

Construction of Digital Teaching Competence for Higher Vocational Education Teachers Based on the Innovation Value Chain Theory

Qu Yujing^{*,†}, Cui Zixuan[†], Lei Lei

Chongqing Normal University, Chongqing, 401331, China

**Corresponding Author*

†These authors contributed equally to this work and share first authorship.

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Abstract: As the national strategy for educational digitalization advances in depth, the digital transformation of vocational education has become a key lever for improving the quality of technical and skilled talent cultivation and promoting educational modernization. As key implementers of this transformation, the digital teaching literacy of higher vocational education teachers directly affects the actual effectiveness of deep integration between digital technology and vocational education. However, the current development of digital teaching literacy among higher vocational education teachers still faces practical challenges. This paper innovatively introduces the Innovation Value Chain Theory as an analytical framework to systematically examine the necessity of constructing digital teaching literacy for higher vocational education teachers. Through theoretical analysis at the macro, meso, and micro levels, it identifies six major challenges in the three stages of idea generation, idea transformation, and idea diffusion. In response to these challenges, this paper proposes a systematic construction pathway based on the three stages of the innovation value chain, aiming to provide a theoretically robust and practically operable solution for the professional development of higher vocational education teachers in the new era.

1. Introduction

Digital technology is reshaping society with unprecedented breadth and depth, and the education sector is undergoing a technology-driven transformation. The digital transformation of education has become an inevitable trend of the times. The Opinions on Deepening the Reform of the Modern Vocational Education System also emphasizes "promoting the digital upgrade of vocational education and enhancing teachers' digital literacy" [1], indicating that the digital transformation of vocational education has risen from an external demand to a national strategic deployment.

As a key sector for cultivating technical and skilled talent and serving economic and social development, the digital transformation of higher vocational education is not only an inevitable choice to keep pace with the times but also an internal requirement to improve the adaptability of vocational education and strengthen its capacity to serve industrial development. Digital technology,

especially the rapid development of AI-assisted technology, offers unprecedented possibilities for breaking the spatial and temporal limitations of traditional practical training and achieving "integration of theory, practice, and virtuality." However, leveraging technological advantages ultimately depends on teachers' effective application. Relevant research and practice show that many higher vocational teachers face multiple difficulties in the wave of digital transformation: a single-dimensional reserve of digital knowledge and skills, imbalanced digital assessment practices [2]; insufficient internal drive for digital development, and a lack of digital teaching research and innovation capability [3]. Traditional teaching competencies mainly based on PPT presentations and simple multimedia operations can no longer meet the needs of higher vocational education, which emphasizes "integration of theory and practice, combination of virtual and real." Therefore, teachers urgently need to develop corresponding digital training design and implementation capabilities to truly support the high-quality development of higher vocational education.

To address the above issues, this paper introduces the Innovation Value Chain Theory as an analytical framework, regards higher vocational teachers' digital teaching literacy as an "innovation" process, and conducts research on the construction of their digital teaching literacy, providing theoretical support and practical guidance for cultivating a high-quality higher vocational teacher workforce adapted to the intelligent era.

2. Necessity of Constructing Higher Vocational Teachers' Digital Teaching Literacy

2.1 Macro Level: Digitalization of Higher Vocational Education as an Engine for National Strategy

From a national macro-strategic perspective, promoting the digitalization of higher vocational education is a powerful engine for cultivating high-quality technical and skilled talents, as well as a key measure for advancing the construction of an education powerhouse and serving regional economic transformation and upgrading. For a long time, there have been significant regional disparities in the allocation of higher vocational education resources in China, with high-quality teaching resources concentrated in central cities and developed regions. Some vocational colleges in central, western, and county areas are relatively weak in terms of faculty, training conditions, and curriculum resources [4]. The digitalization strategy provides a systematic solution to this structural problem.

On the one hand, digital technology, being wide-coverage and replicable, can break through spatial and geographical limitations. Through national smart education platforms and other channels, high-quality practical training resources can be delivered to under-resourced areas at low cost, narrowing the educational quality gap and promoting resource sharing [5]. On the other hand, intelligent technologies represented by artificial intelligence support "teaching according to aptitude." For example, virtual simulation can create to strengthen skills training [6]; big data analysis can analyze learning behavior and recommend personalized learning paths [7]; intelligent assessment can dynamically diagnose job competency [8]. These methods can enhance the scientific and personalized level of higher vocational teaching decisions. Overall, the digital transformation of higher vocational education, through the dual paths of resource sharing and precise intervention, promotes the optimization of educational processes and outcomes, allowing all types of learners to share the dividends of the digital era.

2.2 Meso Level: Teachers' Digital Literacy as the Core Driver for Improving Higher Vocational Education Quality

Teachers' digital literacy is key to connecting digital technology with students' vocational ability

cultivation and is also the driving force for promoting the high-quality development of higher vocational education. Technology itself is neutral; whether it can generate educational value depends crucially on teachers' ability to convert it into effective teaching behaviors. Due to the particularity of teaching objects and contexts, the connotation of higher vocational teachers' digital literacy is richer than that of general education, serving as an important support for moving higher vocational education from "scale" to "quality."

Specifically, this role is reflected in two key abilities: first, deep integration ability, integrating digital tools into project-based teaching, modular teaching, and contextualized practical training according to professional standards and job requirements, constructing a hybrid teaching environment combining online and offline, virtual and real; second, data-driven decision-making ability, i.e., using data to optimize skills training plans and teaching strategies to achieve more precise and personalized guidance. The overall improvement of teachers' digital literacy can promote the transformation of higher vocational teaching from experience-based to data-driven, drive systematic optimization of curricula, teaching methods, and evaluation, and help higher vocational education achieve high-quality, sustainable development.

2.3 Micro Level: Innovation Value Chain Theory as a Systematic Framework for Literacy Construction

From a theoretical perspective, the Innovation Value Chain model provides a suitable analytical framework for constructing higher vocational teachers' digital teaching literacy. Innovation is seen as a value creation process consisting of three stages: "idea generation," "idea transformation," and "idea diffusion" [9]. The overall innovation capacity depends not only on the performance of a single stage but also on the smooth linkage among the three. Unlike traditional training that treats teacher development as a one-time knowledge transfer, this theory views teachers as active learners, emphasizes the continuous transformation from knowledge acquisition to application to innovation, and regards literacy development as a dynamic, value-added process.

In the context of higher vocational education, which is highly practice-oriented and job-related, the three stages correspond to key nodes in generating teachers' digital literacy: the "idea generation" stage requires teachers to understand industry trends and job requirements; the "idea transformation" stage involves converting these understandings into digital teaching solutions that support students' skills training and job adaptation; the "idea diffusion" stage involves teachers summarizing their successful experiences and sharing them with colleagues or peers, promoting the regional or industry-wide dissemination of teaching models.

With its clearly defined and interlocking stages, the Innovation Value Chain theory provides a clear theoretical map and practical guidance for analyzing and reshaping the training path of higher vocational teachers' digital literacy. Based on this, the following sections will use this theoretical framework to systematically examine the current practical obstacles in the construction of higher vocational teachers' digital teaching literacy, from the three stages of idea generation, transformation, and diffusion, aiming to provide theoretical grounds for solving long-standing problems such as training disconnect, transformation difficulties, and innovation isolation.

3. Practical Obstacles in Constructing Higher Vocational Teachers' Digital Teaching Literacy

Using the Innovation Value Chain theory as an analytical framework, we can systematically examine the construction process of higher vocational teachers' digital teaching literacy. The generation and development of digital literacy face multiple interrelated blockages in the three core stages of the value chain—"idea generation," "idea transformation," and "idea diffusion"—which seriously hinder the effective generation and development of literacy.

3.1 "Idea Generation" Stage

3.1.1 Homogenization of Training Content

The digital training content for higher vocational teachers is significantly homogenized [10]. There are two main reasons: first, there are very few composite trainers who understand both digital technology and higher vocational curriculum development and practical training design; second, although policies provide guidance, they have not been refined according to professional categories and job requirements, so training becomes a "one-size-fits-all" approach, only covering general office software and teaching platform operations, neglecting the digital tools and teaching models truly needed for professional teaching and skills training. As a result, what teachers learn is disconnected from actual classroom situations, and innovative ideas lack relevance from the start, making them difficult to implement.

3.1.2 Hindered Cooperation and Communication

Vocational education inherently requires industry-education integration and school-enterprise collaboration. As boundary-crossers, higher vocational teachers need to communicate more with enterprise technicians, curriculum developers, and researchers to promote professional growth [11]. However, there is currently a lack of effective cross-disciplinary communication platforms, and higher vocational teachers have limited contact with industries, enterprises, and research institutions. Teachers are not well-informed about the latest trends in industrial digital transformation; valuable industry information cannot flow into the teaching frontline, and real teaching problems cannot be fed back to enterprises or researchers. Truly good digital teaching solutions often emerge at the intersection of teaching scenarios and industrial practice. Without smooth cooperation channels, high-quality teaching ideas are difficult to generate.

3.2 "Idea Transformation" Stage

3.2.1 Superficial Understanding of Technology

Some teachers only master basic operations, lack contextual application ability, and struggle to integrate technology with teaching pain points [12]. The value of technology lies in providing personalized learning support, creating practical training situations, and driving data-based evaluation, not simply displaying information. Staying at the surface level blocks idea transformation, and innovative value is lost in the process.

3.2.2 Lack of Overall Systematic Support

Individual deficiencies are amplified by the absence of external support systems. Teaching innovation is inherently an uncertain exploration process, and in the strongly practice-oriented context of higher vocational education, this risk is even higher. Currently, institutional support is insufficient: technical failures in practical training classes may cause safety risks, but maintenance staff only understand equipment, not teaching; teaching research activities are mostly public lesson evaluations, rarely analyzing failures in daily innovation exploration. Teachers often have to play multiple roles—instructional designer, technical debugger, and practical training instructor—overly relying on personal effort. Many valuable ideas are eventually abandoned due to high transformation costs.

3.3 "Idea Diffusion" Stage

3.3.1 Single Evaluation Indicators

Even when teachers achieve teaching innovations, the current evaluation system rarely recognizes them [13]. The fundamental problem is that higher vocational education evaluation indicators remain too narrow to measure the multi-dimensional value brought by digital innovation. The improvements brought by such innovation are often reflected in soft indicators such as students' vocational ability, job adaptability, and teaching efficiency, which are difficult to quantify in traditional evaluation. Consequently, teachers' efforts receive little institutional recognition, weakening their motivation and leaving their achievements overlooked.

3.3.2 Difficulty in Promoting Innovative Achievements

Without recognition of diverse value, promotion naturally lacks motivation. First, innovative practices are often highly dependent on specific training equipment, software, and curriculum resources. Differences in regional industrial development levels, digital infrastructure, funding, and program offerings make it difficult to directly replicate teaching models, hindering cross-institutional transplantation and large-scale application. Second, due to the heterogeneous needs of different disciplines and courses, teaching innovation is usually contextualized and individualized. When teachers try to transfer successful experiences from one course to another, they often fail to understand the internal relationships among course characteristics, technical logic, and teaching strategies in the original case, making it difficult to extract reusable design principles, thus interrupting the tail-end transmission of the innovation chain.

4. Pathways for Constructing Higher Vocational Teachers' Digital Teaching Literacy Based on the Innovation Value Chain

To address the breakpoints in the innovation value chain at the stages of idea generation, transformation, and diffusion, systematic strategies are needed to ensure the smooth flow of innovation elements and value addition. The following pathway design aims to reconstruct knowledge input, internal motivation, and collaboration mechanisms, providing higher vocational teachers with high-quality innovation elements that can be directly converted into digital literacy, thereby substantially enhancing their digital literacy.

4.1 "Idea Generation" Stage

4.1.1 Establish Diagnostic and Tiered Training Mechanisms

Based on domestic and international teacher digital capability frameworks and the Vocational Education Teacher Digital Capability Standard, establish a regular diagnostic mechanism covering dimensions such as information awareness, technical knowledge, teaching application, and professional development, embedded in a regional teacher development management platform for dynamic assessment. Based on the diagnostic results, we construct a tiered training curriculum system consisting of basic general modules, professional domain modules (refined by professional category and job requirements, e.g., virtual simulation for intelligent manufacturing, data analysis tools for finance and trade), and frontier exploration modules. We also adopt a blended model combining online self-study with offline practical training, using a “design-practice-reflection-redesign” cycle to enhance teachers' ability to solve real teaching problems.

4.1.2 Build Cross-disciplinary Collaboration and Knowledge Sharing Platforms

Higher vocational education emphasizes industry-education integration; teachers' professional growth requires absorbing cutting-edge industry knowledge. We construct an internal and external dual-cycle mechanism. Internally, using the school as a carrier, we form cross-disciplinary teams consisting of professional teachers, enterprise technicians, curriculum development experts, and technical support personnel, who regularly conduct digital teaching seminars and collaborative design activities. Externally, we establish regional digital resource and expert databases, hold technical workshops and industry frontier lectures, promote two-way interaction between frontline teachers and enterprise experts/researchers, introduce professional forces from universities and technology enterprises, facilitate teachers' participation in technology R&D and transformation, and ultimately form an "industry-university-research-application" collaborative innovation ecosystem.

4.2 "Idea Transformation" Stage

4.2.1 Establish a Practical Closed-Loop Mechanism

Centered on vocational ability cultivation and job standards, use classroom action research as a lever to form a sustained practice mechanism. Teachers should clarify digital intervention directions based on curriculum goals and student needs, design short-term teaching experiments, and track changes in students' skills and job adaptation. We collect process and outcome data, combine quantitative and qualitative analysis to evaluate the effectiveness of technology application, and adjust teaching strategies accordingly. This process should be integrated into daily teaching, forming a "goal-setting-implementation-observation-adjustment" cycle to avoid superficial technology use.

4.2.2 Build a Multi-level Support System

Reducing teachers' innovation risks requires institutional guarantees. At the macro level, the state should formulate guidelines for digital development in higher vocational education, specifying standards for technology, security, resources, etc., and allocate special funds to support under-resourced areas. At the meso level, schools can establish "Digital Teaching Support Centers" integrating technical staff, curriculum experts, enterprise mentors, and data analysts to provide tool selection, practical training design, data interpretation, and emergency troubleshooting support. At the micro level, we establish on-campus "Digital Teaching Research Communities" where teachers share cases and experiences, turning individual successful practices into a shared "practice knowledge base". Meanwhile, we embed training on technology ethics, data privacy, and information security at all levels to enhance teachers' sense of responsibility and standardized operational skills.

4.3 "Idea Diffusion" Stage

4.3.1 Establish a Multi-dimensional Evaluation System

To recognize the value of digital innovation, a formative evaluation system focusing on students' vocational ability development should be constructed. We pay attention to progress in skills mastery, job adaptation, professional literacy, as well as curriculum goal achievement and teaching effectiveness, using both quantitative indicators and qualitative descriptions to record technology application effects. At the same time, we examine teachers' instructional design logic, requiring them to clearly explain the alignment between technology choices and curriculum demands, and the rationality of teaching strategies, thus pushing teachers to move from technology users to research-oriented educators. Evaluation results can also be linked to promotion and professional development

support, forming positive incentives.

4.3.2 Establish a Promotion Mechanism Combining Standardization and Contextualization

Innovations in higher vocational education are highly context-dependent, so promotion cannot be simple replication. First, through regional teaching research, case libraries, and workshops, extract the teaching models, suitability conditions, and core strategies behind successful practices to form transferable experiences. Second, build an open sharing platform for digital innovation achievements, supporting searches by professional category, technology type, and course module, and provide expert guidance to help teachers adapt and redevelop based on their own contexts. Finally, establish a follow-up support mechanism, where regional expert teams or on-campus support centers provide ongoing guidance to help teachers solve problems encountered in imitation, adaptation, and re-innovation, ensuring that achievements are effectively implemented and continuously optimized in different educational contexts.

5. Conclusion

This paper uses the Innovation Value Chain Theory to analyze the construction of digital literacy for higher vocational education teachers. The study identifies six major challenges across the three stages of "idea generation—idea transformation—idea diffusion": homogenized training content, blocked cooperation, superficial application of technology, lack of support, single evaluation indicators, and difficulty in promoting achievements. To address these issues, three pathways are proposed: at the idea generation stage, establish mechanisms for capability diagnosis and cross-disciplinary collaboration; at the idea transformation stage, form a practical closed-loop system and multi-level support framework; at the idea diffusion stage, build a multi-dimensional evaluation system and transferable promotion models. This theory provides a clear direction for systematically enhancing the digital literacy of higher vocational teachers, helping to solve long-standing problems such as the disconnect between training and practice, and difficulties in implementing innovations.

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