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Construction of a Competency Model for Blended Learning among Teachers in Industrial Internet Technology Majors

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Abstract: In the context of digital transformation in vocational education, blended teaching has become an important direction for professional course reform in higher vocational colleges. The Industrial Internet Technology major, characterized by rapid technological updates and strong practical orientation, places higher demands on teachers' blended teaching competencies. Based on competency theory and research on blended teaching, and considering the teaching characteristics of the Industrial Internet Technology major, this study constructs a teacher competency model for blended teaching with four first-level dimensions and eleven second-level dimensions, and develops a corresponding evaluation index system. A questionnaire survey was conducted among teachers of the Industrial Internet Technology major in higher vocational colleges to analyze the current status of their blended teaching competencies. The results show that teachers perform well in understanding blended teaching concepts and applying information technology, but shortcomings remain in integrated virtual–real instructional design, formative assessment implementation, and teaching reflection based on learning data. Based on these findings, the study proposes pathways to enhance teachers' blended teaching competencies through instructional design, assessment approaches, and institutional support, providing a reference for teaching reform and professional development.

1. Introduction

With the deep integration of new-generation information technologies and manufacturing, the Industrial Internet has become a key infrastructure driving the digital, networked, and intelligent transformation of the manufacturing industry. National policies have emphasized accelerating the application of Industrial Internet technologies and cultivating highly skilled technical talents, making the Industrial Internet Technology major one of the emerging disciplines prioritized in higher vocational colleges. The curriculum spans industrial network communication, equipment access, data acquisition and analysis, and other technical domains, characterized by strong

engineering practice, rapid technological iteration, and complex teaching scenarios.

Traditional teaching methods, dominated by classroom lectures and centralized practical training, struggle to meet the demands of talent cultivation in this field. Blended teaching, which integrates online learning resources, virtual simulation technologies, and offline practical training, offers a new pathway for mastering complex technical skills and has gradually become an essential strategy for deepening the "three-teacher reform" in vocational education and promoting digital transformation. Studies have shown that blended teaching enhances learning flexibility and instructional effectiveness; however, its success largely depends on whether teachers possess the necessary teaching competencies [1–2,5].

In practice, blended teaching in the Industrial Internet Technology major still faces challenges. Many teachers can use online platforms for resource distribution and assignment management, yet at the instructional design level, blended teaching is often perceived merely as a combination of "online + offline" formats. This leads to unclear functional differentiation and weak coordination between online learning and offline practice, and insufficient linkage between virtual simulations and real engineering tasks, limiting the educational potential of blended teaching. This aligns with prior research identifying deficiencies in teachers' design and assessment competencies in blended contexts [3–4,6].

Existing literature indicates that teacher competency, especially in vocational contexts, is critical for successful blended teaching implementation. Research based on TPACK and related frameworks emphasizes the integration of technological knowledge, pedagogical knowledge, and content knowledge, as well as competencies in instructional preparation, implementation, evaluation, and reflection [1,6]. In vocational education, teacher competencies should be closely aligned with students' professional development needs and the practical nature of training tasks [4,7]. However, most studies focus on general or common courses, with limited contextualized research on emerging engineering disciplines like Industrial Internet Technology.

Therefore, it is necessary to analyze, from a competency perspective, the core abilities teachers should possess in blended teaching for the Industrial Internet Technology major, and to construct a context-specific competency model with practical guidance for professional development.

2. Construction of the Blended Teaching Competency Structure for Teachers of the Industrial Internet Technology Major

Competency is generally defined as a stable combination of abilities that enables an individual to effectively perform tasks in specific contexts. For teachers of the Industrial Internet Technology major, blended teaching competency is not a simple aggregation of isolated skills, but a systematic structure of abilities centered on professional course teaching tasks, encompassing conceptual understanding, instructional design, teaching implementation, and assessment.

Based on the curriculum system and teaching practice of the Industrial Internet Technology major, analysis of core courses such as *Industrial Internet Implementation and Operation & Maintenance* reveals that these courses typically feature complex systemic structures, strong engineering practice, and difficulties in fully presenting real industrial environments within the classroom. In implementing blended teaching, teachers are generally required to carry out a series of key instructional tasks, including course objective reconstruction, modularization and project-based organization of teaching content, integration of virtual and real teaching, and learning assessment with reflective improvement. Logically, these tasks follow a progressive sequence from "conceptual understanding → instructional design → teaching implementation → evaluation and improvement."

Based on this analysis, this study constructs a structural model of blended teaching competency

for Industrial Internet Technology teachers. The model emphasizes the logical relationships among different competency dimensions throughout the teaching process, rather than presenting them as independent elements, and reflects the complete cycle of blended teaching from "understanding → designing → implementing → improving." The model consists of four first-level dimensions:

(1) Conceptual Understanding and Goal Construction for Blended Teaching. This dimension serves as the foundational prerequisite for teachers to conduct blended teaching, reflecting the extent to which teachers understand the connotation, functional positioning, and vocational education value of blended teaching.

(2) Instructional Design and Resource Organization Competency. This is the core of blended teaching competency and directly determines its effective implementation. Teachers need to align with industry and enterprise requirements, convert typical industrial applications into instructional cases, modularize and projectize complex technical content, and design an integrated instructional workflow that spans online and offline learning.

(3) Technology Integration and Teaching Implementation Competency. This dimension reflects the teacher's ability to integrate information technology tools, instructional activities, and learning processes in real teaching contexts. Blended teaching in the Industrial Internet Technology major typically relies on smart vocational education platforms, virtual simulation systems, and offline training laboratories. Teachers must flexibly select and apply technological tools to guide students in completing learning tasks across different learning contexts.

(4) Teaching Assessment and Reflective Improvement Competency. This dimension ensures continuous enhancement of blended teaching quality. If assessment remains primarily summative and neglects diagnostic feedback during the learning process, the advantages of blended teaching cannot be fully realized. Therefore, teachers need the ability to reflect on teaching based on learning data and continuously adjust instructional design and implementation strategies, forming a dynamic optimization mechanism.

In summary, blended teaching competency for Industrial Internet Technology teachers is not a collection of isolated skills, but a comprehensive ability system that synergistically functions across conceptual understanding, instructional design, teaching implementation, and assessment to effectively fulfill professional teaching tasks.

3. Construction of the Competency Evaluation Index System and Empirical Analysis

Based on the competency structure model, this study further constructs an evaluation index system for the blended teaching competency of Industrial Internet Technology teachers. The construction of the index system follows three principles: (1) professional orientation, meaning that the indicators closely align with the teaching tasks and professional skill requirements of the Industrial Internet Technology major; (2) completeness of the teaching process, ensuring that the indicators cover the entire process of instructional objectives, design, implementation, and assessment; and (3) practical operability, meaning that the third-level indicators are expressed in terms of specific teaching behaviors, facilitating evaluation and improvement.

In the empirical study, full-time teachers of the Industrial Internet Technology major at our institution were surveyed via a questionnaire to investigate the current status of their blended teaching competency. The questionnaire was developed based on the index system and covered teachers' self-perceived knowledge and practice in blended teaching concepts, instructional design, teaching implementation, and teaching assessment.

The results indicate that teachers scored relatively high in the dimension of blended teaching concepts and goal construction, suggesting that most teachers have established a basic understanding of blended teaching and are capable of actively integrating digital tools into their

instructional activities. However, deficiencies were observed in the dimensions of instructional design and resource organization, technology integration and teaching implementation, and teaching assessment and reflective improvement.

Specifically, in instructional design, many teachers still lack the ability to design systematic teaching in virtual–real integrated learning environments, and online learning outcomes are not effectively transferred to offline practical skills. In teaching implementation, teachers face challenges in guiding students to complete learning tasks across different contexts and in promoting the transfer of knowledge to skills. In teaching assessment, teachers demonstrate limited capability in conducting formative evaluation and reflective improvement based on learning data, with assessment still predominantly summative.

Overall, the blended teaching competency of Industrial Internet Technology teachers shows the characteristic pattern of strong conceptual understanding and technical foundation, but relatively weak instructional design and assessment capabilities. This result aligns closely with the practical difficulties teachers face in vocational education reform.

Based on the competency structure model, this study further establishes a blended teaching competency evaluation index system for Industrial Internet Technology teachers, adhering to the principles of professional orientation, completeness of the teaching process, and practical operability, aiming to establish an effective link between theoretical construction and teaching practice, as shown in Table 1.

Table 1. Evaluation Index System of Blended Teaching Competency for Teachers of the Industrial Internet Technology Major

First-level Dimension	Second-level Dimension	Third-level Dimension
Conceptual Understanding and Goal Construction for Blended Teaching	Blended Teaching Concept Cognition	Understand the functional positioning and educational value of blended teaching in vocational education
		Understand the division of roles and complementary relationship between online learning and offline practice in professional competency development
	Course Objective Construction Ability	Be able to reconstruct course objectives based on the talent cultivation program of the Industrial Internet Technology major
		Be able to translate professional job competency requirements into course learning objectives
		Be able to integrate knowledge, skills, and professional literacy in course objectives
Instructional Design and Resource Organization Competency	Teaching Content Reconstruction Ability	Be able to modularize and projectize complex Industrial Internet Technology content
		Be able to design teaching content in layers according to instructional objectives
	Blended Teaching Design Ability	Be able to design an overall instructional workflow integrating online and offline activities
		Be able to construct learning pathways linking online learning with offline practice

	Teaching Resource Integration Ability	Be able to select and integrate digital learning resources suitable for the course
		Be able to incorporate enterprise cases and engineering projects into the blended teaching resource system
Technology Integration and Teaching Implementation Competency	Information Technology Application Ability	Be able to proficiently use teaching platforms for instructional management and learning support
		Be able to utilize virtual simulation and other technologies to support professional teaching activities
	Blended Teaching Organization Ability	Be able to flexibly organize online and offline teaching activities according to the teaching schedule
		Be able to guide students to complete learning tasks in different learning context
	Learning Process Guidance Ability	Be able to provide effective guidance and intervention during students' online learning process
		Be able to facilitate the transformation of students' knowledge understanding into skill application in practical teaching
Teaching Assessment and Reflective Improvement Competency	Learning Evaluation Design Ability	Be able to design evaluation plans covering both online learning and offline practice
		Be able to integrate formative assessment with summative assessment
	Teaching Data Analysis Ability	Be able to analyze students' learning performance using learning platform data
		Be able to adjust teaching strategies based on learning data
	Teaching Reflection and Improvement Ability	Be able to conduct reflective teaching based on implementation outcomes
		Be able to continuously optimize blended teaching design and instructional implementation plans

4. Practical Implications for Teachers' Blended Teaching Based on the Competency Structure

Based on the previously constructed competency structure model for teachers of the Industrial Internet Technology major and the results of the empirical analysis, it is evident that teachers currently possess a certain foundation in conceptual understanding of blended teaching and basic information technology application. However, deficiencies remain in key areas such as instructional design, virtual–real integrated implementation, and formative assessment. Therefore, enhancing teachers' blended teaching competency should be systematically advanced around professional teaching tasks, focusing on teaching practice and evaluation mechanisms.

(1) Orient instructional design toward professional teaching tasks to strengthen design competency

Instructional design competency is central to teachers' blended teaching competency in the Industrial Internet Technology major. Given the strong engineering orientation and complex

knowledge structure of professional courses, teachers should base course content design on typical job competencies and authentic engineering tasks, modularizing and projectizing the content. In blended teaching, the functional roles of online and offline activities should be reasonably planned. By designing coherent learning tasks, teachers can guide students through the transition from knowledge acquisition to skill application, thereby enhancing the systematicity and relevance of instruction.

(2) Emphasize virtual–real integrated implementation to enhance technology integration and teaching organization competency

Blended teaching in the Industrial Internet Technology major typically relies on learning platforms, virtual simulation systems, and offline training environments. Teachers need strong competency in integrating technology with instructional organization. They should appropriately employ information technology tools in alignment with teaching objectives, effectively combining online learning, virtual operations, and offline practice. This enables students to complete learning tasks in different contexts and facilitates the effective transformation of knowledge understanding into practical ability.

(3) Improve formative assessment mechanisms to strengthen data-driven reflective teaching competency

The study indicates that teaching assessment and reflective improvement is currently a weak link in teachers' blended teaching competency. In practice, teachers should integrate formative and summative assessments, utilize learning data collected from digital platforms to conduct diagnostic evaluation and feedback, and reflect on the effectiveness of instructional design and implementation. Teaching strategies should be adjusted in a timely manner to establish a continuously improving instructional mechanism.

5. Conclusion

Based on the characteristics of vocational education and the teaching practice of the Industrial Internet Technology major, this study constructed a competency structure model and an evaluation index system for teachers' blended teaching competency grounded in competency theory, and empirically analyzed the current status of teachers' competency through a questionnaire survey. The results indicate that teachers currently demonstrate relatively high levels of conceptual understanding of blended teaching and basic information technology application. However, significant deficiencies remain in areas such as virtual–real integrated instructional design, implementation of formative assessment, and reflective teaching based on learning data.

The study suggests that the core of teachers' competency in the context of blended teaching for the Industrial Internet Technology major lies not in the proficiency of using technological tools, but in the comprehensive ability to conduct systematic instructional design around professional teaching tasks, effectively organize teaching implementation, and continuously engage in reflective improvement. The competency structure model and evaluation index system developed in this study contribute to a deeper understanding of the blended teaching competency of teachers in higher vocational education and can provide references for teacher training, instructional evaluation, and blended teaching reform in higher vocational colleges.

Given the limitations of the research subjects and methodology, this study has certain constraints. Future research could combine classroom observation, interviews, and teaching case analysis to explore the developmental mechanisms of teachers' blended teaching competency in greater depth.

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