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Research on the Path of Improving the Digital Teaching Ability of College Teachers under the Background of Education Digitalization

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Abstract: With the advancement of technologies such as artificial intelligence and big data, the digitalization of education has become a key direction in higher education reform, imposing new requirements on teachers' professional development. Teachers' digital teaching competence refers to the comprehensive ability to integrate technology and teaching in a digital environment, encompassing five dimensions: technology application, instructional design, resource integration, data analysis, and ethical security, characterized by comprehensiveness and dynamism. Current challenges include outdated concepts, uneven technology application, weak teaching integration, insufficient data literacy, and an incomplete training system. This study proposes a multidimensional collaborative approach: updating concepts, tiered training, enhancing instructional design, strengthening data literacy, improving incentive mechanisms, and building professional communities, to provide references for the development of teachers' digital teaching competence.

Keywords: digital education; university teachers; digital teaching competence; improvement pathways

1. Introduction

With the rapid advancement of next-generation information technologies, digital transformation in education has become a pivotal direction for higher education reform. Technologies such as artificial intelligence, big data, and cloud computing are increasingly integrated into teaching processes, driving profound changes in classroom formats, instructional methods, and learning models [1]. This shift is moving the educational paradigm away from traditional, "one-size-fits-all" instruction toward a more high-precision, interactive, and decentralized ecosystem. Recent breakthroughs in generative AI have opened new possibilities for personalized learning, intelligent tutoring, and automated generation of teaching resources, fundamentally redefining the boundaries of human-machine collaboration and accelerating the transition from "teaching-led" to "learning-centric" environments. At the national level, multiple policy documents have been issued to emphasize the promotion of educational digitalization, the establishment of a smart education system, and the enhancement of teachers' digital literacy and teaching capabilities, aligning institutional goals with the global consensus on digital pedagogical evolution [2].

In this context, university faculty members must not only possess solid disciplinary knowledge and fundamental teaching skills, but also master digital technologies for instructional design, resource integration, learning assessment, and data analysis. Digital teaching competencies have become an essential component of professional development in the new era, serving as the core driver for the sustainability of educational innovation.

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However, during implementation, many educators still face challenges such as outdated concepts, fragmented technology adoption, and insufficient instructional integration, hindering the profound transformation of teaching models. The "digital divide" is no longer merely an issue of hardware access, but a complex gap in the ability to orchestrate technology with pedagogical wisdom [3]. Therefore, systematically examining the conceptual framework of digital teaching competencies, analyzing practical challenges, and exploring actionable improvement pathways hold significant theoretical and practical value for fostering a future-ready academic workforce capable of navigating the complexities of the digital age.

2. The Connotation of Teachers' Digital Teaching Ability

2.1. Definition of Digital Teaching Competence

Teachers' digital teaching competence refers to their comprehensive ability to design and implement high-quality instructional activities in digital environments, integrating digital technologies with teaching content, methods, and evaluation approaches based on educational objectives. This competency integrates technical operations, instructional design, data analysis, and teaching reflection, representing a deep fusion of technological and pedagogical capabilities. To understand this concept, three dimensions must be considered: First, the comprehensive ability to embed technology into teaching contexts, where teachers select appropriate technical tools according to specific instructional goals. Second, its dynamic evolution, continuously advancing with technological iterations and updated educational philosophies [4]. Third, critical reflection, requiring teachers to evaluate the effectiveness of technology applications and identify potential negative effects.

2.2. The Structural Composition of Teachers' Digital Teaching Competence

2.2.1. Digital Technology Application Competence

The foundational competency in digital education encompasses proficiency in utilizing teaching platforms, educational software, multimedia tools, and online collaboration tools. Specifically, this involves: skillfully managing courses through learning management systems, creating instructional micro-lectures using video tools, organizing collaborative learning activities with students via online collaboration platforms, and enhancing classroom engagement through interactive tools. The essence of digital technology application lies in the ability to flexibly select and combine tools according to teaching requirements.

2.2.2. Digital Teaching Design Competence

This refers to teachers' ability to create teaching scenarios, design learning tasks, and organize activities by leveraging digital resources based on curriculum objectives, thereby achieving blended online-offline teaching. It includes designing differentiated learning paths through learner analysis, integrating online and offline learning activities, designing inquiry-based learning tasks with digital elements, and utilizing digital tools to create real or simulated learning environments.

2.2.3. Digital Resource Integration and Development Capability

This encompasses competencies such as curating premium resources, developing micro-lecture videos, and building online course repositories, with a focus on aligning resources with instructional objectives. In the digital era, educators must navigate vast open educational resources to identify high-quality materials that cater to student needs and align with teaching goals—a critical skill [5]. Additionally, teachers should develop fundamental resource development capabilities, including the ability to create micro-lectures and design interactive learning materials tailored to pedagogical requirements.

2.2.4. Learning Data Analysis and Feedback Skills

In digital education environments, teachers can access students' learning behavior data. The ability to analyze learning data, identify learning issues, and provide targeted guidance is a key indicator of digital teaching competence [6]. This includes: understanding the various data metrics provided by learning platforms and their educational implications; using data analysis tools to visualize students' learning status; identifying learning difficulties and deviations from data; and conducting personalized instruction based on data-driven diagnostics.

2.2.5. Digital Ethics and Information Security Awareness

Teachers' awareness and adherence to data privacy protection and network ethics standards are crucial for effective digital teaching. They must understand the ethical boundaries of educational data collection and usage, respect students' data privacy, maintain cybersecurity awareness to prevent information leaks, and guide students in proper use of online resources while developing their ability to discern reliable information.

2.3. Characteristics of Digital Teaching Competence

First, comprehensiveness: Digital teaching competence represents the deep integration of technical and pedagogical capabilities, requiring teachers to achieve organic integration of technology, content, and methods in teaching practice. Second, dynamism: With the rapid evolution of information technology, the definition of digital teaching competence continues to evolve, demanding teachers to maintain a mindset and capacity for continuous learning [7]. Third, contextual relevance: Different disciplines and course types have varying requirements for digital teaching competence, necessitating tailored development pathways. Fourth, developmental progression: The formation of digital teaching competence is a continuous process that progresses from basic to advanced levels, from simple applications to innovative integration.

3. Current Status and Problems of Digital Teaching Competence of College Teachers

3.1. Insufficient Updates in Digital Teaching Concepts: The "New Wine in Old Bottles" Dilemma

While the infrastructure for educational digitalization is rapidly maturing, a significant portion of college educators still operates under a traditional conceptual framework. Many teachers perceive digital technology merely as an "auxiliary tool" for information transmission rather than a catalyst for pedagogical reinvention. This "technocentric" view leads to the phenomenon of "new wine in old bottles," where advanced hardware is used to reinforce outdated teaching methods [8].

For instance, the transition to online instruction is frequently oversimplified as the digital "relocation" of offline classes, where long, unedited video recordings of lectures are uploaded without considering the cognitive load or the need for asynchronous interaction. Furthermore, the understanding of blended learning remains superficial; it is often treated as a mechanical split between online pre-study and offline lectures, failing to achieve an organic synergy where online data informs offline interventions. Most critically, the deeply ingrained teacher-centered logic persists. Many educators use digital tools to "control" the classroom more efficiently rather than to empower students to take agency over their learning, which fundamentally limits the transformative potential of digitalization.

3.2. Uneven Development of Technical Application Capabilities: The Digital Divide Among Faculty

There is a pronounced imbalance in digital proficiency across different demographics and disciplines, creating a "digital divide" within the faculty. On one hand, age-related disparities are evident. Younger "digital native" teachers generally possess higher self-efficacy in navigating new software and social media for teaching. In contrast, some middle-aged and senior faculty members—who are often the pillars of academic research—face "technical anxiety." They may struggle with basic troubleshooting or the complex configuration of Learning Management Systems (LMS), leading to a reluctance to move beyond PowerPoint presentations.

On the other hand, disciplinary barriers are stark. Teachers in STEM fields (Science, Technology, Engineering, and Mathematics) often have an inherent advantage in adopting digital tools due to their technical background. However, instructors in the humanities and social sciences frequently struggle to find discipline-specific digital tools that go beyond simple text and image display. This lack of breadth and depth in application means that for many, technology remains a peripheral ornament rather than a core component of their professional repertoire [9].

3.3. Insufficient Teaching Integration Capability: The Gap Between Tools and Pedagogy

The most significant challenge lies not in the availability of resources, but in the "TPACK" (Technological Pedagogical Content Knowledge) gap—the ability to integrate technology with specific subject matter and instructional methods. Currently, there is a visible decoupling between high-tech "form" and educational "content."

For example, many micro-lectures are produced with high aesthetic value but lack a rigorous mapping to the course's core knowledge points, serving more as entertainment than education. Online discussion forums are often active in terms of "post counts," yet the quality of dialogue remains low because teachers fail to design "wicked problems" that trigger high-order thinking. Similarly, expensive virtual simulation platforms are frequently underutilized, with teachers assigning overly simplistic or scripted tasks that do not challenge students' problem-solving skills. This lack of systematic design thinking results in a fragmented learning experience where technology becomes a distraction rather than a bridge to deep understanding.

3.4. Weak Data Analysis and Feedback Capabilities: The "Data-Rich, Information-Poor" Syndrome

As digital platforms generate unprecedented amounts of behavioral data—such as login frequencies, video watch durations, and quiz response patterns—teachers are increasingly finding themselves in a state of "data overload." Most educators possess basic "data awareness" (knowing that data exists) but lack "data literacy" (the ability to interpret and act upon it).

Many teachers can access the statistics dashboard of an LMS, yet they struggle to perform "learning diagnostics." They may see that 40% of students failed a quiz, but they lack the analytical skills to correlate this failure with specific learning behaviors or content bottlenecks. Consequently, the data remains dormant on the server, failing to inform personalized interventions or adaptive teaching strategies. Without the ability to translate "big data" into "small, actionable insights," teaching remains driven by intuition and experience rather than evidence-based precision [10].

3.5. Incomplete Training Systems and Institutional Support Mechanisms

Finally, the external support ecosystem for digital growth is often fragmented and insufficient. Current teacher training programs in many universities are characterized by "short-termism"—relying on one-off lectures or workshops that focus on "how to use a specific software" rather than the long-term cultivation of digital pedagogical wisdom.

These "one-size-fits-all" sessions fail to address the personalized needs of teachers from different disciplines.

Moreover, there is a lack of "human infrastructure." Teachers often work in silos, lacking access to instructional designers or technical support teams who can help them co-create digital content. This forces teachers to spend excessive time on technical troubleshooting instead of focusing on teaching. Perhaps most importantly, the institutional incentive structure is skewed. In many universities, digital teaching innovation is not sufficiently recognized in professional title evaluations or performance reviews compared to research publications. When the "cost" of digital reform—in terms of time and effort—far outweighs the institutional "reward," faculty enthusiasm naturally wanes, stalling the overall progress of educational digitalization.

4. Pathways for Enhancing Digital Teaching Competence of University Teachers in the Context of Educational Digitalization

4.1. Update Educational Concepts and Enhance Digital Teaching Awareness

Conceptual innovation is the foundation for capability enhancement. Higher education institutions should employ diverse approaches—including thematic seminars, teaching reform forums, and exemplary case studies—to guide faculty in adopting student-centered digital pedagogy, emphasizing technology as a catalyst rather than a substitute. Specifically, this involves organizing specialized workshops on digital teaching philosophies, inviting experts to analyze trends in educational digital transformation, facilitating discussions on outstanding teaching cases, and encouraging faculty to conduct in-depth analyses of their instructional designs and practical experiences. Additionally, teachers should be actively engaged in teaching reform initiatives to deepen their understanding of digital pedagogy through hands-on project implementation.

4.2. Establishing a Hierarchical and Categorized Training System

To address the diverse needs of teachers at different developmental stages, universities should establish a tiered and categorized training system. The training framework can be structured into three levels: foundational training, advanced training, and innovative practice training. Foundational training targets novice teachers in digital teaching, focusing on mastering basic technical operations. Advanced training is designed for teachers with practical experience, emphasizing the integration of instructional design and resource development. Innovative practice training is aimed at highly competent teachers, addressing challenges in teaching innovation and leading by example. The training content should be tailored to the characteristics of different disciplines. To enhance engagement, diverse formats such as workshops and teaching salons should be employed to foster interaction and participation.

4.3. Enhancing Instructional Design Competence

Instructional design competence forms the cornerstone of digital teaching capabilities. Higher education institutions should encourage faculty to implement blended learning reforms in courses, integrating digital technologies throughout the teaching process through project-based learning and flipped classrooms. For instance, organizing instructional design workshops to guide teachers in systematically designing blended online-offline teaching activities, conducting case collection and sharing sessions for instructional design, selecting exemplary cases for faculty discussions, establishing instructional design mentoring mechanisms, and inviting teaching experts to provide one-on-one guidance to new faculty members. In terms of specific teaching strategies, emphasis should be placed on advancing models such as flipped classrooms, project-based learning, and blended teaching to achieve an organic integration of online self-directed learning and offline interactive discussions.

4.4. Enhancing Data Literacy

Data literacy represents an emerging dimension of digital teaching capabilities. Higher education institutions should implement training programs in learning analytics and data interpretation to help teachers understand the significance of data metrics and enhance their ability to make data-driven teaching decisions. Basic data training should be provided to familiarize educators with fundamental concepts of learning analytics and commonly used data indicators. Data interpretation workshops should be organized, using real teaching data as case studies to guide teachers in analyzing learning behaviors behind the data. Building data analysis tool platforms can provide teachers with convenient data visualization tools. Encouraging teachers to conduct data-driven research on teaching improvement actions is essential. The core of cultivating data literacy lies in helping teachers transition from "empirical judgment" to "data-supported" teaching decisions.

4.5. Improving Support and Incentive Mechanisms

The enhancement of teachers' digital teaching competencies requires robust external support systems. Higher education institutions should establish Digital Teaching Support Centers to provide technical consultation and resource-sharing platforms, staffed with professional technicians to offer technical support. These centers should develop digital teaching resource sharing platforms that integrate high-quality teaching resources from both internal and external sources. A technical support response mechanism must be established to ensure teachers receive timely assistance. Regarding incentive mechanisms, digital teaching achievements should be appropriately incorporated into professional title evaluations, with digital course development and teaching resource creation included in the assessment scope. Performance evaluations should reflect contributions to digital teaching, with dedicated awards established to recognize outstanding teachers.

4.6. Promoting the Construction of Teachers' Professional Communities

The professional community of teachers serves as a crucial foundation for the continuous enhancement of digital teaching capabilities. Higher education institutions should establish interdisciplinary teaching communities to elevate overall digital teaching standards through experience-sharing and collaborative research. Digital teaching discussion groups can be created, with regular teaching salons and experience-sharing sessions organized. Online communication platforms should be developed to facilitate teachers' real-time sharing of teaching insights and problem-solving. Interdisciplinary teaching collaboration projects should be implemented to encourage cross-disciplinary inspiration. Mentorship programs or peer support mechanisms should be established, enabling experienced teachers to mentor new educators. The value of professional community development lies in providing continuous learning and emotional support, enabling teachers to gain inspiration and resolve challenges through community interactions.

5. Conclusion

In the context of educational digitalization, the digital teaching competencies of university faculty have become a critical factor in advancing teaching quality. These competencies represent an integrated skill set encompassing technology application, instructional design, resource integration, and data analysis. Currently, university educators still face challenges in conceptual innovation, competency development, and support mechanisms, which constrain overall competency enhancement. To address these issues, this study proposes a multidimensional collaborative improvement pathway: updating educational philosophies to strengthen digital teaching awareness; establishing tiered training systems for targeted development; enhancing instructional design capabilities to achieve deeper technology-integrated teaching; cultivating data literacy to

drive data-driven teaching decisions; improving support and incentive mechanisms to foster a conducive development environment; and promoting faculty professional communities for collective growth. Moving forward, universities should establish institutional mechanisms for sustainable digital teaching competency development, creating a virtuous cycle between faculty professional growth and educational digital transformation to advance high-quality higher education.

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