

The Value Implications and Cultivation Pathways of Teacher Digital Literacy in the Digital Age

Rongzhen Zou*

Guangxi Normal University, Guilin, Guangxi, China

*Author to whom correspondence should be addressed.

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: As the integration of digital technology and education getting more deeply continually, education field faces new challenges in school teaching and learning in the digital age. Due to technological advancements, information technology is increasingly transforming our lives. It not only enriches classroom environments but also reshapes our ways of thinking. Under this circumstances, educational reform and innovation must keep pace with technological progress to make our classrooms more vibrant and diverse. To this end, we should leverage multiple approaches, such as AI-powered collaboration, data-driven precision, personalized guidance, and the integration of virtual environments, to drive classroom transformation and creativity. As technology advances, the major challenges currently faced include how to apply intelligent technologies across various disciplines, how to integrate them with traditional teaching models, and how to construct intelligent learning environments.

Keywords: Digital technology; Teacher digital literacy; Value implications; Cultivation pathways

Online publication: December 31, 2025

1. Introduction

With the advent of the digital age, emerging technologies such as artificial intelligence (AI), learning analytics, and robotics are advancing rapidly, exerting increasingly significant influence and impact across all sectors of society. AI bridges the virtual and real worlds and such capability can compensate for gaps in teacher competencies, gradually transforming teaching practices into new forms of human-machine collaboration. The education sector is shifting its focus from concerns about digital technology replacing teachers to exploring how AI can empower education and what abilities future teachers should possess. With the continuous improvement of technology, educational digitization is widely recognized as the optimal approach to informatization. It encompasses not only all aspects of education but also various elements of educational informatization, enabling autonomous, intelligent, and networked educational activities. This facilitates continuous improvement and enhancement in education.

2. Background analysis of teacher digital literacy

In June 2024, the Ministry of Education issued the *National Smart Education Platform Digital Educational Resources Inbound and Outbound Management Specifications* and the *Content Review Specifications for Digital Educational Resources on the National Smart Education Platform*, to ensure the effective utilization of digital educational resources. In the same year, the Hebei Provincial Department of Education hosted the third specialized seminar on higher education digitization and organized practical activities to enhance students' information literacy. The Guangxi Department of Education announced a major cybersecurity defense exercise for the education system to recognize outstanding teacher education students in information-based teaching applications. This demonstrates that the trend of digital transformation is unstoppable in the education sector. For the future of digital education, the essential qualities and key competencies of teachers will inevitably be closely tied to their digital literacy.

The concept of digital literacy has emerged within the education sector, leading to its integration into educational domains and a shift in teaching objectives. Research themes have evolved from defining the essence of digital literacy to exploring its application across teaching, assessment, management, and other areas. The cultivation of teacher digital literacy remains a relatively new field of study, and the "opportunity" for more systematic exploration of this issue has gradually matured. While relevant research remains limited both domestically and internationally, different scholars continue to explore interpretations from diverse perspectives. Current research trends can be summarized as follows: the significant impact of digital literacy in education, pathways for enhancing teacher competencies, and practical challenges in cultivating teacher digital literacy within the context of digital transformation.

2.1. Era demand for digital transformation in education

Since the early 21st century, the convergence of science, technology, economics, and other fields has intensified globally, forging a dynamic world. This new global landscape has also accelerated mutual learning and integration among nations and regions, thereby building a more inclusive world. With the continuous advancement of AI, this world continues to evolve. As times progress, education is no longer merely an important task but a critical imperative. We must take measures to advance educational reform and cultivate more outstanding future talents. As the starting point for educational digital transformation, the primary purpose of updating educational resources is to revitalize the driving force behind educational reform by renewing the elements of teaching models through digital resources. The digitalization process involves integrating various system components into digital technology to achieve human-machine collaboration, thereby enabling digital resources to empower education. By analyzing the societal foundations underpinning the emergence of digital education, we can foresee that achieving comprehensive transformation and development of educational elements requires leveraging the backdrop of productivity advancement within national and societal development. The upgrading and transformation of the entire education system is inseparable from contemporary society's demand for digitally skilled talent, production capabilities, and technological progress. Therefore, the core objective of digital transformation is to utilize digital technology to drive educational reform, meet societal development needs, and cultivate innovative talent.

2.2. Practical needs for teacher digital literacy

With the rapid advancement of digital technology, the digital transformation of education is reshaping the structure, operational models, and behavioral concepts of human education. Against this backdrop of

transformation, digital technology is driving improvements in global educational quality. The United Nations Educational, Scientific and Cultural Organization (UNESCO), along with Europe, the Americas, Japan, and other nations, are actively participating in this process. They have established diverse, targeted development frameworks to prepare for cultivating future citizens through education. In 2016, the China Education Association released the *Chinese Student Development (Draft for Comment)*, aiming to build nine key learning competencies and behavioral habits for students. Although a core competency framework for teachers has yet to be established, the demands of educational practice in schools have long laid a solid foundation for the development of these competencies ^[1]. Looking at the international landscape and reflecting on domestic practices, the evolution of teacher core competencies has been a protracted process. With the rapid advancement of globalization and informatization, education faces unprecedented challenges and opportunities ^[2]. As transmitters and disseminators of culture, modern education demands that schools shift from knowledge replication to skill transfer, positioning teachers as pivotal agents of educational innovation. To cultivate talent equipped for future societies, nations worldwide are undertaking fundamental curriculum reforms in basic education, where the articulation and advancement of teacher core competencies stand as a critical component.

The core competencies of teachers not only concern their own professional growth but also directly impact students' holistic development and social adaptability. In the process of enhancing digital literacy, teachers will continually explore new teaching models, methods, and tools ^[3]. This necessitates applying digital thinking in educational practice, innovating teaching approaches, and thereby enriching and advancing pedagogical theory. The *Digital Literacy of Teachers* issued by the Ministry of Education serves as a vital industry standard for the education sector. It aims to encourage teachers to fully leverage data, actively exploring, mining, integrating, and adapting diverse data sources to elevate their teaching standards. To foster the development of greater creativity, practical thinking, and adaptability to various challenges, ultimately achieving superior educational outcomes. Regarding policy transformation, theoretically, enhancing teachers' digital skills training is crucial for achieving informatization and intelligence in education. The digital transformation of education stands as a key indicator of educational modernization. As practitioners of educational activities, teachers cannot be confined to cultivating professional competencies and subject knowledge alone; their level of digital literacy directly impacts the advancement of education within the digital era. Furthermore, developing teachers' digital literacy facilitates new explorations and developments in educational theory. As an emerging professional competency, digital literacy plays a positive role in propelling the evolution of educational pedagogy.

3. The value implications of teacher digital literacy

In the early stages of conceptualizing core competencies, teacher core competencies primarily focused on fundamental teaching abilities and professional qualities, such as subject expertise, educational passion, professional ethics, and innovation capabilities. These elements were closely tied to the prevailing levels of productivity and economic development at the time. Today, under the background of educational digital transformation, technological and societal advancements demand enhanced quality and breadth in talent cultivation. Consequently, the development of teacher core competencies has entered a phase of integrated advancement. Regarding the cultivation of teacher digital literacy, the most fundamental requirement is to master the principles and operations of relevant smart technologies ^[4]. In frontline teaching, teachers should strive to not only proficiently handle digital teaching processes but also possess the ability to deeply integrate smart technologies with educational instruction in a reasonable manner, thereby promoting the comprehensive

development of students' core competencies. Additionally, core competencies such as interdisciplinary integration skills, curriculum development capabilities, and teaching evaluation abilities remain applicable to human-machine collaboration classroom teaching. Cultivating teacher digital literacy is essential to meet the demands of educational development in the new era. The development of teachers' core competencies primarily relies on pre-service and in-service training, as well as the accumulation of practical experience through internships and teaching practice. Only by continuously enhancing their professional competence and skills can teachers better meet the demands of educational reform aimed at improving teaching quality, thereby maximizing their self-worth. Beyond fundamental teaching abilities and professional expertise, teachers should also focus on leveraging their central role in educational practice. Teachers should collaborate with learners to adapt to evolving teaching environments, cultivate a lifelong learning mindset, and foster an innovative spirit of practice. Only then can the development of teachers' core competencies be more precisely directed toward promoting their holistic growth and the evolution of personalized teaching approaches.

3.1. Adapting to digital teaching environments

As the bridge between educational resources and learners, teachers' development of core competencies serves as a vital force driving the deepening of educational reform. Teachers equipped with well-rounded core competencies can help children construct healthy mindsets, emotions, morals, and behaviors, thereby promoting their holistic development. Teachers possessing such strong competencies can assist children in accumulating greater specialized knowledge, enhancing their creative thinking, strengthening their practical skills, and laying a solid foundation for their future growth. Only teachers who adapt to digital education and societal life can deeply grasp the concepts and objectives of educational digital transformation, actively engage in the practical exploration of educational innovation, and provide robust support for the comprehensive development of both students and themselves. In the future, advancements in intelligent technologies will drive the development of teachers' core competencies, with digital literacy continuing to serve as the cornerstone for deepening and expanding these capabilities. From the perspective of social productivity and talent market demands, teachers must embrace digital teaching as the driving force for the comprehensive development of their core competencies. On the one hand, with the continuous improvement of education digital transformation, teachers should place greater emphasis on the deep and rational integration of intelligent technologies and physical educational robots across different times and spaces with the teaching process^[5]. On the other hand, with the accelerated development of educational internationalization and cultural globalization, teachers need to focus more on cross-cultural communication and the expansion of their international perspectives. It is worth noting that the evaluation system for teachers' core competencies will also be continuously refined and optimized, working in tandem with teacher digital literacy to better promote both their professional growth and students' comprehensive development.

3.2 Collaborative division in education and teaching tasks

With technological advancement, human-machine collaboration has become an indispensable component of educational resources. It transcends mere technology, embodying a cultural ethos and a legacy of knowledge transfer. This approach aims to empower teachers to master and leverage digital technologies, thereby enhancing their knowledge, skills, and emotional intelligence to better adapt to future teaching demands. In recent years, scholars have actively explored integrating learning technologies into educational assessment processes. They combine intelligent analytical techniques from the economic sphere with the human-machine collaboration teaching models that teachers will encounter in the future. This approach seeks to elevate teachers' professional

competencies, thereby presenting new challenges for educational reform. By applying data technology to education and integrating AI techniques, teacher digital literacy can be significantly enhanced, enabling them to better master core knowledge, which is also a crucial path for cultivating their digital competence ^[6]. Teacher digital literacy refers to their ability to achieve multifaceted goals in learning, work, and daily life by leveraging intelligent technologies and devices during educational digital transformation. The application of these technologies and tools empowers teachers to process and filter diverse data more effectively, thereby elevating educational quality. By effectively utilizing CNC equipment and digital resources, teachers can place greater emphasis on cultivating students' advanced thinking skills and mathematical ethics. Simultaneously, teachers' foundational knowledge, advanced mathematical reasoning abilities, and digital literacy are enhanced, thereby effectively addressing all aspects of human-machine coordination teaching. Taking teaching practice and instructional tasks as the focal points of teacher digital literacy training, teachers' digital literacy will continuously enhance the development of their teaching skills and promote collaborative division of labor in instructional tasks.

4. Cultivation pathways for teacher digital literacy

In this era of widespread intelligence, we must prioritize how to become outstanding teachers in this environment. To this end, we should enhance training in teachers' data processing capabilities and integrate these skills into classroom instruction. Only then can we empower teachers to realize their value amidst an ever-evolving societal landscape, thriving within an atmosphere of continuous innovation and intelligence. With the digital transformation of education, the synergistic role of teachers and machines has become undeniable. Not only can they assist teachers in imparting knowledge, but they also enhance teaching effectiveness through intelligent technologies. Simultaneously, they help teachers better understand, assess, and guide students' learning behaviors. Through in-depth research on teacher digital literacy, we can more effectively explore the interactive activity among teachers, computers, and students supported by artificial intelligence technologies ^[7]. Among these, the most crucial task for teacher digital literacy lies in leveraging intelligent technologies to support teaching and learning activities between teachers and students, as well as interactions among all three parties. This approach channels digital empowerment toward human-machine collaboration, thereby driving innovation in traditional teaching models, enhancing instructional quality, and stimulating educational creativity. As defined by the industry standards issued by the Ministry of Education, teacher digital literacy should encompass a comprehensive framework—spanning both conceptual understanding and practical application, that extends from specific competencies to holistic capabilities.

4.1. Manifestation of digital awareness in classroom

Under the background of educational digital transformation, "Digital Literacy" has emerged as a crucial metric in contemporary educational practice ^[8]. It represents both a fundamental competency and a vital form of wisdom. Teachers must not only master digital technologies but also cultivate sound digital awareness to flexibly apply digital literacy in guiding their instruction based on real-world contexts. This approach enables teachers to receive timely feedback on classroom content and make informed decisions. With the continuous advancement of technology, educational environments equipped with cutting-edge artificial intelligence technologies are becoming increasingly vital. To better support these emerging educational concepts, we must strengthen teachers' digital thinking and comprehensive competencies. This will enable teachers to better grasp classroom content, guide student thinking more effectively, activate innovative thinking, drive classroom transformation, and serve societal development, ultimately achieving greater efficiency and superior outcomes.

By integrating with advanced AI technologies, we can effectively manage diverse data formats while meeting ethical requirements.

4.2. Innovation in pre-service training processes

For the cultivation of teacher digital literacy, we must update both training practices and conceptual frameworks. Education digital transformation demands more than merely separating teaching elements from learners to implement embodied literacy programs. It requires teachers to develop digital literacy across multiple dimensions, such as knowledge, skills, and attitudes, while leveraging the inherent strengths of intelligent technologies in teaching support: powerful practicality, contextual relevance, personalization, and intuitive engagement^[9]. Major shifts in educational objectives and the educational ecosystem have led countries and regions worldwide to recognize that traditional centralized, standardized, and short-term training cannot effectively enhance teacher digital literacy. Currently, countries in Europe and America are actively exploring diverse embodied training approaches, tailoring professional development programs for teachers through MOOCs, textbooks, and blended learning courses. These models help teachers master AI applications in education, pair educational technology specialists with frontline teachers in one-on-one mentoring teams, to help teachers set development goals, formulate action plans, implement strategies, and evaluate outcomes. Ultimately, these approaches enable teachers to achieve personalized, continuous professional development that is embedded within their teaching practice. These findings reveal that we can foster the cultivation of digitally literate teachers by focusing on practical teaching challenges. Through supplementary online training courses, teaching activities can be integrated into teachers' personalized pre-service professional learning journey in advance.

4.3. Digital collaboration in the training process

Teachers' professional growth requires improving teaching methods. Therefore, we should strive to establish a refined digital literacy training system for teachers to enhance their digital competence. First, we must learn to fully leverage new technologies such as big data, learning analytics, and IoT sensing^[10]. This enables the continuous, automated, and unobtrusive collection of comprehensive data throughout the entire process of teacher-student interaction. By conducting intelligent analysis, personalized instruction tailored to each student becomes feasible. Second, integrate teacher training with professional ethics and daily teaching scenarios, enabling teachers to proactively leverage resources to understand each student's learning profile. Utilizing new technologies like data mining and knowledge graphs, teachers can pre-simulate customized, scenario-based courses and refine their teaching skills through autonomous, collaborative, and inquiry-based approaches. Finally, provide teachers with comprehensive, continuous, embodied digital literacy development support services. This enables them to experience technology-empowered training through intelligent means, achieving enhanced digital literacy and personalized professional growth pathways. Since the knowledge and skills acquired by teachers during training require prolonged, repeated practice to ultimately transform into stable competencies, cultivating teachers' digital literacy necessitates long-term, continuous, and personalized guidance and support throughout this process. The ideal approach involves teacher cultivation and the coordinated integration of a "co-education" culture linking students, schools, and society. This entails connecting pre-service and even in-service teachers with outstanding educational technology specialists, instructional researchers, technical developers, and support personnel from both within and beyond their regions. The goal is to establish long-term digital guidance and service programs tailored to frontline teachers.

5. Conclusion

In summary, creating an immersive process and resources for developing teacher digital literacy is a critical component of teacher development. When teacher cultivation becomes a routine part of professional development, the frameworks and concepts involved will generate value-driven guidance in response to changes in productivity. Although our emphases may differ, the three dimensions of knowledge, skills, and values form a complex and comprehensive system. They establish interconnected and mutually reinforcing relationships throughout the process of cultivating teacher literacy. Therefore, teacher digital literacy should also be a synthesis of these three elements. It enables teachers to demonstrate professionalism and appropriateness across diverse teaching environments, fully leverage intelligent technologies, and disseminate human civilization in more vivid ways.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Yan Z, Fu J, Zhu Y, et al., 2020, Discipline-Specific Pedagogical Content Knowledge Integrating Artificial Intelligence Technology (AI-TPACK): Connotation, Teaching Practice, and Future Issues. *Journal of Distance Education*, 38(05): 23–34.
- [2] Liu L, Xie Z, 2019, Research on the Model and Cultivation Pathways of Teachers' Core Competencies. *Academic Journal of Education*, (06): 77–85.
- [3] Xu Y, Peng X, Cao Y, et al., 2020, The Connotation, Function, and Development of Teachers' Digital and Intelligent Competencies in the Context of Human-Machine Collaboration. *Journal of Distance Education*, 38(06): 13–21.
- [4] Luo X, 2024, Development Model and Practical Pathways for Digital Intelligence Competencies of Vocational College Teachers in the Context of Deep Learning. *Mechanical Vocational Education*, (04): 29–34.
- [5] Zhou Q, Wen X, 2020, Practical Forms of “AI+Teacher” Collaborative Teaching in the Intelligent Era. *Journal of Distance Education*, 38(02): 37–45.
- [6] Zhang P, Wang Y, Shang J, 2024, Generative Artificial Intelligence and Educational Transformation: Values, Challenges, and Strategies. *Modern Educational Technology*, 34(06): 14–24.
- [7] Luo L, 2024, Pathways for Cultivating Teachers' Digital Literacy: International Perspectives and Chinese Approaches. *Primary and Secondary School Management*, (05): 17–20.
- [8] Liu Z, Shen P, 2024, The Value Implications, Practical Challenges, and Development Pathways of Teacher Digital Literacy. *Teacher Education Forum*, 37(03): 24–30.
- [9] Chen Y, 2024, Strategies for Enhancing Teacher Digital Literacy in a Curriculum Integration Perspective. *Education Science Forum*, (20): 46–48.
- [10] Liu B, Yin H, 2024, AI-Empowered Enhancement of Teacher Digital Literacy: Strategies, Scenarios, and Evaluation Feedback Mechanisms. *Modern Education Technology*, 34(07): 23–31.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.