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Reform and Practice of Industrial Internet Configuration Modeling Course Based on OBE Concept

Junda Huang
Wenzhou Polytechnic, Wenzhou 325000, China

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Abstract

The concept of Outcome-Based Education (OBE) emphasizes students' learning outcomes, and the curriculum system and teaching process are designed through reverse thinking. Based on the teaching practice of the Industrial Internet Con-figuration Modeling course, this paper studies how to improve students' engi-neering practice ability and professional quality by reconstructing curriculum objectives, optimizing teaching content, innovating teaching mode and refining evaluation system from three dimensions of OBE concept: goal orientation, re-verse design and continuous improvement. Practice shows that the curriculum reform based on OBE concept effectively promotes the coordinated develop-ment of students' knowledge, ability and quality, and provides experience for similar curriculum construction.

Keywords

OBE Concept; Industrial Internet; Configuration Modeling; Curriculum Reform; Engineering Practice Ability

1. Introduction

Industrial Internet Configuration Modeling is a core course, which aims to train students to master the engineering application ability of industrial configuration software, and have the development and debugging skills of configuration control system in industrial Internet scenario. However, there are the following problems in traditional curriculum teaching. Firstly, the course objectives is not closely match the needs of the enterprise, which is difficult for students to form a complete engineering mindset. Secondly, most project training focuses on single functions, making students lack comprehensive application capabilities in complex industrial scenarios. Thirdly, the traditional evaluation system based on the final examination is insufficient, ignoring the evaluation of learning process, teamwork, problem solving and other abilities.

The OBE concept emphasizes reverse design and forward implementation [1]. Training objectives are made according to industry needs, and curriculum content and teaching activities are designed and improved continuously to achieve these objectives [2]. This paper studies the curriculum reform based on OBE concept to improve teaching quality meeting industrial needs.

2. Curriculum Reform Design

2.1. Reconstruct Curriculum Objectives

The primary task of OBE is to clearly define students' learning outcomes. The curriculum team analyzes the ability requirements of talents in the field of industrial Internet in the curriculum standards. This analysis is combined with the talent training plan and the actual needs of the industrial Internet engineering and technical personnel positions [3]. A new outcome indicators system is constructed from the three dimensions of knowledge, ability and quality.

For knowledge objectives, students are required to master core technologies such as the system composition, data object definition, animation configuration, and code programming. Meanwhile, students should be familiar with the operation processes and engineering specifications of industrial configuration software. The corresponding course contents include water level control system, manipulator control system, and other comprehensive practical projects.

For ability objectives, students should be capable of designing the configuration system according to industrial requirements, and be able to solve practical problems by debugging and analyzing operating data. In the course, contents such as system joint debugging and troubleshooting in project practical training contribute to achieving these ability objectives.

For quality objectives, students should have rigorous spirit and teamwork ability, and abide by the industry standards and develop safe and standardized operating habits. To realize these quality objectives, the course organizes group cooperation practice in projects and emphasizing engineering specifications such as authority settings and safety mechanisms during practical training.

2.2. Reorganize Teaching Content

Traditional curricula content are often divided by software functional modules, making it hard for students to build a complete engineering cognition. Based on OBE concept, the tasks are broken down into smaller parts and connect each task result to course objectives. The course is reorganized into three progressive modules, which are basic skill training module, comprehensive project practice module, and innovative expansion module.

For basic skill training module, using typical cases such as water level control system as example, knowledge objectives are broken down into specific tasks. In the system design task, sub-tasks such as interface design, data object definition, animation connection, alarm setting and curve output, enable students to master core skills including object setup, animation configuration, and code programming. Meanwhile, engineering specifications such as safety mechanisms and permission management are integrated into these tasks, corresponding to the knowledge and quality objectives.

For comprehensive project practice module, comprehensive projects such as manipulator control system, automatic spraying system, and object sorting system are introduced. Each project covers the full process of requirements analysis, scheme design, system development, and system optimization. For example, manipulator control system requires students to complete interface configuration, animation design, and code programming with team collaboration. Through simulation debugging to verify system functions, students can develop system integration capabilities and practical problem-solving abilities, which correspond to the course's ability and quality objectives.

For innovative expansion module, by integrating cloud configuration project comprehensive practice, students are guided to compare the operational logic differences between different configuration software, such as the interaction logic, as well as the specific features of cloud configuration. Students are encouraged to attempt personalized function development in projects, such as implementing cloud data storage, which develops innovative thinking and technical exploration capabilities.

2.3. Innovate Teaching Model

Guided by the OBE concept, the course adopts a student-centered approach, emphasizes learning by doing, and establishes an integrated teaching system that combines case-driven instruction, project-based training, and progression development [4][5]. Teaching activities are designed to achieve outcomes, and focus on deep integration of teaching, learning and practice. Through importing real industrial scenario, separate phased task, and comprehensive practice, it helps students build knowledge systems and application abilities.

The course firstly activates learning objectives through real industrial scenarios such as factory water tank level monitoring and object sorting in automated production lines. Videos and animations are used to show project requirements clearly, guiding students to analyze what needs to be done and how to achieve it.

The course uses five-stage teaching methods, including scenario introduction, case demonstration, project practice, after-class exercises, and skill exploration. The course sets outcome-oriented tasks in each unit. Take the animation configuration session as an example: the specific implementation steps of a water tank level movement animation are demonstrated in class, and students follow and practice operation in class, and solid their skills through after-class exercises. In comprehensive projects, students are required to independently design complex animations such as the spraying motor movement, and complete the ability progression from imitation to innovation.

Due to difference of students, practical tasks are divided into mandatory and optional items to balance basic skill development and innovative exploration. For example, basic tasks of code programming focus on conditional statements usage to meet basic ability requirements, while optional tasks encourage complex logic such as loop control and function calls to improve programming skills. Meanwhile, a group collaboration model with three students per team is also adopted. Members are responsible for the entire project process, including requirements analysis, interface design, code programming, debugging, and reporting. This allows students to develop communication and coordination skills in real project, and enhance both professional competencies and soft skills.

3. Teaching Implementation and Evaluation Reform

3.1. Teaching Resource Construction

Based on the recommended textbook Configuration Control Technology and Applications, specific training manual has been made including local real production line cases. The course has developed supporting digital resources such as videos, operation demonstration animations, and troubleshooting guides for preview and review.

The course training room has prepared touch screens, simulation platforms, and cloud configuration servers, which provides a real engineering environment for students. Students are available to the training room to complete exploration tasks after class.

3.2. Formative Evaluation

The OBE concept requires the establishment of an evaluation system combining formative evaluation and summative evaluation to comprehensively track the achievement of students [6]. The formative evaluation accounts for 60% of the total evaluation. The evaluation methods include project training report, project practice and group report. The assessment focuses on operation standardization, problem solving ability, teamwork performance and learning attitude. The summative evaluation of this course accounts for 40% of the total evaluation. The evaluation methods include four phased tests and one final comprehensive project examination including knowledge mastery, system development completeness, function debugging effect, and document specifications.

For example, in the practical training of the water level control system project, the formative evaluation focuses on whether the students can correctly set the attributes of data object, reasonably arrange the monitoring interface, and standardize the code comments. However, the summative evaluation is to assess whether the system realizes the functions of water level control and historical data display, and whether the students can clearly explain the design ideas.

3.3. Continuous Improvement

At the end of each semester, the curriculum is adjust after collecting student feedback, enterprise tutor interviews, and student work analysis [7]. For example, to solve students' difficulty in programming complex code, a special section on modular code design is added and a common code library is provided for reference. To strengthen cloud platform training, additional tasks like cloud data upload and remote monitoring are added in comprehensive practice.

4. Reform Achievements and Reflections

4.1. Preliminary Achievement

A comparative analysis of two classes shows an increase in project practical training completion rates from 75% to 92%. In the competitions, the success rate of students who participated in this course's training has increased by 30%. Feedback from enterprises indicates that students' adaptation period in configuration system development has been significantly reduced, and they can quickly complete engineering applications [8][9].

A teaching case library with 12 typical cases and 8 comprehensive projects has been built, along with over 20 supporting micro-course resources. The training manual has been revised to better fit our students' foundations. It establishes a comprehensive curriculum resource system that encompasses teaching, learning, practical application, and assessment.

By group project presentations and engineering specification assessments like code comments, students' professional skills and qualities have significantly improved. Training feedback shows that 90% of students recognize the improvement of security and quality awareness in training, and 85% of students are satisfied with improvement of team collaboration.

4.2. Reflections and Prospects

Although enterprise real cases are introduced into the class, the projects are simplified and the actual production process is more complicated. In the future, the school-enterprise cooperation development model can be explored. The industrial Internet projects implemented by enterprises can be transformed into teaching tasks, allowing students to participate in the development of real projects.

At present, the training of industrial Internet projects relies on hardware equipment. In the future, virtual simulation technology such as digital twin platform can be combined to build a virtual training environment. It can solve the problem of insufficient hardware of industrial equipment, and improve the convenience and safety of complex system debugging.

Establish a more precise quantitative system for outcome indicators, such as analyzing students' performance in knowledge, ability, and quality dimensions through radar charts to provide data support for personalized training.

To enhance the evaluation system, a multi-layer and dynamic indicator framework can be established [10]. The knowledge dimension can be refined into mastery of professional theories and frontier knowledge. The ability dimension can include critical thinking and innovative problem-solving capabilities. The quality dimension needs to include team collaboration awareness, and social responsibility.

Through a three-dimension dynamic radar chart model, the system enables visual tracking of students' development. Combined with big data analysis, the platform automatically generates individual competence maps, and identifies strength and weakness areas. Students who are weak in practical ability can be recommended for more industry projects, and those who are good at innovative thinking can take more complex tasks.

5. Conclusion

The reform of Industrial Internet Configuration Modeling based on the OBE concept, has formed a closed loop system of goal orientation, reverse design and continuous improvement by reconstructing curriculum objectives, optimizing teaching content, innovating teaching mode and refining evaluation system. Practice has shown that the reform has effectively improved students' engineering practice ability and professional quality, which is in line with the school's positioning in cultivating applied talents. In the future, it is necessary to further deepen the integration of industry and education, strengthen the construction of digital teaching resources, and enable courses to better serve the needs of regional industrial development.

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