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Original Paper

Research on Teaching Reform of Civil Engineering Construction Course

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Abstract

*In light of the long-standing and prominent issues in the teaching of the Civil Engineering Construction course, such as the simplistic teaching method, the severe disconnection between theoretical teaching and practical teaching, the lack of learning initiative and participation among students, the insufficiency of online teaching resources, and the insufficient manifestation of curriculum characteristics, based on the student-centered concept, through innovative teaching design, the restructuring of course content, and integrated teaching approaches, a new teaching model of "**Three Rings and Six Integration**" is constructed. That is, through the teaching design of "before class, during class, and after class", the integration of teaching materials and subject frontiers, theory and virtual reality, offline and online resources, evaluation and teaching activities, teaching and scientific research, and ideology and politics and knowledge transfer is achieved. In combination with the teaching content of the course, inquiry-based teaching is carried out, and the teaching evaluation method of the course is innovated.*

Keywords

civil engineering construction, reform in education, Curriculum construction

1. Introduction

"Civil Engineering Construction" is a compulsory professional course available for junior students majoring in civil engineering and intelligent construction. After analyzing the teaching content and knowledge structure of this course, the following characteristics are identified: (1) The knowledge structure of this course encompasses building materials, civil engineering survey, structural mechanics, and another related knowledge, making it comprehensive. (2) This course is closely associated with

civil engineering production, and most of the knowledge points are derived from the summary of construction experience, thus having strong practicality. (3) With the advancement and progress of science and technology, new materials and new processes keep emerging constantly, so it demonstrates relatively obvious timeliness.

2. Teaching Pain Points

2.1 Textbook Content Lags Behind

With the rapid development and progress of science and technology, although the textbooks have been revised for many times, some contents of the textbooks have failed to keep pace with the development of the industry in time, resulting in outdated teaching contents and lack of cutting-edge and practical.

2.2 Outdated Teaching Methods

Most of the traditional teaching methods are based on teachers teaching theoretical knowledge, supplemented by blackboard writing and multimedia, abstractly teaching complex civil engineering construction technology and methods. Students' learning initiative and participation are not enough, which is not conducive to the cultivation of students' ability to actively explore problems and innovation

2.3 Lack of Online Teaching Resources

Many engineering practice cases are needed in the teaching process of Civil Engineering Construction. At present, the development of construction technology is accelerating, and new engineering cases are emerging in an endless stream. However, the construction of curriculum resources is not systematic, which cannot meet the needs of teaching, especially the needs of online and offline mixed teaching.

2.4 Insufficient Practical Aspects

Theory teaching is not closely connected with practice, and course design is often superficial. The interval between production practice and course in construction site is long, and the process of production practice is shallow, which is difficult to achieve the established effect of combining theory and practice.

3. Measures and Methods of Teaching Reform

With teaching pain points as the logical starting point, cause analysis as the important basis, moral education as the value of the guidance, from the teaching content, methods, resources, assessment and evaluation, ideological and political elements and other aspects of innovative reform, explore the formation of the "Three Rings and Six Integration" teaching innovation path.

3.1 The "Three Rings" Design Highlights the Advanced Nature of the Course

3.1.1 Before Class: Students Find Problems and Ask Questions in the Process of Self-Study

Teachers publish guide task lists and tests on the online learning platform, and students learn by themselves. The teacher grasps the students' learning situation and accurately locates the teaching plan.

3.1.2 During Class: Teachers and Students Analyze and Solve Problems Together

CBL (Case-Based Learning) teaching method is adopted in the teaching process. It is a group discussion teaching method that is based on construction cases, student-centered, and problem oriented. Its core is to guide students to actively learn and solve problems through real cases, so as to deepen understanding and master knowledge.

The teaching method aims to increase students' interest in learning, help students internalize knowledge, and stimulate students' interest and motivation in learning through real cases and problems. Enabling students to transform theoretical knowledge into practical skills is conducive to cultivating talents with innovative spirit and practical ability.

3.1.3 After Class: Expansion and Improvement, In-depth Exploration, Induction and Summary

After class, teachers track students' learning progress at any time, supervise and help them consolidate knowledge, deepen teaching content, and obtain teaching feedback. Specifically, it includes one-on-one discussions in offline office hours, online learning platforms publishing voting and Q&A sessions to understand students' mastery, and common and typical problems reflected in them will be used as generative resources for feedback in the next class.

3.2 The "Six Integration" Teaching Method Breaks the Limitation of Time and Space

3.2.1 The Integration of Teaching Materials and Academic Foreland Reconfigures the Hierarchical Content System

According to the target of talent training and graduation requirements, the logical relationship between knowledge is deeply explored. The teaching team adopts the network analysis system to build the core knowledge graph of the course. In combination with the core knowledge map, the teaching team breaks the original knowledge system of the textbook, organically integrates ideological and political elements, disciplinary frontiers, and practical cases, and reconstructs the stepped content system to form three knowledge modules-course introduction, construction technology, and construction organization, which solve the problems of the course being difficult, the teaching content being not logical, and lack of frontier and innovation.

3.2.2 The Integration of Theory and Virtual Reality Establishes an Integrated Teaching Model

Due to the large number of students in university classes, it is difficult for teachers to fully ensure the safety of students by taking students to the actual construction site for practical teaching of civil engineering construction. BIM (Building Information Modeling) and VR (Virtual Reality) technologies, as the development direction of building informatization, integrate big data, Internet and cloud computing into the design, construction and operation and maintenance of buildings. It can effectively combine theory with practice and improve students' innovative ability. In the teaching process, the BIM model produced in advance is imported into the VR platform to form a simulation teaching system, leading the innovation of teaching methods.

With the help of immersive VR helmets, students can enter virtual construction sites anytime and anywhere, and have in-depth experiences and learning of site management, safety management, construction techniques. This innovative teaching method effectively compensates for the regret that students cannot frequently visit the construction site in traditional teaching, making the learning process more practical and enhancing students' practical and problem-solving abilities.

3.2.3 The Integration of Offline and Online Resources Emphasizes Innovative Course Resources

After years of collection and collation, a wealth of online and offline resources have been built, including construction case database, ideological and political elements database, auxiliary teaching materials. Students can study selectively according to their own characteristics. At the same time, a large number of Case-Based Learning (CBL) is introduced into the course teaching to highlight the novelty and effectiveness of the teaching content.

The specific characteristics are shown in the following six characteristics, which are objectives, focusing on a specific type of construction tasks; Timeliness, keeping pace with rapidly evolving construction technology; Authenticity, to develop students' ability to solve complex problems; Typicality, closely related to the knowledge points taught in class; Systematic, covering important knowledge points in teaching; Ideological and political elements, cultivate students' spirit of responsibility and professionalism.

In the course of teaching, online teaching and offline teaching are combined. In offline teaching, teachers first introduce knowledge points by sharing cases, then carry out theoretical knowledge learning, guide students to solve practical problems with theoretical knowledge, and improve students' ability to analyze and solve problems. Online teaching is the use of construction cases to assist learning, including three links, which are pre-class preparation, analysis and discussion in class, and extension after class.

3.2.4 The Integration of Evaluation and Teaching Activities Forms a Process Evaluation Mechanism

In view of the single and one-sided teaching evaluation method, the teaching team of Civil Engineering Construction introduced the teaching evaluation mechanism of OBE (Outcomes Based Education).

According to national development needs, industrial development needs, employer needs, school development positioning and teachers' and parents' expectations, the learning outcome needs are determined, and then the learning outcome is decomposed into the determination of training programs, and then the learning process is implemented. In this process, the teacher team, curriculum system and related support conditions need to be implemented. Conversely, these factors will also affect the implementation of the learning process, to evaluate the training program, to evaluate the learning results, and to require the learning results to meet various needs.

In the teaching process, formative evaluation is adopted to collect students' learning progress and feedback in time so as to adjust teaching strategies. Formative evaluation can be carried out through various forms such as classroom observation, homework analysis, group discussion report, mid-term

inspection, etc. Based on the evaluation results, provide timely feedback to students, point out their strengths and weaknesses in the learning process, and give suggestions for improvement. At the same time, the teaching team will also reflect on and improve the teaching methods and strategies according to the evaluation results, in order to continuously improve the teaching quality.

3.2.5 The Integration of Teaching and Scientific Research Reflects the High Quality of the Course Content

During the process of teaching implementation, teaching is taken as the lead to propose research topics for scientific research as scientific research support. Meanwhile, scientific research can indicate the direction for industrial upgrading and provide technical support. Industry can offer industry guidance and resources for personnel training, which will have a reciprocal effect on teaching. Conversely, teaching can supply industry with specialized talents. Industry can provide a research platform and achievement transformation for scientific research, and scientific research can offer technical support for teaching. In the teaching process, we always adhere to the guidance of scientific research and utilize relevant scientific research projects to promote students' thinking, stimulate their exploration ability and cultivate the scientific spirit.

Based on a number of research projects of the teacher team, including "A Reusable Sleeve Grouting Fullness Monitoring Tool", "Numerical Simulation Study on the Bending Performance of Prefabricated Reinforced Concrete Composite Beams" and other university-level projects, the advantages of research resource platform are fully utilized, and students are encouraged to participate in scientific research innovation practice through the full tutor system of undergraduates and the multi-channel scientific research projects. With scientific research projects as the carrier, undergraduate students are fully guaranteed to participate in scientific research innovation practice and cultivate scientific research innovation ability. Adhere to the guidance of scientific research, and use the relevant scientific research projects to promote students' thinking, stimulate students' exploration ability and cultivate scientific spirit.

3.2.6 The Integration of Ideology and Politics with Knowledge Teaching Achieves All-Round Education

In addition to focusing on subject knowledge and skills, process and teaching methods, this course gives full play to the collective wisdom of the teaching team, forms a joint force for educating people, and fully taps into four ideological and political elements: engineering consciousness and professional skills, engineering ethics, artisans of great powers, and feelings of family and country. Five basic knowledge links of "engineering material cognition (engineering object), construction machinery familiarity (engineering machinery), construction technology and method mastery (engineering means), construction quality standard understanding (engineering specifications), defect problem disposal (engineering innovation)" are proposed. The "salt" of ideology and politics dissolves in the "soup" of curriculum, and moistens things silently into the whole process of teaching and learning.

4. Conclusion

Through this course reform and innovation, students' learning interest and participation have been heightened, making the learning process more vivid and engaging, and stimulating students' learning appetite and enthusiasm. Meanwhile, by means of practical operation and roaming learning in the virtual environment, students can consolidate and deepen their theoretical knowledge in practice and enhance their practical skills. The construction and sharing of online digital resources offer students a convenient approach to learning and achieve the improvement of teaching quality.

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