students is crucial for successful transformation, requiring a systematic training system and incentive mechanisms. Third, data-driven approaches are the engine. Building a unified data governance system to promote evidence-based decision-making and precise services is the only way to unlock the value of data and achieve intelligent governance. Fourth , a collaborative ecosystem is the guarantee. Digital transformation cannot be accomplished by a single university; it requires collaboration among government, universities, enterprises, and society to build an open, shared, and win-win development ecosystem.

5.Systematic Path to Deepen the Digital Transformation of Higher Education in my country

Based on the above analysis, deepening the digital transformation of higher education in my country is a systematic project that requires concerted efforts from five dimensions: concepts, capabilities, models, governance, and ecosystem.

5.1 Reshaping the Concept: Returning to the Original Intention of Education from a Technology-Centric Approach

Establish a correct perspective on transformation: Guide university administrators, faculty, and students to deeply understand that the essence of digital transformation is a systemic change in education, rather than a simple technological upgrade. Adhere to a people-centered approach, with the core goal of promoting students' all-round development and personalized growth, and avoid falling into the misconception of "technology determinism."[10]

Strengthen top-level design and strategic coordination: Universities should establish dedicated digital transformation agencies (such as a Digital Transformation Leading Group or a Chief Digital Officer (CDO)) led by university leaders to develop a digital transformation roadmap highly aligned with the university's development strategy. Break down departmental barriers and establish cross-departmental collaborative mechanisms to ensure the integrated advancement of planning, construction, application, and evaluation.

5.2 Building a Foundation for Capabilities: Comprehensively Enhancing the Digital Literacy and Skills of Teachers and Students

Construct a tiered and categorized teacher development system: Drawing on the EU's DigCompEdu framework and the UNESCO Teacher AI Literacy Framework, design tiered and categorized training courses for teachers with different subject backgrounds, age groups, and developmental needs. Content should cover modules such as digital tool application, blended learning design, data analysis and evaluation, and AI ethics. Establish incentive mechanisms and incorporate digital literacy into the teacher assessment and professional title evaluation system.

Cultivating students' core competitiveness in the digital age: Integrate digital literacy education into the general education curriculum and the entire professional teaching process, offering courses such as the fundamentals of artificial intelligence, data analysis, and digital ethics. Encourage students to use digital tools for independent inquiry and collaborative learning, focusing on cultivating students' critical thinking, creativity, communication and collaboration skills, and ability to solve complex problems, rather than merely tool operation skills. For example, in exhibition education, students should be trained to use AI tools for data analysis and creative planning (Liu Linyan et al., 2026).

5.3 Model Innovation: Promoting the deep integration of technology and education.

Reconstructing the digital curriculum and resource system: Leveraging technologies such as knowledge graphs and AI, promote the structuring, modularization, and dynamic updating of course content. Develop high-quality digital textbooks, virtual simulation experiments, and online open courses to create an "intelligent+" professional and curriculum system. Encourage university-industry collaboration, integrating cutting-edge industry technologies and real-world cases into teaching content.

Promote student-centered smart teaching models: widely implement new teaching models such as blended learning, flipped classrooms, project-based learning (PBL), and personalized learning. Utilize intelligent teaching platforms and learning analytics systems to track the learning process in real time, accurately diagnose learning difficulties, and provide each student with customized learning paths and resource recommendations. For example, in the practical teaching of ideological and political education courses, VR/AR technology can be used to construct immersive scenarios to enhance the attractiveness and effectiveness of teaching (Liu Yingying, 2026).

Innovative data-driven educational evaluation mechanisms: shifting from singular outcome-based evaluation to a multi-dimensional evaluation combining process and outcome. Utilizing big data and AI technologies, collecting and analyzing multi-dimensional data on students during the learning process (such as online learning time, discussion

participation, and homework completion quality) to create a comprehensive digital profile. Introducing new evaluation tools such as electronic portfolios and digital badges to present students' learning outcomes and ability development in a more holistic way.

5.4 Governance Restructuring: Building an Agile and Efficient Digital Governance System

Building an integrated data platform and intelligent brain: Breaking down data silos, unifying data standards, and aggregating various data from across the university, including teaching, research, personnel, finance, and assets, to construct a university-level data platform. Based on this, develop an intelligent decision support system to provide scientific basis for discipline layout, resource allocation, quality monitoring, and risk warning.

Establish a sound data security and ethical framework: Establish a data management and ethics committee and formulate comprehensive management systems for the entire process of data collection, storage, use, sharing, and destruction. Strengthen cybersecurity protection and establish a data breach emergency response mechanism. For the application of generative AI, issue clear usage guidelines to guide students and teachers to use AI tools responsibly and ethically, preventing academic misconduct and algorithmic bias risks.

Optimize digital management and service processes: Guided by the needs of teachers and students, promote the online, mobile, and intelligent transformation of management and service processes. Build a "one-stop" online service hall to improve efficiency and user experience. Utilize technologies such as intelligent customer service and virtual assistants to provide personalized services 24/7.

5.5 Ecological Collaboration: Building an Open and Integrated Smart Education Community

Deepen the collaborative education mechanism among universities, government, enterprises, and society: The government should increase its support for the digital transformation of universities through special funds and policy guidance. Universities should proactively connect with industry enterprises to jointly build joint laboratories, practice bases, and industry-university collaborative colleges, utilizing digital platforms to promote deep integration of industry, academia, research, and application, and cultivate interdisciplinary talents adapted to industry needs. For example, exhibition education needs to cooperate with leading enterprises to jointly build AI practice bases, achieving alignment between teaching and industry capabilities.

Promote the open sharing of high-quality digital resources: Encourage universities to open up their high-quality MOOCs, virtual simulation experiments, and other digital resources to the public to promote educational equity. Actively participate in relevant projects and platforms of international organizations, strengthen exchanges and cooperation with international counterparts, learn from international best practices, and share Chinese solutions.

Foster a positive and progressive culture of transformation: Through publicity and guidance, case sharing, and awards and recognition, cultivate a campus culture that embraces change and encourages innovation. Encourage pioneering efforts, establish a mechanism for tolerating and correcting errors, and stimulate the intrinsic motivation of faculty and students to participate in digital transformation.

6. Conclusion and Outlook

Digitalization of education is an inevitable path to educational modernization, and the digital transformation of higher education is a strategic precursor to building a strong education nation. Currently, my country's digital transformation of higher education has entered a more complex phase, facing more intricate challenges and arduous tasks. Only by moving beyond simple technological advancements and returning to the essence of education—nurturing people—can we truly unleash the transformative potential of digital technology through a systemic approach that promotes comprehensive changes in concepts, models, capabilities, and governance.

Looking to the future, with the further development of cutting-edge technologies such as artificial intelligence, digital twins, and metaverse, higher education will enter a new stage that is more intelligent, personalized, ubiquitous, and lifelong. The smart campus of the future will be a deep integration of physical and digital spaces; learning will no longer be confined to the classroom but will occur anytime, anywhere; teachers will transform from knowledge transmitters to designers, guides, and companions of learning; and students will transform from passive recipients to active explorers and creators.

Realizing this vision requires consensus and concerted efforts from the government, universities, enterprises, and all sectors of society. We must adhere to a combination of top-level design and grassroots exploration, encouraging universities to forge differentiated and distinctive transformation paths based on their own positioning and characteristics. We must continuously strengthen basic and applied research to provide solid theoretical support and scientific action guidelines for the transformation. We must attach great importance to digital ethics and security, ensuring that technology is used for good, so that the benefits of digital transformation reach every teacher and student, ultimately building a more equitable, higher-quality, and more resilient

new ecosystem for higher education, providing strong talent support and intellectual guarantee for China's modernization.

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