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Analysis of Talent Cultivation for Construction Engineering Majors in Vocational Undergraduate Education under the "Double High Plan" Background

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***Abstract*:** Under the dual context of the comprehensive advancement of the "Double High Plan" and the transformation of the construction industry towards industrialization, digitalization, and green development, the talent cultivation system for construction engineering majors in vocational undergraduate education is facing an urgent need for systematic reconstruction. This study focuses on this professional field, and by analyzing the deep structural contradictions existing in the current talent cultivation in terms of curriculum system, faculty, teaching mode, and evaluation mechanism, it reveals the core problems such as the disconnection from the forefront needs of the industry and the indistinctive characteristics of vocational education. Based on this, the article proposes to dynamically drive the reconstruction of the curriculum system with the needs of the industrial chain, and construct a modular curriculum group featuring "shared foundation, separate directions, and project integration"; deepen the reform of faculty construction and teaching mode through "school-enterprise collaboration and integration of education and training", and promote the deep integration of teaching scenarios and engineering practice; improve a multi-dimensional evaluation system oriented to competency output, integrating process-based, value-added, and certification-based evaluation, and strengthen the effective connection with career development. This study aims to provide theoretical reference and practical paths for vocational undergraduate construction engineering majors to achieve precise alignment between the supply side of talent cultivation and the demand side of the industry, and to build a new model of high-quality talent cultivation that reflects the characteristics of vocational education and meets the needs of industrial changes.

1. Introduction

Under the strategic backdrop of the nation's accelerated advancement of modern vocational education, the implementation of the "China's High-Level Higher Vocational Schools and Specialized Professional Construction Program" (Double High Plan) marks China's vocational education entering a new stage of high-quality development characterized by quality improvement, excellence cultivation, value-added empowerment[1]. As a type of education parallel to general higher education, vocational education, especially vocational undergraduate education, is facing historical opportunities as well as profound challenges of system reconstruction. The construction engineering industry, as an important pillar industry of the national economy, is undergoing profound technological changes and industrial upgrades centered on industrialization, digitalization, and green transformation, and the demand for high-level technical and skilled personnel is increasingly urgent. However, the traditional talent training model shows obvious inadequacy in adaptability and leadership when facing new trends such as the deep integration of intelligent construction, prefabricated buildings, and BIM technology[2].

In this context, the vocational undergraduate construction engineering major, as a key carrier for cultivating high-quality technical and skilled personnel needed for the transformation and upgrading of the construction industry, the optimization and reconstruction of its talent training system is not only related to the survival and development of the major itself, but also directly affects the realization of the strategic goals of the "Double High Plan" and the improvement of the core competitiveness of the construction industry[3]. At present, although pilot universities have carried out active explorations in the construction of vocational undergraduate construction engineering majors, there are still a series of structural contradictions that need to be solved urgently in terms of the connection between the curriculum system and the forefront of the industry, the adaptability of the teaching staff to the type of education, the effectiveness of the teaching model in cultivating students' ability to solve complex engineering problems, and the support of the evaluation mechanism for lifelong career development[4].

Therefore, this study takes the "Double High Plan" construction as the macro background and the vocational undergraduate construction engineering major as the specific research object, aiming to systematically analyze the contemporary demands and realistic dilemmas of its talent training, and propose feasible optimization paths based on this analysis. The study will follow the logical main line of "goal positioning, problem analysis, path construction," and deeply explore how to construct a dynamically adaptive curriculum system, how to create a collaborative education model that deeply integrates industry and education, and how to improve the evaluation mechanism that promotes sustainable development, in order to provide theoretical reference and practical guidance for the high-quality development of vocational undergraduate construction engineering majors, and ultimately provide solid talent support and intellectual guarantee for the modernization transformation of the construction industry.

2. Era Demands and Core Objectives

2.1 Deepening Requirements of the "Double High Plan" on the Positioning of Vocational Undergraduate Education

In the grand blueprint for the reform and development of vocational education in the new era, the comprehensive implementation of the "Double High Plan" marks China's vocational education entering a new stage of high-quality, connotation-driven development. This national strategy not only points out the direction for the development of higher vocational colleges but also puts forward unprecedentedly deepened requirements for the talent cultivation of vocational undergraduate education. From the perspective of policy connotation, the "Double High Plan" aims to concentrate efforts on building a number of high-level vocational schools and professional clusters that lead reform, support development, embody Chinese characteristics, and reach world-class standards, thereby driving the continuous deepening of vocational education reform and strengthening connotation construction. This policy orientation has a core impact on the talent cultivation of architectural engineering in vocational undergraduate education, which is reflected in three dimensions: First, the clarification of school-running positioning requires vocational undergraduate education to firmly adhere to the attributes of type education, get rid of the path dependence of "undergraduate compressed biscuits" or "extended versions of junior colleges," and truly build an education model that conforms to the growth law of high-level technical and skilled talents. Second, the alignment of professional construction emphasizes the alignment of professional settings with industrial needs, the alignment of curriculum content with occupational standards, and the alignment of teaching processes with production processes[5]. This requires the architectural engineering profession to closely follow the technological changes and transformation and upgrading of the construction industry. Finally, the excellence of training quality promotes vocational undergraduate education to form replicable and scalable reform experiences in the construction field by building a highland for technical and skilled talent training and a technical and skilled innovation service platform.

As a pillar industry of the national economy, the construction industry is undergoing a profound transformation from traditional extensive development to deep integration of industrialization, digitalization, and greening. The comprehensive promotion of prefabricated buildings requires talents to master new process technologies such as modern component production, hoisting construction, and node connection. The in-depth application of Building Information Modeling (BIM) technology has spawned digital management needs throughout the entire life cycle from design and construction to operation and maintenance, requiring talents to have the ability of cross-professional collaboration and data integration analysis. The development of green building and energy-saving technologies puts forward higher requirements for talents' sustainable development concepts, application of environmentally friendly materials, and energy consumption simulation analysis. These industrial changes not only change the technological paradigm of architectural engineering but also reshape the talent capability structure of the industry. The ability framework traditionally centered on construction technology is evolving into a composite ability system of "technology + management + innovation."

2.2 Special Characteristics of Talent Cultivation in Vocational Bachelor Programs

As a new type in China's higher education system, vocational bachelor education must establish its unique value in comparison with general bachelor education and higher vocational college education. Analyzing from the perspective of talent cultivation goals, general bachelor programs in architectural engineering focus on mastering the principles of engineering science and cultivating theoretical research abilities. Their graduates primarily engage in architectural design, structural analysis, scientific research and development, and emphasize the systematic nature of knowledge and innovative theorizing. Higher vocational college programs in architectural engineering technology, on the other hand, focus on the operational skills of specific positions and the proficient application of technological processes, cultivating frontline technical backbones for construction sites, and emphasize the proficiency of skills and the execution of norms. Vocational bachelor programs in architectural engineering are precisely at the critical intersection of these two. The specificity of their talent cultivation is reflected in three core aspects: First is the complexity of the knowledge structure, which requires students to not only master solid basic theories and professional knowledge of architectural engineering, but more importantly, to integrate this knowledge across fields to solve complex technical integration problems on construction sites[6].

Second is the hierarchy of the ability system. Vocational bachelor graduates in architectural engineering should form a three-level ability structure of "technology application, process optimization, engineering management." At the technology application level, students are required to master the use of basic technical tools such as BIM modeling, construction surveying, and quality inspection; at the process optimization level, they should be able to propose improvement plans for construction processes based on site conditions, solving the applicability problems of traditional processes in new scenarios; at the engineering management level, they need to have preliminary management skills such as project progress control, resource coordination and allocation, and risk early warning and handling. This ability level differs from the single dimension of vocational college education, which focuses on "technology application," and is also different from the innovation-oriented approach of general bachelor education, which focuses on "design and research and development." Instead, it forms a gradual chain of abilities from technology to management. Finally, there is the extensibility of job orientation. The career development paths of vocational bachelor graduates show obvious characteristics of horizontal expansion and vertical extension. Horizontally, they can cover multiple job clusters such as architectural design assistance, construction technology management, engineering quality monitoring, engineering cost consultation, and building information services. Vertically, they have a career advancement channel from technician to technical chief, project engineer, and project manager. This job adaptability avoids the problem of the low career ceiling of vocational college graduates, and also makes up for the lack of initial practical ability of general bachelor graduates, truly achieving the talent cultivation goal of "being able to go down, stay, be used well, and move up." Especially in the context of the digital transformation of the construction industry, the competitive advantages of vocational bachelor graduates in emerging positions such as BIM technicians, prefabricated building engineers, and intelligent construction administrators will become increasingly prominent, which is an important reflection of the value of vocational bachelor education.

2.3 Clear Training Objectives

Based on the policy guidance of the "Double High Plan" and the upgrading needs of the construction industry, combined with the unique nature of vocational undergraduate education, we can clearly define the core objectives of vocational undergraduate talent training in architectural engineering as a comprehensive goal orientation of "Solid Foundation, Strong Practice, Innovation Ability, and Management Knowledge." This objective system is not only a concentrated response to the aforementioned demands of the times but also serves as a general guideline for subsequent curriculum design, teaching implementation, and evaluation reform. "Solid Foundation" emphasizes the integrity and advancement of the theoretical knowledge system. In the field of architectural engineering, this means that students must systematically master the theoretical knowledge of traditional core courses such as architectural mechanics, engineering materials, building structures, and construction technology, while actively integrating emerging interdisciplinary content such as green building principles, intelligent construction overview, and building digital technology. "Strong Practice" highlights the cultivation of technical application ability and engineering implementation ability. The practical teaching of vocational undergraduate education should not be limited to repetitive training of operational skills but should construct a four-stage progressive practical ability training system of "Cognition, Simulation, Operation, Innovation." From the basic cognition of architectural drawing and interpretation to the virtual simulation of BIM collaborative design, then to the on-site operation of prefabricated component installation, and finally to the innovative practice of construction plan optimization, a complete path for the growth of practical ability is formed. "Innovation Ability" focuses on the cultivation of innovation ability in process improvement and technology optimization, which is a key characteristic that distinguishes vocational undergraduate talents from higher vocational college talents[7]. In the field of architectural engineering, this innovation is mainly reflected in the partial improvement of construction technology, the adaptive adjustment of technical solutions, and the creative solution of engineering problems. Cultivating "micro-innovation" ability requires the introduction of a large number of engineering case analyses, technical solution comparisons, and optimized design training in teaching to stimulate students' critical thinking and divergent thinking, so that they can grow into engineering technicians who can not only construct according to drawings but also implement policies according to local conditions.

"Management Knowledge" focuses on the cultivation of engineering project organization, coordination, and resource integration capabilities. With the expansion of architectural engineering project scale and the increase in technical complexity, modern architectural engineering talents must go beyond the level of simple technical execution and possess preliminary project management awareness and teamwork ability. This includes understanding the basic management elements such as engineering progress, quality, cost, and safety; coordinating the relationships among design, construction, supervision, and suppliers; and handling emergency engineering events. In the implementation of teaching, students' systematic thinking and overall planning ability should be cultivated through project management software applications, construction organization design preparation, engineering dispute case analysis, and team project practice. In particular, attention should be paid to the cultivation of soft skills such as communication and expression, negotiation and consultation, and leadership and motivation. The actual value of these abilities in the engineering site is often no less than that of professional technical abilities. In short, the four major objectives of "Solid Foundation, Strong Practice, Innovation Ability, and Management Knowledge" are mutually supportive and organically unified, together constituting the objective matrix of vocational undergraduate talent training in architectural engineering.

3. Existing Problems and Root Cause Analysis

3.1 Disconnection between Curriculum System and Industry Needs

A significant structural disconnect exists between the current vocational undergraduate construction engineering curriculum system and the needs of the rapidly upgrading construction industry. This has become the primary bottleneck restricting the improvement of talent cultivation quality. This disconnect is primarily manifested in a noticeable "time lag" between curriculum content and industry technological development. Although the construction industry has fully entered a new development stage characterized by industrialization, digitalization, and green development, the curriculum of many vocational undergraduate institutions remains within a framework centered on traditional cast-in-place construction techniques. This lag directly results in a generational gap between the technical skills acquired by graduates and the actual needs of the industry, making it difficult to meet the urgent demand of modern construction enterprises for talent proficient in new technologies and processes. A deeper problem lies in the fact that the curriculum organization logic has not yet escaped the confines of the disciplinary system. Although various institutions generally emphasize "work process orientation," in actual curriculum arrangement, they still largely follow the disciplinary progressive order of "structural mechanics, engineering materials, building structure, construction technology," rather than restructuring according to the actual engineering project implementation process. This curriculum logic, dominated by knowledge systematicness, fragments the integrity and contextuality of technology application, making it difficult for students to build comprehensive abilities to solve complex engineering problems in fragmented course learning. The imperfect mechanism for aligning the curriculum system with industry standards is an institutional reason for the disconnect. As a special type of education connecting vocational education and higher education, vocational undergraduate education should fully integrate the latest norms and technical standards of industry enterprises into the curriculum standard formulation. However, the actual situation is not optimistic. On the one hand, the dynamic updating of industry standards has not been reflected in the curriculum standards in a timely manner. On the other hand, the integration of curriculum content with the "1+X" certificate system is insufficient. Although the state vigorously promotes the vocational skill level certificate system, most institutions still arrange certificate training and daily teaching in parallel, resulting in a dilemma of increased academic burden for students and limited ability improvement. The fundamental reason is that enterprises are not deeply involved in the curriculum standard development process, and industry experts are mostly in a consulting role rather than a leading role, which makes it difficult for the curriculum content to truly reflect the actual needs of the job position.

3.2 Adaptability Challenges in Faculty and Teaching Models

The structural deficiencies within the faculty represent a central issue restricting the improvement of teaching quality in vocational undergraduate architectural engineering programs. Despite years of emphasis on building a "dual-qualified" teacher workforce, the reality falls short of expectations. Quantitatively, the proportion of teachers genuinely possessing both "teacher + engineer" and at least three years of first-line work experience in enterprises is generally low. The majority of professional teachers have advanced along an academic path "from university to university," lacking firsthand awareness of the latest technological trends and engineering practices in the construction industry. Qualitatively, a significant portion of existing "dual-qualified" teachers' enterprise experience is limited to early construction experience. They lack in-depth understanding and practical accumulation of technological changes in emerging fields such as industrialized construction and digitalization, making it difficult for them to undertake teaching tasks in cutting-edge courses such as intelligent construction and BIM collaborative management. Of even greater concern is the significant disconnect between teachers' enterprise practice experience and their ability to translate this into teaching. Many teachers, even when participating in enterprise practice, often regard it as a supplement to their personal resume, failing to systematically transform new technologies, new processes, and new case studies from engineering practice into teaching resources, resulting in a substantial loss of the "teaching value" of practical experience.

The insufficient adaptability of teaching models to the characteristics of vocational undergraduate education is another pressing problem. Currently, the classroom teaching of most vocational undergraduate architectural engineering programs is still dominated by the traditional model of teacher lecturing and student note-taking. Teaching methods that align with the principles of vocational education, such as project-based teaching, case-based teaching, and work-process-oriented teaching, often remain at the level of public demonstration classes, failing to become normalized teaching practices. This situation arises, on the one hand, from teachers' insufficient ability to master new teaching methods. Project-based teaching requires teachers to not only possess solid theoretical knowledge but also rich engineering practice experience, project organization skills, and interdisciplinary knowledge integration capabilities, which poses a severe challenge for teachers who have long grown up under traditional teaching models. On the other hand, the allocation of teaching resources fails to provide sufficient support for teaching model reform. Conducting genuine project-based teaching requires small class sizes, ample practical training venues, authentic engineering case libraries, and flexible scheduling, but most institutions are constrained by realities such as excessively high student-teacher ratios, limited practical training resources, and rigid management systems, making it difficult to meet these basic requirements. Of particular note is that the integration of information technology and teaching remains in the superficial application stage. Although hardware facilities such as smart classrooms and virtual simulation training platforms have been heavily invested in, their application is mostly limited to multimedia display and simulated operation training, failing to deeply reconstruct the teaching ecology. Technologies such as BIM, digital twins, and mixed reality (MR), which should be shining in architectural engineering teaching, have failed to fully realize their potential value in creating real work scenarios and achieving immersive learning due to teachers' insufficient technical application capabilities, insufficient integration of teaching design and technology, and a lack of high-quality digital resources.

3.3 Lack of Alignment between Evaluation Mechanisms and Career Development

Systemic defects in the evaluation mechanism are a key factor hindering the accurate measurement of talent cultivation quality in vocational undergraduate construction engineering programs. Currently, the academic evaluation systems of most institutions are still deeply influenced by general undergraduate education, exhibiting a clear "knowledge-oriented" characteristic. Course assessments often take the form of closed-book final exams, with the exam content focusing on the memorization and understanding of theoretical knowledge, while severely undervaluing the evaluation of vocational core competencies such as technical application ability, process optimization ability, and engineering management ability. Even in practical course assessments, scoring is often based on superficial indicators such as the completion of projects and the standardization of operations, lacking effective assessment of students' in-depth abilities in problem analysis, team collaboration, and innovative thinking demonstrated during the practical process. This evaluation orientation of "emphasizing results over process and knowledge over ability" directly leads to the alienation of students' learning behavior: they are more inclined to memorize knowledge points to cope with exams, rather than deeply understanding technical principles and mastering practical skills. Especially in the context of vocational undergraduate education emphasizing the cultivation of "innovation" ability, the existing evaluation system is almost unable to make scientific judgments on students' technical innovation awareness and process improvement ability, let alone effectively guide and incentivize students' innovative behavior.

The disconnection between evaluation standards and industry standards is another manifestation of the distortion of the evaluation mechanism. As an education type that connects to industry needs, the quality of talent cultivation in vocational undergraduate education should ultimately be tested by industry enterprises. However, the reality is that there is a clear gap between on-campus evaluation standards and industry employment standards. School teachers often formulate evaluation standards based on teaching syllabi and textbook content, while enterprises measure talent quality based on job competency requirements. For example, in a construction organization design course, teachers may pay more attention to the standardization and completeness of the plan text, while enterprise project managers pay more attention to the feasibility, economy, and innovativeness of the plan. This misalignment of standards leads to the difficulty for talents cultivated by schools to quickly adapt to enterprise requirements, prolonging the job adaptation period for graduates. More seriously, the connection mechanism between vocational skill level certificates and academic education is not yet sound. Although the "1+X" certificate system aims to achieve the integration of certificates and academic credentials, in actual operation, certificate training is often independent of the regular teaching system, creating a double burden for students who have to complete academic requirements and prepare for certificate exams. The fundamental reason is that the certificate assessment content and the course teaching content have not achieved substantial integration, and the course standards and certificate standards are formulated by different entities, lacking a unified framework connection.

4. Optimization Paths

4.1 Dynamically Adaptive Curriculum System Construction

Systemic improvement of the talent cultivation quality of vocational undergraduate construction engineering programs must begin with the structural reform of the curriculum system. The traditional discipline-logic curriculum framework is no longer suitable for the new requirements of technological integration in the construction industry and competency integration in job positions. It is urgent to construct a dynamically adaptive system "starting from the needs of the industry chain, focusing on the capabilities of job clusters, and using modular courses as carriers." This restructuring process first requires the establishment of a normalized industry demand research and feedback mechanism. Colleges and universities should jointly establish a construction industry talent demand analysis center with industry associations, leading enterprises, and professional research institutions to systematically carry out the compilation of regional construction industry technology development reports and talent demand white papers every academic year. Through a focused analysis of emerging fields such as intelligent construction, new industrialized construction, green building and energy-saving engineering, and building operation and maintenance management, new job positions and competency requirements generated by industrial chain upgrades can be accurately identified.

On the basis of clarifying job clusters and competency sets, the curriculum system should completely shift from "discipline-oriented" to "work process-oriented," and develop a modular curriculum group of "basic sharing, direction separation, and project penetration." The basic sharing module focuses on consolidating students' engineering literacy and sustainable development concepts. In addition to traditional courses such as engineering mechanics, engineering materials, and building construction, it is necessary to add general and specialized integrated courses such as an introduction to the construction industry, principles of green building, building engineering ethics, and digital foundation to build a broad and cutting-edge knowledge base. The direction separation module should closely connect with the subdivided fields of the construction industry, and set up professional directions such as intelligent construction, prefabricated building engineering, construction engineering management, and building digital operation and maintenance. Each direction forms a course package consisting of 3-4 core courses. For example, the intelligent construction direction can set up courses such as intelligent construction technology, application of building robots, and IoT and building equipment monitoring; the prefabricated building direction can cover core content such as prefabricated component design and production, prefabricated structure construction and testing, and prefabricated building project management. The knowledge points and skill points in each course package must strictly correspond to the typical work tasks and competency requirements of relevant job clusters, and introduce the latest industry standards, technical regulations, and real engineering cases.

The core of curriculum restructuring lies in the implementation of "project penetration." It is necessary to break the traditional linear teaching arrangement of theory first and then practice, and design a series of comprehensive practical projects that run through multiple semesters and increase in complexity. To ensure the timeliness and authenticity of teaching resources, it is necessary to cooperate deeply with leading companies in the industry to jointly develop loose-leaf textbooks, workbook-style textbooks, and supporting digital resources. The textbook content should focus on the latest technical specifications, typical construction techniques, common quality defect prevention, and excellent engineering cases, and be fully updated every 1-2 years. At the same time, virtual simulation training resources should be developed and widely applied to enabling students to master key technologies and emergency response capabilities in a safe, economical, and repeatable environment. Especially for high-risk, high-cost, and high-complexity construction scenarios, such as super high-rise building construction, large-span steel structure installation, deep foundation pit engineering, and building fire protection system testing.

4.2 Deepening the Reform of Facult "School-Enterprise Collaboration"

The implementation of the curriculum system fundamentally relies on a "dual-qualified" faculty with outstanding engineering practice capabilities and teaching innovation abilities. Under the "Double High Plan" background, vocational undergraduate institutions must go beyond the formal pursuit of "dual-qualified" credentials and focus on building a new ecosystem for teacher professional development characterized by "school-enterprise collaboration and mutual empowerment." A core measure is the implementation of institutionalized arrangements for "dual employment by schools and enterprises and two-way mobility." Institutions should select and employ a group of industry professors, technical masters, or master craftsmen from cooperative enterprises who possess sophisticated technology, rich experience, and are good at imparting knowledge, and give them substantive responsibilities such as curriculum development, teaching implementation, graduation design guidance, and mentoring of young teachers, and establish a salary payment and incentive mechanism based on workload. At the same time, a system should be established whereby full-time teachers in the school spend at least one year in enterprises every five years, and the practical positions should focus on technical management, process innovation, project consulting, and other positions that can access core technologies and cutting-edge trends, rather than simple job placement.

Information technology and artificial intelligence technology should provide revolutionary empowerment for the reform of teaching models. Institutions should systematically build a "Smart Construction Training Center," integrating a BIM collaborative design platform, a smart construction site management platform, a building energy consumption simulation platform, a virtual reality (VR)/augmented reality (AR) training system, etc., to build a digital teaching environment covering the entire process of design, construction, and operation and maintenance. In this environment, teaching activities should make full use of new teaching methods such as blended learning and flipped classrooms. For example, factual and conceptual knowledge such as the study of standard clauses and basic software operations should be made into online micro-courses for students to study independently before class; class time should be concentrated on higher-order thinking and teamwork activities such as project discussion, program optimization, collaborative design, and virtual construction. The role of teachers should shift from knowledge transmitters to designers, guides, and collaborators in the learning process, using learning analysis technology to track each student's learning trajectory and ability development status and provide personalized guidance. Ultimately, through the deep integration of school-enterprise collaboration and deeply information-based teaching innovation, a new type of open, interactive, intelligent, and efficient teaching ecosystem will be built.

4.3 Improving Multi-Dimensional Evaluation and Alignment Mechanisms

A scientific and effective evaluation system serves as both a "command stick" and a "testing instrument" for the quality of talent development. Addressing the prominent issues in current evaluations, it is essential to construct a multi-dimensional comprehensive evaluation system that is output-oriented and integrates formative assessment, value-added assessment, and summative assessment. The core of formative assessment is to establish an "electronic student ability growth file" covering the entire learning cycle. This file should meticulously record a student's performance in each project task, practical operation, and course, including not only the final assignments or works but also emphasizing qualitative evaluations of aspects such as the logic of solution design, selection of technical approaches, contributions to teamwork, and innovative thinking highlights demonstrated by the student in the problem-solving process. The evaluation body should be expanded from a single teacher evaluation to a combination of teacher evaluation, corporate mentor evaluation, peer review, and self-evaluation. Especially in team projects, a contribution-based multi-dimensional peer review mechanism needs to be introduced to objectively reflect the student's comprehensive performance in complex tasks. Evaluation standards must be closely aligned with the work quality standards and technical specifications of industries and enterprises, and even directly incorporate evaluation scales from enterprise project acceptance to ensure the isomorphism of on-campus evaluations and job requirements.

Value-added assessment aims to focus on the magnitude of students' ability improvement and development potential from enrollment to graduation, rather than solely focusing on their final absolute level. This requires institutions to conduct professional awareness and basic ability diagnoses upon new student enrollment to establish personalized ability baselines. During the learning process, the effectiveness of their learning and development potential is dynamically assessed by comparing students' progress in comprehensive tasks such as complex engineering problem-solving, technical innovation proposals, and project management simulations. At the summative assessment level, the barriers between "academic certificates" and "vocational skill level certificates" must be completely removed to achieve the substantial integration of "certificate fusion." Institutions should take the lead in jointly developing "X" certificates based on vocational bachelor training standards with leading industry enterprises and training evaluation organizations, or organically integrate the assessment content and standards of existing certificates into talent development programs. Through credit recognition and conversion systems, students can be exempted from or replace corresponding course modules' credits after obtaining relevant vocational skill level certificates, achieving mutual recognition of learning outcomes. More importantly, institutions should actively build a lifelong learning support system that is aligned with career development.

5. Conclusion

This study systematically demonstrates the necessity and feasibility of systemically optimizing the talent development of vocational undergraduate construction engineering programs under the guidance of the "Double High Plan" strategy and the backdrop of profound changes in the construction industry. The research indicates that the key to solving the current talent development dilemma lies in completely abandoning the path dependence of the disciplinary system, firmly establishing the positioning of vocational education, and constructing a modern education system that takes dynamic industrial demands as its starting point, comprehensive vocational ability cultivation as its core, and deep integration of industry and education as its support. Specifically, it is essential to ensure the advancement and practicality of teaching content by constructing a curriculum system that deeply couples the "industry chain, job cluster, competency set, and course chain"; to build a high-level "dual-teacher" team and reshape the teaching ecosystem by implementing a "dual-appointment, two-way flow" mechanism between schools and enterprises and reforming the contextualized teaching model; and to effectively guide students' learning direction and empower their lifelong career development by establishing a multi-dimensional comprehensive evaluation and long-term development support mechanism. Ultimately, the vocational undergraduate construction engineering program should develop into a talent development hub that can actively respond to and even lead industrial technological changes, providing solid and sustainable high-quality technical and skilled personnel support for the high-quality development of the construction industry, and fully demonstrating the unique value and mission of vocational undergraduate education in the modern vocational education system.

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