

TEACHERS' DIGITAL COMPETENCE FOR HIGHER VOCATIONAL COLLEGES IN CHINA

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Abstract

The digital transformation of education represents a fundamental paradigm shift in contemporary pedagogy. In China, enhancing teachers' digital competence has become a cornerstone of educational modernisation, particularly in higher vocational colleges that act as engines for innovation and workforce development. This paper synthesises theoretical perspectives, policy frameworks, and developmental pathways concerning teachers' digital competence within China's vocational education context. Drawing on national policy analysis, international models such as DigCompEdu and UNESCO's ICT-CFT, and recent empirical studies, it explores how digital competence is conceptualised, implemented, and institutionalised. The findings reveal key challenges, including unequal infrastructure, limited institutional support, and the absence of localised competence frameworks suited to vocational pedagogy. To address these issues, the paper proposes multi-level strategies emphasising coherent policy coordination, institutional capacity building, and sustainable professional learning. By contextualising China's vocational education reform within global discourses on digital empowerment and educational equity, this research contributes to advancing theoretical understanding and practical innovation in digitalised teaching and learning.

Keywords: Teachers' Digital Competence, Vocational Education, Digital Transformation, Professional Development, Educational Policy

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INTRODUCTION

The twenty-first century is defined by rapid technological innovation that continues to reshape economic systems, industrial structures, and educational paradigms worldwide. Education, as the foundation of human capital formation, stands at the nexus of technological, economic, and social transformations. The integration of digital technologies into education extends beyond the mere adoption of tools; it signifies a profound pedagogical and institutional reconfiguration that redefines how knowledge is created, mediated, and assessed. Teachers' digital competence has therefore emerged as a decisive factor in ensuring that the digital transformation of education leads to genuine improvements in learning quality, accessibility, and equity. Globally, digital competence has become one of the defining components of teachers' professional identity. International organisations such as UNESCO, OECD, and the European Commission have developed frameworks that emphasise not only technological proficiency but also ethical awareness, pedagogical adaptability, and collaborative engagement. The UNESCO ICT Competency Framework for Teachers (ICT-CFT) positions digital competence as a critical enabler for achieving Sustainable Development Goal 4—Quality Education—by advancing inclusion, lifelong learning, and innovation. Similarly, the OECD Education 2030 Framework highlights the necessity for teachers to integrate technology both creatively and responsibly to meet the evolving needs of learners.

In China, the digital transformation of education is deeply embedded in national modernisation strategies such as Digital China, Education Informatisation 2.0, and the Education Powerhouse Construction Plan (2024–2035). These initiatives conceptualise teachers as pivotal agents of educational change who bridge the gap between technological advancement and classroom practice. Within the context of higher vocational education, where teaching is closely tied to industrial processes and applied technologies, teachers' digital competence becomes especially vital. Teachers are expected not only to master digital pedagogy but also to translate emerging technologies—such as artificial intelligence (AI), the Internet of Things (IoT), and digital simulation—into authentic learning experiences and practice-oriented curricula. Despite remarkable national progress, substantial disparities persist across institutions and regions. Provinces such as Shaanxi—an important hub for intelligent manufacturing and aerospace industries in western China—continue to face challenges related to uneven infrastructure, insufficient teacher training, and limited institutional capacity for digital reform. Consequently, teachers' digital competence in many higher vocational colleges remains fragmented and inconsistent.

This study seeks to conceptualise, contextualise, and advance the understanding of teachers' digital competence within China's higher vocational education system. Through theoretical synthesis and policy analysis, it identifies systemic challenges and proposes actionable strategies to enhance teachers' capacity for educational innovation. By situating China's reform efforts within the broader global discourse on digital education, the paper contributes both to theoretical development and to international policy dialogue on the future of digitally empowered teaching in vocational education.

RESEARCH BACKGROUND AND THEORETICAL FOUNDATIONS

2.1 Global Frameworks for Teachers' Digital Competence

Over the past decade, multiple influential frameworks have emerged to conceptualise and assess teachers' digital competence. Among them, the European Framework for the Digital Competence of Educators remains one of the most comprehensive and widely utilised (Caena & Redecker, 2019). It articulates six dimensions—professional engagement, digital resources, teaching and learning, assessment, learner empowerment, and facilitation of learners' digital competence. The framework emphasises reflective practice and pedagogical integration rather than technical proficiency alone.

Similarly, the UNESCO ICT-CFT expands on these principles by incorporating ethical, cultural, and policy dimensions. It conceptualises teachers' digital competence as progressing through three developmental levels: technology literacy, knowledge deepening, and knowledge creation. The ISTE Standards for Educators further highlight innovation, collaboration, and digital citizenship as the cornerstones of digitally competent teaching.

While these frameworks collectively recognise digital competence as multidimensional—encompassing cognitive, technical, and affective domains—they often assume resource-rich environments with high professional autonomy. This assumption limits their direct applicability to developing contexts and vocational institutions, where digital transformation is often constrained by policy structures, infrastructure limitations, and collective governance mechanisms.

2.2 Theoretical Perspectives

A range of theoretical perspectives informs the analysis of teachers' digital competence development. The Technological Pedagogical Content Knowledge (TPACK) model remains the dominant conceptual lens (Koehler & Mishra, 2009), illustrating how teachers integrate technology, pedagogy, and content knowledge in a coherent instructional framework. In vocational education, this integration assumes a distinctive character: teachers must also relate technology use to authentic, practice-oriented learning environments, requiring fluency not only in pedagogy but also in technical and applied domains.

The Self-Determination Theory provides another valuable lens (Deci & Ryan, 2000), suggesting that teachers' motivation to engage with digital technologies is shaped by their perceptions of autonomy, competence, and relatedness. Institutional contexts that promote experimentation, trust, and peer collaboration enhance intrinsic motivation and, consequently, digital adoption (Chiu et al., 2024). Complementing this, the Sociocultural Theory underscores the social and cultural nature of learning, positioning digital competence as a socially mediated process that develops through interaction, participation, and organisational support (Vygotsky, 1978).

2.3 Adaptation to the Vocational Education Context

Vocational education presents unique pedagogical and structural conditions that demand contextual adaptation of global frameworks. Teachers in this sector operate in practice-based, enterprise-linked environments that require the alignment of digital tools with authentic professional practices and competency-based curricula. Therefore, a localised model of digital competence in vocational education must address three interdependent layers:

(1) Pedagogical Adaptation: Teachers should be able to design and manage digital learning environments that replicate workplace realities, facilitate project-based learning, and support the acquisition of technical and problem-solving skills.

(2) Curriculum Relevance: Teachers' digital competence must align with authentic classroom needs and evolving curriculum goals. It should empower educators to create learning experiences that integrate theory with practice, promote innovation, and nurture creativity and learner engagement.

(3) Organisational Ecosystem: Institutional leadership, supportive policy frameworks, and access to adequate digital infrastructure jointly determine whether teachers' digital skills can be systematically developed and effectively applied.

This tripartite understanding underscores the necessity of a contextualised digital competence framework tailored to China's vocational education system—one that bridges international benchmarks with local realities.

CURRENT SITUATION AND POLICY LANDSCAPE

3.1 National Policies Driving Digital Transformation

The Chinese government has long acknowledged the transformative potential of digitalisation in education. Since the introduction of Education Informatisation 2.0 in 2018, a succession of national policies has sought to integrate digital technologies into all facets of teaching and learning. The Digital Education Action Plan (2021–2025) and the Education Powerhouse Construction Plan (2024–2035) elevate digital competence to a strategic national priority, setting explicit goals for teacher development, digital resource sharing, and the establishment of national smart education platforms (Gao Hui & Zeng Hai, 2024).

For vocational education, the National Vocational Education Reform Implementation Plan mandates digital transformation across teaching, administration, and evaluation systems. It calls for teachers to embed digital technologies in instructional design, virtual training, and learner assessment, while also strengthening collaboration between colleges and industries to cultivate workplace-oriented digital skills. Collectively, these policies signal a paradigm shift toward systemic, policy-driven educational digitalisation.

3.2 Regional Implementation in Shaanxi Province

Shaanxi Province illustrates how national strategies are localised in practice. As an industrial centre of western China, Shaanxi has prioritised intelligent manufacturing and digital skills in its educational development agenda. The Shaanxi Province's Action Plan for Advancing 'Artificial Intelligence + Education' (2025–2027) promotes smart campus construction, large-scale digital training programs for teachers, and the development of online learning platforms.

Nonetheless, regional disparities remain pronounced. Leading institutions in Xi'an enjoy advanced digital infrastructures and collaborations with companies such as FANUC and Huawei, whereas smaller rural colleges continue to struggle with inadequate resources and limited internet access (Lan et al., 2024). The uneven implementation of digital reform thus reflects broader socio-economic disparities between urban and rural regions.

3.3 International Comparisons and Policy Lessons

Comparative analysis reveals valuable insights. Finland integrates digital competence into teacher certification standards, ensuring that professional qualification encompasses digital pedagogy. Singapore complements national digital literacy policies with continuous professional learning frameworks. In contrast, China's approach—though comprehensive and centrally coordinated—faces challenges of implementation fidelity and institutional flexibility. Bridging this gap requires balancing national policy guidance with institutional autonomy, empowering local colleges to design context-specific digital competence programs aligned with national development goals.

INFLUENCING FACTORS AND DEVELOPMENT CHALLENGES

Despite clear policy direction, several interrelated challenges hinder the systematic development of teachers' digital competence in vocational education.

4.1 School Support and Institutional Environment

Institutional culture and leadership are fundamental in shaping teachers' engagement with digital innovation. Supportive policies, incentives, and professional recognition encourage teachers to experiment with technology-enhanced pedagogy (Caena & Redecker, 2019). Conversely, hierarchical management structures and performance-based assessment systems may discourage innovation. In Shaanxi's vocational colleges, the establishment of innovation laboratories and interdepartmental training networks has proven effective in narrowing competence disparities (Althubyani, 2024).

4.2 Professional Development and Teacher Motivation

Professional development represents the most direct pathway to improving teachers' digital competence. Long-term, practice-oriented programs embedded within teachers' professional routines produce more sustainable outcomes than fragmented, short-term training (Cabero-Almenara et al., 2020). Motivation is also critical: the Technology

Acceptance Model (Davis, 1989) suggests that perceived usefulness and ease of use determine teachers' adoption of digital tools. Environments that support autonomy, reflection, and collaboration are essential for nurturing intrinsic motivation (Chiu et al., 2024).

4.3 Digital Ethics and Security

Ethical and responsible use of technology forms the moral foundation of teachers' digital competence. Teachers must ensure data privacy, intellectual property protection, and equitable access. Yet, in many vocational colleges, digital ethics remains peripheral within teacher training. The Ministry of Education's 2022 guidelines call for integrating ethical literacy across all training programs to ensure responsible and sustainable technology use (Caena & Redecker, 2019).

4.4 Technological and Regional Inequalities

Persistent technological inequities between urban and rural regions exacerbate the digital divide. Western provinces such as Shaanxi still face infrastructure limitations, resulting in unequal opportunities for digital teaching and learning (Meylina et al., 2021). Generational differences further compound these disparities: younger teachers tend to demonstrate greater digital fluency, while senior educators often exhibit lower confidence or limited exposure to training (Romero-Garcia et al., 2020). These challenges necessitate long-term investment and the creation of mentorship-based ecosystems.

STRATEGIES AND DEVELOPMENT DIRECTIONS

Building upon the challenges identified above, this section outlines a multi-level strategy for developing teachers' digital competence sustainably in higher vocational education.

5.1 National-Level Strategies

At the policy level, coherence and continuity are vital. Establishing a National Digital Competence Index for Teachers would provide a standardised framework for evaluation. Integrating digital competence into teacher certification and promotion systems could further incentivise continuous professional growth. Expanding the Smart Education Platform of China would democratize access to digital teaching resources, enabling teachers from different provinces to benefit equally from national initiatives.

5.2 Institutional Reform and Leadership Empowerment

Institutions must transition from passive compliance to strategic innovation. School leaders should embed digital transformation within institutional strategies, aligning it with teaching quality assurance and curriculum reform. Creating Digital Innovation Laboratories and interdisciplinary project teams can help bridge policy intentions with pedagogical practice. Investment in technology must be accompanied by human capacity building and leadership development to ensure sustainable change.

5.3 Strengthening Professional Learning Systems

Professional learning should be continuous, collaborative, and evidence-based. Tiered training models that distinguish between foundational ICT literacy and advanced pedagogical integration can address diverse needs. Teachers should participate in Professional Learning Communities that foster collective reflection, peer mentoring, and shared innovation (Falloon, 2020). In doing so, professional learning becomes both a driver and an outcome of digital transformation.

5.4 Ethical and Reflective Practice

Embedding digital ethics in teacher education is imperative. Training should include modules on cybersecurity, digital rights, and responsible AI use. Encouraging teachers to maintain reflective journals or digital portfolios promotes ongoing self-assessment and professional accountability. These reflective mechanisms not only enhance ethical awareness but also contribute to the continuous refinement of teaching practices.

5.5 Collaborative Engagement and Community Partnerships

Collaboration between vocational institutions, enterprises, and local communities strengthens the relevance and sustainability of digital competence development. Shared resource platforms, co-teaching arrangements, and regional alliances can promote mutual learning and innovation while ensuring that vocational education remains aligned with societal and economic transformation.

CONCLUSION

Teachers' digital competence stands at the core of educational modernisation and the transformation of vocational learning. Within China's higher vocational education system, it represents both a pedagogical necessity and a strategic lever for achieving national development objectives. This paper has examined global theoretical foundations, reviewed national and regional policy landscapes, and identified key institutional and developmental challenges.

The findings suggest that enhancing teachers' digital competence requires multi-level coordination: national policy leadership, institutional reform, and individual empowerment. Digital competence must be cultivated not through isolated interventions but through a cohesive ecosystem that integrates infrastructure, professional development, ethics, and reflective practice.

Theoretically, this study extends global frameworks by embedding them within a policy-oriented and practice-based context, illustrating how digital competence evolves in a centrally guided yet locally adaptive education system. Future research should empirically validate these propositions through comparative and longitudinal analyses across different provinces and institutional types. Ultimately, strengthening teachers' digital competence is not only a national priority for China but also a shared global mission to ensure that education remains equitable, innovative, and responsive in the digital age.

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