

Research on Key Influencing Factors of Digital Education in University Teaching

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Abstract

To investigate the pivotal factors impacting the efficacy of digital education in higher education, this study constructed a four-dimensional analytical framework (Teacher, Student, Technology, and Institution). The findings reveal that teacher digital competency, student capacity for self-directed learning, technological affordance, and institutional incentive mechanisms are the core determinants of implementation outcomes, exhibiting a systemic interplay. The study concludes that holistic optimization is imperative, achievable through establishing an empowerment-oriented faculty development system, providing comprehensive student learning support, fostering an open smart education ecosystem, and cultivating a sustainable culture of incentives, thereby enhancing the quality of talent development.

Keywords

Digital education; University teaching; Influencing factors; Pedagogical Reform.

1. Introduction

The wave of the information age is exerting an unprecedented intensity and scale on all sectors of society, among which the reshaping of university teaching is particularly evident^[1-2]. New-generation information technologies, such as big data, artificial intelligence, virtual reality technology (VR), and augmented reality technology (AR), are no longer merely auxiliary tools for teaching, but rather systematically drive universities to innovate in aspects such as teaching concepts, teaching models, learning methods, and evaluation mechanisms^[3-4]. Especially, the global sudden public health emergencies have prompted universities to fully implement online teaching and practice, significantly promoting the development of digitalization in higher education in China. The Chinese government attaches great importance to the construction of digital education, has issued policy documents such as the "Education Digitalization 2.0 Action Plan", and has pointed out the strategic direction of educational digitalization, while providing strong policy guarantees for digital education^[5]. Major universities have also responded and explored actively, with emerging teaching models such as flipped classrooms and online virtual simulation experiments, significantly improving teaching quality and enhancing students' learning efficiency^[6-9].

Behind online learning and policy guarantees, the development of digital education still faces many challenges. How to effectively integrate digital technologies with teaching, how to enhance teachers' and students' digital literacy, how to build a high-quality digital education ecosystem, and how to scientifically evaluate the effectiveness of digital teaching, etc., have become complex and urgent issues to be solved in the current higher education field. Existing research mostly focuses on the application effect of a single technology or the practical exploration of a specific model, but there is still a lack of systematic and comprehensive

research on various factors influencing the effectiveness of digital education and their interactions.

This study will draw on the latest theoretical and practical research results at home and abroad, combined with the educational practice of Chinese universities, to propose a multi-dimensional influence factor analysis framework. It will explore the restrictive and promoting factors that affect the impact of digital education on university teaching from multiple dimensions such as teachers, students, technology, and institutions, and clarify the internal reasons for the influence of digital education on university teaching, in order to provide practical insights for deeply understanding the laws of digital education, promoting the formulation of effective digital education transformation strategies by Chinese universities, improving university teaching practices, and enhancing the quality of talent cultivation.

2. Relevant Theories and Current Situation Analysis

(1) Relevant Theories

The implementation of digital teaching requires matching and integration with educational theories. This article combines three types of educational theories - constructivism, connectivism, and immersive learning - with digital education to analyze and elaborate on the support of digital education for these theories.

Constructivist Learning Theory. This theory holds that learning is the process of learners actively constructing knowledge. The digital environment provides a rich platform for students to actively construct knowledge. Massive online learning resources and convenient human-computer interaction methods enable students to explore, collaborate, and create learning content and difficult problems conveniently, rapidly, and comprehensively, achieving deep and autonomous knowledge construction^[10].

Connectivist Learning Theory. Connectivism emphasizes that learning is the process of establishing and maintaining network connections. In the digital education era, knowledge is endowed with networked and distributed characteristics, which perfectly align with the digital teaching platform. Various social knowledge media and academic communities connect students to larger knowledge network nodes, using networked teachers and online classmates to enable students to continuously learn and obtain digital educational information flow during the process of constantly aligning progress and supervising check-ins^[11].

Immersive Learning Theory. Immersive learning emphasizes that students use realistic and interactive situations to enhance learning efficiency. Represented by VR/AR, it enables students to "be there"^[12]. In experimental operations, skill training, and scenario experiences, it has unique application advantages, significantly enhancing learners' participation and strengthening the ability of knowledge transfer.

Digital education has brought significant changes to the teaching methods and learning methods of university teaching in the context of the integration of these theories and technologies. It has also improved the teaching effectiveness of these learning theories.

(2) Current Situation Analysis

Driven by the integration of these theories and technologies, global higher education digital development shows a trend of rapid development and innovation reshaping. This article starts from the current situation at home and abroad and analyzes the research status of the key influencing factors of digital education on university teaching.

Domestic Development Situation. Under the guidance of domestic policies, the construction of digital infrastructure in Chinese universities has developed rapidly. The construction and application of MOOCs rank among the world's top. A three-level online open course system has been formed at the national, local, and university levels^[13]. The blended teaching and

assessment model has been widely applied and has become an important means for improving new teaching quality^[14]. Virtual simulation experimental teaching projects and other teaching models have been accelerating their popularization. However, due to the imperfect mechanism of "construction, use, management, and evaluation" of digital resources, the development of digital education in different regions and universities is unbalanced, and the reform and innovation of teaching models need to be strengthened.

International Development Situation. Developed countries started their research in digital education earlier and focused more on how to use digital technology to improve learning outcomes. They often use learning analysis technology to monitor students' learning status, prevent learning risks, provide learning path guidance and personalized learning content recommendations^[15]. AI teaching assistants and adaptive learning systems have been applied in some countries' universities^[16]. In addition, developed countries place greater emphasis on the cultivation of teachers' digital literacy and the quality assurance of digital education, providing good inspirations for China's digital education.

Given the current situation of digital technology empowering higher education, the research on the key influencing factors of university teaching has become the cornerstone and support for the digital transformation of education.

3. Research on Key Factors of Digital Education in University Teaching

The achievements of digital education do not solely rely on a single factor. Essentially, they are the result of the joint action of multiple entities and factors. This article analyzes the influencing factors of digital education into teacher and student, digital technology and resources, policies and mechanisms.

(1) Teacher-led Design

Teachers are the organizers and implementers of digital education. From "the transmitter of knowledge" to "the leader and designer of learning", the role of teachers is crucial. The teacher factor directly affects the depth and quality of digital education practice.

Digital Literacy of Teachers. Digital literacy not only refers to the ability of teachers to operate computer software and hardware, but also is a kind of "teaching content knowledge integration ability (TPACK)" that integrates technology and subject teaching. Some teachers can use various software, but in teaching design, they "repackage old wine in new bottles", failing to truly exert the important role of digital technology. For example, they merely move PPT to the learning platform and output in a one-way manner during live streaming. Teachers with high-level digital literacy can, based on teaching needs and student conditions, creatively use AR/VR technology for scenario creation and teaching, effectively constructing teaching scenarios and contents that match the teaching content and comply with the teaching syllabus requirements, and at the same time, using data statistics analysis software to understand student conditions, appropriately guide students, and improve teaching efficiency.

Teachers' Teaching Philosophy. Deeply rooted teaching concepts are the decisive factor of teachers' behavior. If teachers adhere to the "teaching-centered" concept, they will not be able to actively and proactively try the "learning-centered" digital teaching model. On the contrary, teachers who adhere to the constructivist learning theory will necessarily take students' active construction as the core, be willing to spend more time and energy exploring new teaching methods, and use digital education technology as an effective tool for individualized teaching in efficient teaching. The teaching philosophy of teachers is the innovative driving force for the transformation from "shallow application" of digital teaching to "deep integration" of digital teaching.

Teacher's Teaching Reflection. Digital education brings abundant teaching resources while also accompanying a large number of course discussion processes, online homework submissions,

and video learning records, providing rich and objective data basis for teachers' reflection on the teaching process. Teachers can make good use of the above teaching data to analyze, deconstruct, and improve the digital teaching process and effect. At the same time, universities, while building digital teaching platforms, provide continuous, systematic, and personalized development teaching platform training, course guidance, teaching competitions, etc., which can effectively help teachers conduct teaching course reflection, help teachers improve digital teaching literacy, change teaching concepts, and complete teaching reflection.

(2) Student Active Construction

Students are the main body of learning. Their learning methods and abilities directly determine the ultimate effectiveness of digital education in university teaching.

Students' Autonomous Learning and Self-Regulation Ability. The digital learning environment is highly autonomous and resource-rich, which places higher demands on students' autonomous learning ability. It requires clear learning goals and plans, efficient time management for learning, and the ability to actively seek help when encountering difficulties. Online learning lacks supervision, and students with weak autonomous learning and self-regulation ability are prone to procrastination and distraction, resulting in low learning efficiency. Therefore, setting effective monitoring links in digital teaching and guiding students to learn autonomously, as well as cultivating students' self-regulation ability, are highly challenging tasks in digital teaching.

Students' Digital Learning Habits and Information Discrimination Ability. Contemporary college students are "digital natives". They are familiar with social and entertainment application software on the internet, but most of them still do not have efficient digital learning habits and are not good at using academic databases, professional teaching software, and shared collaboration platforms for in-depth learning. At the same time, the growth of massive online information has led to information overload and the proliferation of false information. Students' information literacy mainly lies in their ability to critically select, evaluate, and integrate information, which directly determines the effectiveness of their learning.

Students' Learning Motivation and Interactive Participation Degree. Compared with traditional offline lecture classes, the interaction between teachers and students, as well as among students, is more likely to be facilitated by technological tools, which can easily lead to a sense of detachment. Students' internal driving force for learning and their interest in knowledge are the fundamental driving forces and key factors for continuous learning. Whether the teaching design can stimulate students' interest, bring them positive and effective interactive experiences, directly determines their participation and sense of belonging, and thus affects students' learning satisfaction and learning effectiveness.

(3) Support from Digital Technology Vessels

A well-established digital technology platform and excellent digital course resources are the material foundations for achieving high-quality digital education.

Completeness and Accessibility of Infrastructure. Digital education has high requirements for infrastructure, including stable campus networks, comprehensive wireless signal coverage, and necessary interactive equipment and facilities for smart classrooms. Network lag, outdated equipment, and difficult interaction will all affect the teaching experience of digital education. At the same time, "accessibility" is not only about physical availability but also needs to take into account the usage needs of different student groups to ensure that the platform has barrier-free design.

Efficiency of Digital Education Platforms and Tools. An excellent digital education learning management system should have features such as integrated functions, convenient operation, data visualization, and support for personalization. A user-friendly platform interface, functions that fit the teaching process, the ability to seamlessly connect with virtual simulation

software, online assessment tools, etc., all affect the teaching experience and teaching effectiveness of teachers and students. The application of new technologies such as AR/VR provides a new teaching experience while effectively compensating for the shortcomings of some professional practice scenarios that are difficult to replicate, expensive operation and experimental materials, but the high cost, difficult content production, and complex venue requirements make it difficult to be widely popularized.

Richness and Openness of Digital Resources. High-quality digital education cannot be achieved without high-quality digital resources. Currently, the main resources are concentrated in online open courses, new media playback platforms, excellent video lectures, virtual simulation experiments, massive electronic books and journal databases, etc. The current resource construction presents problems such as "heavy on construction, light on application", "heavy on quantity, light on quality", and homogeneity of resources. How to establish a resource sharing and co-construction mechanism, encourage teachers to create high-quality course resources with subject characteristics, high-levelness, and innovation, is an important part of improving the connotation of digital teaching.

(4) Policy Guarantee and Incentives

Policies and mechanisms play a guiding and fundamental role in ensuring the healthy and sustainable development of digital education, and are another key influencing factor of digital education in university teaching.

Clarity of top-level design and policy guidance. Whether the national and school development plans are clear and the policy support is direct have a huge impact on the promotion of digital education. The macro-level development planning needs to establish development goals, investment directions and quality requirements. The school implementation level must combine digital transformation with the overall development planning of the school, and form implementation paths and supporting measures that are in line with the actual development needs of the school.

Orientation of evaluation system and incentive mechanism. This factor is the most practical factor affecting teachers' willingness to invest. If the evaluation system for titles and performance assessment in universities still mainly consider traditional research papers and offline classroom teaching hours, and lack effective recognition and rewards for teachers' work in digital course construction and teaching mode innovation, then the enthusiasm of teachers for teaching reform will definitely be low. Establishing a set of evaluation standards that can scientifically calculate the workload and effectiveness of digital education, and providing an appropriate special reward for the evaluation of teaching workload, can effectively stimulate teachers' motivation.

Systematic organizational culture and support services. Whether the university has formed an organizational culture that encourages innovation, tolerates failure, and supports cooperation is crucial for the promotion of digital education. It is very important for the school to form a systematic support service system. The information technology department that provides technical support, the teacher development center that provides teaching support, and the library that provides resource construction, etc., work collaboratively to form a one-stop support service, to solve the digital education problems encountered by teachers and students in practice.

4. Optimization Strategy Suggestions

Based on the above influencing factors, to promote the high-quality and in-depth development of digital education in colleges and universities, this paper proposes optimization strategies from the following four aspects.

(1) Build a multi-dimensional and empowering professional development system

Carry out stratified and categorized precise digital literacy training, providing differentiated training for teachers of different ages, disciplines, and digital literacy levels, to cultivate teachers' skills from basic technology application to advanced teaching design, achieving precise empowerment for digital education.

Establish an integrated "technology + teaching" workshop. Addressing the issue of the separation between technology training and teaching method training, design cross-disciplinary workshops driven by solving real teaching problems, and invite information technology experts and teaching design experts to assist teachers in enhancing their ability to integrate teaching content knowledge.

Cultivate digital teaching innovation teams and model courses. Through project support and policy guidance, support teachers in building subject teaching innovation teams and cultivating a batch of digital model courses, promoting the long-term and healthy development of the "passing on, helping, and guiding" model course system.

(2) Implementing Holistic Guided Learning Support

Offer general courses such as information literacy, self-directed learning strategies, and academic norms that freshmen must master, under the title of "Digital Learning", to enable students to acquire the skills for rapid learning in the digital education era as early as possible upon entering the university.

Teachers should consciously incorporate clear learning roadmaps, self-assessment for each stage of learning, and collaborative tasks in their teaching designs to guide students to gradually learn self-control, and this should be carried out throughout the entire university learning process.

Build a large database of students' learning situations and utilize learning analytics technology in digital education to achieve early warnings and interventions. Warn students with potential problems and have counselors, teachers, or teaching assistants follow up promptly to provide personalized learning guidance and assistance to students.

(3) Building an Integrated and Open Educational Environment

We will continue to improve the network infrastructure, build more intelligent classrooms that support flexible grouping, remote interaction, and instant feedback, and vigorously promote the construction of virtual simulation experimental teaching centers. For disciplines with high costs, high risks, and extreme environments, we will use VR/AR technology to break through physical limitations and create innovative achievements in digital education.

We will build a "platform + tool" ecosystem. When choosing or creating core teaching platforms, we will emphasize their openness and compatibility to facilitate the convenient integration of various excellent third-party teaching tools and meet the teaching needs of multiple disciplines, avoiding the creation of "information silos" that are self-built and self-used.

Establish a mechanism for the joint construction, sharing, and regular update of high-quality resources: Promote the joint construction and sharing of high-quality course resources between schools and enterprises. Establish a reasonable evaluation and access mechanism, and set up special funds to help teachers regularly update existing high-quality resources to ensure their timeliness.

(4) Creating a sustainable incentive institutional culture

Incorporate the digital achievements such as the construction of teaching network courses, teaching innovation outcomes, and guiding students' online learning into the main workload assessment and evaluation basis for teachers. Establish a teaching innovation award fund to truly achieve "more effort, more reward; better effort, better award", and build a digital education evaluation and incentive mechanism.

Establish a multi-dimensional and networked digital education quality monitoring and guarantee system including peer review, student evaluation, supervision inspections, and data analysis. Regularly release digital education quality reports, form a "evaluation - feedback - improvement" quality improvement closed-loop system, and achieve a sound quality assurance and continuous improvement mechanism.

The school should advocate an innovative organizational culture that encourages experimentation, sharing, and tolerance of failure. Form a work system for multiple departments and multiple majors to jointly build and share, establish a cross-departmental collaborative working mechanism, break down departmental and institutional barriers, form synergy, and jointly promote the school's digital transformation strategy, providing solid and reliable organizational support for teachers and students.

5. Conclusion

Digital education has a comprehensive and profound impact on university teaching. It is a deep integration of educational concepts, educational subjects, educational organizations, and educational methods with digital technology, which is bound to bring about significant changes. It is a technological revolution in university teaching and a revolution in teaching methods and educational concepts. This article constructs a "four-in-one" analysis framework of influencing factors to reveal the key roles of teachers, students, digital technology and resources, policies and mechanisms in university teaching. The influencing factors of each dimension form a complex system, and none of them is independent; they interact and influence each other. Therefore, promoting the digital transformation of higher education cannot be considered solely from a technical perspective. Instead, a systematic and holistic thinking approach should be adopted to jointly promote the development of teachers' and students' capabilities, the optimization of the technical environment, and the reform of institutional culture. Only in this way can we better harness the power of technology and achieve the connotative development of higher education, cultivating innovative talents who are suitable for future development needs.

Acknowledgements

General Project of Higher Education Teaching Reform and Practice in Hebei Province in 2025, "Research on the Construction of Practical System for Emergency-related Undergraduate Students Based on Virtual Scenarios of Typical Accidents and Disasters" (Project Number: 2025GJJG476);

General Project of Hebei Higher Education Society's "14th Five-Year Plan" in 2024, "Research on Digital Teaching and Learning Mode Transformation in Higher Education and Its Influencing Factors" (Project Number: GJXH2024-284.)

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