Research on the Practice of Integrated Training Mode for Civil Engineering Talents in Higher Vocational Education Driven by New Quality Productive Forces

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Abstract: The development of new quality productive forces is an important current task, a key to promoting high-quality economic and social development, and to shaping new competitive advantages for China. In developing new quality productive forces, talent is the key. At present, we still face the problem of a shortage of high-level technical and skilled talents, which has become a bottleneck restricting industrial upgrading and technological innovation. The integrated training of higher vocational and undergraduate talents is an important measure to promote the vertical integration of vocational education and cultivate high-quality technical and skilled talents. It is of great significance to further improve and perfect the training mode. Focusing on the development needs of new quality productive forces, this paper deeply analyzes the difficulties and problems existing in the current integrated training of higher vocational and undergraduate talents, and takes the civil engineering major as an example to explore the training path from aspects such as training objectives, training principles, integration mechanisms, curriculum system, training mode, and assessment and evaluation, with the aim of providing some reference for the industry.

***Keywords*:** integrated talent training; higher vocational-undergraduate; civil engineering; new quality productive forces

1. Introduction

In September 2023, the concept of new quality productive forces was proposed for the first time. Since then, it has been repeatedly emphasized that all regions and fields should develop new quality productive forces according to local conditions and vigorously promote high-quality development. New quality productive forces are a form of productive forces driven by scientific and technological innovation, characterized by high technology, high efficiency, and high quality, and have had a profound impact on the traditional civil and construction industries. Driven by new quality productive forces, emerging formats such as green buildings, prefabricated buildings, intelligent construction, digital design, and construction industrialization have developed rapidly, and the demand for industry talents has also changed accordingly, with increasingly higher requirements for technical and skilled talents. At the same time, in recent years, with the deep implementation of China's "two major tasks" and "two new" strategies, a large number of major infrastructure construction projects, including the Yaxia Hydropower Station, have been launched one after another, and the total demand for civil engineering talents has continued to rise. As a systematic and continuous educational design, the integrated training mode of higher vocational and undergraduate education not only provides students with a sustainable development pathway, but also offers solid talent support for the civil engineering industry driven by new quality productive forces.

2. Overview of the "Higher Vocational–Undergraduate" Integrated Training Mode

Integrated training is an important component of the construction of China's modern vocational education system and an important way to realize the integration and connection of different levels of education. The "higher vocational–undergraduate" integrated training mode builds a bridge between higher vocational colleges and undergraduate universities, providing students with a new pathway for growth and success. At present, the "higher vocational–undergraduate" integrated training mode includes models such as "3+2" and "3+3" (3 years of higher vocational education + 2 years of undergraduate education, or 3 years of undergraduate education after passing the transition examination in the third year of higher vocational study, and then continuing at the corresponding undergraduate university). Upon completion of their studies, students can obtain graduation certificates from both the junior college and the undergraduate institution.

From the perspective of social demand, the majors set up under the "higher vocational–undergraduate" integrated training mode are generally those with longer training cycles, higher technical skill requirements, and strong social demand, such as civil engineering, medicine, and mechanical engineering, aiming to cultivate urgently needed technical and applied talents for the country. From the perspective of student development, integrated training differs from the traditional "junior

high school–senior high school–university" model in terms of academic system, professional skills, and employment direction, especially providing diverse new pathways for the growth and development of students with relatively lower entrance scores. From the perspective of schools, integrated training builds a bridge for cooperation among institutions of different levels, which helps fully stimulate the enthusiasm and initiative of different educational entities, promotes pragmatic cooperation among institutions, and jointly contributes to providing high-quality technical and skilled talents to drive the development of new quality productive forces and promote regional industrial transformation and upgrading. From the perspective of society, the integrated training mode helps improve social and public stereotypes about vocational education, guides many young people onto the path of vocational education development, and provides talent support for consolidating China's status as a strong manufacturing country.

3. Main Objectives, Basic Principles, and Training Approach of the "Higher Vocational–Undergraduate" Civil Engineering Integrated Talent Training

3.1 Training Objectives

Against the backdrop of the rapid development of new quality productive forces, the integrated training of civil engineering talents should closely follow future industry development trends, with a focus on green, industrialized, and intelligent directions. It should strengthen the comprehensive learning of cutting-edge technologies in fields such as intelligent construction, green construction, and BIM technology application, and strive to cultivate well-rounded technical talents who develop morally, intellectually, physically, aesthetically, and in labor. Such talents should systematically master the theoretical knowledge of civil engineering and related disciplines, possess outstanding engineering practice abilities, good professional ethics, team spirit, international vision, and a sustainable development mindset, as well as strong lifelong learning abilities and innovative thinking, so as to meet the needs of new formats and new technologies in industry development.

3.2 Training Principles

The "higher vocational–undergraduate" integrated training of civil engineering talents should adhere to the principles of "broad caliber, solid foundation, deep integration, and strong convergence." "Broad caliber" emphasizes moderately lowering the admission threshold and expanding cooperation among schools to allow more students the opportunity for higher education. "Solid foundation" highlights the need for solid grounding in basic knowledge such as mathematics and mechanics, while also focusing on cultivating rigorous engineering thinking and logical reasoning skills as the prerequisites for solving complex problems. "Deep integration" refers to the intersection of this major with disciplines such as information, materials, and environment. Through interdisciplinary learning with surrounding disciplines, students' knowledge breadth and depth are expanded, enabling better cultivation of comprehensive abilities. "Strong convergence" does not mean the simple addition of knowledge and skills, but rather the continuous coupling of skills and knowledge around production practice, production projects, and production products, thereby achieving qualitative change through quantitative accumulation.

3.3 Training Mode

The "higher vocational–undergraduate" integrated training of civil engineering talents should follow the training mode of "disciplinary integration, curriculum integration, resource aggregation, and industry–education integration." This mode is also an extension of the training principles of "broad caliber, solid foundation, deep integration, and strong convergence." By systematically integrating civil engineering with related courses in planning, transportation, environment, and project management, foundational knowledge can be merged. At the same time, teaching resources from both inside and outside the school, online and offline, and physical and virtual platforms can be maximized and integrated. Through approaches such as apprenticeship programs, order-based classes, industry colleges, enterprise participation in schools, and school–enterprise cooperation, deep integration of industry and education can be promoted, forming a systematic closed-loop talent cultivation system.

4. Problems and Deficiencies in the "Higher Vocational–Undergraduate" Integrated Talent Training

4.1 Lack of Systematic Curriculum Content and Poor Connection Between Stages

Higher vocational and undergraduate institutions differ in training objectives, teaching modes, and student management. In integrated training, due to differences in textbooks, courses, and teaching orientations, there may be problems such as weak connection between stages and unclear progression of teaching content. The result is often more physical stacking than

chemical reaction, failing to build a systematic curriculum and training system, and even leading to overlap, repetition, and disconnection, which affects training efficiency. For example, in integrated training, higher vocational colleges often place excessive emphasis on skills training, while neglecting solid instruction in basic knowledge. As a result, students may find it difficult to cope with theoretical courses after advancing to undergraduate studies. In addition, some institutions fail to keep course content up to date, and do not timely follow new materials, new technologies, and new processes in the construction field, resulting in a disconnection from engineering practice.

4.2 Insufficient School–Enterprise Collaboration and Inadequate Industry–Education Integration

Industry–education integration is a crucial part of integrated training and an indispensable approach to cultivating applied and technical talents. In talent integration training, higher vocational and undergraduate institutions often lack sufficient coordination in school–enterprise cooperation, with issues such as fragmented enterprise resources and separated training environments, which affect systematic training outcomes. The foundation of school–enterprise cooperation is not solid, and the starting points and objectives of both sides are inconsistent. Enterprises lack motivation to participate in talent training, as the long training cycle conflicts with their short-term benefits. Enterprises are more willing to employ mature workers rather than allow students to engage in more real estate projects or construction engineering design, research, and development. Furthermore, due to limitations in funding and technology, some institutions have low levels of digitalization and informatization in education, lacking effective virtual simulation platforms, which leads to unsatisfactory simulation training effects.

4.3 Weak Overall Quality of Teachers and Low Proportion of "Dual-Qualified" Faculty

The integrated training mode imposes new and higher requirements on teachers' knowledge reserves and competency. Teachers need to have a solid theoretical foundation, strong practical skills, and rich practical experience, as well as professional ethics and sustainable development capabilities. They must keep pace with the times, master industry frontiers and technological trends, and pass them on to students. However, in reality, many teachers in higher vocational and undergraduate institutions lack enterprise work experience and project operation experience. The proportion of "dual-qualified" teachers is relatively low, and the overall competence of the teaching staff is insufficient.

4.4 Divergent Orientations, Insufficient Connection in Teaching Evaluation, and Lack of Scientific Rigor

The higher vocational–undergraduate integrated talent training mode involves two different types of institutions: higher vocational colleges and undergraduate universities. Naturally, the orientations of their teaching evaluations differ. Higher vocational colleges place more emphasis on practical assessments and obtaining professional qualification certificates, while undergraduate studies focus more on academics and theory, emphasizing assessments such as graduation theses and academic reports. The evaluations of the two stages lack effective connection, and the transition examination is overly simple, lacking an integrated and continuous design for the entire five-year training cycle, thus failing to form a cohesive educational synergy. In the assessment and evaluation process, the participation of enterprises and employers is too limited, often confined to symbolic meetings without substantive involvement, resulting in relatively single and incomplete evaluation mechanisms.

5. Practical Pathways for Higher Vocational Civil Engineering Talent Integration Driven by New Quality Productive Forces

5.1 Strengthening Curriculum and Textbook Alignment and Establishing a Dynamic Adjustment Mechanism

It is recommended that teachers from higher vocational and undergraduate institutions, together with industry experts, form a teaching guidance committee to enhance curriculum research and design, breaking the situation of isolated management at the two stages. On the one hand, the overall curriculum arrangement across the higher vocational–undergraduate stages should be coordinated to form a joint training system. The advantages of higher vocational and undergraduate institutions should be fully leveraged, and curriculum content should be arranged scientifically according to the realities of each stage to improve teaching effectiveness. Key courses that cultivate skills and professional literacy should mainly be arranged in the higher vocational stage, while key courses that enhance technical application ability and overall competence should mainly be arranged in the undergraduate stage, ensuring complementary strengths and advantages. For emerging technologies related to new quality productive forces—such as intelligent construction, green building, BIM technology, construction robotics, intelligent surveying, and 3D printing—the number of courses can be appropriately increased to

enhance specificity. On the other hand, effective alignment of textbooks across the two stages should be promoted through the development of self-compiled teaching materials. By means of dual development between schools and enterprises, as well as inter-institutional collaboration, emphasis should be placed on developing a batch of loose-leaf and manual-style textbooks that reflect professional characteristics. These should be dynamically updated in accordance with industrial development and technological iteration needs. By complementing self-compiled materials with standardized textbooks, the teaching continuity between the two stages can be improved.

5.2 Enhancing School–Enterprise Collaboration and Strengthening Innovation in Teaching Scenarios and Training Base Construction

Higher vocational and undergraduate institutions should further strengthen the cooperation and sharing of enterprise training resources, coordinating training bases and partner enterprises on both sides to maximize utilization. School–enterprise cooperation should be deepened by exploring the establishment of "school–enterprise cooperation consortia," forming communities of shared interests through mechanisms such as personnel exchange and sharing, joint construction and use of training bases, collaborative research on technical challenges, and joint cultivation of students and employees, thereby stimulating enterprises' enthusiasm for participating in integrated talent training. Under the background of new quality productive forces, the pace of technological iteration is rapid, and a normalized school–enterprise communication mechanism should be established to promptly transform new technologies, processes, and materials into teaching modules and project cases, ensuring that teaching content remains aligned with industry development. Education management systems should be further reformed by implementing flexible learning systems and credit accumulation and transfer systems, while adopting more open teaching models such as project-based, case-based, and flipped teaching to improve teaching outcomes. In response to difficulties such as insufficient funding and weak technical capacity in some institutions, school–enterprise cooperation should be further promoted, focusing on developing intelligent training management platforms and jointly creating virtual simulation systems to overcome the challenges of high-risk training. For example, Hunan Engineering Vocational and Technical College, in cooperation with third-party enterprises, built a "cloud construction site" system, using "BIM + VR" to replicate civil engineering scenarios such as bridges, tunnels, factories, and residential complexes, allowing students to learn construction techniques and project organization immersively. The system is also connected with platforms such as the "China Railway Construction Shield Cloud" system used in enterprise projects under construction, enabling students to access real enterprise data and engage in highly realistic practice operations.

5.3 Strengthening Faculty Training and Cultivating More "Dual-Qualified" Teachers

The integrated training model places higher overall demands on faculty teams, especially under the context of new quality productive forces, which requires teachers to embrace new concepts, adapt to rapid technological iteration, and pursue continuous development. For vocational and undergraduate institutions engaged in integrated training, it is essential to establish a comprehensive joint teacher training mechanism. Targeted strategies should be developed according to the source of faculty—whether recent graduates or industry professionals. For teachers without prior enterprise experience, a minimum of six months to one year of full-time enterprise practice should be arranged to strengthen their practical skills. For enterprise experts serving as faculty, the emphasis should be on training in cutting-edge civil engineering technologies and new building materials to enhance their teaching capacity in the field of new quality productive forces.Active participation in lesson-presentation contests and teaching skills competitions should be encouraged to cultivate faculty competence through practice and competition. For example, Sichuan College of Architectural Technology has innovatively implemented a "classification-based standard setting—spiral advancement—dynamic flow" training mechanism, dividing teachers into four categories: theoretical, practical, comprehensive, and social service-oriented. Specific training plans are designed for each category, supported by approaches such as mentoring, apprenticeships, and project-based guidance, aiming to cultivate more "dual-qualified" teachers. In addition, the college introduces numerous enterprise civil engineers as part-time faculty through cooperative arrangements, achieving complementary advantages between academic and industry teaching teams — a practice worth referencing.

5.4 Reforming the Teaching Evaluation Mechanism to Enhance Scientific Rigor and Guidance

The integrated training of vocational and undergraduate talents should adhere to the basic principles of "broad entry with strict exit", "diversified evaluation", and "competence orientation", while emphasizing regional coordination. Local governments and institutions should align evaluation systems with the direction of new quality productive forces and the demand for technical talents, thereby establishing a sound talent quality assessment framework.In civil engineering, special emphasis should be placed on assessing practical ability, innovation awareness, and professional ethics. Moving away from

"score-only" assessments, the system should place greater weight on process evaluation, as well as students' applied skills and innovative capacity, to ensure assessments reflect both their current status and future potential. Increasing the proportion of evaluations by industry enterprises is crucial, enabling comprehensive assessment of students' theoretical knowledge, professional skills, and non-technical qualities from the perspective of employment demand, thus improving professionalism and guidance in evaluation.The difficulty of transition examinations in the integrated model should be appropriately raised. Students failing to pass may be offered re-examinations or required to continue studies at the vocational stage. Exam content should be jointly designed by vocational and undergraduate institutions. By increasing difficulty and applying moderate pressure, the overall quality of integrated training can be enhanced.For instance, Shanghai Modern Chemical Vocational College has developed a "teaching-evaluation integration" model for student training assessment, embedding evaluation standards into syllabi and curriculum design, while involving enterprise mentors and industry experts in the evaluation process. The use of virtual simulation platforms and training management systems enables data collection on student performance, thereby improving the scientific rigor and accuracy of evaluation. Reforming evaluation orientation should place greater emphasis on problem-solving ability and innovative thinking. Based on evaluation results, teaching content and methods can be adjusted promptly to provide targeted guidance for students, while also serving as tools for teaching quality monitoring and program development, thus driving educational reform.

6. Conclusion

Against the backdrop of the development of new quality productive forces, the demand for technically skilled civil engineering talents in the country is increasing. Continuously advancing the integrated training model between vocational and undergraduate education helps further integrate teaching resources, innovate educational models, promote school-enterprise collaboration, and enhance training efficiency. It effectively addresses issues such as isolation between stages of education, insufficient articulation, limited academic qualifications, and weak competencies in talent cultivation, while also promoting effective alignment between the talent supply side and industry demand side. In the future, the vocational-undergraduate integrated training model will inevitably become a key trend in the development of higher vocational education. Through systematic and unified cultivation, it will produce a large number of qualified civil engineering technical talents, contributing to the high-quality development of China's infrastructure and construction sectors.

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