Reform and Practice of Railway Track Course Integrating OBE Concept in the Background of "Emerging Engineering Education"

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Abstract: Based on the requirements for the construction of the " Emerging Engineering Education "system, the relevant research and practice work of the course teaching of "Railway Track" is carried out, integrating the educational concept of OBE and the development needs of industry talents. The following researches are mainly carried out, such as scientifically planning the teaching content and implementation mode of the course, adopting teaching methods such as “micro scientific research” and “micro site”, improving and perfecting the mechanism of course assessment and continuous improvement, and actively carrying out ideological and political education of the course. The proposed measures have effectively solved the outstanding contradictions in the teaching of existing courses, fully mobilized students' learning enthusiasm and cultivated their ability to analyze and solve complex railway track engineering problems, along with their enthusiasm to devote themselves to the cause of railway construction in the motherland.

1. Introduction

With the implementation of the "Belt and Road Initiative" and the "Globalization Strategy of China's High-Speed Railway", railway construction has entered a new era of intelligent development. The industry's progress demands an increased supply of innovative, multifaceted, and internationally-minded high-level railway engineering professionals with mastery of core technologies[1]. As a conventional engineering discipline, it is imperative to respond to the national initiatives aimed at cultivating a substantial cohort of exceptional engineering and technology talents who will lead future technological and industrial advancements. This requires active engagement in research related to the upgrade and transformation of "Emerging Engineering Education"[2]. The educational concept of Outcome Based Education (OBE), emphasizing outcome orientation, student-centeredness, and continuous improvement, provides crucial guidance for the practical implementation of the Emerging Engineering Education[3].

As a traditionally advantageous major, our civil engineering program has already passed the re-assessment of engineering education accreditation. The fields of Civil Engineering, Railway Engineering, Road, Bridge, and River-Crossing Engineering have all been approved as top undergraduate major of China development sites. In order to better align with the concept of engineering education certification and do a good job in the upgrading and transformation of "Emerging Engineering Education", it is necessary to benchmark the "Emerging Engineering Education" and engineering education professional certification requirements. This includes emphasizing the cultivation of general education concepts, strengthening the reserve of basic knowledge in mathematics, physics, and industry majors, and constructing a modular curriculum system that integrates new elements of interdisciplinary technology. And vigorously building railway new technology characteristic courses under the background of the era such as "intelligent construction".

The course "Railway Track" is the core professional characteristic course of civil engineering, railway engineering and other majors, and plays a vital role in the training of professional talents. It

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focuses on the design and mechanical analysis of track structures, comprehensively and systematically introducing the composition and functions of track structures, track geometry, mechanical analysis of track structures, railway turnout, continuous welded rail, and other contents. The current curriculum teaching exists problems such as less class time, more content, less student participation and out of touch with the development of new technology in the industry, and insufficient ability to train students to solve complex track engineering problems.

Therefore, how to integrate the relevant educational concepts of "Emerging Engineering Education" and OBE, carry out the teaching reform of the "Railway Track" course, commit to cultivating students' abilities, and play a very important role in improving the level of professional construction and carrying out the construction of related professional courses. This reform mainly includes aspects such as curriculum teaching objectives, teaching content and methods, assessment methods, and the development of curriculum ideological and political education.

2. Main Problems

Through years of teaching experience in the "Railway Track" course, feedback and suggestions from participating in engineering education certification, as well as careful sorting of the construction requirements of the "Emerging Engineering Education", it has been found that the main problems in the teaching of this course are as follows:

2.1. The Compression Process of Class Hours has Resulted in Excessive Deletion of Teaching Content and Incomplete Course Teaching System

The course "Railway Track" has gradually been compressed from 64 class hours to 32 class hours, and the corresponding curriculum outline has been partially deleted from the main teaching content. The course teaching only considers a limited number of classroom hours, mainly introducing the basic composition of traditional ballasted tracks, track geometry, quasi-static calculation of track mechanics, ordinary railway turnout, and continuous welded rail. It lacks the supplement of new knowledge and concepts brought by the development of modern high-speed railways, as well as the content of ballastless tracks, track dynamics analysis, track structure vibration reduction and noise reduction. The overall timeliness is poor, and the course teaching system is not complete enough, Causing low interest in classroom teaching content among students.

At the same time, there is a lack of organic integration of modern information technology in the course teaching process. Although various forms of online teaching were carried out during the epidemic, the overall course resources are relatively scarce, and the online teaching methods are single. There is insufficient research on how to reasonably utilize modern information technology, scientifically plan teaching content, and timely carry out blended online and offline teaching. The organic unity of online and offline teaching has not yet been achieved.

2.2. Lack of Industry Experts' Participation in Setting and Implementing Course Objectives, and Lack of Industry Development Adaptability in Course Teaching

The formulation of talent cultivation objectives based on the OBE concept requires the in-depth participation of industry experts. However, as an important support for the achievement of talent cultivation goals, there is a lack of participation of industry experts in the process of setting and implementing curriculum goals. At present, the formulation, achievement evaluation, and continuous improvement suggestions of course objectives are basically completed through discussions organized by the course team based on course assessment and student feedback. There are issues such as inadequate adaptation of course objectives to the development of new technologies on site, and inadequate mechanisms for industry experts to participate in the achievement and improvement of course objectives. There is a lack of effective measures to moderately strengthen the participation of industry experts, conduct relevant discussions, and conduct on-site teaching activities in course teaching. There is a certain gap between talent cultivation and the requirements of the "Emerging Engineering Education" and OBE concepts.

2.3. Lack of Evaluation Mechanism for the Teaching Process in the Traditional Assessment Methods and Insufficient Continuous Improvement of the Courses

The original assessment of the "Railway Track" course mainly focused on the final concentrated exam. The proportion of their usual grades is generally less than 30%, and they have the characteristic of "one exam determines the world". Under the OBE education concept, curriculum assessment and evaluation are more concerned with students' learning outcomes and development potential. The process and achievement of knowledge acquisition, ability improvement, and quality development have also been given special attention[4]. There is a lack of quantitative analysis of the corresponding course objectives in the teaching process, and the evaluation of student participation in achieving results is insufficient. Moreover, the construction of a continuous improvement mechanism for curriculum evaluation, feedback, and improvement based on the OBE concept lacks corresponding data support.

Overall, scientifically and effectively setting up course assessment methods, increasing the proportion of process formative assessment, clarifying the evaluation and analysis methods for achieving course objectives, and carrying out continuous improvement work play a very important role in improving the achievement of course objectives.

2.4. Inadequate Teaching of Civics in the Curriculum and Lack of Clear Civics Objectives and Effective Ways of Implementation

The ideological and political construction of railway engineering courses must fully integrate professional characteristics, talent training objectives, and course teaching content, and continuously explore ideological and political elements. And in the process of teaching implementation, various forms of curriculum ideological and political education are carried out to achieve the goal of ideological and political education in the curriculum[5]. However, for traditional engineering majors as a whole, curriculum teaching is generally based on natural cognition, and the teaching process mainly emphasizes the mastery and application of "technology"[6]. There is a lack of teaching content that transforms the cutting-edge achievements of ideological and political disciplines into professional courses through curriculum design. And there is a lack of proper thinking in making professional course teaching more ideological and political, and more penetrating.

The original curriculum of "Railway Track" lacked the goal of ideological and political education in the course. During the teaching process, some courses were carried out based on the development history of railways and the development of new railway technologies, but overall, there was a lack of systematic consideration. There was no clear ideological and political content and target requirements in the main teaching links of the course, and there was a lack of effective organization and implementation methods.

3. Main Improvement Measures

3.1. Scientifically Plan the Teaching Content of the Course and Timely Carry Out Mixed Online and Offline Teaching

Further sorting out the teaching content of the course, constructing an online resource learning platform for the course, and carrying out mixed online and offline teaching. According to the importance and difficulty of the course content, select some teaching content, such as an overview of railway track development, continuous welded rail design on bridges, track structure vibration and noise, track construction and construction, etc., to adopt online teaching mode. The main content, learning methods, and corresponding class hours of the course "Railway Track" are shown in Figure 1.

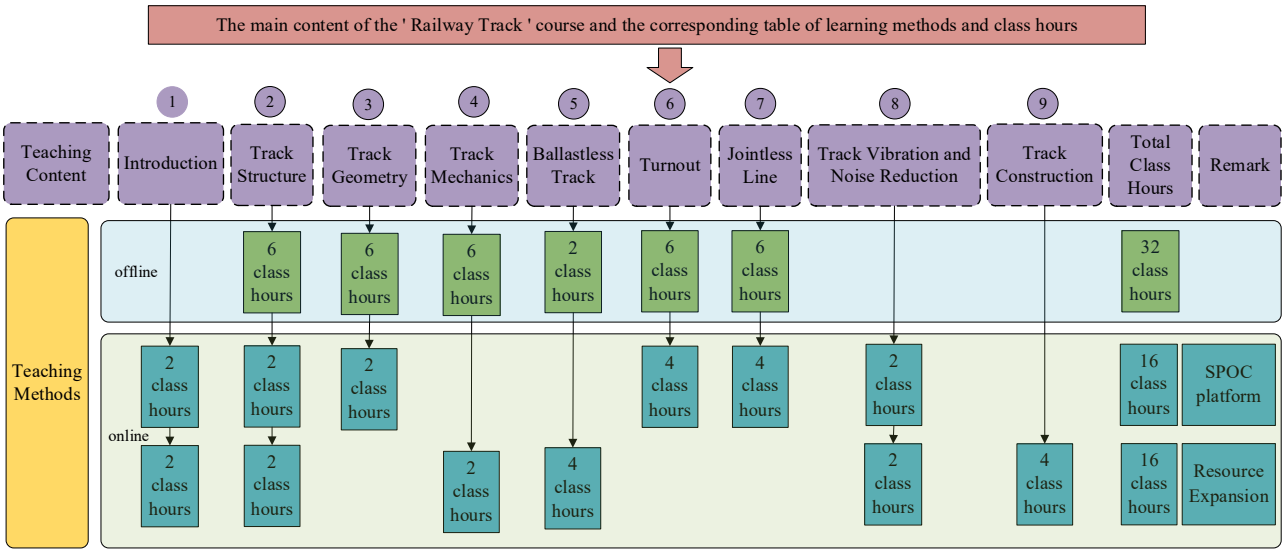

Figure 1 Main contents and learning style of railway track course.

Online resource learning mainly adopts the established SPOC platform to carry out relevant learning and assessment, and provides expanded resource learning in corresponding chapters by introducing high-quality online resource sharing courses and collecting a large amount of video materials. The study of basic theories in the curriculum relies more on online learning, and classroom teaching places more emphasis on students' understanding of key and difficult knowledge and the cultivation of innovative practical abilities. Flipped classrooms are adopted in a timely manner, through thematic discussions, mutual sharing, and mutual learning, to enhance their self-learning ability. The teaching process integrates industry-relevant, research-driven, innovative content, increasing the knowledge complexity and enhancing students' passion for learning and creativity.

3.2. Adopting Teaching Methods such as "Micro Scientific Research" and "Micro Site" to Enhance the Adaptability of Talent Training and Industry Development

To address industry growth and outdated teaching content, each instructor is required to create ' micro scientific research ' videos based on their relevant research project involvement. These videos, combined with practical engineering, explore scientific challenges in track development. For example, using the Yinchuan-Xi'an High-speed Railway project, we've produced a video on 'Analyzing Ballast Track Adaptability for High-speed Rail.' This video thoroughly covers the 250km/h-adapted ballasted track structure, detailing longitudinal and lateral resistance of the ballasted bed, track vertical stiffness testing, and methods to assess track irregularities. Through study and seminars, students gain insights into the discipline's forefront and a clearer understanding of fundamental track structures. Utilizing college faculty participation in Qinghai-Tibet Railway construction-related research projects, we've created a video titled 'Plateau Railway Continuous Welded Rail.' This video delves into continuous welded rail design, especially in unique regions. Portions of this content are integrated into classroom instruction, subsequent course design, and graduation projects, systematically cultivating students' abilities to solve complex engineering problems. By introducing related 'micro-research' projects, students gain insight into BIM-designed track structures and the application of SIMPACK and ABAQUS software for track simulation and dynamic analysis, laying a strong foundation for future coursework.

Actively engaging with alumni from the railway track maintence department and industry experts, we use platforms like "Tencent Meeting" to conduct real-time live teaching sessions for daily maintenance, repair, and major railway track work. This "micro site" live teaching approach brings the teaching activities closer to the engineering site, leading to increased student engagement and proactiveness in learning.

Following the course assessment, instructors calculate the attainment of course objectives. They analyze the achievement of both overall and specific objectives, taking into account student

self-assessments, and propose continuous improvement measures and recommendations. In the case of less-than-satisfactory attainment of course objectives, the course team is required to conduct specialized discussions and suggest adjustments to teaching content and improvements in teaching methods based on classroom data analysis.

3.3. Improvement of Course Assessment Methods and Improvement of the Mechanism for Continuous Improvement of Courses

The course assessment combines formative and final examinations, integrating both formative and summative assessment approaches. Formative assessment consists of four components: online resource learning, assignments, question-and-answer discussions, and in-class quizzes. The formative assessment accounts for 50% of the overall course grade. The final comprehensive examination emphasizes the use of non-standard answers and covers all course objectives. It prioritizes assessing students' capabilities and requires approval from the course coordinator and the department head. The course assessment places a strong emphasis on evaluating students' learning processes and achieving diversification in assessment methods, enabling a more comprehensive and objective evaluation of course objective attainment. Following the course assessment, students engage in a self-assessment of their learning achievements.

After the course assessment, instructors calculate the attainment of course objectives. They analyze the achievement of both overall and specific objectives, considering student self-assessments, and propose continuous improvement measures and recommendations. In cases where course objectives are not satisfactorily achieved, the curriculum team is required to conduct specialized discussions. They use classroom data analysis to suggest adjustments to teaching content and improvements in teaching methods.

3.4. Fully Exploiting the Elements of Curriculum Civics to Carry Out Value Guidance

The course "Railway Track" closely focuses on the fundamental task of cultivating moral character, builds a new model of "four-in-one" course ideology and politics of value, emotion, knowledge and ability, mines red resources from the history of railroad construction, school history and professional development, and cultivates the scientific spirit of the students as well as their ability to understand, analyze and solve problems by using the Marxist point of view and methodology.

In the process of formulating the course outline, the curriculum committee is required to clearly define the ideological and political goals of the course based on comprehensive discussions. These goals are then broken down into various aspects of course instruction, with their integration into the primary content of classroom teaching in each section. By introducing the development of rail transportation both domestically and internationally, the course narrates the challenging and dedicated journey of railway personnel in serving the country, highlighting the " road-building spirit", " Qinghai-Tibet spirit", "high-speed rail spirit," and "Sichuan-Tibet spirit" that have emerged during the railway construction process. Through the presentation of individual examples, students are educated and guided to aspire to greatness, become determined individuals, foster a spirit of perseverance, and ignite a sense of patriotism. Through the development of track mechanics, innovation of track structure system and continuous innovation of railroad turnout design theory, we cultivate correct design concept, serious scientific attitude and innovative spirit of exploration. Through the arduous journey of teachers and students of the School of Civil Engineering who have been involved in the investigation, design, construction, operation and maintenance of the Qinghai-Tibet Railway for more than 20 years, the students are educated and inspired to combine their personal pursuits with the development of the country and the railroad, and to contribute to the construction of railroads for the motherland.

4. Conclusion

The thesis is based on the requirements of the construction of "Emerging Engineering Education" system, integrating the educational concept of OBE, and carrying out the research and

practical work related to the teaching of "Railway Track" course. By systematically planning the content and delivery methods of the curriculum, utilizing teaching methods such as "micro scientific research" and "micro site," improving and refining course assessments, and actively engaging in ideological and political education within the curriculum, significant contradictions in course teaching have been effectively resolved. It really realizes the purpose of letting students move and get busy, comprehensively improves students' ability to analyze and solve complex railway track engineering problems, and realizes the purpose of cultivating practical and innovative talents in the context of new engineering disciplines. The teaching reform and practice of the curriculum are crucial in ensuring the quality of railway engineering professionals' education and can serve as a valuable reference for the reform of other related courses.

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Reference

[1] Wang, T.J. (2019) Study on the Development Strategy of China Intelligent High Speed Railway. China Railway, 1, 9-14.

[2] Gu, P.H. (2017) The Concept, Framework and Implement Approaches of Emerging Engineering Education (3E) and the New Paradigm. Research in Higher Education of Engineering, 6, 1-13.

[3] Li, Z.P., Zhang, J.R., Yang, R.W., et al. (2022) Exploration and Practice of the Teaching of Civil Engineering Materials Course with OBE Concept under the Background of “Emerging Engineering Education”. Education and Teaching Forum, 9, 89-92.

[4] Liu C.Y., Li, X.L., Xia, F.M., et al. (2021) Teaching Reform and Practice under the Background of Engineering Education Certification: Taking the Concrete Structure Design Course as an Example. Education and Teaching Forum, 46, 73-76.

[5] Yan, C.B., Yang, J.Z., Liang, Y., et al. (2019) Cultivation of Engineering Consciousness and Craftsman Spirit Under Construction of Emerging Engineering Education: A Case Study of Civil Engineering Majors. Journal of Beijing University of Aeronautics and Astronautics (Social Sciences Edition), 32(6), 152-160.

[6] Zhang, D.L., Ning, Z.J., He, B., et al. (2022) Exploration and Practice of Promoting Ideological and Political Construction of Civil Engineering Course: Taking the Course of Introduction to Civil Engineering as an Example. Journal of Shenyang Jianzhu University (Social Science), 24(1), 103-108.