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Exploration and Practice of Talent Cultivation Model for Construction Majors in Secondary Vocational Schools under the Background of Industry-Education Integration

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Abstract: Against the backdrop of rapid economic development and industrial upgrading, vocational education faces new opportunities and challenges. The talent cultivation of the building engineering technology specialty in secondary vocational schools needs to closely integrate with industry demands and explore effective teaching models. The "integration of production, education, and research, and joint cultivation of schools and enterprises" model, as a new educational concept, optimizes the curriculum system and teaching content through deep cooperation between schools and enterprises, enhancing students' practical abilities and competitiveness in employment. This paper explores the talent cultivation scheme for the building engineering technology specialty under the "integration of production, education, and research, and joint cultivation of schools and enterprises" model from theoretical foundations, practical exploration, implementation paths of school-enterprise cooperation, and analysis of talent demand in the field. Through the construction of a talent cultivation effectiveness evaluation system and continuous improvement of the model, optimization suggestions are proposed to provide a reference for the development of vocational education.

Keywords: Integration of production, education, and research; Joint cultivation of schools and enterprises; Secondary vocational education; Building engineering technology; Talent cultivation

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1. Introduction

With the adjustment of industrial structure and technological progress, the demand for high-quality technical talents in the field of building engineering technology is increasing. However, traditional vocational education models are insufficient to meet the needs of industry development, and there is an urgent need to explore new teaching models to enhance the quality of talent cultivation. The "integration of production, education, and research, and joint cultivation of schools and enterprises" model, as an innovative educational concept, provides a new approach for cultivating technical talents adapted to industry needs through close cooperation between

schools and enterprises, realizing resource sharing and complementary advantages. This study aims to construct a scientific curriculum system and teaching content and enhance students' comprehensive quality and practical abilities through the exploration and practice of a talent cultivation scheme for the building engineering technology specialty in secondary vocational schools under the "integration of production, education, and research, and joint cultivation of schools and enterprises" model.

2. Overview of the integration of production, education, and research, and joint cultivation of schools and enterprises model

2.1. Theoretical basis and practical exploration of the integration of production, education, and research

The integration of production, education, and research is a crucial concept in modern vocational education, with its theoretical foundation stemming from various educational and economic theories. Firstly, the theory of the knowledge economy emphasizes the central role of knowledge and technology in economic development, necessitating a close alignment between the educational system and industrial demands. In the context of the knowledge economy, the upgrading of industrial structures and technological innovations impose higher requirements on education, demanding vocational education to adapt to and guide these changes, fostering high-quality technical talents. Secondly, modern vocational education theories advocate for the integration of education with productive labor, emphasizing the importance of practical teaching. Through the combination of theoretical learning and practical application, students can better understand and master professional knowledge and skills, thereby enhancing their competitiveness in employment. Thirdly, the theory of collaborative innovation suggests that the integration of production, education, and research facilitates resource sharing and collaborative innovation between educational institutions and enterprises, driving technological progress and industrial upgrading [1].

In practice, the integration of production, education, and research has achieved significant results globally. Germany's "dual system" vocational education model serves as an exemplary embodiment of this integration, allowing students to gain rich practical experience during their studies through joint training provided by schools and enterprises, thereby enhancing their employability. In recent years, China has also placed great emphasis on the integration of production, education, and research, encouraging universities and vocational colleges to engage in multi-level and multi-form cooperation with enterprises through a series of policy measures. For example, the Ministry of Education has issued the "Measures for Promoting Cooperation between Vocational Colleges and Enterprises", outlining the basic principles and implementation paths of school-enterprise cooperation, providing policy support for the integration of production, education, and research.

Specifically for the building engineering technology specialty, the implementation of the integration of production, education, and research can significantly improve the quality and effectiveness of talent cultivation. Through deep cooperation with construction companies, schools can introduce advanced technologies and management practices from enterprises, update teaching content and methods, and enhance the targetedness and practicality of teaching. Enterprises, on the other hand, can provide internship and employment opportunities for students, helping them accumulate experience in real work environments and improve their professional competence and practical skills. This win-win cooperation model contributes to the mutual development of education and industry.

2.2. Connotation and implementation paths of joint cultivation of schools and enterprises

Joint cultivation of schools and enterprises is an important form of realizing the integration of production,

education, and research, focusing on the joint participation of schools and enterprises in the talent cultivation process to achieve resource sharing and complementary advantages. The connotation of joint cultivation of schools and enterprises includes jointly formulating talent cultivation plans, jointly developing curriculum systems, and jointly implementing teaching and practical training. Through such deep cooperation, schools and enterprises can better meet the needs of industrial development and cultivate high-quality technical talents with practical abilities.

In terms of implementation paths, joint cultivation of schools and enterprises can be conducted in various ways. Firstly, jointly formulating talent cultivation plans is the foundation of joint cultivation of schools and enterprises. Schools and enterprises should jointly determine talent cultivation objectives and standards and design reasonable curriculum systems and teaching content based on the needs of industry development and job requirements. For example, schools can invite enterprise experts to participate in curriculum design to ensure the forward-looking and practical nature of the curriculum content. Secondly, jointly developing curriculum systems and teaching resources. Enterprises can provide the latest technologies and equipment, participate in curriculum design and textbook writing, and ensure the forward-looking and practical nature of teaching content. Additionally, enterprise experts can also serve as part-time teachers, participating in classroom teaching and practical training guidance to enhance the practical effectiveness of teaching [2].

The construction and operation of training bases are also crucial aspects of the joint cultivation of schools and enterprises. Schools can collaborate with enterprises to jointly build training bases inside and outside the campus, providing students with real work environments and practical opportunities. For example, students majoring in building engineering technology can conduct on-site training at construction sites, understanding and mastering the entire process of construction, and cultivating practical operation capabilities and professional qualities. At the same time, enterprises can also utilize school laboratories and research facilities to carry out technological research and innovation activities, enhancing their technological level and competitiveness.

2.3. Analysis of talent demand in the building engineering technology specialty

As an integral part of the construction industry, the talent demand for the building engineering technology specialty exhibits distinct industry characteristics and regularities. Firstly, talents in the building engineering technology specialty need to possess solid theoretical foundations and strong practical abilities. The rapid development and technological progress of the construction industry require practitioners to continuously update their knowledge and skills, mastering the latest construction technologies and management methods. Therefore, talent cultivation in the building engineering technology specialty must emphasize the combination of theory and practice, cultivating students' comprehensive qualities and innovative abilities.

Secondly, the talent demand for the building engineering technology specialty is characterized by strong diversity and hierarchy. The construction industry involves various positions and occupations, each with different requirements for knowledge, skills, and qualities. For example, construction site management personnel need to have strong organizational and coordination abilities and adaptability to handle complex construction issues and emergencies; while technical research personnel need to have strong innovative and technical research abilities to carry out technological breakthroughs and product development. Therefore, talent cultivation in the building engineering technology specialty must be tailored to the needs of different positions, designing multi-level and diversified talent cultivation plans to ensure that graduates can meet the diverse demands of the industry.

Furthermore, the talent demand for the building engineering technology specialty also exhibits strong regional characteristics. Different regions have varying levels of economic development, industrial structures,

and market demands, leading to significant differences in the development of the construction industry. For example, economically developed regions have a greater demand for construction market and high-quality, highly skilled talents; while some economically underdeveloped regions require more application-oriented talents that can adapt to local market demands and possess strong practical abilities. Therefore, talent cultivation in the building engineering technology specialty must fully consider the actual situation of regional economic and industrial development, formulate tailored talent cultivation plans according to local conditions, and ensure close alignment between talent cultivation and market demand.

3. Design and practice of talent cultivation scheme for building engineering technology specialty in secondary vocational schools

In modern vocational education, the formulation and implementation of scientific and systematic talent cultivation schemes are key to cultivating high-quality technical and skilled talents. Especially in the field of building engineering technology, the design and practice of talent cultivation schemes must be closely integrated with industry demands, fully embodying the advantages of the integration of production, education, and research, as well as school-enterprise cooperation [3].

3.1. Formulation of talent cultivation objectives and standards

The formulation of talent cultivation objectives and standards for the building engineering technology specialty is a crucial step to ensure education quality. Firstly, the talent cultivation objectives should clearly define the positioning of vocational education, emphasizing the cultivation of students' professional ethics, professional literacy, and practical abilities. Specifically, the building engineering technology specialty should focus on cultivating high-quality technical talents with solid knowledge of building theory, proficient technical operation capabilities, and innovative consciousness. The cultivation objectives should also emphasize students' teamwork abilities and problem-solving skills to meet the needs of modern construction projects.

Secondly, the formulation of talent cultivation standards should fully consider the actual demands and development trends of the construction industry. The standards should include the basic skills, professional skills, and comprehensive qualities that students should possess. For example, basic skills include abilities in reading drawings, measurements, and construction organization; professional skills include structural design, project budgeting, construction management, and so on; while comprehensive qualities encompass professional ethics, communication abilities, teamwork spirit, and so on. These standards should not only reflect the current demands of the construction industry but also possess a certain degree of foresight to adapt to the trends of technological progress and changes in management modes within the industry.

When formulating talent cultivation objectives and standards, it is also essential to actively incorporate opinions and suggestions from enterprises and industry experts. Through school-enterprise cooperation, inviting enterprise experts to participate in the formulation of teaching standards can ensure that the cultivation objectives and standards are more closely aligned with practical production demands. Additionally, by regularly convening industry forums and participating in industry seminars, the latest industry dynamics and technological development directions can be understood, allowing for timely updates and adjustments to talent cultivation objectives and standards, maintaining their advancement and practicality [4].

3.2. Optimization of curriculum systems and teaching contents

The optimization of curriculum systems and teaching contents is an important approach to improving the quality of talent cultivation. Firstly, the design of curriculum systems should reflect the principle of combining

theory with practice. The curriculum of the building engineering technology specialty should include three major modules: basic theory courses, professional technical courses, and practical training courses. Basic theory courses mainly cover topics such as building structures, building materials, and structural mechanics, aiming to establish students' theoretical foundations. Professional technical courses include topics such as structural design, construction technology, project management, and so on, aiming to enhance students' professional skills. Practical training courses include on-campus training and off-campus internships, aiming to cultivate students' practical operational abilities and professional qualities.

Secondly, the optimization of teaching content should focus on closely integrating with industry development and technological progress. Teaching contents should be updated promptly to reflect the latest technologies and management methods in the construction industry. For example, with the development of information technology, the application of Building Information Modeling (BIM) technology in the construction industry is becoming increasingly widespread. Therefore, the curriculum should include relevant content on BIM technology to equip students with knowledge of this emerging technology. Additionally, teaching content should also emphasize the proportion of practical operations. By increasing the proportion of experiments, training, and project practical sessions, students' practical operational abilities and problem-solving skills can be improved.

To better achieve the optimization of curriculum systems and teaching contents, cooperation with enterprises should be strengthened. Enterprises can provide the latest technical materials and equipment, and participate in curriculum design and textbook writing to ensure the advancement and practicality of teaching contents. Additionally, enterprise experts can serve as part-time teachers, participating in classroom teaching and practical training guidance, providing students with practical cases and solutions, thereby enhancing the targetedness and practicality of teaching. Furthermore, through cooperation with enterprises, off-campus internship bases can be established to provide students with more practical opportunities, enriching their practical operation experience.

3.3. Construction and operation of school-enterprise cooperation platforms

School-enterprise cooperation platforms are the key carriers for realizing the "integration of production, education, and research, and joint cultivation of schools and enterprises" model. Firstly, the construction of school-enterprise cooperation platforms should focus on resource sharing and complementary advantages. Schools can utilize enterprises' advanced technologies and equipment to update teaching contents and methods, improving teaching quality; meanwhile, enterprises can leverage schools' research capabilities and talent resources to enhance their technological innovation capabilities and management levels. Through resource sharing and complementary advantages, schools and enterprises can achieve mutual benefits and win-win results, jointly promoting the development of vocational education and industrial upgrading [5].

Secondly, the operation of school-enterprise cooperation platforms should focus on standardization and the long-term effectiveness of mechanisms. To ensure the sustainability and stability of school-enterprise cooperation, schools and enterprises should sign long-term cooperation agreements, clarify rights and obligations, and formulate implementation plans and management systems for cooperation projects. For example, a school-enterprise cooperation committee can be established to coordinate and manage the implementation of cooperation projects. Regular communication mechanisms can be established to promptly address problems encountered during cooperation, ensuring the smooth progress of cooperation projects.

The construction and operation of school-enterprise cooperation platforms should also focus on multi-level and multi-form cooperation. In addition to regular internship and training cooperation, various forms

of cooperation projects can be launched. For example, joint research projects can be conducted to tackle technical problems together, enhancing technological innovation capabilities; academic seminars and technical training sessions can be jointly organized to improve the professional level of teachers and enterprise technical personnel; enterprise-oriented training and customized education can be carried out to meet specific talent demands of enterprises. Through multi-level and multi-form cooperation, cooperation content can be enriched, and cooperation effects can be enhanced.

4. Evaluation and improvement of talent cultivation effectiveness in the "integration of production, teaching, and research, and joint cultivation of schools and enterprises" model

4.1. Construction of talent cultivation effectiveness evaluation system

Constructing a scientific talent cultivation effectiveness evaluation system is a crucial means to ensure the effective implementation of the "integration of production, teaching, and research, and joint cultivation of schools and enterprises" model. Firstly, the evaluation system should include multidimensional evaluation indicators covering aspects such as students' knowledge mastery, skill levels, comprehensive qualities, and professional ethics. Knowledge mastery can be assessed through theoretical exams and course assessments; skill levels can be evaluated through practical operation exams and project practical assessments; while comprehensive qualities and professional ethics can be assessed through comprehensive quality assessments, enterprise evaluations, and alumni tracking surveys. These evaluation indicators should be scientific and operational, reflecting students' actual abilities and qualities comprehensively and accurately.

Secondly, the evaluation system should focus on the combination of process evaluation and result evaluation. Process evaluation mainly includes students' learning performance during their school period, internship performance, and participation in school-enterprise cooperation projects. Result evaluation mainly includes students' graduation thesis, graduation design, employment status, and career development. By combining process evaluation with result evaluation, it is possible to comprehensively understand students' learning outcomes and growth trajectories, timely identify and address problems existing in the teaching process, continuously improve teaching contents and methods, and enhance the quality of talent cultivation [6].

Finally, the evaluation system should introduce a third-party evaluation mechanism. To ensure the objectivity and fairness of the evaluation, third parties such as industry experts, enterprise representatives, and educational evaluation institutions can be invited to participate in the evaluation work. Third-party evaluation can be conducted through on-site inspections, questionnaires, seminars, internship reports, and so on, comprehensively understanding students' actual abilities and qualities, and objectively evaluating the teaching quality and talent cultivation effectiveness of schools. Additionally, third-party evaluation can provide schools with improvement suggestions and guidance, helping schools continuously improve and enhance teaching quality.

4.2. Continuous improvement and innovative development of the model

To maintain the vitality and advancement of the "integration of production, teaching, and research, and joint cultivation of schools and enterprises" model, continuous improvement and innovative development must be carried out. Firstly, continuous improvement should be based on evaluation results and feedback. Through regular evaluation and feedback, problems and shortcomings in the talent cultivation process can be promptly identified, and corresponding improvement measures can be taken. For example, to address issues such as outdated curriculum content and single teaching methods, the latest industry technologies and teaching methods

can be introduced, updating curriculum content and enriching teaching methods. To address issues such as insufficient practical skills and weak employability of students, practical teaching can be strengthened, and additional practical training courses and off-campus internship opportunities can be added to improve students' practical operational abilities and employability.

Secondly, continuous improvement should focus on the construction and development of the teacher team. Teachers are the implementers of the "integration of production, teaching, and research, and joint cultivation of schools and enterprises" model, and their professional qualities and teaching abilities directly affect the effectiveness of talent cultivation. To enhance teachers' professional qualities and teaching abilities, measures such as organizing teacher participation in industry training, academic exchanges, and corporate internships can be implemented to improve teachers' professional levels and practical abilities. Additionally, by introducing enterprise experts and technical backbones as part-time teachers, the practical experience and industry background of the teacher team can be enhanced. Furthermore, establishing a teacher incentive mechanism to encourage teachers to participate in research projects and school-enterprise cooperation projects can enhance their teaching enthusiasm and innovation capabilities.

Finally, continuous improvement should focus on the establishment and operation of innovative mechanisms. To maintain the innovation of the "integration of production, teaching, and research, and joint cultivation of schools and enterprises" model, a school-enterprise cooperation innovation platform can be established to encourage schools and enterprises to jointly carry out research projects and technological innovations. By establishing innovation and entrepreneurship bases, support can be provided for students and teachers to carry out innovation and entrepreneurship practices, cultivating their innovation awareness and entrepreneurship abilities. Additionally, by introducing modern information technology, an online school-enterprise cooperation platform can be established to achieve real-time information sharing and remote cooperation, enhancing cooperation efficiency and effectiveness. By establishing and operating innovative mechanisms, the "integration of production, teaching, and research, and joint cultivation of schools and enterprises" model can be continuously enriched and developed, maintaining its advancement and adaptability.

5. Conclusion

The "integration of production, teaching, and research, and joint cultivation of schools and enterprises" model has significant practical significance in talent cultivation in vocational schools' architectural engineering technology majors. Combining theory with practice and constructing a scientific talent cultivation program can effectively enhance students' professional qualities and practical abilities. Future research should further deepen the school-enterprise cooperation mechanism, explore more diverse cooperation models, and promote the deep integration of vocational education and industry development. At the same time, there is a need to continuously optimize the talent cultivation effectiveness evaluation system, improve teaching quality and effectiveness, and provide solid theoretical and practical support for the development of vocational education.

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