Structure and Practice of Road and Bridge Engineering Professional Curriculum System under the Background of New Engineering Science

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Abstract: With the continuous advancement of the construction of new engineering disciplines, the reconstruction and practice of the curriculum system of the road and bridge engineering specialty, as an important part of the traditional engineering field, is particularly important. This article firstly analyzes the challenges and opportunities of road and bridge engineering majors in the context of new engineering disciplines, and then puts forward the idea of constructing the curriculum system based on the industry demand and ability cultivation. The article describes in detail the design principles of the curriculum system, the core curriculum modules, the practical teaching links and the safeguard measures for the implementation of the curriculum, and finally verifies the practical effect of the curriculum system through case studies. The research of this paper has certain reference value for promoting the education and teaching reform of road and bridge engineering and cultivating high-quality engineering talents to meet the needs of the new era.

Keywords: new engineering; road and bridge engineering; curriculum system; construction; practice

1 INTRODUCTION

With the rapid development of science and technology and the deepening of globalization, the construction of new engineering disciplines has gradually become an important issue in the field of higher education[1]. Road and bridge engineering, as an important discipline in the traditional engineering field, the quality of its personnel training plays a crucial role in the construction and development of national transportation infrastructure. However, under the background of new engineering disciplines, road and bridge engineering majors are facing unprecedented challenges and opportunities[2]. The traditional curriculum system of road and bridge engineering often pays too much attention to the teaching of theoretical knowledge and neglects the cultivation of students' practical ability and innovative spirit. This teaching mode has been difficult to adapt to the needs of road and bridge engineering professionals in the new era[3]. Therefore, the construction of road and bridge engineering professional curriculum

P. Batista et al. (eds.), *Proceedings of the 2024 International Conference on Humanities, Arts, Education and Social Development (HAESD 2024)*, Advances in Social Science, Education and Humanities Research 892,
https://doi.org/10.2991/978-2-38476-344-3_14

system adapted to the background of new engineering disciplines has become one of the important tasks of the current reform of higher education[4]. The purpose of this paper is to discuss the construction and practice of the curriculum system of road and bridge engineering under the background of new engineering disciplines[5]. Through in-depth analysis of the characteristics of road and bridge engineering majors and the requirements of the construction of new engineering disciplines, this paper puts forward the idea of constructing the curriculum system based on the industry demand and ability cultivation[6].

2 CHALLENGES AND OPPORTUNITIES OF THE ROAD AND BRIDGE ENGINEERING PROGRAM IN THE CONTEXT OF NEW ENGINEERING DISCIPLINES

Rapid technological update: With the continuous emergence of new materials, new processes and new technologies, the technological update in the field of road and bridge engineering is accelerating. The traditional professional knowledge system of road and bridge engineering has been difficult to adapt to this rapidly changing technological environment, which poses new challenges to the teaching content and teaching methods of road and bridge engineering.

Demand for interdisciplinary integration: The new engineering discipline emphasizes the cross-fusion of disciplines, requiring the road and bridge engineering major to deeply integrate with other related disciplines, such as civil engineering, mechanical engineering, electronic engineering, etc., to form a comprehensive knowledge system. This puts forward higher requirements for the curriculum and faculty construction of the road and bridge engineering program.Internationalization Trend: With the acceleration of globalization, international cooperation and communication in the field of road and bridge engineering are becoming more and more frequent. This requires that students majoring in road and bridge engineering have international vision and cross-cultural communication ability to adapt to the competition and cooperation in the international market.

From Table 1,development of new technology: the development of new technology provides new design, construction and management means for road and bridge projects. For example, the application of new technologies such as BIM technology, Internet of Things (IoT) technology, artificial intelligence and other new technologies in road and bridge engineering has revolutionized the design, construction and operation of road and bridge engineering. This provides a broad development space and innovation opportunities for the road and bridge engineering specialty.

Table 1. Challenges and opportunities

Challenges and Opportunities	Description	Specific Data or Information
Technological Advancement	Rapid adaptation to new technologies and materials.	Rate of introduction of new materials annually.

Interdisciplinary Collaboration	Strengthening collaboration with other engineering disciplines such as materials science and information technology	Growth rate of interdisciplinary projects.
Sustainable Development	Designing environmentally friendly and cost-effective solutions for road and bridge engineering.	Increase in the use of renewable materials or reduction in carbon emissions.
Talent Development	Cultivating diverse talents with strong engineering practice and innovation capabilities.	Employment rates of graduates, particularly in emerging technology sectors.

3 CONSTRUCTION OF CURRICULUM SYSTEM BASED ON INDUSTRY DEMAND AND ABILITY CULTIVATION

The curriculum system should be closely centered on the latest development dynamics and technical trends of the road and bridge engineering industry to ensure a high degree of compatibility between the course content and the industry demand. Through in-depth research on the industry's demand for talents, the professional training objectives should be clarified to make the curriculum system more in line with the industry's development requirements. The curriculum system should take the cultivation of students' comprehensive ability as the core, focusing on the coordinated development of knowledge, ability and quality. In the curriculum, it should not only consolidate students' basic professional knowledge, but also strengthen students' practical ability and innovation spirit, and cultivate students' engineering literacy and interdisciplinary collaboration ability. The curriculum system should be systematic and flexible, not only to ensure the coherence and completeness of the course content, but also to make dynamic adjustments according to the development of the industry and the needs of students. Through the setting of elective courses and extension courses, students are provided with diversified learning paths and development space.

Basic Theory Courses: These include the fundamentals of natural sciences such as mathematics, physics and chemistry, and instrumental courses such as computers and foreign languages. These courses aim at consolidating students' basic knowledge and cultivating their scientific literacy and cross-cultural communication skills.

Specialized Core Courses: covering the core contents of the basic principles of road and bridge engineering, materials, structural design, construction technology, and so on. Through systematic study of these courses, students can comprehensively master the professional knowledge and skills of road and bridge engineering, laying a solid foundation for future career development.

Practical link courses: including experiments, internships, course design, graduation design and other practical teaching links. These courses aim to strengthen students' engineering practical ability and innovative spirit, and to cultivate students' practical operation ability and problem solving ability. By cooperating with enterprises in practical teaching, students are directly involved in actual engineering projects to enhance their practical ability and professionalism.

Extension and Elective Courses: Extension and elective courses are set up according to students' interests and career planning. These courses can cover cutting-edge content such as new technologies, new materials, new processes, etc., and can also involve knowledge and skills in interdisciplinary fields. By taking these courses, students can broaden their knowledge and enhance their overall quality and competitiveness.

4 CASE ANALYSIS AND VALIDATION OF PRACTICAL EFFECTIVENESS

4.1 Case Analysis

This study selected the road and bridge engineering major at a well-known university as a case for analysis. Under the new engineering background, this university carried out a comprehensive reform of the curriculum system for the road and bridge engineering major. From Table 2,measures such as involving industry experts in curriculum design, strengthening practical teaching components, and establishing school-enterprise cooperation internship bases were implemented to construct a curriculum system closely aligned with industry demands.

Table 2. Curriculum System Status and Student Academic Performance

Category	Subcategory	Number/Proportion	Year/Percentage
Course Type	Basic Courses	15	30%
	Major Courses	25	50%
	Elective Courses	10	20%
Teaching Method	Traditional Lecture	20	40%
	Experimental Practice	15	30%
	Project-Based Teaching	10	20%
	Online Teaching	5	10%
Before Reform	Average Score	72	85%
	Pass Rate	85%	10%
First Year After Reform	Average Score	75	88%
	Pass Rate	88%	15%

4.2 Practical Effectiveness Validation

To validate the practical effectiveness of the constructed curriculum system, this study adopted various evaluation methods, including the analysis of student academic performance, surveys on graduate employment, and feedback from employers. The specific validation results are as follows:

Student Academic Performance Analysis: By comparing the academic performance of students before and after the reform, it was found that the average scores and pass rates of students increased after the reform, with a significant rise in the proportion of high-scoring students. This indicates that the new curriculum system better meets students' learning needs and developmental requirements.

Graduate Employment SurveyA follow-up survey on the employment status of graduates after the reform showed a steady increase in the employment rate, with a high relevance between job positions and the studied major. This suggests that the new curriculum system has effectively enhanced students' employment competitiveness.

5 CONCLUSIONS

Under the background of new engineering disciplines, road and bridge engineering majors are facing challenges such as rapid technological updating, interdisciplinary integration demand and internationalization trend, and at the same time, they have also ushered in opportunities such as the development of new technologies, national policy support and higher education reform.

The construction of curriculum system based on industry demand and ability cultivation is the key to the education and teaching reform of road and bridge engineering. By clarifying the principles, core components and implementation safeguards of the curriculum system, the curriculum system of road and bridge engineering can be constructed to adapt to the background of new engineering disciplines.

ACKNOWLEDGMENT

We would like to thank the following fund numbers for their support:Construction and Practice of Road and Bridge Engineering Professional Curriculum System under the Background of New Engineering Science(JXJG-22-53-5),Research on Artificial Intelligence-based Tunnel Multi-source Heterogeneous Monitoring Data Fusion and Collapse Safety Early Warning Method (2022H0026),Research on Corrosion-Fatigue Degradation Stimulation and Corrosion Detection Equipment Technology for Bridge Cables under Greenhouse Environment (2021H00006),Intelligent Inspection, Monitoring and Warning Cloud Intelligence Platform and Engineering Demonstration of Port Deep Foundation Pit Construction Based on 5G Technology (S2021ZXXMC0272),Research and Engineering Demonstration of 5G-based Intelligent Health Monitoring Cloud Platform for Existing Old Buildings (S2023ZXXMC0288).

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