Journal of Education and Educational Research
ISSN: 2957-9465 | Vol. 15, No. 3, 2025

Research on the Reform of Network Operation and Maintenance Courses under the School-Enterprise Cooperation Mode

Mingyu Zhang, Ruihua Shi, Lin Lu

Suzhou Vocational Institute of Industrial Technology, Suzhou Jiangsu, 215104, China

Abstract: By analyzing the connotation of school-enterprise cooperation and the significance of the integration of courses and certificates, this study focuses on the professional literacy, basic knowledge, and skill requirements specified in the Network System Construction and Operation and Maintenance Certificate (Intermediate Level). It conducts a comparative analysis with the curriculum system, curriculum standards, and curriculum structure outlined in the talent training program for the Modern Communication Technology major. Specific measures—including adding new courses, strengthening course content, expanding content scope, and transforming competence—are adopted to optimally adjust the training program, thereby realizing the modularization, structuring, and systematization of the curriculum system. This study promotes the implementation and development of the integration of courses and certificates, aiming to cultivate compound technical and skilled talents that meet the practical needs of enterprises and employers.

Keywords: Network System Construction and Operation and Maintenance; Curriculum Reform; Talent Cultivation.

1. Introduction

School-enterprise cooperation serves as a core model for the in-depth connection between vocational education and industrial development. Its essence lies in breaking down the barriers between education and industry, and achieving the synchronous alignment of talent cultivation in schools with the job demands of enterprises. The integration of the concept of "integration of courses and certificates" further enriches the connotation of school-enterprise cooperation, upgrading it from simple resource complementarity to the construction of a closed loop of "education-certification-employment". [1-5]

From the perspective of core objectives, traditional school-enterprise cooperation tends to focus on superficial cooperation, such as organizing internships, practical training, and teacher exchanges. However, after integrating the concept of courses and certificates, both schools and enterprises need to reconstruct the talent training program around the dual-certificate requirement of "academic certificate and vocational skill level certificate". Specifically, schools adjust the curriculum system in accordance with enterprise job standards, while enterprises integrate job skill certification standards into the teaching process. This collaborative mechanism ensures that students can obtain industry-recognized vocational certificates through practical project experience while acquiring academic qualifications, thereby achieving the training goal of "graduating with certificates and being job-ready with certificates". [6-8]

In terms of implementation approaches, the integration of courses and certificates makes school-enterprise cooperation more targeted. Enterprises are no longer merely providers of internship venues; instead, they deeply participate in key links such as curriculum design and teaching evaluation. For instance, enterprises may send technical backbones to participate in textbook compilation, transforming the latest technical standards into accessible teaching content. On the other hand, schools build simulated training bases according to enterprise certification requirements, enabling students to improve their practical skills in simulated job scenarios and meet the hands-on operation requirements of certificate assessments. This cooperation model not only addresses the disconnection between school teaching and industrial practice but also helps enterprises reserve skilled talents that meet job standards in advance. [7-10]

From the perspective of value orientation, school-enterprise cooperation integrated with courses and certificates places greater emphasis on the "competence-based" educational philosophy. Through the connection between academic certificates and vocational certificates, as well as the mutual recognition of credits, it breaks down the boundary between theoretical learning and skill training. This allows students to consolidate their professional foundation while accurately aligning their capabilities with job requirements during the learning process, ultimately achieving a win-win situation for personal career development and enterprise industrial upgrading. Notably, this orientation also represents a key direction for the high-quality development of modern vocational education. [9-11]

Based on the talent training model of "integration of courses and certificates", this study embeds the content of certificates into professional curriculum teaching by aligning professional curriculum standards with certificate certification units. This practice enables credit mutual recognition and the replacement of course credits with certificates, realizing the unification of professional talent training objectives and vocational job requirements. Following the learning outcome framework and the professional teaching standard system, and combining with the skill standard requirements of the Network System Construction and Operation and Maintenance Vocational Skill Level Certificate (Intermediate Level), the research team revises the talent training program and curriculum standards, adjusts teaching practices, and conducts assessments and the conversion and certification of learning outcomes. In this way, the integration of academic certificates and vocational skill level certificates is achieved, realizing multi-dimensional

integration and constructing a course-certificate integration teaching model centered on vocational competence cultivation. [5-10]

Research surveys indicate that the demand for network application and maintenance positions across the country is on the rise. Especially with the rapid development of 5G networks, there exists a significant talent gap in this field. From the perspective of enterprise recruitment, the demand for higher vocational college students in this sector is relatively high. Based on the actual survey results, the school analyzes job demands and adheres to the talent training philosophy of "integrating education and training, and developing both professional ethics and skills". In accordance with the Ministry of Education's teaching standards for the Modern Communication Technology major and the technical standards of the Network System Construction and Operation and Maintenance Vocational Skill Level Certificate (Intermediate Level), and combining with the actual needs of industries and enterprises, the school sorts out and integrates the knowledge points and skill points contained in the teaching standards and skill level standards. This process forms an application-oriented talent training program that takes the needs of network operation enterprises as the employment orientation, focuses on the vocational competence of key positions, takes typical work tasks as the carrier, uses vocational skill level assessment as the standard, and integrates vocational skill literacy education into the teaching process. [7-11]

This study focuses on the professional literacy, basic knowledge, and skill requirements in the certificate for the Modern Communication Technology major, and conducts a comparative analysis with the curriculum system and curriculum standards in the existing training program. Specific measures—such as adding new courses, strengthening content, supplementing content, expanding content, and transforming competence—are adopted to optimize and adjust the curriculum system, so as to realize the modularization, structuring, and systematization of the curriculum system. By aligning with certification units and integrating and optimizing the professional curriculum structure, a multi-dimensional curriculum module based on "public basic courses + professional basic courses + professional core courses + professional extension courses and practical skill courses" is built. The teaching concept of mutual recognition between vocational qualification certificates and academic certificates is implemented, a curriculum system corresponding to certification certificates is constructed, and a course-certificate integration map is developed.

2. Curriculum Reform Strategies under the Background of Course-Certificate Integration

Vocational skill level certificates ultimately serve vocational positions. Therefore, it is necessary to strengthen school-enterprise cooperation, enhance the construction of teaching teams, integrate existing professional teaching standards with vocational skill level standards, and ensure the seamless connection between certification content and job requirements. In addition, the development of three-dimensional curriculum resources related to certificates is conducive to meeting the diversified learning needs of students and further improving learning effects.

2.1. Improvement of the Diversified Curriculum Evaluation System

Based on the evaluation indicators specified in the curriculum standards—including basic knowledge, basic skills, learning attitude, communication and collaboration, and innovative spirit—the Modern Communication Technology major constructs a diversified curriculum evaluation system. This system abandons the use of a single and narrow standard to measure talent cultivation; instead, it emphasizes the diversification of evaluation subjects, evaluation standards, and evaluation methods.

Diversification of evaluation subjects: Evaluators can be teachers, students, or enterprise tutors. Students are also encouraged to conduct self-evaluation and group mutual evaluation, ensuring that evaluation results reflect a comprehensive perspective.

Diversification of evaluation standards: The standards include students' daily formative evaluation (e.g., class participation, homework completion), summative evaluation of learning outcomes (e.g., final exams, project reports), and evaluation of students' professional quality (e.g., work ethics, teamwork awareness). This helps students identify their advantageous areas in knowledge and skills and achieve better self-development.

Diversification of evaluation methods: A variety of methods are adopted, including theoretical examinations (to assess knowledge mastery), practical operation examinations (to evaluate hands-on skills), and course design reports (to test comprehensive application capabilities). These methods cover a variety of related competence elements, making the curriculum evaluation more occupation-oriented and effective.

2.2. Construction of a Multi-Dimensional Learning Ecology

To fully realize the integration of courses and certificates in vocational education, it is essential to firmly follow the student-centered teaching concept, which places students' learning needs, cognitive rules, and career development demands at the core of educational design. In the context of the digital age, we further leverage information technology as a powerful driving force to promote in-depth classroom teaching reform, breaking the limitations of traditional single - classroom teaching and forming a comprehensive multi - dimensional learning ecology. This ecology integrates three key components: physical classrooms, online courses, and practical innovation classrooms, each playing a unique and complementary role to cater to the diverse learning styles of students—such as visual learning, auditory learning, and hands - on learning—and ultimately significantly improve the overall teaching effect.

Guided by the clear construction idea of "aligning with positions, structuring courses, and granularizing resources", we strictly adhere to the principle of integrating education and training, ensuring that every link of the learning ecology is closely connected to actual job requirements and certificate assessment standards. The research team, composed of professional teachers, enterprise technical experts, and educational technology researchers, conducts in - depth research on industry development trends, job post competencies, and certificate examination content. On this basis, they systematically develop high - quality digital teaching resources that integrate multiple forms: micro -

courses (each focusing on a specific knowledge point or skill operation, with a duration of 5 - 15 minutes to facilitate fragmented learning), virtual simulations (replicating complex workplace scenarios such as equipment maintenance, project operation, and emergency handling, allowing students to practice repeatedly without the constraints of physical conditions), question banks (covering basic knowledge questions, application - oriented questions, and comprehensive case analysis questions that align with certificate exam difficulty levels), and case banks (collecting real enterprise cases, including successful project experiences and typical problem - solving processes, to enhance students' practical thinking abilities).

We make full use of the functions of the online teaching platform—such as resource storage, interactive communication, and data statistics—to carry out "online + offline" blended teaching, which effectively makes up for the inherent shortcomings of traditional teaching models. Traditional teaching often suffers from limited interaction (where teachers dominate the classroom and students passively accept knowledge) and single content delivery (relying mainly on textbooks and blackboard lectures, lacking dynamic and vivid expressions). In the blended teaching mode, the online platform serves as a bridge connecting pre - class, in - class, and post - class learning. Before class, teachers upload pre - recorded micro - courses, preview materials, and simple test questions to the platform, guiding students to conduct independent preview and initially grasp basic knowledge points. During class, teachers focus on explaining key and difficult points, organizing group discussions, and guiding students to use virtual simulation resources for hands - on practice; meanwhile, they can use the platform's real - time interaction function to answer students' questions, conduct on - the - spot quizzes, and adjust teaching progress according to students' feedback. After class, teachers assign targeted assignments through the platform, push extended reading materials and related industry information for knowledge expansion, and provide one - on - one Q&A guidance for students who have difficulties in learning.

This integrated teaching model not only significantly increases the proportion of practical teaching content—allowing students to apply theoretical knowledge to simulated or real workplace scenarios in a timely manner—but also greatly improves the interest of classrooms. The vivid virtual simulations, interactive discussions, and personalized learning paths stimulate students' enthusiasm for learning and initiative. Moreover, it enhances the flexibility of teaching: students can log on to the online platform at any time and anywhere to review course content, complete assignments, or consult teachers, breaking the constraints of time and space and enabling them to learn independently at their own pace. For example, students who master knowledge quickly can advance to more challenging learning content through the platform, while those who need more time to understand can repeatedly watch micro - courses and practice with virtual simulations until they fully grasp the relevant knowledge and skills. This multi - dimensional learning ecology not only lays a solid foundation for the integration of courses and certificates but also cultivates students' autonomous learning abilities and practical operation skills, better preparing them for future career development.

2.3. Construction of High-Quality Teaching Teams

The integration of courses and certificates can only be truly realized with a high-quality teaching team as the fundamental and indispensable prerequisite. To achieve this, we adopt a multi-pronged strategy encompassing special training programs, workshops led by master teachers, industry-university-research collaborative development and innovation initiatives, and enterprise practice training. Through these efforts, we formulate a high-level team construction plan and a comprehensive management system, aiming to build a "double-qualified and double-competent" mixed teaching team that combines academic expertise and practical industry experience. This team serves as a robust human resource foundation, providing unwavering support for the seamless integration of courses and certificates.

In alignment with the technical categories of the certificates, we establish three distinct school-enterprise mixed teaching teams, each with a clear focus. The first is the "5G" technology team, dedicated to the cutting-edge field of fifth-generation communication technology. The second is the network technology team, concentrating on network architecture, operation, and maintenance. The third is the information security technology team, focusing on safeguarding digital assets and systems. These teams undertake targeted tasks such as the construction of curriculum resources tailored to certificate requirements, the development of loose-leaf teaching materials that are flexible and industry-relevant, and in-depth research on topics related to certificate standards and assessment.

Within these teams, teachers from educational institutions and enterprises collaborate with a well-defined division of labor, leveraging their respective advantages. School teachers take the lead in theoretical teaching, curriculum design, and academic research, ensuring that the teaching content is grounded in solid knowledge frameworks. On the other hand, enterprise teachers bring their extensive industry experience to the table, providing guidance on practical operations, adherence to industrial standards, and insights into real-world workplace scenarios. This synergy ensures that students receive a balanced education that combines theoretical depth with practical applicability.

Moreover, we actively encourage all teachers to engage in enterprise practice and specialized training programs. Enterprise practice allows teachers to stay abreast of the latest industry trends, technological advancements, and operational processes, ensuring that their teaching remains relevant and up-to-date. Special training sessions focus on enhancing teachers' abilities in designing and implementing "integrated theory and practice" teaching models, where theoretical concepts are immediately applied in practical exercises, and "modular" teaching, which breaks down complex knowledge into manageable, interconnected modules. These initiatives not only improve the teachers' professional competencies but also foster a dynamic and innovative teaching environment, ultimately benefiting the students' learning experience and preparing them for successful careers in their chosen fields. By continuously investing in the development of our teaching team, we ensure that the integration of courses and certificates is not just a concept but a tangible reality that drives educational excellence and industry relevance.

2.4. Optimization of Teaching Methods and Content Design

In strict accordance with students' learning characteristics, the chapter content is meticulously organized in a progressive manner from simple to complex, forming a coherent knowledge chain that aligns with their cognitive development. Each course project is strategically structured to follow the process of "guidance-discovery-verification-demonstration". In the guidance phase, teachers clearly present project objectives, requirements, and relevant knowledge points to lay a solid foundation. During the discovery phase, students are encouraged to explore problems independently, propose solutions, and engage in collaborative discussions. The verification phase allows them to test their ideas through hands-on practice or simulation, while the demonstration phase provides a platform for showcasing results, exchanging experiences, and receiving feedback. This systematic process ensures a logical and highly efficient learning experience, enabling students to develop both theoretical understanding and practical skills step by step.

Teaching methods are widely recognized as the core of teaching and the key implementation approach for talent cultivation in vocational education. In classroom teaching, we prioritize student-centered methods such as "project-based teaching", "task-driven teaching", and "flipped classroom". In project-based teaching, students tackle real-world projects that mirror actual workplace scenarios, allowing them to apply theoretical knowledge in practical contexts. Task-driven teaching breaks down complex projects into manageable tasks, each with clear goals and deadlines, fostering students' sense of responsibility and time management skills. The flipped classroom model empowers students to learn basic concepts independently before class through pre-recorded videos or online materials, while in-class time is dedicated to in-depth discussions, problem-solving, and skill practice. These innovative methods are supplemented by traditional Q&A sessions, which provide personalized guidance to address individual learning needs, clarify doubts, and cater to diverse learning paces.

Specifically, based on vocational skill level standards, we meticulously select typical enterprise projects that are not only representative of industry practices but also align with the latest technological developments. These projects serve as carriers to organize teaching content, ensuring that the content is highly professional and closely integrated with industry demands. By incorporating real enterprise projects, we effectively bridge the gap between theory and practice, enabling students to understand how theoretical knowledge is applied in actual work situations. Guided by the actual work process, the curriculum content is organized according to the sequence of project implementation, which includes project initiation, planning, execution, monitoring, and closure. This sequence strictly follows students' cognitive and learning rules, allowing them to build knowledge incrementally. Projects are decomposed from simple to complex, starting with basic tasks that focus on individual skills and gradually progressing to comprehensive projects that require teamwork and multi-disciplinary knowledge integration. This decomposition facilitates students' gradual learning and mastery of knowledge, from fundamental concepts to advanced techniques. Simultaneously, as students complete each project phase, they become familiar with the actual work process, including communication with team members, coordination with different departments, and adherence to industry standards and deadlines. This comprehensive approach not only enhances students' professional competencies but also cultivates their workplace literacy, preparing them for successful careers in their respective fields.

3. Conclusion

Practical training is the foundation for improving students' job adaptability and vocational competence. It is not only the most important part of the integration of courses and certificates but also a key link for students to achieve skill-based success. The experience and insights gained from practical training also provide valuable references for the further reform of courses. Notably, practical training courses are closely corresponding to core courses, which is conducive to students' application and consolidation of theoretical knowledge in practice. Based on the integration of courses and certificates, this study revises the talent training program and reconstructs the curriculum system by formulating a course-certificate integration map, optimizing curriculum standards, and filing conversion rules. This practice realizes the in-class integration of academic certificates and the Network System Construction and Operation and Maintenance Vocational Skill Level Certificate (Intermediate Level), and effectively cultivates qualified talents that meet the actual needs of employers.

In the future, the research team will further deepen school-enterprise cooperation, update curriculum content in line with the latest industrial trends (such as the application of 6G technology in network operation and maintenance), and continuously optimize the course-certificate integration model to better serve the high-quality development of vocational education and the talent demand of the network industry.

Acknowledgments

This paper is a research result of the General Project of Philosophy and Social Sciences Research in Jiangsu Universities "Research on Countermeasures to Promote Suzhou Enterprises Active Participation in Industry-Education Integration" (Project No.: 2023SJYB1590) and the Suzhou Vocational Institute of Industrial Technology Curriculum Construction Project (Double High Special Project) (Project No.: 2025SGKC02).

References

[1] Li, S. K., Feng, F. P., & Feng, Y. H. (2012). A Research on the Reform of Practice Teaching Mode Related to Major Cluster of Port and Channel Engineering in Vocational Colleges—Taking Nantong Vocational & Technical Shipping College as an Example. Journal of Nantong Vocational & Technical Shipping College.

[2] Mu, H., & Cui, Y. (2019). Discussion on the Development of School-Enterprise Cooperation under the Practice Teaching of Design Major of Colleges and Universities. In Proceedings of the 2019 3rd International Conference on Education, Economics and Management Research (ICEEMR 2019). https://doi.org/10.2991/assehr.k.191221.141.

[3] Zhang, C., & Shao, T. (2023). Conduction Current in Nanosecond-Pulse Diffuse Discharges at Atmospheric Pressure. Springer Singapore. https://doi.org/10.1007/978-981-99-1141-7_18.

[4] Zhao, Y., Yang, Y., & Liu, H. (2019). Research on the Problems and Countermeasures of College-Enterprise Cooperation in Higher Vocational Colleges Under the Background of Big Data. https://doi.org/ 10.1109/ ICVRIS. 2019.00040.

[5] Xu, M. (2011). The Practice and Research on the Win-Win School-Enterprise Cooperation Mode Linked by Assets. In Proceedings of the International Network on Innovative Apprenticeship International Conference. Foreign Language Teaching and Research Press.

[6] Tang, W. L., & Yang, L. P. (2010). Discussion on the Pattern of Enterprise-University-Research Cooperation under the Spiral Software Talents Training Mode. Experimental Technology and Management.

[7] Zhou, L. Research on Teaching Reform Model of Purchasing and Supply Management Course under the Vision of School-Enterprise Cooperation. [Unpublished conference proceeding].

[8] Sun, X. (2017). On the Reform of Introduction to Computer Science under the Mode of School-Enterprise Cooperation. https://doi.org/10.2991/CETCU-17.2017.66.

[9] Yan, H., & Yin, Q. (2021). Research on the School-Enterprise Cooperation Training Mode of Big Data Professional Engineering and Technical Talents. In Proceedings of the 2021 1st International Conference on Control and Intelligent Robotics. https://doi.org/10.1145/3473714.3473841.

[10] Tian, D., & Wang, T. (2021). Research on Teaching Reform of Operating System Course under the Mode of School-Enterprise Coordination and Education. [Unpublished journal article].

[11] Hu, X., Tan, A., & Gao, Y. (2022). The Construction of the Development Mode of School-Enterprise Cooperation in Higher Vocational Education with the Aid of Sensitive Neural Network. Wireless Communications & Mobile Computing, 2022. https://doi.org/10.1155/2022/6323872.