

Digital Transformation Drives the Innovation and Improvement of Teachers' Digital Literacy

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Abstract: In the context of educational digital transformation, teachers' digital literacy has become a pivotal element in advancing pedagogical reforms and fostering high-quality education. This study defines the core concepts of educational digital transformation and teachers' digital literacy, clarifies their intrinsic interdependence and synergistic development, and systematically analyzes prominent challenges in three key dimensions: digital application proficiency, resource management capabilities, and pedagogical philosophy understanding. By proposing four innovative approaches—innovative training systems, optimized digital resource development and utilization, implementation of digital teaching models, and cultivation of digital ethics and security awareness—the research establishes pathways for enhancing teachers' digital literacy in the digital transformation era. The findings provide practical frameworks for cultivating teachers' digital literacy in the context of educational digitalization, facilitating the deep integration of digital technologies with teaching practices, and driving the successful realization of educational digital transformation objectives.

Keywords: digital transformation; teacher digital literacy; integration of teaching and technology; development of digital resources; digital ethics

1. Core Connotations and Logical Connections of Digital Transformation and Teachers' Digital Literacy

1.1. Definition of Core Connotation

The digital transformation in education, powered by next-generation technologies like big data, artificial intelligence, and virtual reality, represents a comprehensive overhaul of teaching philosophies, methodologies, resource systems, and management frameworks. Its core mission is to break free from the time-space constraints of traditional education, driving a shift from standardized, homogeneous approaches to personalized, intelligent learning [1]. This transformation aims to enhance teaching quality, optimize resource allocation, and ensure equitable access to educational resources, making it an inevitable trend and key direction for digital-era education. Teachers' digital literacy, as an extension of their professional competencies in the digital age, constitutes an essential skill set for digital education. It encompasses foundational digital operation skills, the ability to curate and creatively apply digital resources, the capacity to implement digital teaching concepts, along with awareness and capabilities in digital ethics and cybersecurity. These skills form the core foundation and critical competencies for teachers to adapt to educational digitalization and deliver high-quality digital instruction [2].

1.2. Intrinsic Logical Association

The digital transformation of education and teachers' digital literacy share an intrinsic logical connection of bidirectional coupling and synergistic development. On one

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hand, the digital transformation of education serves as the core driving force for enhancing teachers' digital literacy [3]. As digital transformation advances, it imposes higher standards and more comprehensive requirements on teachers' digital capabilities, compelling them to break through traditional teaching mindsets, proactively learn emerging digital technologies, update their digital teaching concepts, and systematically elevate their digital literacy. On the other hand, the overall improvement of teachers' digital literacy is the key support for implementing educational digital transformation. The deep integration of digital technology with teaching and learning ultimately needs to be realized through teachers' practical teaching experiences. Only when teachers possess solid digital literacy can they effectively integrate digital technology into all aspects of teaching design, implementation, and evaluation, fully leverage the educational value of digital technology, drive innovation and transformation in teaching models, and truly achieve the development goals and core values of educational digital transformation [4].

2. Current Status and Outstanding Issues in Teachers' Digital Literacy Development

2.1. Divergent Characteristics of Digital Application Competence, Urgent Need to Enhance the Integration of Teaching and Technology

The digital literacy of teachers exhibits marked stratification and disciplinary disparities, reflecting a complex landscape of digital adoption where a profound gap exists between basic computer proficiency and the deep integration of technology with pedagogy. Veteran educators, despite possessing solid subject expertise and extensive teaching experience, often encounter a "digital wall." Their entrenched teaching habits and psychological attachment to traditional classroom dynamics make it challenging to adopt emerging AI-driven or cloud-based tools [5]. Operational deficiencies in navigating complex online platforms frequently disrupt the fluidity of instructional processes, leading to technical interruptions that diminish student engagement and undermine instructional authority.

Conversely, younger teachers, often categorized as "digital natives," demonstrate high technical proficiency in basic software operations and platform navigation. However, their lack of pedagogical seasoning frequently results in "technology for technology's sake." They often focus on superficial integration-prioritizing aesthetically pleasing multimedia courseware or interactive gadgets that lack instructional substance. This results in a "pedagogical disconnect," where digital tools are misaligned with core learning objectives, failing to facilitate higher-order thinking or meaningful knowledge construction [6].

Significant disparities also persist across academic disciplines. STEM teachers, influenced by their academic focus on logic and data, typically demonstrate higher adoption rates and adeptness in using specialized software for complex simulations and quantitative analysis. In contrast, humanities teachers often remain entrenched in text-heavy, lecture-based methods, showing limited capacity to leverage digital archives, collaborative storytelling tools, or digital humanities resources. This disciplinary divide prevents a holistic digital transformation across the curriculum. Ultimately, these divergent characteristics highlight an urgent need for a more nuanced approach to professional development that bridges the gap between raw technical skill and the sophisticated "Technological Pedagogical Content Knowledge" (TPACK) required for the modern digital era [7].

2.2. Weak digital resource processing capability and insufficient innovation development awareness and ability

Teachers exhibit significant gaps in the selection, integration, and innovative application of digital resources, hindering the full realization of their pedagogical value and practical effectiveness. Confronted with the vast array of digital educational materials online, most educators lack scientific screening criteria and effective methods to

accurately assess resource quality, relevance, and instructional alignment. This often leads to the selection of materials that fail to match teaching objectives or students' cognitive levels, directly impacting instructional outcomes. While some teachers manage to collect digital resources, their integration remains superficial—merely piecing together materials without systematic organization or optimization tailored to curriculum content and student learning characteristics [7]. This results in disjointed resources that fail to help students build coherent knowledge systems. Consequently, the information explosion in the digital sphere often becomes a burden rather than an asset, as many educators lack the instructional design expertise to act as effective content curators. This deficiency creates a "content-pedagogy gap," where sophisticated digital tools are frequently used to deliver fragmented or poorly structured information. Furthermore, teachers generally lack awareness and capability for innovative digital resource development. They predominantly rely on textbook supplements or off-the-shelf online materials, lacking the ability to reprocess or creatively develop resources addressing subject-specific challenges and individualized learning needs. Without the ability to re-engineer static assets into interactive or modular formats, the transition from passive resource consumption to active knowledge construction remains unfulfilled, thereby restricting the practical value of digital resources in personalized education [8].

2.3. The outdated digital teaching philosophy is out of sync with the evolving demands of digital education

Some educators' digital teaching philosophies have failed to keep pace with the digital transformation of education, where cognitive biases directly impact practical outcomes. On one hand, deeply entrenched traditional teaching concepts persist. Many teachers still adhere to teacher-centered knowledge transmission models, simplistically equating digital teaching with online adaptations of conventional classrooms. When using online platforms, they fail to fully leverage interactive and collaborative features to guide students in self-directed, cooperative, and inquiry-based learning, neglecting students' central role and personalized learning needs—a stark contrast to the student-centered, individualized teaching principles advocated by digital technology. On the other hand, perceptions of digital teaching remain superficial [9]. Most educators view digital tools merely as auxiliary means rather than core drivers for pedagogical innovation. They occasionally use basic digital formats like PPTs and instructional videos without integrating digital technology throughout the entire teaching process (design, implementation, and evaluation), thus failing to fully utilize its advantages in learning analytics, precision teaching, and personalized assessment. Furthermore, some teachers lack accurate understanding of digital-era students' cognitive characteristics. While these students exhibit active thinking, strong self-awareness, and high digital technology acceptance, educators still rely on traditional teaching methods and content designs. The monotonous teaching formats and dull content fail to meet students' digital learning demands, making it difficult to effectively stimulate their initiative and enthusiasm for learning.

2.4. Weak Awareness of Digital Ethics and Challenges in Digital Well-being

In the process of educational digital transformation, teachers often neglect the ethical and psychological dimensions of digital technology, which has become a significant bottleneck for high-quality development. Firstly, there is a pronounced deficit in digital ethics and legal awareness, particularly regarding student data privacy and intellectual property. Many educators, while collecting and analyzing student learning data, lack a systematic understanding of data desensitization and protection protocols, leading to potential risks of leaking students' personal information. Simultaneously, in the development of digital resources, the "copy-paste" habit remains prevalent; many teachers

utilize copyrighted images, videos, or academic materials without proper authorization or attribution, resulting in frequent intellectual property infringements.

Secondly, the phenomenon of "digital burnout" has become increasingly prominent. The "always-on" nature of digital communication platforms, such as DingTalk and WeChat, has blurred the boundaries between work and personal life, leading to information overload and psychological exhaustion among teachers. This digital fatigue not only diminishes instructional enthusiasm but also fosters a passive or resistant attitude toward new technological adoptions. Without addressing these ethical gaps and the issues of digital well-being, the sustainable implementation of educational digital transformation remains at risk [10].

3. Innovative Path of Digital Literacy Improvement Driven by Digital Transformation

3.1. Innovating Digital Literacy Training System to Enhance Teachers' Core Competencies in Digital Application

Building an innovative digital literacy training system tailored to teachers' practical needs is the key to enhancing their core digital application capabilities. Firstly, developing precise and personalized training programs. Through professional digital literacy assessment tools, teachers are comprehensively evaluated across dimensions such as digital awareness, digital skills, resource utilization ability, and digital ethics cognition. Based on the assessment results combined with teachers' years of service and subject characteristics, educators are categorized into different competency levels. Teachers with weak digital technology foundations receive practical skill training, while those with existing foundations are provided with advanced skill enhancement courses. Differentiated training content is designed for science/technology and humanities teachers to achieve precision and personalization. Secondly, implementing blended training models combining online and offline approaches. Online training utilizes professional online learning platforms to establish a digital literacy curriculum system covering basic digital technology knowledge, teaching software application tutorials, and cutting-edge educational theories. This includes video lectures, online quizzes, and interactive seminars to support flexible learning anytime, anywhere. Offline activities like workshops, thematic lectures, and case studies invite digital technology experts and renowned educators to provide on-site guidance and experience sharing. Emphasizing hands-on practice and face-to-face communication, these activities promptly address teachers' learning challenges, achieving organic integration of theoretical knowledge and practical application. Thirdly, establish a dynamic update and optimization mechanism for training content. Form a training content development team comprising digital technology experts, educational researchers, and frontline teachers. Closely monitor the latest applications and trends of digital technology in education, and promptly incorporate new technologies, methods, and case studies into the training content. Regularly collect feedback from teachers on the application of digital technology in teaching practices. Based on the teaching characteristics of different academic stages and subjects, dynamically adjust and optimize the training content to enhance its timeliness and practicality.

3.2. Optimize the Construction and Utilization of Digital Resources, Enhance Teachers' Resource Processing Capabilities

The development and efficient utilization of high-quality digital educational resources serve as a crucial material foundation and practical vehicle for enhancing teachers' digital resource management capabilities. Firstly, promoting collaborative development and integration of premium digital resources requires educational authorities and schools to establish dedicated funds. These initiatives support teachers in creating subject-specific online courses, teaching case libraries, and instructional material repositories, while simultaneously conducting specialized training programs to improve

their practical skills in developing high-quality digital resources. Concurrently, establishing cross-regional and inter-school digital resource collaboration mechanisms is essential. This involves integrating resources from universities, educational research institutions, and enterprises, leveraging their respective disciplinary, research, and technological strengths to build a diversified resource supply framework. The goal is to create a multi-disciplinary, multi-domain, and multi-level repository of high-quality digital educational resources. Secondly, constructing and refining standardized digital resource sharing platforms is critical. These platforms should feature clear categorization, user-friendly interfaces, and advanced search engines for multi-dimensional resource retrieval. Professional review teams must rigorously assess uploaded resources based on scientific validity, compliance standards, copyright considerations, and applicability. Encouraging teacher-student evaluations and feedback enables dynamic resource optimization. Additionally, security measures such as encryption and access control should be implemented to strengthen platform management and safeguard both resource integrity and user information security. Thirdly, a specialized program is launched to enhance teachers' digital resource utilization skills. Through targeted training, educators will learn methods for precise resource searching, scientific selection, and systematic integration, complemented by hands-on exercises using subject-specific teaching cases. Schools will also organize practical activities such as digital resource application competitions and outstanding case submissions, creating a platform for teacher collaboration to encourage experience sharing. These initiatives aim to boost teachers' overall proficiency in digital resource management through practical application and peer exchange.

3.3. Promoting Innovation in Digital Teaching Models and Deepening the Integration of Pedagogy and Technology

The innovation and implementation of digital teaching models represent the core process through which educators transform digital literacy into practical instructional capabilities. The essence of this shift lies in the seamless integration of digital technologies throughout the entire pedagogical cycle.

Firstly, digital technologies should be leveraged to diversify and enrich student-centered instructional methodologies, such as project-based learning (PBL), inquiry-based learning, and gamified instruction. Collaborative cloud-based platforms, such as Tencent Docs and Shimo Docs, are utilized to transcend spatio-temporal constraints, enabling students to form project teams that cultivate collective intelligence and digital information processing skills. For inquiry-based learning, specialized platforms like NOBOOK virtual laboratories and industry-specific simulation software provide immersive environments where students can conduct experimental explorations that might be too costly or hazardous in physical labs—a feature particularly vital for vocational education. Furthermore, by embedding curriculum content into educational gaming frameworks, teachers can enhance student engagement, effectively realizing the pedagogical objective of "learning through play."

Secondly, comprehensive digital integration must be achieved across all instructional stages: preparation, delivery, and evaluation. During the lesson preparation stage, teachers should utilize the National Smart Education Platform for Vocational Education and specialized Open Educational Resources (OER) to access high-quality lesson plans, granular knowledge components, and case studies. Interactive tools, such as Seewo Whiteboard, allow for the design of multi-dimensional courseware. During the classroom instruction stage, multimedia equipment combined with synchronous communication tools like DingTalk or Tencent Meeting facilitates blended learning environments. Teachers can foster real-time interaction through instant polling, group discussions, and digital brainstorming. Furthermore, the application of Virtual Reality (VR) and Augmented Reality (AR) can visualize abstract technical concepts, making complex

vocational skills more intuitive. In the evaluation stage, Learning Management Systems (LMS) such as Moodle or Canvas are employed to track and archive comprehensive learning data. Through embedded data analytics, educators can conduct precise, evidence-based assessments of student progress. Digital evaluation tools (e.g., Wenjuanxing) facilitate real-time feedback and formative assessment, providing the empirical data necessary to adjust teaching strategies and implement precision-based instruction.

3.4. Enhancing Digital Ethics and Security Education, and Improving the Teacher Digital Literacy System

Digital ethics and security awareness form the cornerstone of teachers' digital literacy, serving as essential prerequisites for ensuring orderly digital education. Firstly, a comprehensive digital ethics and security curriculum system should be established. The course content should cover core topics including fundamental theories of digital ethics, student data privacy protection, cybersecurity measures, and legal knowledge about digital resource copyright, enabling teachers to clearly understand ethical standards and security requirements in digital teaching. Meanwhile, by addressing practical issues encountered in teaching practices and keeping pace with digital technology trends, we can dynamically update course content to enhance its relevance and timeliness. Second, we should cultivate a positive campus culture of digital ethics and security. Through activities such as specialized lectures, thematic training sessions, and knowledge competitions, professionals should be invited to deliver presentations and analyze real-world case studies, thereby improving teachers' awareness and practical response capabilities. Additionally, establishing a long-term development mechanism is crucial. Digital ethics and security should be integrated into school daily management and teachers' professional development systems, with behavioral guidelines formulated to guide teachers' voluntary compliance through supervision and incentive mechanisms. Finally, establish concrete digital ethics and security guidelines for teachers. Regarding data privacy protection, teachers must comply with relevant regulations, standardize procedures for collecting, using, and sharing student information, and implement measures like encrypted storage to ensure data security. For online conduct, clear guidelines should be set for teachers' behavior on digital platforms, prohibiting the dissemination of false information and non-academic online activities. In terms of digital resource usage, standardized practices for resource acquisition and citation should be enforced, emphasizing legal authorization and academic copyright compliance. These guidelines should be integrated into teacher training programs, with multi-channel promotion and specialized workshops to help teachers fully understand and voluntarily implement them.

4. Conclusion

The digital transformation of education is an inevitable trend in the digital era. As a core element driving this transformation, enhancing teachers' digital literacy requires a systematic and long-term effort. This paper defines the core concepts of educational digital transformation and teachers' digital literacy, clarifies their bidirectional logical relationship, and systematically analyzes three key challenges: teachers' digital application skills, resource management capabilities, and digital teaching philosophies. It proposes a comprehensive innovation pathway through four dimensions: training system innovation, digital resource optimization, teaching model implementation, and digital ethics cultivation. This approach balances technical proficiency with ethical and conceptual soft skills, forming a complete theoretical-practical system. Moving forward, it is essential to align with big data and AI trends, establish sustainable training mechanisms, deepen school-community-enterprise collaboration, and promote high-

quality digital transformation through holistic teacher development. These efforts will lay the foundation for cultivating innovative talents in the digital age.

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