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The Impacts of Digital Literacy among Chinese Higher Vocational Teachers: Uncovering the Professional SILO Effect

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Abstract

In the burgeoning era of Education 4.0, the digital transformation of higher vocational education has become a strategic imperative for fostering a high-quality technical workforce. However, teachers in vocational colleges face a unique dual-professional challenge: they must simultaneously possess industry-specific professional skills and digital pedagogical capabilities. Despite the growing body of literature on Teacher Digital Literacy (TDL), existing research often treats it as a monolithic construct, failing to scrutinize how distinct sub-dimensions—specifically Social Responsibility Literacy (SRL), Digital Pedagogical Literacy (DPL), and Professional Digital Literacy (PDL)—synergistically or differentially influence overall digital competence. Addressing this gap, this study conducted a large-scale empirical survey of teachers from higher vocational colleges across 11 prefecture-level cities in Jiangxi Province, China. Utilizing a stratified cluster sampling method, 400 valid questionnaires were collected and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The results reveal a heterogeneous influence on mechanism. Digital Pedagogical Literacy (DPL) exerts the strongest significant positive influence on TDL, confirming that pedagogical integration is the operational core of digital competence. Social Responsibility Literacy (SRL) also demonstrates a significant positive impact, functioning as a critical normative anchor for ethical technology use. However, contrary to the skill transfer assumption prevalent in vocational education policy, Professional Digital Literacy (PDL) showed no statistically significant direct effect on TDL. This finding uncovers a "Professional Silo Effect," suggesting that mastery of industry-specific digital tools does not naturally translate into general educational digital competence. The study concludes with targeted policy recommendations for bridging the gap between industry skills and pedagogical application in the digital age.

Keywords: Teacher Digital Literacy, Higher Vocational Education, Digital Pedagogical Literacy, PLS-SEM, Professional Silo Effect, Chinese Vocational Teachers

Introduction

Research Background

The rapid proliferation of emerging technologies, such as Artificial Intelligence (AI), Big Data, Cloud Computing, and the Internet of Things (IoT), is fundamentally reshaping the landscape of global education (Annapareddy, 2025; Magash & Saaida, 2024). International frameworks, such as the European Commission's Digital Education Action Plan and UNESCO's ICT Competency Framework for Teachers, underscore that digital literacy is no longer an optional skill but a fundamental competency for educators in the 21st century. In China, this global trend converges with a national strategic mandate. The Ministry of Education of the People's Republic of China in 2022 has launched the *National Education Digitalization Strategic Action,* explicitly prioritizing the digital empowerment of teachers as a critical lever for high-quality educational development (Huang, 2025). This strategy envisions a teacher workforce capable of blending physical and digital spaces to create immersive, personalized learning experiences.

To operationalize these macro-strategic goals, several established frameworks have been deployed to guide and assess Teacher Digital Literacy (TDL). Prominent examples include the UK's JISC Digital Literacy Framework, the US ISTE Standards for Educators, and the European Union's DigCompEdu (Antonietti et al., 2022). While these instruments have proven to be robust guiding tools, a critical limitation persists they are predominantly designed for foundational and general higher education (Nguyen & Habók, 2024) Consequently, they do not adequately address the unique and complex digital ecology of Higher Vocational Education (HVE) (Jiao et al., 2026; Zheng & Wu, 2025).

Within this macro-context, Higher Vocational Education (HVE) occupies a pivotal yet complex position (Jiao et al., 2026; Zheng & Wu, 2025) Unlike general higher education, which often focuses on academic and theoretical knowledge, HVE is tasked with cultivating high-caliber technical and skilled personnel who can immediately adapt to industrial upgrades (Zhang, 2025). Consequently, vocational teachers are required to embody the Double-Qualified (or Dual-Teacher) standard: they must be educators capable of sophisticated instructional design and simultaneously serve as industry experts proficient in the latest vocational technologies. From a theoretical perspective, this dual identity complicates the application of the aforementioned general frameworks, including the classic Technological Pedagogical Content Knowledge (TPACK) model(Mishra & Koehler, 2006). In HVE, "Content Knowledge" (CK) is not merely academic; it is synonymous with industry-specific technical proficiency, often manifested as the mastery of complex professional digital tools. This creates a theoretical tension: while current frameworks treat digital literacy as a generalizable construct, vocational teachers must navigate a bifurcated digital space—balancing general pedagogical technologies with highly specialized industrial software (Kukkonen et al., 2025).

Jiangxi Province, situated in central China, serves as a significant observational window for this phenomenon. As a national pilot zone for vocational education innovation and development, Jiangxi has invested heavily in digital infrastructure, establishing numerous virtual simulation training centers and smart classrooms. However, a persistent hardware-rich, software-poor paradox remains. While the physical availability of technology has surged, the soft power, specifically the digital literacy of teachers, has not evolved at a commensurate pace (Jing & Zhongbo, 2024). Educational administrators increasingly realize that the mere

provision of advanced industry tools does not automatically result in digitally competent teaching, highlighting the need for a more nuanced understanding of how different types of digital literacies interact.

Problem Statement

Despite the increase in research on Teacher Digital Literacy (TDL), significant theoretical and practical gaps persist, particularly regarding the internal structure of digital competence in vocational settings. First, existing literature predominantly treats TDL as a homogeneous construct or focuses heavily on generic technological skills, often referred to as Technological Knowledge (TK) within the TPACK framework. This approach obscures the multidimensional nature of digital literacy, especially in the vocational context where distinct literacies may compete for a teacher's cognitive resources. Specifically, the relationship between a teacher's ethical awareness (Social Responsibility Literacy), their teaching methodology with technology (Digital Pedagogical Literacy), and their industry-specific technical skills (Professional Digital Literacy) remain underexplored. The question of how these distinct dimensions weigh against each other in forming a teacher's overall digital identity has not been adequately answered.

This homogeneous approach is widely evident in recent systematic reviews of teacher digital competence, which predominantly rely on general educational frameworks (Skantz-Åberg et al., 2022). While some scholars have begun to contextualize digital literacy models for Chinese teachers across different regions (Qing & Jing, 2024; Xu & Guo, 2024), these adaptations still fundamentally lack the mechanism to operationalize the distinct cognitive load required by vocational educators. Specifically, the literature has yet to empirically disaggregate the ethical dimensions (UNESCO, 2019; Tondeur et al., 2023) from the pedagogical and industry-specific technical domains. This absence of a multidimensional assessment leaves a critical theoretical gap in understanding how diverse literacies compete or synergize within the vocational teaching context.

Second, there is a prevailing assumption in vocational education policy, which can be termed the Transfer Hypothesis that enhancing a teacher's industry skill set will automatically elevate their overall digital competence as an educator. Colleges often invest heavily in training teachers on advanced industrial software, expecting a spillover effect on their teaching quality. However, whether this cross-drama transfer occurs remains empirically unverified. If technical expertise in an industry does not translate into digital competence in education, then current training resource allocation strategies may be fundamentally flawed. This study seeks to investigate whether the mastery of professional digital tools acts as a bridge or a barrier to general teacher digital literacy.

The necessity to empirically test this explicit gap is further emphasized by emerging research highlighting the contextual disconnect between industry applications and academic instruction (Dias & Santos, 2024). Although the general mechanisms of knowledge transfer in the digital age have been investigated (Kumar, 2024), the specific assumption that production-oriented digital skills organically morph into instructional efficacy lacks robust empirical validation in the HVE sector (Younis, 2024). Without rigorously challenging this literature gap, current institutional investments in teacher training risk functional

misconfiguration. By addressing this empirical void, this study transitions the "Transfer Hypothesis" from a policy assumption to an empirically testable mechanism.

Research Objectives and Significance

To address these gaps, this study adopts a variance-based Partial Least Squares Structural Equation Modeling (PLS-SEM) approach to deconstruct the influence mechanisms of TDL among vocational teachers in Jiangxi. The study aims to achieve three specific objectives.

First, it seeks to determine the extent to which Digital Pedagogical Literacy (DPL) predicts overall TDL, thereby verifying the role of pedagogy as a primary driver.

Second, it assesses the impact of Social Responsibility Literacy (SRL) on TDL to establish the importance of digital ethics as a foundational element.

Third, it empirically tests the Transfer Hypothesis by examining the direct effect of Professional Digital Literacy (PDL) on TDL.

Theoretically, this study enriches the TPACK framework and the DigCompEdu framework by contextualizing them within the unique ecosystem of Chinese vocational education. It challenges the monolithic view of digital literacy by proposing a multi-dimensional model that separates industry skills from pedagogical skills. Practically, the findings will provide evidence-based guidance for educational administrators in Jiangxi and similar developing regions to optimize teacher training programs. The goal is to move beyond mere technical skills accumulation toward a more integrated, pedagogically driven digital empowerment strategy that effectively utilizes the dual expertise of vocational teachers.

Literature Review and Hypotheses Development

Theoretical Foundation: Integrating TPACK and DigCompEdu

This study is grounded in two complementary theoretical frameworks: the Technological Pedagogical Content Knowledge (TPACK) framework proposed by Mishra and Koehler (2006) and the European Framework for the Digital Competence of Educators (DigCompEdu) developed by Redecker (2017). TPACK posits that effective teaching with technology requires the intersection of three knowledge domains: Content, Pedagogy, and Technology. In the context of vocational education, Content Knowledge is synonymous with industry-specific professional knowledge. DigCompEdu further expands this by emphasizing Professional Engagement and Digital Citizenship. Based on these theories, this paper conceptualizes TDL not as a single variable, but as a composite outcome influenced by ethical, pedagogical, and professional-industrial dimensions. This multidimensional perspective allows for a more granular analysis of how specific competencies contribute to general teaching efficacy in a digital environment.

Teacher Digital Literacy (TDL) as the Outcome Variable

Teacher Digital Literacy (TDL) is defined in this study as a teacher’s comprehensive capability to utilize digital technologies to retrieve information, create content, communicate, and solve problems within an educational setting to facilitate student learning (Skantz-Åberg et al., 2022). It goes beyond functional IT skills, such as operating a computer, to include cognitive, sociological, and emotional dimensions of interacting with digital environments. In the vocational education sector, TDL represents the teacher's capacity to function effectively in a digitized educational ecosystem (Lo, 2024), serving as the dependent variable that reflects overall professional competence in the digital age. It captures the teacher's self-efficacy and

adaptability in the face of rapid technological change, acting as the ultimate indicator of workforce readiness.

Social Responsibility Literacy (SRL) and TDL

Social Responsibility Literacy (SRL) refers to the ethical, legal, and safe use of digital technologies. It encompasses awareness of copyright and intellectual property rights, protection of student data privacy, prevention of cyberbullying, and the ethical use of emerging technologies like Generative AI. As digital environments become more pervasive, the boundary between public and private, and between appropriate and inappropriate use, becomes blurred (Li, 2025). UNESCO emphasizes that Digital Citizenship is the prerequisite for digital competence. A teacher lacking SRL may possess high technical skills but fails to model responsible behavior for students, thereby undermining their overall digital efficacy (Huang et al., 2025). Scholars argue that SRL acts as a normative anchor or a moral compass. When teachers possess high SRL, they are more likely to engage in reflective practices regarding technology, ensuring their digital usage aligns with educational values (Wang & Tan 2025; Xu & Guo, 2024). Consequently, ethical awareness is posited as a foundational driver of overall digital literacy. Based on this, the study proposes the first hypothesis: Social Responsibility Literacy (SRL) has a significant positive influence on Teacher Digital Literacy (TDL).

Digital Pedagogical Literacy (DPL) and TDL

Digital Pedagogical Literacy (DPL) represents the ability to integrate digital technologies into instructional design, implementation, and assessment. It corresponds to the Technological Pedagogical Knowledge (TPK) component of the TPACK framework. DPL is distinct from mere technical knowledge; a teacher with high DPL does not just use a projector but understands how the visual aid enhances cognitive retention. They do not just use an online forum but know how to facilitate collaborative learning within it (Qing & Jing, 2024, Zinn et al., 2019). Research suggests that pedagogical beliefs are the strongest predictors of technology integration. Starkey (2020) further argues that digital competence is inherently pedagogical; technology is void of educational value until it is activated by a teaching strategy. Therefore, DPL is expected to be the most direct and potent predictor of a teacher's overall digital literacy, serving as the "operational engine" of their practice. Thus, the study proposes the second hypothesis: Digital Pedagogical Literacy (DPL) has a significant positive influence on Teacher Digital Literacy (TDL).

Professional Digital Literacy (PDL) and TDL

Professional Digital Literacy (PDL) is the distinguishing variable of this study, specifically tailored to the vocational education context. It refers to the mastery of specialized digital tools, software, and standards used in the specific industry or trade the teacher instructs. The "Double-Qualified" teacher policy in China assumes a positive correlation between industry skills and teaching ability (Zhao & Ko, 2024). The logic is that deep immersion in industry digitalization should enhance a teacher's confidence and capability in the general digital education environment via the mechanism of "skills transfer."

Hence, the "Transfer Hypothesis" serves as a foundational, albeit often implicit, assumption in global and Chinese vocational education policy, positing that a teacher’s mastery of industry-specific digital tools will naturally *spill over* into their general educational digital

competence. This hypothesis is rooted in the "Double-Qualified" teacher paradigm, which suggests that deep immersion in the digital tools of a specific trade, such as CAD for engineering or ERP for logistics, lowers the cognitive and psychological barriers to adopting pedagogical technologies.

Proponents of this view argue that the technical self-efficacy gained through professional software proficiency creates a positive transfer of learning, where the logic of industrial digitalization acts as a bridge to broader digital teaching efficacy. Consequently, many institutional training strategies focus heavily on high-end industrial software, operating under the belief that elevating a teacher's status as an industry expert will automatically produce a more digitally competent educator (Kumar, 2024). Accordingly, the study proposes the third hypothesis: Professional Digital Literacy (PDL) has a significant positive influence on Teacher Digital Literacy (TDL). By empirically testing this hypothesis, this study seeks to determine if this assumed cross-domain transfer actually occurs or if these competencies remain isolated within their respective professional spheres.

Conceptual Framework

Based on the synthesis of the TPACK and DigCompEdu frameworks, this study proposes a multi-dimensional research model to examine the formation of teacher digital competence within the vocational context. The model moves beyond a monolithic view of literacy by isolating three distinct precursors: the normative-ethical foundation (Social Responsibility Literacy), the instructional-operational core (Digital Pedagogical Literacy), and the industry-specific technical domain (Professional Digital Literacy). By structuring the framework in this manner, the study seeks to verify whether these literacies act as synergistic drivers or if certain domains, particularly industry-specific skills, remain functionally isolated from a teacher's general digital efficacy. The resulting conceptual framework, illustrated in Figure 1, serves as the theoretical roadmap for the subsequent empirical analysis and hypothesis testing.

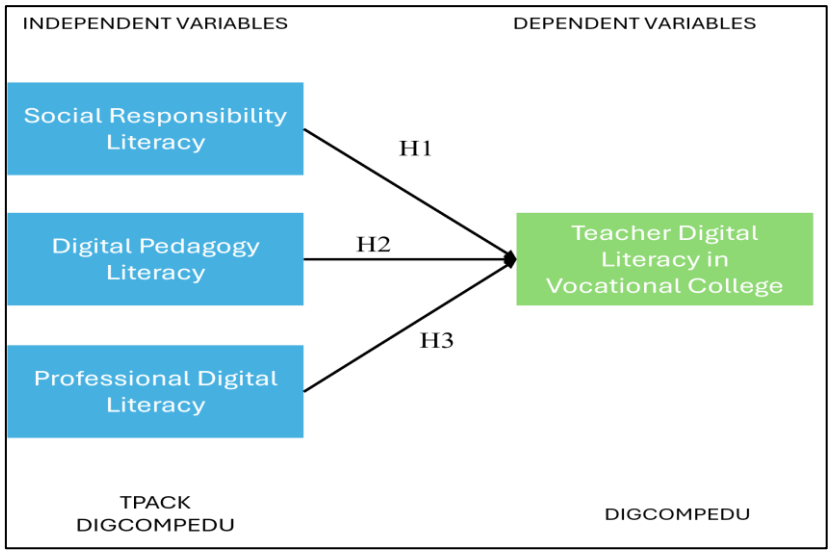

Figure 1 Conceptual Model for the Impacts of Digital Literacy Dimensions on TDL among Chinese Higher Vocational Teachers.

Methodology

Research Design and Sampling

This study employs a quantitative, cross-sectional survey design to test the proposed hypotheses. The population consists of in-service teachers working in Higher Vocational Colleges in Jiangxi Province, China. To ensure the sample was representative of the province's diverse economic and educational landscape, a Stratified Cluster Sampling technique was utilized. The sampling process involved three stages. First, the 11 prefecture-level cities of Jiangxi, including major urban centers like Nanchang and regional hubs like Ganzhou and Jiujiang, served as the strata. Second, within each city, one representative higher vocational college was randomly selected as a cluster to ensure geographical coverage. Third, all full-time teachers within specific departments of the selected colleges were invited to participate. Data collection was conducted via an online platform. A total of 421 questionnaires were distributed. Rigorous data cleaning was applied to ensure the integrity of the dataset. Responses with completion times under 120 seconds, those with invariant response patterns such as selecting the same option for all items, and those with missing demographic data were excluded. The final dataset comprised 400 valid responses (N=400), yielding an effective response rate of 95.01%. The sample demographics were balanced, with 46% male and 54% female participants. Approximately 65% of the respondents held a Master's degree or higher, reflecting the increasing qualification levels in Chinese vocational education. The sample covered diverse disciplines including Engineering (35%), Management (25%), Arts (15%), and Others (25%), ensuring the findings are applicable across various vocational fields.

Research Instrument

The survey instrument utilized a 5-point Likert scale ranging from "1 = Strongly Disagree" to "5 = Strongly Agree." To ensure cross-cultural validity, all items underwent a rigorous translation and back-translation process by bilingual experts in educational technology. Social Responsibility Literacy (SRL) was measured using items adapted from the UNESCO Digital Citizenship Education framework (2019) and Choi (2016), focusing on awareness of copyright, data privacy, and digital ethics. Digital Pedagogical Literacy (DPL) was assessed using items adapted from the European DigCompEdu framework, measuring the ability to design digital learning activities and assess students digitally. Professional Digital Literacy (PDL) was measured using items developed based on the Professional Standards for Vocational Teachers, focusing on proficiency with industry-specific tools. Finally, Teacher Digital Literacy (TDL) was measured using items adapted from Falloon (2020), comprising statements that measure overall self-efficacy and competence in a digital educational environment.

Data Analysis

The study utilized Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS software. PLS-SEM was selected over covariance-based SEM (CB-SEM) for two primary reasons. First, the research goal is exploratory and predictive, aiming to identify key drivers of TDL rather than confirming a global fit of a theoretical model. Second, PLS-SEM is robust against non-normal data distributions, which are common in self-reported social science data. The analysis followed a standard two-step procedure, beginning with the assessment of the Measurement Model to ensure reliability and validity, followed by the assessment of the Structural Model to test the hypothesized paths.

Results and Discussion

Evaluation of the Measurement Model: Reliability and Validity.

The reliability and validity of the measurement model were evaluated using indicator loadings, Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE). As shown in Table 4.1, all indicator loadings exceeded the recommended threshold of 0.708, indicating satisfactory indicator reliability.

Internal consistency reliability was assessed using Cronbach's alpha and composite reliability. The results show that Cronbach's alpha values for Social Responsibility Literacy (SRL), Digital Pedagogical Literacy (DPL), Professional Digital Literacy (PDL), and Teacher Digital Literacy (TDL) ranged from 0.82 to 0.91, while composite reliability values ranged from 0.88 to 0.94, demonstrating strong internal consistency across all constructs.

Convergent validity was examined using the AVE. As reported in Table 4.1, all constructs achieved AVE values between 0.58 and 0.72, exceeding the recommended threshold of 0.50 and confirming adequate convergent validity.

Table 4.1
Construct Reliability and Convergent Validity

Construct	Cronbach's Alpha	Composite Reliability	AVE
SRL	0.82	0.88	0.58
DPL	0.91	0.94	0.72
PDL	0.85	0.90	0.61
TDL	0.88	0.92	0.65

Discriminant validity was assessed using the heterotrait–monotrait ratio (HTMT). The results presented in Table 4.2 indicate that all HTMT values were below the conservative threshold of 0.85, suggesting that the constructs are empirically distinct. In addition, collinearity diagnostics showed that variance inflation factor (VIF) values were below 3.0, indicating no multicollinearity issues among the predictor variables.

Table 4.2
Discriminant Validity (HTMT)

Construct	SRL	DPL	PDL	TDL
SRL	—			
DPL	0.64	—		
PDL	0.58	0.71	—	
TDL	0.69	0.79	0.62	—

Structural Model Assessment

The structural model was evaluated to examine the explanatory power and the hypothesized relationships among the constructs. The coefficient of determination (R^2) indicates that the model explains 45.2% of the variance in Teacher Digital Literacy (TDL) ($R^2 = 0.452$), suggesting a moderate level of explanatory power in behavioral research.

Predictive relevance was further assessed using the blindfolding procedure. The results produced a Q^2 value greater than zero, indicating that the model demonstrates adequate predictive relevance for the endogenous construct.

Path Analysis and Hypothesis Testing
A bootstrapping procedure with 5,000 subsamples was conducted to generate the t-statistics and p-values for hypothesis testing. The results of the structural model are presented in Table 4.3

Table 4.3
Path Coefficients and Hypothesis Testing Results

Hypothesis	Path Relationship	β	t-value	p-value	Decision
H1	SRL → TDL	0.215	3.115	0.002	Supported
H2	DPL → TDL	0.582	12.652	<0.001	Supported
H3	PDL → TDL	0.043	0.895	0.370	Not Supported

As shown in Table 4.3, two of the three proposed hypotheses were supported.
First, the analysis confirmed that Social Responsibility Literacy (SRL) has a significant positive influence on Teacher Digital Literacy (TDL) (β = 0.215, t = 3.115, p = 0.002), thereby supporting Hypothesis 1. This finding indicates that teachers' ethical awareness and responsible digital behaviors contribute positively to their overall digital literacy.

Second, Digital Pedagogical Literacy (DPL) demonstrated the strongest significant positive influence on TDL (β = 0.582, t = 12.652, p < 0.001), supporting Hypothesis 2. With the highest path coefficient among the constructs, this result suggests that the ability to integrate digital tools into teaching practices plays a crucial role in developing teacher digital literacy.

However, Professional Digital Literacy (PDL) did not show a statistically significant direct effect on TDL (β = 0.043, t = 0.895, p = 0.370). Therefore, Hypothesis 3 was not supported. Although theoretical assumptions suggest that professional or industry-related digital skills may transfer to broader digital literacy, the results of this study indicate that mastery of professional software does not significantly predict overall teacher digital literacy.

The results of the structural model assessment and the path coefficients are visually summarized in Figure 2. As illustrated, the solid paths for H1 and H2 indicate significant positive relationships, reinforcing the roles of Social Responsibility and Pedagogy as primary drivers of TDL. Conversely, the dashed line representing H3 visually depicts the lack of statistical significance between Professional Digital Literacy and overall, Teacher Digital Literacy. This graphical representation highlights the identified 'Professional Silo Effect,' where industry-specific technical skills fail to intersect with the broader educational digital competence of vocational teachers in the Jiangxi province. Hence, while SRL and DPL significantly predict TDL, the lack of relationship with PDL suggests a critical gap in the current vocational training model which will be discussed in detail below.

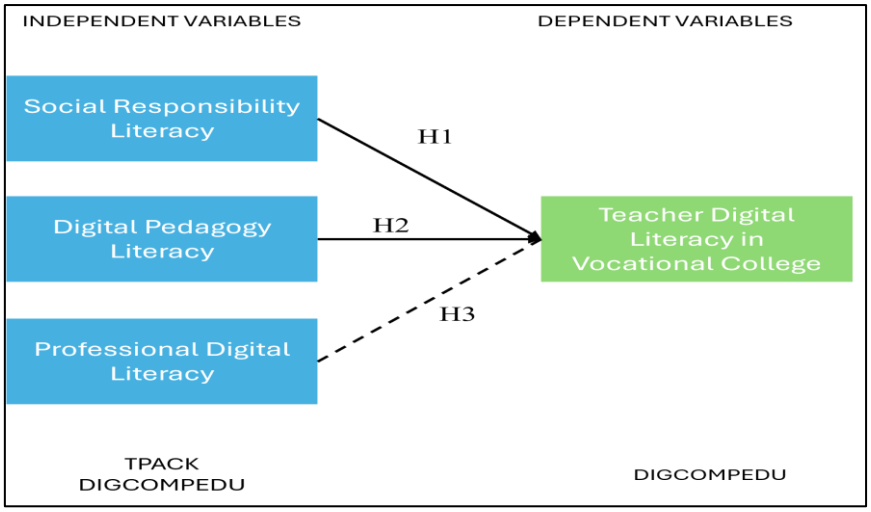

Figure 2 PLS-SEM Results of the Structural Model showing the Professional Silo Effect.

Discussion

The findings of this study provide a nuanced understanding of the digital literacy landscape in Chinese higher vocational education, offering both confirmations of established theories and unexpected insights into the "Double-Qualified" teacher paradigm.

The Primacy of Pedagogy: DPL as the Core Driver

The finding that Digital Pedagogical Literacy (DPL) is the dominant predictor of TDL resonates with the core tenet of the TPACK framework: technology is only effective when successfully integrated with pedagogy. In the context of Jiangxi's vocational colleges, this implies that a teacher's ability to design a digital lesson plan or facilitate an online discussion contributes more to their digital identity than mere technical proficiency. This validates the shift in international discourse from "computer literacy" to "digital pedagogical competence." For vocational teachers, the confidence derived from successfully managing a digital classroom serves as a self-reinforcing mechanism, elevating their overall sense of digital efficacy (Mishra & Koehler, 2006; Starkey, 2020). It suggests that the essence of being a digitally literate teacher lies not in the sophistication of the tools used, but in the pedagogical intent behind their use.

The Ethical Foundation: SRL as the Normative Anchor

The significant impact of Social Responsibility Literacy (SRL) highlights the often-overlooked ethical dimension of digitalization. In an era where students consume vast amounts of unregulated digital content, teachers serve as gatekeepers and role models. The study suggests that teachers who are cognizant of copyright laws, privacy issues, and digital ethics possess a more sophisticated understanding of the digital ecosystem (UNESCO, 2019; Wang & Tan (2025). This "ethical mindfulness" likely encourages them to explore digital tools more cautiously yet more deeply, thereby enhancing their overall literacy. This finding is particularly relevant given the recent proliferation of Generative AI tools, where ethical judgment is paramount. Teachers who understand the ethical implications of technology are better equipped to navigate the complexities of the digital world, making SRL a crucial foundation for broader digital competence.

The "Professional Silo Effect": The Paradox of PDL

The most striking finding of this study is the non-significant impact of Professional Digital Literacy (PDL) on Teacher Digital Literacy (TDL) (β= 0.043, p = 0.370). The most striking finding of this study is the non-significant relationship between Professional Digital Literacy (PDL) and Teacher Digital Literacy (TDL), which directly challenges the widely accepted "Transfer Hypothesis" in vocational education as mentioned by Zhao and Ko (2024). Rather than functioning as a bridge, industry-specific digital competence appears to operate within an isolated domain, giving rise to what this study conceptualizes as the *Professional Silo Effect*. This effect can be understood through three interrelated mechanisms. First, there is a cognitive mismatch between industry and educational contexts. Professional digital tools are typically designed for efficiency, precision, and task completion within structured workflows, whereas educational technologies prioritize interaction, adaptability, and student-centered learning. As a result, mastery of industrial software does not necessarily equip teachers with the cognitive frameworks required for pedagogical integration (Younis, 2024).

Second, there exists a functional disconnect between usage contexts. Industry tools are often used in production-oriented environments, while educational technologies are embedded in communicative and instructional settings (Dias & Santos, 2024). Without explicit opportunities to translate these tools into teaching practices, teachers may compartmentalize their skills, applying them only within their original professional domain.
Third, an institutional gap further reinforces this separation. Current teacher training programs in vocational education tend to emphasize either technical upskilling or pedagogical training, but rarely the integration of both. The absence of structured "bridging mechanisms"—such as collaborative curriculum design, interdisciplinary workshops, or practice-based digital pedagogy training—limits the transferability of professional digital skills into teaching competence.

This finding has important theoretical implications. It suggests that digital competence development is not merely accumulative but integrative in nature. The acquisition of isolated competencies does not automatically lead to holistic digital literacy unless these competencies are meaningfully connected. Therefore, the Professional Silo Effect highlights a critical condition in digital competence theory: transfer across domains requires intentional pedagogical mediation (Kumar, 2024).

From a practical perspective, this implies that vocational education systems must move beyond the assumption that industry expertise inherently enhances teaching quality. Instead, targeted strategies are needed to bridge the gap between professional and pedagogical domains, ensuring that digital skills are not only acquired but also effectively translated into educational practice (Dias & Santos, 2024).

Conclusion and Implications

Conclusion

This empirical study in Jiangxi Province deconstructs the monolithic concept of Teacher Digital Literacy. It concludes that Digital Pedagogical Literacy is the engine and Social Responsibility Literacy is the rudder of a vocational teacher's digital competence. Crucially, it identifies a structural disconnect—the Professional Silo Effect—where industry-specific digital skills fail to naturally translate into broader educational digital literacy. This indicates that the current

pathway to developing digitally competent "Double-Qualified" teachers is fragmented. The findings suggest that possessing industry skills alone is insufficient for developing a digitally competent teacher workforce; rather, the ability to integrate these skills into pedagogical practice is paramount.

Policy Recommendations

Based on these findings, three key policy recommendations are proposed. First, vocational colleges should restructure training programs to shift from "Tech-Driven" to "Pedagogy-Driven" training. Instead of isolated workshops on software operation, training should focus on the pedagogical application of those tools, such as how to use industrial simulation software to facilitate inquiry-based learning. Second, educational authorities should encourage the formation of "Digital Teaching Communities of Practice" to establish "translation" mechanisms. These communities would explicitly focus on translating hard industry skills into soft teaching resources, helping teachers bridge the gap between PDL and TDL. Third, given the significance of SRL, modules on digital ethics, data security, and AI governance should be mandatory in continuing education, ensuring teachers act as responsible digital citizens.

Limitations and Future Research

This study relies on self-reported data, which may be subject to social desirability bias. Future research could employ performance-based assessments to measure literacy more objectively. Additionally, this study utilized a cross-sectional design, which captures a snapshot in time; longitudinal studies are needed to observe the dynamic evolution of these literacies over time. Finally, further qualitative research is required to unpack the psychological mechanisms behind the "Professional Silo Effect" and identify specific barriers to skill transfer. Such research could provide deeper insights into how to effectively bridge the gap between industry expertise and educational competence.

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