

Competency Model Construction and Development Path Optimization for “Double-Qualified” Civil Construction Teachers in Yunnan’s Higher Vocational Colleges

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Abstract

This study aimed to: (1) Construct a competency model for "Double-qualified" teachers in the civil construction categories of higher vocational colleges in Yunnan Province; (2) Analyze the current status and influencing factors of teacher competency; (3) Formulate the appropriate guidelines to support the development of "Double-qualified" teachers' competency in the civil construction categories of public higher vocational colleges in Yunnan Province. The sample consisted of 202 civil construction teachers from 17 public higher vocational institutions in Yunnan Province. They were selected using stratified random sampling to ensure representation across teaching experience, professional titles, and institutional types. The primary instruments for data collection included a structured questionnaire, in-depth interviews, and expert consultations. The primary instruments for data collection included a structured questionnaire, in-depth interviews, and expert consultations. Data were analyzed using descriptive statistics, exploratory factor analysis, and content analysis to ensure both quantitative rigor and qualitative depth. The research results were found as follows:

1. The competency model comprises four interrelated components: professional knowledge, vocational skills, IT literacy, and attitudes & motivation, with professional knowledge and vocational skills forming the foundational layer, and IT literacy and attitudes serving as transformative drivers.

2. Current competency levels were found to be uneven, with strengths in theoretical knowledge and teaching commitment, but notable gaps in emerging IT literacy (e.g., BIM, digital twin applications) and industry-integrated practical experience, particularly among younger teachers.

3. External enabling factors—including depth of school–enterprise cooperation, targeted policy support, and frequency of industry training—were identified as significant catalysts for competency enhancement, mediating the progression from foundational to advanced industry–relevant expertise.

This research not only fills a regional knowledge gap in the professional development of "Double–qualified" teachers in the civil construction categories but also provides actionable insights for policymakers, education administrators, and training institutions to design targeted capacity–building programs.

Keywords: "Double–Qualified" Teachers; Civil Construction; Competency Model; Vocational Education; Yunnan Province

Introduction

In recent years, the transformation and upgrading of China's construction industry have posed higher demands on the quality of teachers in higher vocational education, particularly in civil construction disciplines. "Double–qualified" teachers—those possessing both solid professional knowledge and practical industry skills—are regarded as the backbone for bridging theoretical instruction with applied skill training. According to the National Vocational Education Reform Implementation Plan (Ministry of Education of China, 2019), building a high–caliber "Double–qualified" teachers workforce is pivotal to realizing the integration of industry and education. Existing studies (Li & Wang, 2022; Zhang et al., 2023) have explored competency elements in various vocational fields, but few have focused on systematically modeling these competencies for civil construction teachers in a provincial context. Moreover, while previous research has identified influencing factors such as policy support, enterprise cooperation, and training participation, there is a lack of a validated, field–specific competency model that can guide targeted professional development. This gap limits the precision of teacher training programs and weakens the alignment between teaching capacity and industry needs.

The present study situates itself within the field of teacher competency modeling for higher vocational education, with a specific focus on the civil construction category in Yunnan Province. This group is characterized by its double requirement for pedagogical expertise and industry practice capability, yet it faces constraints including uneven access to professional training, insufficient IT literacy,

and varying levels of engagement with industry partners. The research team has previously investigated the competency composition and influencing factors in this field, establishing an empirical foundation for model construction. The target audience of this research includes policymakers, educational administrators, vocational teacher trainers, and institutional leaders who seek to optimize "Double-qualified" teachers development in line with local industrial transformation.

This study aims (1) To construct a competency model for "Double-qualified" teachers in the civil construction categories of higher vocational colleges in Yunnan Province, and (2) To formulate the appropriate guidelines to support the development of "Double-qualified" teachers' competency pathways. Methodologically, the study integrates literature review, expert consultation, and empirical validation through quantitative analysis. The structure of this article follows a logical progression: the first section presents the theoretical basis and methodological approach for model construction; the second section details the model's dimensions and validation results; the third section proposes evidence-based development guidelines; and the final section discusses the implications for policy and practice. The findings are expected to enrich the academic discourse on vocational teacher competency modeling and provide practical tools for enhancing teacher quality, thereby supporting the sustainable development of vocational education in China's less-developed regions.

Research Objectives

This study focuses on "Double-qualified" teachers in the civil construction categories of higher vocational colleges in Yunnan Province, with the following specific objectives:

1. To construct a validated competency model

Develop a scientifically sound, systematic, and empirically grounded competency model for "Double-qualified" teachers, integrating teaching proficiency, technical expertise, and industry engagement. The model will serve as both a theoretical and practical basis for systematically assessing teacher competencies, ensuring a high degree of alignment between teaching standards and the evolving demands of the civil construction industry.

2. To formulate the appropriate guidelines to support the development of "Double-qualified" teachers' competency pathway based on the model

Propose a competency enhancement pathway tailored to Yunnan's regional characteristics, resource conditions, and the developmental trends of the civil construction sector. Beyond strengthening teaching and technical skills, the pathway will emphasize adaptability to emerging construction technologies, interdisciplinary cooperation capabilities, and the practical application of sustainable construction practices.

By achieving these objectives, this research aims to bridge the gap between theoretical competency frameworks and practical application in vocational education. The findings will not only contribute to the academic refinement of competency modeling for vocational teachers but also provide actionable strategic references for educational administrators, teacher training institutions, and policymakers, thereby promoting the high-quality development of "Double-qualified" teaching teams in the civil construction field.

Literature Review

1. Competency Frameworks for "Double-qualified" teachers

The concept of "Double-qualified" teachers—those not only have theoretical teaching skills, but can also practical teaching skills,—has been widely recognized as a strategic priority in vocational education reform. Foundational competency theories proposed by Boyatzis (1982) and Spencer & Spencer (1993) highlight the integration of behavioral attributes, technical skills, and cognitive abilities as predictors of superior professional performance. In China, this framework has been contextualized by the Ministry of Education's (2020) policy directives, which emphasize the systematic cultivation of teacher teams capable of bridging academia and industry. Empirical research by Liu and Xu (2022) and Zhang et al. (2021) further refines this model, identifying essential domains such as instructional design, applied industry practice, and reflective professional growth. Nevertheless, current competency frameworks tend to adopt a generalized approach, lacking the specificity required to address the nuanced demands of particular disciplines. In the civil construction sector, where technical precision and regulatory compliance are critical, the absence of specialized competency standards significantly constrains both teacher evaluation and professional development efforts.

2. Competency Modeling in Civil Construction Education

The civil construction discipline presents unique requirements for vocational educators, encompassing mastery of national engineering codes, application of CAD/BIM technologies, and the capacity to manage safety and environmental standards in accordance with evolving industry regulations. International research, such as Mulder et al. (2007), underscores the importance of integrating technical proficiency with methodological adaptability and interpersonal skills to meet workplace demands. Domestic studies by Wang and Li (2023) and Sun and He (2022) point to the need for vocational teachers to maintain active engagement with construction enterprises in order to keep pace with technological advancements and regulatory changes. However, in Yunnan Province, there is a scarcity of competency models that explicitly link teacher qualifications to regional development imperatives, such as seismic safety construction and green building practices. This lack of localized modeling diminishes the relevance and effectiveness of competency assessment systems in guiding targeted recruitment, performance evaluation, and ongoing professional development for civil construction educators.

3. Pathways for Competency Development

Research on the cultivation of "Double-qualified" teachers has identified multiple pathways, including industry–education integration, competency–based teacher training, and experiential learning through enterprise partnerships. Huang and Zhou (2021) emphasize that sustainable competency growth requires institutional mechanisms that align training programs with industrial needs, while Gao (2022) advocates for competency–based performance evaluation as a means to ensure continuous improvement. In the civil construction field, Li and Zhao (2021) highlight the importance of embedding real–world engineering projects into the teaching process to enhance both technical and pedagogical competencies. Wang and Yang (2020) further demonstrate that long–term industry placements can foster practical problem–solving abilities and strengthen the link between theoretical instruction and industry application. Despite these insights, much of the existing literature remains conceptual, lacking empirical validation and operational frameworks capable of addressing the practical constraints of vocational colleges in regions such as Yunnan, where economic structures and industrial priorities present distinct challenges.

A synthesis of the literature reveals three significant gaps that this research aims to address. First, existing competency frameworks for "Double-qualified" teachers are insufficiently specialized for

the civil construction discipline, failing to reflect the technical depth and regulatory knowledge required in practice. Second, there is a notable absence of models that align competency components with the economic and industrial development priorities of less-developed yet rapidly urbanizing provinces, particularly Yunnan. Third, current recommendations for competency development pathways are often generic and lack robust empirical testing, which limits their applicability in real vocational college contexts. Addressing these gaps necessitates the construction of a discipline-specific competency model supported by empirical evidence and the design of optimized development pathways tailored to the unique educational and industrial landscape of Yunnan Province.

Conceptual Framework

This research is an empirical study aiming to construct a competency model and propose optimized development pathways for "Double-qualified" teachers in civil construction programs at higher vocational colleges in Yunnan Province. The researcher defines the research conceptual framework based on Boyatzis' Competency Theory and Spencer & Spencer's Iceberg Model, integrated with the industry-education integration approach advocated by the Ministry of Education (2020). The framework links the independent variables—representing the key factors influencing teacher competency—with the process of competency model construction and development pathway optimization, leading to the dependent variable, namely the enhanced professional performance and industry relevance of Double-qualified civil construction teachers. The details are as follows:

Independent Variables:

Teacher professional knowledge (pedagogical theory, curriculum design skills)

Industry-related technical expertise (construction engineering codes, BIM/CAD proficiency, project management)

Teaching and research capabilities (applied research, instructional innovation)

Soft skills (communication, teamwork, problem-solving)

Policy and institutional support (training opportunities, performance evaluation systems)

Process / Tools / Area / Target Audience:

Mixed-methods approach (quantitative surveys, qualitative interviews, expert Delphi method)

Competency modeling techniques (behavioral event interviews, factor analysis)

Application to civil construction departments of selected higher vocational colleges in Yunnan Province

Target audience: "Double-qualified" teachers , academic administrators, and industry partners

Dependent Variable:

A validated "Double-qualified" teachers competency model tailored for the civil construction discipline in Yunnan

Optimized development pathways enhancing teachers' instructional quality, technical relevance, and adaptability to industry needs

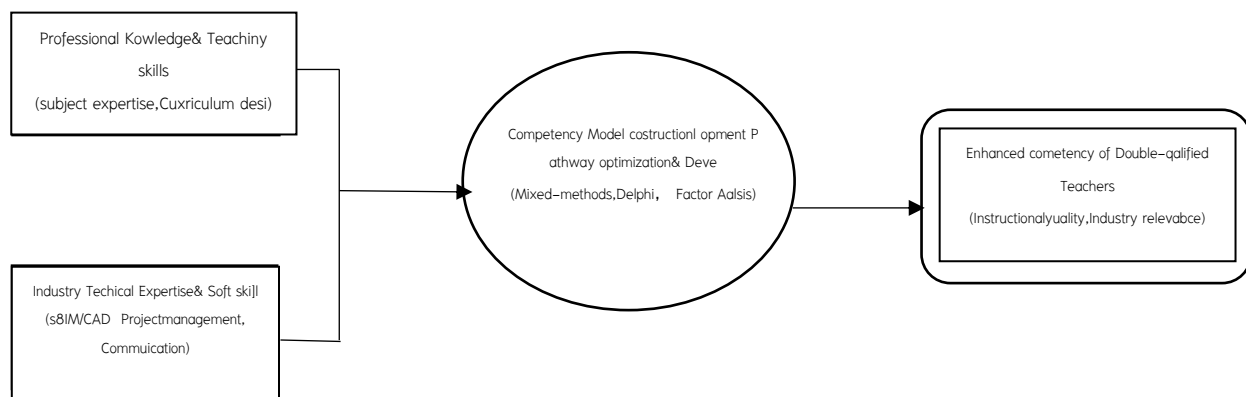


Fig.1 Conceptual Framework

Research Methodology

1. Research Subjects and Sample

The research subjects of this study were in-service "Double-qualified" teachers members in Civil construction-related majors at representative higher vocational colleges in Yunnan Province. The sample encompassed diverse college types, regions, and disciplines to ensure broad representation and diversity. Using a stratified random sampling method, questionnaires were distributed via Wenjuanxing to vice presidents, deans, department heads, department heads, and "Double-qualified" teachers in civil construction programs at 17 higher vocational colleges. These teachers were asked to share the questionnaires in their work groups. A total of 210 questionnaires were distributed, of which 202 were valid, for a response rate of 96.19%. Regarding demographic characteristics, male teachers accounted for approximately 55.4% and female teachers for approximately 44.6%. Civil engineering majors accounted for 38.6% of the total teachers, and 66.3% held intermediate or higher double-qualified

qualifications. This composition not only reflects the overall characteristics of the "Double-qualified" civil construction teachers in Yunnan Province but also provides a solid empirical foundation for developing competency models and optimizing development pathways.

2. Research Tools

The core data collection instrument was the Competency Questionnaire for Civil construction "Double-qualified" teachers in Higher Vocational Colleges, developed based on domestic and international theories of "Double-qualified" teachers competency, the Ministry of Education's certification standards, and the practical teaching requirements of Civil construction majors. It was further refined to align with Yunnan's regional characteristics and industry needs through multiple rounds of expert review. The questionnaire consisted of four primary dimensions—professional knowledge, vocational skills, IT literacy, and attitude & motivation—subdivided into 16 secondary indicators, such as curriculum design and implementation, integration of engineering cases, technological innovation capability, and awareness of professional norms. A pilot test (N=30) and content validity review by five industry experts and three higher vocational education researchers were conducted prior to formal deployment. Reliability analysis yielded an overall Cronbach's α coefficient of 0.930, with each dimension exceeding 0.85. Construct validity tests indicated a KMO value of 0.895 and a significant Bartlett's test ($p < 0.001$), confirming suitability for factor analysis. The instrument effectively quantified the multidimensional characteristics of Double-qualified teachers competency, providing a robust measurement foundation for subsequent model construction and pathway optimization.

3. Data Collection and Procedures

To ensure comprehensiveness and accuracy, data collection employed a combination of online and offline questionnaire distribution. The online survey was developed via Wenjuanxing platform and disseminated to target teachers groups through institutional teaching affairs offices via departmental notifications and teacher workgroups. The offline survey was conducted by research team members through on-site visits, offering guidance on completion and collecting responses immediately. The content of the online and offline questionnaires was identical, accompanied by a research description and instructions to ensure consistent understanding among participants. In accordance with ethical research principles, informed consent was obtained, and anonymity and confidentiality were strictly maintained. The data collection process lasted two months, from March to April 2024. All returned

questionnaires were screened prior to SPSS entry, with incomplete or logically inconsistent responses removed, resulting in 202 valid samples. This multi-channel, phased approach ensured both sufficient sample size and high data quality, thereby enhancing the reliability and external validity of the research findings.

4. Data Analysis Methods

Data analysis was conducted using SPSS 26.0 and AMOS 24.0 to ensure statistical rigor and methodological robustness. Descriptive statistics were first applied to profile the sample's demographic characteristics and distribution of competency scores across dimensions. Exploratory Factor Analysis (EFA) was then performed to identify the underlying structure of the questionnaire, with items showing low factor loadings or excessive cross-loadings removed to refine the scale. Confirmatory Factor Analysis (CFA) was subsequently employed to test the goodness-of-fit of the proposed competency model, ensuring structural validity and explanatory power. Pearson correlation analysis was used to explore interrelationships among competency dimensions, followed by multiple regression analysis to identify the predictive influence of each dimension on overall competency levels. Furthermore, qualitative data from semi-structured interviews were analyzed using content analysis to uncover contextual factors and deeper explanatory insights underlying the quantitative results. By integrating quantitative and qualitative approaches, this study not only validated the scientific rigor and applicability of the Civil construction double-qualified teachers competency model but also provided targeted empirical and theoretical support for optimizing developmental pathways.

Research Results

Objective 1 The results indicated that the competency of "Double-qualified" civil construction teachers in higher vocational colleges of Yunnan Province presented notable variation across dimensions, with generally higher proficiency in professional knowledge ,vocational skills and Attitude & Motivation , relatively lower IT literacy . Descriptive statistical analysis showed that the mean score of professional knowledge reached 4.28 (SD=0.51), indicating that most respondents possessed solid subject-matter expertise and the ability to integrate theoretical knowledge into teaching. Vocational skills followed closely with a mean score of 4.23 (SD=0.55), reflecting teachers' theoretical and practical teaching skills, as well as their research and social service capabilities. Attitude & Motivation

(Mean = 4.15, SD = 0.58) also scored high, reflecting a strong sense of responsibility and commitment to teaching. However, information technology literacy, with an average score of 3.91 (SD = 0.63), indicates that while many teachers are proficient in computer technology, their practical application of engineering software remains limited. ANOVA results further confirmed statistically significant differences in competency scores across academic ranks ($p < 0.05$), with higher-ranked teachers exhibiting stronger industry engagement and innovation capacity.

Table 1 Competency Dimension Scores of Double-qualified teachers (n=202)

Competency Dominion	Mean	SD
Professional Knowledge	4.28	0.51
vocational skills	4.23	0.55
IT literacy	3.91	0.63
Attitude & Motivation	4.15	0.58

Objective 2 The results also demonstrated that factors influencing the competency level of Double-qualified teachers are multidimensional, with teaching experience, enterprise work background, and frequency of industry engagement emerging as the most significant predictors. Multiple regression analysis revealed that teaching experience had the strongest positive effect ($\beta = 0.372$, $p < 0.001$), followed by enterprise work background ($\beta = 0.295$, $p < 0.01$), and participation in industry-university collaborative projects ($\beta = 0.241$, $p < 0.05$). teachers with more than five years of engineering practice scored on average 0.43 points higher in the engineering practice competence dimension compared to those without such experience. Moreover, those who engaged in enterprise-based training or collaborative R&D at least twice a year reported higher scores in industry-education integration ability (mean=3.92) than those with less frequent engagement (mean=3.37). Interestingly, academic qualification alone (bachelor's, master's, or above) did not show a significant direct impact on overall competency, suggesting that professional growth in this context is more strongly driven by hands-on industry practice and sustained interaction with the sector. These results point to the importance of embedding continuous industry immersion and collaborative innovation activities within teachers development frameworks, rather than relying solely on academic qualifications or short-term training programs.

Table 2 Regression Analysis of Factors Influencing Competency Level

Predictor Variable	β	p-value	Significance
Teaching Experience	0.372	<0.001	***
Enterprise Work Background	0.295	<0.01	**
Frequency of Industry–University cooperation	0.241	<0.05	*
Academic Qualification	0.086	0.217	n.s.

Discussions

This study focuses on constructing and optimizing the development path of the competency model for "Double-qualified" Civil construction teachers in higher vocational colleges in Yunnan Province. The results indicate that competency is not a homogeneous accumulation of skills, but an interwoven system comprising four core dimensions: professional knowledge, vocational skills, IT literacy, and attitudes & motivation. This structure aligns with ontology of competence, the iceberg model, and behavioral competency theory: observable teaching and practical behaviors are driven by deeper layers of value orientation and professional motivation, while IT literacy serves as an "enabling layer" in the context of the digital transformation of Civil construction (e.g., BIM, smart construction, and green building standards). The scale reliability coefficients exceeded 0.8, and validation through expert consultation and focus group interviews confirmed good internal consistency and contextual adaptability of the model.

Regression analysis further revealed the decisive role of external contextual factors in competency formation. Depth of enterprise cooperation emerged as the strongest positive predictor ($\beta=0.32$, $p<0.001$), suggesting that nominal school–enterprise cooperation is insufficient; genuine improvement in teachers' competency requires deep co-construction—joint R&D, co-leading projects, technology standard conversion, and curriculum community building—embedding complex industry tasks into teaching, thus synchronously enhancing instructional design, practical guidance, and research–service capacities. Policy support ranked second ($\beta=0.24$, $p<0.01$), not directly boosting individual skills but reallocating resources, institutional arrangements, and evaluation mechanisms to reduce the systemic costs of cross-boundary cooperation and continuous professional development, forming a

virtuous cycle of “more capable teachers taking greater responsibility, and greater responsibility fostering higher capability.” Frequency of industry training ($\beta=0.18$, $p<0.05$) had a smaller yet significant effect, indicating that short-term training effectively addresses “point” skill gaps but, without sustained on the job practice and a school-enterprise community, fails to crystallize into stable behavioral traits.

From the disciplinary perspective, Civil construction “Double-qualified” teachers face a “double frontier”: compliance with engineering codes and local requirements (e.g., high-seismic construction, green building) and adaptation to paradigm shifts such as BIM/digital twin technologies. The model shows that IT literacy is not an ancillary skill but a transversal competency integrating professional knowledge renewal, organization of practice-based teaching, and research-service functions. Thus, any optimized development path should internalize digital capabilities as a prerequisite for curriculum design and project-based learning, rather than an optional enhancement.

Based on this mechanism, teacher development is better suited to a “Task-Context-Evaluation” triple-coupling pathway: embedding authentic engineering tasks from industry into teaching and practice (task), organizing cross-disciplinary cooperation under the double constraints of regional industrial upgrading and local regulations (context), and institutionalizing multi-dimensional evaluation loops centered on tangible outputs and student learning evidence (evaluation) to transform and solidify capability gains. Corresponding policy tools should shift from “qualification-oriented” to “evidence- and process-oriented” frameworks, incorporating joint research/technical service outputs, co-developed curricula, and students’ real-world project performance as core evidence for teacher promotion and performance appraisal, with KPIs aligned to shared school-enterprise goals.

It is equally important to guard against “formalistic cooperation.” Superficial engagement, such as short-term placements or ceremonial exchanges, risks “surface-level” improvement. To avoid the “passive participation-low-intensity tasks-low-value outputs” lock-in, colleges should establish clear governance and incentive structures: integrating joint projects into teaching schedules, replacing equivalent workloads; implementing a “double-mentor” system involving enterprise and campus mentors with clearly defined project and instructional responsibilities; and adopting a double-track incentive system combining project-based funding and competency points to quantify and reward contributions to technology transfer, standard-setting, and industry-education integrated course building.

From a regional development perspective, the absence of localized certification standards dilutes the model's explanatory power during implementation. It is recommended that, under the national standard framework, Yunnan-specific Civil construction requirements—seismic protection, green building, prefabrication, and smart construction—be embedded into teacher certification and assessment indicators. This should be supported by co-created certification programs and training bases with provincial industry associations and leading enterprises to ensure alignment between “standards–curricula–practice–evaluation.”

The study also highlights that attitudes and motivation act as “slow variables” sustaining long-term competency growth. In a highly uncertain technology–industry environment, responsibility, learning motivation, and self-reflection ability determine whether teachers can transform short-term training and project experience into transferable professional schemas. Therefore, development pathways should integrate professional learning communities based on “reflection–peer cooperation–evidence,” enabling the conversion of fragmented experiences into replicable teaching and mentoring paradigms through peer observation, collaborative lesson planning, and evidence-based improvement plans.

It is worth noting that the contextual boundaries of this research may affect external validity. The sample was drawn from public higher vocational colleges in Yunnan Province, where regional industrial structure and resource endowment impose prior constraints on cooperation depth and training availability. Moreover, cross-sectional data and self-reported measures may involve self-selection and common method biases. Future research could adopt longitudinal designs incorporating student learning outcomes and employer evaluations as multi-source evidence, or conduct causal inference in natural experiment settings involving policy/project implementation, to further validate the “cooperation depth–competency gain–education quality improvement” chain.

Overall, through a progressive theory–empirical–application design, this study constructs a competency model tailored to regional industry characteristics for “Double-qualified” Civil construction teachers, identifies key external levers driving its enhancement (cooperation depth, policy support, training frequency), and proposes a development path that is not a simple addition of training and evaluation but a systemic restructuring of task organization, institutional support, and evidence-based assessment. Such restructuring can synergistically link individual capacity growth with the high-quality development of the regional Civil construction industry, establishing a sustainable mechanism for vocational education to serve local economic development.

Knowledge from Research

The findings of this study enrich the body of knowledge on the competency development of "Double-qualified" Civil construction teachers in higher vocational colleges, particularly within the regional and industrial context of Yunnan Province. The research integrates theoretical foundations from the iceberg model of competence, behavioral competency theory, and IT literacy frameworks, and extends them by embedding industry-specific requirements such as seismic-resistant construction, prefabricated building technologies, and BIM-enabled project management.

The synthesized conceptual framework clarifies the multi-layered structure of competency, encompassing four interdependent domains:

Professional Knowledge – mastery of Civil construction theories, regulatory codes, and emerging construction technologies.

Vocational Skills – practical capabilities in project implementation, on-site supervision, and technology transfer to students.

IT literacy – proficiency in BIM, digital twin modeling, and data-driven construction management.

Attitudes and Motivation – intrinsic professional responsibility, continuous learning orientation, and adaptability in dynamic industry contexts.

The model further identifies external enabling factors—depth of school-enterprise cooperation, targeted policy support, and frequency of industry training—as key drivers that catalyze the progression from foundational competence to advanced, industry-relevant expertise.

Conclusion

This study systematically explored the competency structure and development pathways of "Double-qualified" teachers in the Civil construction disciplines of higher vocational colleges in Yunnan Province, using empirical data to bridge the gap between theoretical models and practical needs. The research confirms that the core competencies of "Double-qualified" teachers extend beyond professional knowledge and teaching skills, encompassing pedagogical innovation, industry engagement, and continuous self-development. Through quantitative analysis and qualitative validation, the findings reveal significant disparities between current competency levels and the

demands imposed by rapid industrial upgrading, particularly in areas of applied technological literacy, interdisciplinary integration, and project-based instructional design. Moreover, the study highlights that institutional support, professional development opportunities, and effective evaluation mechanisms are critical drivers for sustaining and enhancing teacher competencies. The proposed optimization framework—emphasizing targeted training programs, strengthened school–enterprise cooperation, and systematic career progression—provides actionable strategies for both educational administrators and policymakers. By aligning teacher competency development with regional industrial transformation goals, this research contributes to the construction of a talent ecosystem capable of fostering skilled graduates who can meet the evolving needs of the construction sector. Ultimately, the study enriches the theoretical discourse on vocational teacher development while offering a replicable model for other regions seeking to elevate their double-qualified teaching workforce.

Suggestions

1. Strengthen Targeted Professional Development Programs

It is recommended that higher vocational colleges in Yunnan Province design and implement modular, competency-oriented training programs for Civil construction "Double-qualified" teachers. These programs should integrate advanced pedagogical strategies with the latest industry technologies, ensuring that educators can seamlessly translate theoretical knowledge into practical, project-based teaching scenarios. Training content must be tailored based on competency gap analyses, focusing on emerging construction technologies, digital engineering tools, and sustainable development practices to align teaching with industry evolution.

2. Enhance School–Enterprise Collaborative Mechanisms

Educational institutions should establish long-term, structured partnerships with leading enterprises in the construction sector. Such cooperations can provide teachers with continuous industry immersion opportunities, including short-term internships, joint research projects, and co-development of course materials. Embedding teachers in real-world engineering projects not only updates their technical expertise but also strengthens their ability to integrate authentic industrial cases into classroom instruction, thereby enhancing students' job readiness.

3. Optimize Competency Evaluation and Feedback Systems

A comprehensive, multi-dimensional evaluation system should be developed to assess both teaching and professional practice competencies. This system must include self-assessment, peer review, student feedback, and external industry expert appraisal, ensuring objectivity and relevance. Evaluation results should be directly linked to promotion, incentives, and targeted professional growth plans, creating a feedback loop that continuously drives improvement in teaching quality and industry adaptability.

4. Promote Interdisciplinary and Innovation-Oriented Teaching

Given the cross-disciplinary nature of modern construction projects, teachers should be encouraged to integrate knowledge from related fields such as environmental engineering, digital design, and project management. Innovation incubators, interdisciplinary teaching teams, and collaborative design studios can serve as platforms for developing creative instructional approaches that reflect complex real-world challenges, cultivating students' problem-solving and innovation skills.

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