Construction and Practical Exploration of the "Position-Course-Competition-Certificate" Education Model based on OBE Concept - A Case Study of Electronic Information Majors at Shanwei Institute of Technology

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Abstract: To address the disconnection between traditional vocational education systems and rapidly evolving industrial demands, this paper constructs an education model based on the OBE Outcome-based Education concept, termed the "Position-Course-Competition-Certificate" framework. Starting from the logical foundation of occupational competency requirements, the model employs a reverse-design approach to define talent cultivation objectives. It establishes a modular curriculum system that integrates "position-course alignment," "competition-course synergy," and "certificate-course embedding," alongside a three-chain collaborative model ("objective chain-curriculum chain-evaluation chain") and a dual-loop dynamic feedback mechanism (internal and external cycles). Practical implementation demonstrates that this model, through collaborative curriculum development with enterprises, joint construction of practical platforms, and dual-qualified faculty development, significantly enhances students' job adaptability. The framework provides a replicable pathway for improving the quality of talent cultivation in vocational colleges, offering actionable insights for bridging education and industry needs.

Keywords: OBE Concept (Outcome-Based Education); Vocational Education; Position-Course-Competition-Certificate; Education Model; Electronic Information Majors

1. Introduction

In recent years, vocational education has been positioned as a key pillar of the national education system in our country. In 2023, The General Office of the State Council jointly issued the "Opinions on Deepening the Reform of Modern Vocational Education", further emphasizing that vocational education should be guided by the principle of "serving development and promoting employment", and promote quality improvement through top-level design and institutional innovation [1]. In this context, graduates from higher vocational colleges who possess both academic qualifications and skill certificates are more competitive in the job market. Therefore, this article addresses the issue of disconnection between traditional education models and industry needs by proposing a four-dimensional integration path based on the OBE (Outcomes-Based Education) concept, integrating 'job-course-competition-certification' into the education system. Through empirical research on the electronic information major at Shanwei Vocational and Technical College, the article systematically integrates the OBE concept into the 'job-course-competition-certification' education system, forming a closed-loop quality assurance mechanism, and verifies its significant effectiveness in enhancing teaching quality and talent cultivation.

2. The Present Situation and Problems of Cultivating Talents in Electronic Information Majors in Higher Vocational Colleges

2.1 Lagging Talent Training Mode and Technology Iteration

As China's emerging industries, such as artificial intelligence and intelligent manufacturing, are booming, higher demands are placed on technical and skilled personnel. However, there is a noticeable disconnect between the traditional vocational education system and the rapidly evolving industrial needs, particularly evident in vocational colleges in less developed regions. On one hand, some institutions adhere to the traditional' 2.5+0.5' training model, which is based on the cyclical design of traditional manufacturing and fails to align with the 3-6 month technical iteration cycle of the electronics information industry, leading to a mismatch between the academic structure and the industrial pace. On the other hand, there is a significant gap between the practical training system and the latest industrial technologies, with equipment often being outdated upon arrival at school. For instance, the SMT (Surface Mount Technology) machines purchased by schools are still equipped with mechanical vision systems, while the industry has already adopted AI vision inspection technology. This mismatch between the talent training model and the pace of technological advancement ultimately results in a paradox where companies face labor shortages while students struggle to find employment.

2.2 The Curriculum System is not Suitable for Industrial Demand

As a typical technology-intensive sector, the electronic information industry is experiencing deep integration of technologies such as 5G communication, the Internet of Things (IoT), and artificial intelligence. However, the curriculum systems of most vocational colleges still follow traditional structures, lagging behind the rapid technological advancements in the industry [2]. This is evident in three main areas: First, core course content is seriously outdated, with most institutions focusing on analog circuits and discrete components, while cutting-edge topics like SMT assembly, FPGA development, and intelligent sensing technology are often absent. Second, there is redundancy and repetition in the course structure, with traditional courses such as electronic circuit technology and electronic technology having high repetition rates and primarily consisting of verification experiments, lacking project-based teaching designs based on intelligent production lines. This structural contradiction leads to multiple educational challenges: the lack of core cutting-edge content and the homogenization of courses limit students 'innovative thinking. More concerning is that while some institutions have introduced the' 1+X 'certificate system, the assessment standards for these certificates have not been effectively integrated with the school-based curriculum, leading to a' course-sequence separation' phenomenon, which further undermines the job adaptability of talent cultivation. This systemic lag has become a critical bottleneck hindering the high-quality development of electronic information majors.

2.3 The Cooperation Between Universities and Enterprises is not Deep Enough

The integration of industry and education and school-enterprise cooperation in higher vocational education plays an important role in promoting regional economic development and the training of technical skills, but it still faces multiple structural contradictions in the actual promotion process, which is particularly significant in less developed areas. Specifically, the challenges are mainly reflected in the following two aspects:

Firstly, the imbalance in regional industrial structures leads to a lack of intrinsic motivation for school-enterprise cooperation. In less developed regions, limited by economic development and resource endowments, the industrial structure is predominantly traditional manufacturing, agriculture, or low-value-added services, with a low proportion of high-tech industries. For instance, in Shanwei City, emerging industries such as electronics and intelligent manufacturing have not yet achieved significant scale. This industrial structure results in a demand for vocational college graduates that tends to be 'low-end,' with many positions concentrated in basic technical roles like operators and junior technicians. There is a limited demand for high-quality technical talents with digital skills and the ability to adapt to intelligent production lines. This supply-demand mismatch often confines school-enterprise cooperation to superficial on-the-job internships, making it difficult to achieve deep collaboration in areas such as technology research and development and curriculum co-construction.

Secondly, the diverse interests of multiple stakeholders have led to an imbalance in participation, characterized by 'schools being enthusiastic while enterprises are indifferent.' The essence of school-enterprise cooperation is the clash between educational and market logics. Enterprises in less developed regions often face survival pressures and resource constraints, significantly reducing their willingness to participate in the education chain. This imbalance is evident in three aspects: Firstly, the cost-benefit ratio is imbalanced, which constrains enterprises 'willingness to invest. A survey of over 10 manufacturing companies in Guangdong Province found that 73% of these companies believe that school-enterprise cooperation involves significant costs, such as equipment wear and mentor salaries. However, issues like the long cycle for technology transfer and low student retention rates weaken the expected benefits of cooperation, leading enterprises to prefer low-risk models like' order classes. 'Secondly, there are institutional barriers to cross-regional cooperation. To improve the quality of cooperation, institutions in less developed regions often seek connections with leading enterprises in the Pearl River Delta, Yangtze River Delta, and other areas. However, they face high coordination costs due to spatial distance and resource flow blockages caused by local protectionism. Lastly, the precision of policy incentives is insufficient. Current tax reduction and subsidy policies primarily target local enterprises, and the application process is cumbersome, failing to effectively stimulate the enthusiasm of enterprises, especially those in cross-regional cooperation. This' policy disconnection' phenomenon means that school-enterprise cooperation often relies on the social responsibility of individual enterprises, making it difficult to form a sustainable cooperative ecosystem.

3. The Connotation of the Comprehensive Education Mode of "Post, Course, Competition and Certificate" under the OBE Concept

The 'Position-Course-Competition-Certificate' model is a collaborative education approach in vocational education that focuses on job requirements, centers on the curriculum system, is driven by skills competitions, and evaluates through professional certificates. In this model, the 'course' serves as a hub, using modular courses to transform job standards, competition standards, and certificate standards into teaching content [3]. OBE (Outcome-Based Education) is an educational theory based on learning outcomes. This concept has been widely applied in curriculum reform in recent years, advocating a student-centered approach with teacher support. It emphasizes that students should achieve corresponding learning outcomes throughout the teaching process, with a focus on developing their autonomous learning skills. The 'Position-Course-Competition-Certificate' comprehensive education model, grounded in the OBE philosophy, integrates this philosophy systematically into the 'Position-Course-Competition-Certificate' system. The job standards, competition standards, and certificate standards serve as the primary basis for course content and curriculum systems. The 'position,' 'competition,' and 'certificate' are seen as the outcomes of the 'course' learning process, and they are used to evaluate the effectiveness of the 'course.' This forms a closed-loop quality assurance mechanism characterized by demand-driven, capability progression, and industry-education collaboration, creating a three-chain collaborative education model of 'goal chain-course chain-evaluation chain.' As illustrated in Figure 1, the essence of this model is reflected in the following points:

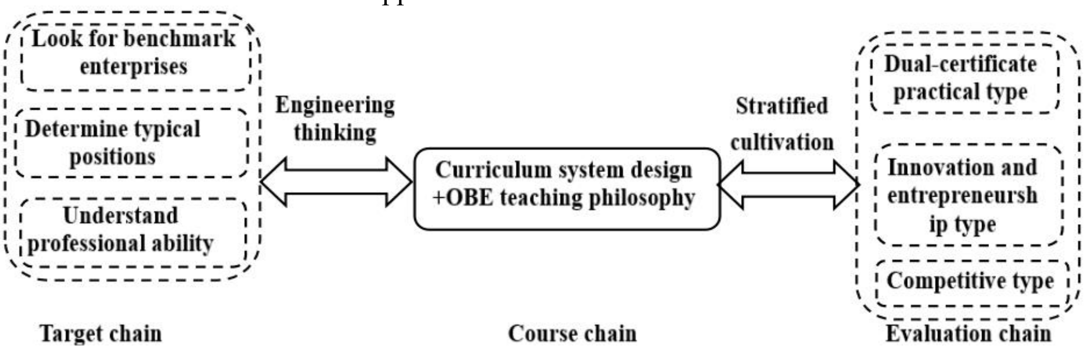

Figure 1. Schematic Diagram of the Three-Chain Synergistic Model

First, the logical starting point is the job requirements. Based on the industry's job competency standards (positions), the training objectives are designed in reverse to ensure that the teaching content aligns directly with the current industry needs. For example, through enterprise research and job analysis, emerging skill requirements such as intelligent terminal debugging and embedded development are identified and transformed into course objectives.

Second, the curriculum system serves as a hub for integration. As the core carrier, courses are restructured through 'job-course alignment' to modularize teaching content (for example, transforming real-world projects from enterprises into teaching cases). Through 'competition-course integration,' competition technical regulations are integrated into practical teaching (such as using the questions from electronic design competitions as practical tasks). Through 'certificate-course integration,' the standards for vocational certificate assessments are embedded in course evaluations (for example, the '1+X' certificate requirements directly correspond to course assessments).

The third approach is to use competitions and certificates as a means of capability verification. Skill competitions and professional certificates serve as dual tools for assessing outcomes. Firstly, competitions drive innovation by stimulating students 'practical and innovative abilities through academic contests (such as the Guangdong Province Vocational Skills Competition), thereby enhancing their ability to tackle complex problems. Secondly, the effectiveness of course instruction is validated through quantitative indicators such as the pass rate of' 1+X 'certificates and enterprise certifications, ensuring that students' skills align with industry standards.

Fourth, collaboration between schools and enterprises and the empowerment of dual-qualified teachers. By jointly building practical platforms, pairing teachers with enterprise mentors, and facilitating resource sharing (such as bringing enterprise equipment into schools and providing customized talent training), this approach breaks down traditional educational barriers, creating an integrated ecosystem for industry-education integration that encompasses teaching, learning, doing, and evaluation.

4. Construction of the Framework of the Comprehensive Education System based on OBE Concept of "Position, Course, Competition and Certificate"

4.1 General Idea

The construction of the 'position-course-competition-certification' comprehensive education system, based on the OBE philosophy, follows the principles of 'outcome-oriented, reverse design, and multidimensional collaboration.' Firstly, it starts from the logical foundation of industry job competency requirements, aligning with the standards of vocational skills competitions and the requirements of professional qualification certificates. It then reverses to derive talent cultivation goals, clearly defining core capability indicators such as knowledge, skills, and literacy. Secondly, it constructs a 'four-dimensional integration' course system: by 'position-course alignment,' modular course content is restructured, transforming typical job tasks into teaching projects; through 'competition-course integration,' competition technical regulations are integrated into practical teaching to enhance innovation capabilities; and through 'certification-course combination,' professional qualification standards are embedded in course assessments to ensure that learning outcomes can be verified [4]. Additionally, a dynamic adjustment mechanism is established, leveraging the school-enterprise collaboration platform to timely incorporate new technologies and norms, forming a closed-loop operation model of 'demand analysis-goal setting-course development-teaching implementation-evaluation feedback.' Finally, a diversified evaluation system is constructed, verifying the effectiveness of education through multiple dimensions such as process evaluation, competition results, certificate acquisition, and enterprise feedback, forming an 'ability progression, industry-education linkage, closed-loop optimization' education ecosystem, ultimately achieving precise alignment between students' professional abilities and industry needs.

4.2 Talent Training Revision Path

To address the shortcomings in traditional talent cultivation, efforts have been made to construct and implement a four-dimensional integrated talent development model based on the OBE philosophy, focusing on the construction of a course system. Building on the traditional '2.5+0.5' talent cultivation model, an innovative '2+0.5+0.5' model has been proposed. Under this model, students spend two years at school, starting their fifth semester in a cooperative enterprise for specialized and directional learning, followed by a sixth semester dedicated to on-the-job training. This innovative talent cultivation model primarily aims to address the issue of lagging behind in technical iteration within the talent cultivation model,

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The construction of the 'position-course-competition-certificate' integrated talent cultivation system based on OBE theory involves analyzing the talent development plan through the integration of 'position-course-competition-certificate'. Firstly, it involves revising the talent development plan by aligning with the job requirements of the electronic information engineering technology major, benchmarking against national occupational competency standards, '1+X' certificates and vocational qualification certificates, and relevant professional competitions. This revision adheres to the principles of OBE education, ensuring that the revised talent development plan clearly defines specific outcome indicators for achieving its goals. Secondly, in the design of course teaching, the OBE project-based teaching theory should be applied to the design and organization of teaching, especially for professional courses, where obtaining the corresponding certificate serves as a learning outcome, forming a closed-loop quality assurance mechanism. The 'position-course-competition-certificate' talent cultivation relationship diagram based on the OBE concept is illustrated in Figure 2.

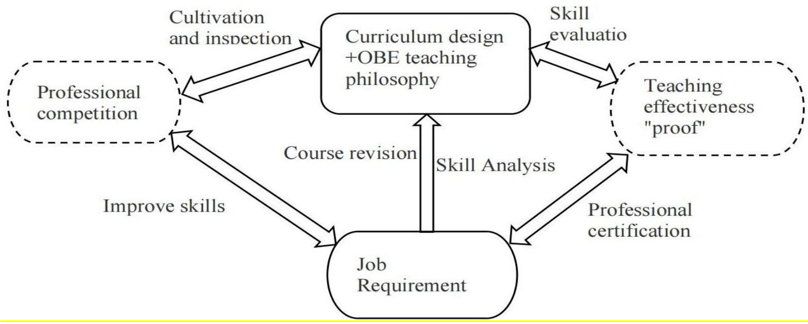

Figure 2. Shows the Relationship between "Post, Course, Competition and Certificate" Talent Training based on OBE Concept

4.3 Construction of Curriculum System

The course system design refers to the systematic arrangement of courses and their structure designed by schools to achieve specific educational goals. The sequence of courses directly influences the order in which students learn them. The design of the course system reflects the talent cultivation goals, which serve as the primary basis for the course system, with both aspects being mutually reinforcing. To better meet social and vocational skill demands and boost students 'employment confidence, adjustments have been made to the existing courses. These adjustments include changing the learning sequence, content, and integrating new technologies into the curriculum. The course content now includes the assessment points required for professional skill level certificates and' 1+X 'certificates in electronic information majors, with the course standards revised to align with these certification requirements. Additionally, courses that meet new technology requirements have been introduced in response to certification and skill level requirements. This approach not only enhances students' skill levels and employment capabilities but also, guided by the OBE educational philosophy, makes it easier for students to obtain the necessary certificates. The course system architecture for this major is illustrated in Figure 3.

The curriculum for electronic information majors is primarily divided into four main components: public foundation courses, professional foundation courses, core professional courses, and 'professional + direction' courses. The first three semesters are crucial for developing students 'ideological and political commitment, moral and technical skills, and a solid professional foundation. Therefore, ideological and political courses and other public foundation courses are offered in the first three semesters. Professional foundation courses, such as microcontroller application technology and electronic circuit CAD design, are introduced in the second and third semesters. In recent years, based on the OBE teaching philosophy, course design has been added to professional foundation courses like analog electronic technology and electronic CAD technology, and some students are encouraged to participate in professional competitions like the' Lanqiao Cup 'to assess their learning outcomes. In the fourth semester, students focus on core professional courses, including sensor application technology, embedded application technology, and advanced courses in new technology application development. During this semester, students can participate in professional competitions such as the

Guangdong Province Vocational Skills Competition for intelligent electronic product design and development, the' Challenge Cup 'College Students' Extracurricular Academic Science and Technology Works Competition, and the Guangdong Province Electronic Design Competition. In the fifth semester, 'professional + direction' courses are offered, such as embedded edge computing software and hardware development for the 1+X certification in intelligent hardware application development, and mobile phone principles and repair, WeChat mini-program development, and other 1+X certification courses. In the sixth semester, students complete their on-the-job internships and graduation project designs. The whole curriculum framework is closely based on the "position, course, competition and certificate" talent training design based on the OBE concept, and the talent training goal is clear.

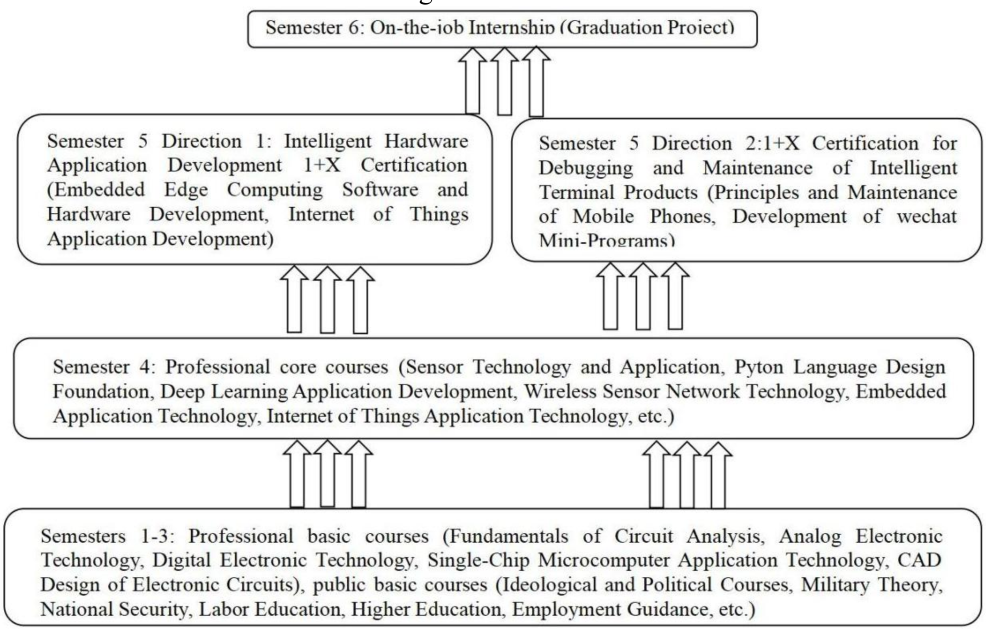

Figure 3. Course System Architecture

5. Implementation Path of "Post-Course-Competition-Certificate" Curriculum System based on OBE Concept

The implementation of the 'position-course-competition-certificate' comprehensive education system, based on the OBE philosophy, should focus on outcome-oriented education. This can be achieved through collaboration between schools and enterprises, optimizing faculty resources, and restructuring courses to ensure a precise alignment between talent development and industry needs. The following discussion will focus on three aspects: school-enterprise cooperation, faculty development, and curriculum system revision.

5.1 Build an Ecological Environment for Industry and Education Integration

5.1.1 Jointly Formulate Talent Training Programs

To address the challenges of diverse student backgrounds and varied talent needs, Shanwei Vocational and Technical College focuses on building professional clusters. It aligns closely with emerging industries such as smart terminals and optoelectronic displays, collaborating deeply with world-renowned companies like TCL Technology Group. Together, they are reconstructing the talent development system by integrating real job competency standards from enterprises into course content and introducing real-world projects into classroom teaching. Firstly, both parties jointly develop a 'job-course-competition-certificate' integrated course module. Considering the characteristics of vocational college students, such as a single knowledge structure, a lack of R&D skills, and strong practical abilities, they have identified typical positions, such as smart terminal product debugging and maintenance engineers. Secondly, they co-develop a '1+X' smart terminal product debugging and maintenance practical training course. They collaborate with enterprise mentors to discuss the job tasks, and develop the course standards, teaching content, and practical training manuals for the '1+X' smart terminal product debugging and maintenance practical training course.

5.1.2 Joint Construction of Practical Teaching and Competition Platform

By integrating real enterprise projects and competition resources, the school has established an integrated platform of 'teaching-practice-competition.' It uses subject competitions as a key tool for developing practical skills and transforms enterprise projects into teaching cases. Since 2021, the school has successfully hosted four Science and Technology Culture Festivals and co-organized professional competitions such as the Intelligent Electronic Design Competition and the Electronic Welding Competition with McQuay, an industry college. The participation rate of students in these competitions is 80% of the total student body, effectively integrating enterprise technology into course practices and enhancing students' practical skills.

5.1.3 Sharing of Resources and Teachers

The company provides technical equipment, internship positions, and real-world projects, while the school supplies customized talents to meet the needs of enterprises. The school hires enterprise mentors to collaborate with teachers in developing courses and virtual simulation programs, achieving 'joint research and sharing of resources.' Enterprise mentors and in-school teachers jointly teach, forming a 'dual mentor system' that aligns teaching with industry trends.

5.2 Improve the Ability of Teaching and Industry Connection`

Encourage teachers to actively engage in corporate practices, accumulate industry experience, and integrate real-world safety into course design to enhance the authenticity of teaching content. Teachers should also participate in technology research and development to ensure that teaching content is updated in line with industry advancements. Through collaboration between school and enterprise research teams, jointly develop curriculum standards and teaching resources, aligning with vocational skills competitions and the '1+X' certificate standards. This will help reconstruct teaching content and establish a dynamically updated curriculum framework. Enterprise mentors should be involved in the review of course designs to ensure that teaching projects closely match the needs of enterprises.

Since 2021, Shanwei Vocational and Technical College has introduced a '1+X' certificate system pilot program for the electronic information major, focusing on the debugging and maintenance of intelligent terminal products. The college has implemented a 'dual-teacher empowerment' plan, offering specialized training for teacher evaluators. Teachers from relevant majors have participated in the '1+X' Intelligent Terminal Product Debugging and Maintenance Teacher Training Program organized by TCL Human Resources Service Co., Ltd., as well as the Guangdong Province Vocational Skills Level Recognition Evaluation Training Program organized by the Guangdong Labor Association. To date, 22 teachers have completed the training, and 39 have received the 'dual-teacher' certification from Guangdong Province, achieving an 80% 'dual-teacher' certification rate.

5.3 Deep Integration of "Job, Course, Competition and Certificate"

5.3.1 Reverse Design Course Objectives

Based on the job competency requirements, competition examination points, and certificate standards, the course objectives are derived in reverse. Through enterprise research and job recruitment data analysis, combined with the questions from provincial skills competitions and the '1+X' certificate standards, common competency points are distilled as the core goals of the course, forming a four-dimensional learning outcome matrix that integrates 'job, course, competition, and certificate.' For example, in the foundational course 'Embedded Application Technology' of the school's electronic information major, new technologies in embedded edge computing software and hardware development have been integrated into the electronic information major curriculum.

5.3.2 Modular Curriculum Reconstruction

Transform the course content into project-based and task-oriented modules, integrating the use of simulation tools like Multisim and Proteus to enhance students 'circuit design and debugging skills [5]. By designing modular and situational teaching tasks through project-based learning, improve students' circuit analysis and design capabilities, thereby fostering their practical and problem-solving skills. The teaching design involves project design, task decomposition, and situational creation. Through job analysis and vocational ability analysis, projects are broken down into multiple sub-tasks, each corresponding to specific knowledge points and skill points, ensuring that students can gradually master the relevant skills. Practical work tasks, such as virtual simulation and physical circuit design and debugging, are transformed into teaching projects, with a complete process from requirement analysis to scheme design, implementation, and testing integrated into the teaching content. The OBE-based teaching implementation process changes the traditional lecture-based theoretical teaching model. Students clearly understand their learning goals and specific tasks, transforming from passive to active in class, actively tackling each task one by one. The OBE-based teaching model is illustrated in Figure 4.

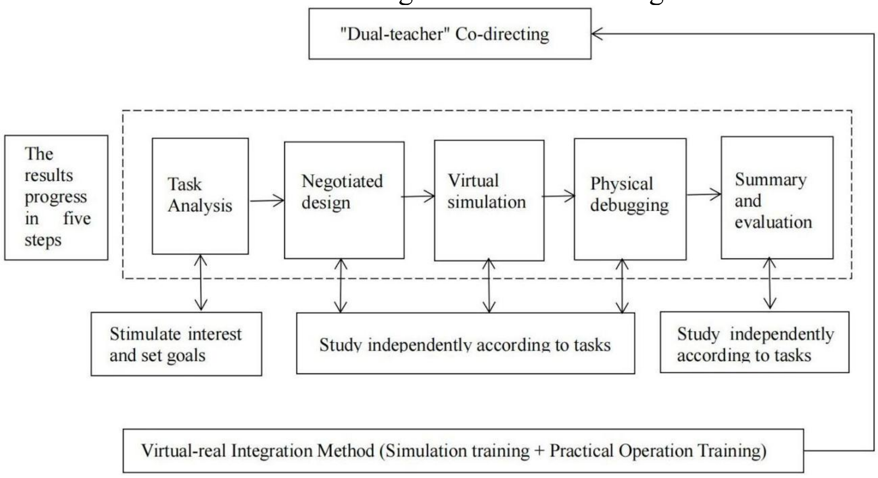

Figure 4. A Teaching Model based on OBE

5.3.3 Establish a Feedback Mechanism for "Double Circulation Inside and Outside"

Internal feedback refers to the real-time feedback that focuses on the teaching process and learning outcomes, using a variety of evaluation methods (process evaluation) and information technology tools to dynamically adjust teaching strategies. The process evaluation system spans the entire course cycle, covering classroom performance and course design. The entire assessment and evaluation process is recorded through the Chaoxing Learning Platform, allowing teachers to monitor students' learning progress in real time and adjust teaching priorities accordingly.

The external cycle involves using a school-enterprise collaborative feedback mechanism to convert industry technology trends and changes in job skills into data for curriculum updates. The pass rate of vocational qualification exams and competition win rates are used as key indicators of course quality, which in turn drives the alignment of teaching standards with industry standards. For example, in the school's electronic information program, the assessment requirements for the' 1+X Intelligent Terminal Product Debugging and Repair Certificate 'are broken down into specific course knowledge points. Each year, the pass rate data is analyzed to identify teaching weaknesses, and targeted improvements are made to the practical training components. For instance, in the first year, the pass rate for the certification exam was only 86.78%. The main reason was that students were not proficient in repairing, disassembling, soldering, and pasting on smartphones. Therefore, the practical training course on' Intelligent Terminal Product Debugging and Repair' included more hours dedicated to disassembling, soldering, and pasting. As a result, the pass rate in the second year increased to 88.24%.

The core of the "dual circulation" feedback mechanism is to dynamically link industrial needs, teaching processes, and learning outcomes, driving the continuous evolution of the curriculum system through data-driven approaches. Only by establishing an open, collaborative, and intelligent feedback system can we ensure that the "job-course-competition-certificate" curriculum system remains in sync with the latest industry trends.

6. Conclusion

This study, based on the OBE philosophy, has developed a comprehensive talent cultivation model of 'job-course-competition-certificate.' By deeply integrating job demand orientation, curriculum system restructuring, competition-driven approaches, and certificate evaluation, this model effectively addresses the issue of traditional vocational education being out of sync with industry needs. The practical experience of the electronic information major at Shanwei Vocational and Technical College demonstrates that this model, supported by school-enterprise collaboration and guided by 'reverse design and dynamic feedback,' has formed a closed-loop talent cultivation ecosystem of 'goal chain-course chain-evaluation chain.' This has significantly enhanced students 'vocational skills, increased their participation in competitions, and boosted their acquisition of vocational certificates, achieving a precise alignment between talent cultivation and industry needs. Through the construction of' dual-qualified 'faculty, the integration of real enterprise projects into teaching, and the' internal and external dual circulation' feedback mechanism, the curriculum system has been continuously optimized, providing an operational model for higher vocational colleges to deepen the integration of industry and education. In the future, it is necessary to further expand the scope of school-enterprise cooperation, strengthen cross-regional resource integration, promote the rapid integration of new technologies into teaching, and explore the application of intelligent evaluation tools to meet the higher demands of industrial upgrading, thereby injecting sustained momentum into the high-quality development of vocational education.

Acknowledgement

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