Academic Education Publishing House

Higher Education and Practice Vol. 2 No. 1, 2025

Research on the Curriculum Reform of "Road and Bridge Construction Technology" Based on OBE Concept

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Abstract: This paper delves into the curriculum reform of "Road and Bridge Construction Technology" under the guidance of the Outcome - Based Education (OBE) concept. It comprehensively analyzes the current situation and existing problems of the course, elaborates on the specific reform strategies from multiple aspects such as curriculum objectives, teaching content, teaching methods, and assessment methods. The aim is to enhance the teaching quality of the course and cultivate high - quality road and bridge engineering professionals who can meet the demands of the industry. Through this research, it is expected to provide valuable references for the innovation and development of relevant courses in the field of road and bridge engineering education.

Keywords: OBE; Curriculum Reform; Strategies; Implementation; Assurance Measures

1. Introduction

The road and bridge construction industry is a fundamental pillar of the national economy, and its continuous development calls for a large number of high - quality professionals. "Road and Bridge Construction Technology" is a core practical course in road and bridge engineering majors, playing a decisive role in cultivating students' professional skills and practical capabilities. However, the traditional teaching model of this course has gradually exposed some limitations, making it challenging to fully meet the industry's requirements for compound and innovative talents.

The Outcome - Based Education (OBE) concept, which has emerged in recent years, emphasizes that all educational activities should revolve around the expected learning outcomes of students. It advocates that the entire teaching process should be designed and implemented to ensure that students can achieve clear and measurable learning outcomes, thereby promoting students' all - round development and enhancing their competitiveness in the job market. Applying the OBE concept to the curriculum reform of "Road and Bridge Construction Technology" is of great significance for improving the quality of talent cultivation in this field.

2. Current Situation and Existing Problems of "Road and Bridge Construction Technology" Course

2.1 Teaching Objectives

The current teaching objectives of the "Road and Bridge Construction Technology" course are generally set in a broad and general way. They mainly focus on students' understanding and mastery of basic knowledge and skills, such as understanding the construction principles of different road and bridge structures and being able to operate some common construction equipment. However, specific, measurable, and industry - relevant outcome - based objectives are lacking. For example, there is no clear stipulation on students' ability to independently design a small - scale road construction plan that meets engineering standards after the course, or their ability to effectively manage and solve problems during the construction of a simple bridge project. This lack of clear outcome - based objectives makes it difficult to accurately evaluate teaching effectiveness and students' learning achievements [1].

2.2 Teaching Content

2.2.1 Outdated content

The teaching content of "Road and Bridge Construction Technology" has not been updated in a timely manner to keep up with the rapid development of the industry. In road

construction, for instance, the teaching still predominantly focuses on traditional asphalt pavement construction methods, while new construction technologies such as warm - mix asphalt technology and recycled asphalt pavement technology, which are widely used in modern road construction, are either briefly introduced or not covered at all. In bridge construction, the teaching of new - type bridge structures like self - anchored suspension bridges and composite beam bridges is relatively scarce, and students lack in - depth understanding and practical knowledge of these advanced structures [2].

2.2.2 Lack of integration

The teaching content is often fragmented, lacking effective integration between different knowledge modules. For example, the teaching of road subgrade construction, pavement construction, and bridge foundation construction is carried out separately, without guiding students to establish the internal connection between these parts in actual engineering projects. As a result, students have difficulty forming a systematic understanding of the overall road and bridge construction process, and it is challenging for them to apply knowledge comprehensively when facing practical engineering problems [3].

2.3 Teaching Methods

2.3.1 Traditional lecture-based

The teaching method of the "Road and Bridge Construction Technology" course is still mainly dominated by traditional teacher - centered lectures. Teachers usually explain theoretical knowledge in the classroom, and students passively listen and take notes. This teaching method ignores students' initiative and creativity, and it is difficult to stimulate students' interest in learning. Moreover, due to the lack of practical operation and real - scene experience, students often have a poor understanding of abstract construction concepts and processes, and it is hard to transform theoretical knowledge into practical skills [4].

2.3.2 Insufficient practical teaching

Although practical teaching is an important part of the "Road and Bridge Construction Technology" course, in actual implementation, there are issues such as insufficient practical teaching hours, backward experimental equipment, and a lack of practical training bases. For example, some schools only arrange a few weeks of practical training for students, and the experimental equipment used is old - fashioned and cannot meet the needs of modern road and bridge construction experiments. Additionally, the lack of stable cooperation with construction enterprises makes it difficult for students to participate in real - world construction projects, resulting in a large gap between students' practical abilities and industry requirements [5].

2.4 Assessment Methods

2.4.1 Single - mode assessment

The current assessment method of the "Road and Bridge Construction Technology" course mainly relies on written examinations, with a relatively small proportion of practical operation assessment and process assessment. Written examinations often focus on the assessment of theoretical knowledge, and it is difficult to comprehensively evaluate students' practical skills, problem - solving abilities, and innovative thinking. For example, in a written exam, students may be able to answer questions about construction principles, but they may not be able to actually operate construction equipment correctly or solve construction problems encountered in practice [6].

2.4.2 Lack of connection with learning outcomes

The assessment content is not closely related to the expected learning outcomes of the course. The assessment mainly focuses on whether students have mastered the knowledge points taught in class, rather than whether students have achieved the specific abilities and qualities required by the course objectives. As a result, students may pass the exam by rote memorization, but they do not truly possess the practical abilities and professional qualities needed for road and bridge construction [7].

3. Curriculum Reform Strategies of "Road and Bridge Construction Technology" Based on OBE Concept

3.1 Clear and Measurable Curriculum Objectives

3.1.1 Based on industry needs

The curriculum objectives of "Road and Bridge Construction Technology" should be

closely aligned with the actual needs of the road and bridge construction industry. Through in - depth research on industry standards, job requirements, and the development trend of the industry, specific and measurable learning outcomes are determined. For example, it can be set that after the course, students should be able to independently complete the construction plan of a road section with a certain length and width, including the selection of construction materials, the determination of construction processes, and the formulation of quality control measures. In addition, students should be able to analyze and solve at least three common construction problems in road and bridge construction and propose reasonable improvement plans [8].

3.1.2 Hierarchical setting

The curriculum objectives should be set hierarchically, including knowledge - level objectives, skill - level objectives, and quality - level objectives. Knowledge - level objectives require students to master basic knowledge such as road and bridge construction materials, construction machinery, and construction principles; skill - level objectives require students to be proficient in operating common construction equipment, conducting construction surveys, and processing construction data; quality - level objectives require students to have engineering ethics, teamwork spirit, and innovation ability [9].

3.2 Optimization of Teaching Content

3.2.1 Updating and modernizing content

The teaching content of "Road and Bridge Construction Technology" should be updated in a timely manner to reflect the latest achievements and development trends of the industry. Incorporate new construction technologies, new materials, and new equipment into the teaching content. For example, in road construction, introduce new technologies such as intelligent paving technology and green construction technology; in bridge construction, add content about the construction of large - span, high - tech bridge structures such as cable - stayed bridges and suspension bridges. At the same time, pay attention to the integration of theoretical knowledge and practical applications, and introduce real - world engineering cases to help students understand how to apply new technologies in actual projects [10].

3.2.2 Integrating knowledge modules

Break through the fragmentation of teaching content and strengthen the integration of different knowledge modules. For example, in the teaching process, combine road subgrade construction, pavement construction, and bridge construction, and guide students to understand the mutual influence and connection between these parts in the overall road and bridge project. Through case - based teaching, students can be trained to comprehensively use knowledge from different modules to analyze and solve complex engineering problems. For instance, when teaching a case of a road - bridge connection project, students can be guided to consider issues such as the settlement control of the road subgrade near the bridge, the transition of pavement structure types, and the connection of bridge piers and roadbeds [11].

3.3 Diversification of Teaching Methods

3.3.1 Project - based learning

Adopt project - based learning methods, and divide the teaching content into several practical projects. For example, set up projects such as "Design and Construction of a Small - Scale Road" and "Construction of a Simple Bridge Model". Students are required to form project teams, independently complete project planning, implementation, and evaluation under the guidance of teachers. In the process of project implementation, students can not only apply the knowledge they have learned but also cultivate their teamwork ability, communication ability, and problem - solving ability [12].

3.3.2 Blended learning

Combine online learning resources with classroom teaching to carry out blended learning. Use online platforms to provide students with rich learning resources, such as construction process videos, virtual simulation experiments, and online courses. Students can conduct autonomous learning online after class, and teachers can use classroom time for in - depth discussion, problem - solving, and practical operation guidance. For example, before the teaching of bridge construction, students can first watch relevant construction process videos on the online platform to have a preliminary understanding of the construction

process, and then in the classroom, teachers can organize students to discuss the key points and difficulties of the construction process and conduct on - site demonstration and operation guidance of bridge construction equipment [13].

3.3.3 Field - based teaching

Strengthen field - based teaching, and actively cooperate with construction enterprises to establish off - campus practice bases. Arrange students to participate in real - world road and bridge construction projects, allowing students to experience the actual construction environment, understand the construction organization and management process, and master the latest construction technologies and methods. For example, students can participate in the construction of a local road expansion project, where they can directly observe and participate in various construction processes such as earthwork excavation, subgrade compaction, and asphalt pavement paving, and communicate with front - line construction workers and engineers to gain practical experience.

3.4 Establishment of a Comprehensive Assessment System

3.4.1 Combination of multiple assessment methods

Establish a comprehensive assessment system that combines process assessment, practical operation assessment, and final examination. Process assessment accounts for a certain proportion, and teachers regularly evaluate students' performance in class participation, group project progress, and homework completion. Practical operation assessment is mainly used to evaluate students' practical skills, such as their ability to operate construction equipment, conduct construction surveys, and complete construction drawings. The final examination focuses on evaluating students' comprehensive understanding and application of knowledge.

3.4.2 Alignment with learning outcomes

The assessment content should be closely aligned with the expected learning outcomes of the course. Each assessment item should be designed to evaluate whether students have achieved the corresponding learning outcomes. For example, in the practical operation assessment, if one of the learning outcomes is that students can correctly operate a certain type of asphalt paver, then the assessment content should include the actual operation of the asphalt paver by students, and the evaluation should be based on whether students can operate the equipment in accordance with the correct procedures, adjust the paving parameters, and ensure the quality of the paving.

4. Implementation and Assurance Measures of Curriculum Reform

4.1 Teacher Training

4.1.1 Industry - experience training

Encourage teachers to participate in industry - experience training programs. Teachers can be arranged to work in construction enterprises for a certain period, such as six months to one year, to understand the latest industry development trends, construction technologies, and engineering management models. Through practical experience in the industry, teachers can bring real - world engineering cases and practical experience into the classroom, enriching the teaching content and improving the practicality of teaching.

4.1.2 OBE - concept training

Organize teachers to participate in OBE - concept training courses to deeply understand the connotation and implementation methods of the OBE concept. Through training, teachers can master how to design teaching objectives, teaching content, teaching methods, and assessment methods based on the OBE concept and improve their ability to carry out curriculum reform.

4.2 Construction of Teaching Resources

4.2.1 Textbook construction

Develop new textbooks that meet the requirements of the OBE concept. The textbooks should be based on the latest industry standards and research results and focus on the cultivation of students' practical abilities and innovative thinking. The content of the textbooks should be vivid and easy to understand, with a large number of practical cases and engineering drawings. In addition, textbooks can be equipped with digital resources, such as online learning platforms, construction process videos, and virtual simulation software, to provide students with a more comprehensive learning experience.

4.2.2 Laboratory construction

Strengthen the construction of road and bridge construction laboratories. Update and improve experimental equipment to meet the needs of modern road and bridge construction experiments. For example, introduce advanced construction simulation equipment, such as virtual reality (VR) and augmented reality (AR) technology - based construction simulation systems, which can simulate various construction scenarios and help students better understand the construction process. At the same time, expand the scale of the laboratory to provide more experimental space for students to carry out practical operations.

4.2.3 Practice base construction

Actively cooperate with well - known construction enterprises to establish stable off - campus practice bases. Sign cooperation agreements with enterprises to clarify the rights and obligations of both parties. The practice bases should be able to provide students with a variety of practical training opportunities, such as internships, on - site observation, and participation in actual projects. In addition, enterprises can also send experienced engineers to schools to give lectures and guide students' practical training, strengthening the connection between schools and enterprises.

4.3 Quality Monitoring and Evaluation

4.3.1 Establishment of a quality monitoring system

Establish a comprehensive quality monitoring system for the curriculum reform of "Road and Bridge Construction Technology". The system should cover all aspects of the teaching process, including teaching plan formulation, teaching implementation, student learning, and assessment. Regularly collect and analyze relevant data, such as student performance data, teacher teaching evaluation data, and industry feedback data, to understand the implementation effect of the curriculum reform.

4.3.2 Continuous improvement

Based on the results of quality monitoring and evaluation, continuously adjust and improve the curriculum reform plan. If problems are found in the teaching process, such as unreasonable teaching content, ineffective teaching methods, or insufficient assessment accuracy, timely take corrective measures, such as adjusting teaching content, changing teaching methods, or optimizing assessment methods. Through continuous improvement, ensure that the curriculum reform can continuously improve the teaching quality and achieve the expected learning outcomes.

5. Conclusion

The curriculum reform of "Road and Bridge Construction Technology" based on the OBE concept is an inevitable choice to meet the needs of the development of the road and bridge construction industry. By clarifying clear and measurable curriculum objectives, optimizing teaching content, diversifying teaching methods, and establishing a comprehensive assessment system, and strengthening the implementation and assurance measures, it can effectively improve the teaching quality of the course, cultivate students' practical abilities, innovative thinking, and professional qualities, and provide strong talent support for the development of the road and bridge construction industry. However, the curriculum reform is a long - term and systematic project, which requires continuous exploration, practice, and improvement to achieve better results.

Acknowledgments

This work is supported by following foundation: GuangDong Technology College 2024 "Quality Engineering" Project: Reform and Practice of the "Road and Bridge Construction Technology" Course Based on the Outcome-Based Education Concept (Project Number: JXGG2024032).

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