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First-class courses guided by new problems and cases based on the concept of engineering education Reform of Teaching Mode—Taking Foundation Engineering Course as an Example

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Abstract: The concept of engineering education has been introduced into the professional construction of the vast majority of engineering majors. Under the background of engineering education, how to effectively carry out teaching reforms in the teaching of engineering courses and effectively realize the three important concepts of engineering education accreditation has been a hot research topic in the undergraduate teaching of engineering colleges and universities. Based on the concept of engineering education, this paper carries out a series of teaching reform measures with “new problems” and “new cases” as the starting point of reform in the teaching of the first-class course “Foundation Engineering”. After nearly two rounds of teaching implementation, the teaching effect has been significantly improved, effectively mobilized the students' learning initiative, and in the practical and innovative ability to get a certain exercise, better to achieve the course objectives and road and bridge engineering professional training objectives.

1. Introduction

At present, many majors in many colleges and universities are actively applying for engineering professional accreditation, and professional accreditation has been widely recognized by the society, which has confirmed its scientific and reasonable nature. Improving teaching quality is the fundamental purpose of participating in professional accreditation of engineering education. Professional accreditation imposes strict requirements on the training program, on the course syllabus, course objectives and how to achieve the course objectives. The three concepts of engineering education accreditation are (1) student-centered, (2) outcome-oriented/output-based/goal-oriented, and (3) continuous improvement. Among them, Student Centered (SC) is the purpose, Outcome Based (OBE) is the requirement, and Continuous Improvement (CQI) is the mechanism. Professional accreditation especially requires that our teaching conforms to the teaching concept of OBE, in which student-centeredness, specifically student development, student learning, and learning outcomes, form the outcome-oriented instructional design, instructional implementation, and instructional evaluation.

For problem and case-based teaching, there are also many scholars who have conducted research

on the local scope of related professions, such as “The Value of Problem-Based Teaching Combined with Case-Based Teaching in Cardiovascular Imaging Training”, “Exploration of the Application of Case-Based Teaching in Mathematics Problem Teaching”, and “Problem-Oriented Case-Based Teaching of Artificial Intelligence Applications”. However, the research direction mainly focuses on individual fields such as medicine, mathematics, artificial intelligence, etc., and there are deficiencies in portability and universality, and the exploration of problem and case-based teaching under the guidance of the concept of engineering education in the fields of civil engineering and transportation engineering is seldom seen [1].

So, under the guidance of engineering education concept, how to effectively carry out the teaching reform around the “new problems” and “new cases” is a brand new topic for us. Here we take the basic course of road, bridge and river crossing engineering as an example to illustrate the process of teaching reform.

2. Content of curriculum reform under the concept of engineering education

The concept of engineering education indicates the goal and direction of reform for the course reform of Basic Engineering. Based on the three important concepts of engineering education accreditation, combined with the teaching objectives of this course, positive and effective reforms are carried out in the following aspects[2].

2.1 Teaching aspect

According to the requirements of knowledge, ability and professionalism of the teaching objectives, the teaching design, teaching process and teaching evaluation are planned scientifically and reasonably.

2.2 Teaching management

Analyze students' learning situation, enrich teaching resources by taking credit courses across schools, and determine suitable teaching videos, online exercises and assignments according to the school's course hours and teaching contents.

For the tasks that need to be completed in the online course, we should establish a supervision plan and carry out scientific management for students in a methodical and systematic way, for example, establishing a student duty system and letting students supervise students, so as to ensure the learning effect of students.

2.3 Examine

Reasonably set the assessment content and proportion, the content of the closed-book examination should be determined by the teaching team, the final course grade consists of two parts: the usual grade and the final examination grade, the usual grade is decided by the online teaching management platform according to the students' online learning, exercises and offline homework completion, etc. The final examination adopts the closed-book examination, and the quality of the questions should be strictly controlled, and the questions are rich in question types, with the difficulty and quantity of the questions being appropriate, and focusing on the examination of students' comprehensive application of theoretical knowledge to solve problems. The test questions are rich in type, moderate in difficulty and volume, focusing on the ability of students to comprehensively apply theoretical knowledge to solve practical problems. Finally, according to the degree of achievement of the course objectives, we will find out where the problems lie and make

timely teaching adjustments[3].

2.4 Focus on the cultivation of students' creative thinking and innovative design

We need to cultivate students' ability to flexibly apply knowledge in teaching, enabling them to master the interrelationships between professional courses and the ability to integrate learned knowledge to solve problems. We encourage students to participate in professional competitions such as school, provincial, and national competitions, which not only apply their knowledge but also broaden their horizons and cultivate good professional qualities.

3. Teaching mode with “new problems” and “new cases” as the starting point

The main content of the course “Foundation Engineering” is the structure, design and construction technology of common bridge foundations, which can be divided into three main lines in the knowledge mapping, namely, foundation structure, foundation design and foundation construction, among which, foundation design is the key content. How to ask questions and solve problems according to the students' natural understanding of the ideas, so that the students' learning process becomes a process of self-exploration and self-explanation is the original intention of the reform of this course[4].

In the classroom, we should guide students to ask questions in an interactive manner, gradually introduce knowledge points, and ultimately summarize them into the key content of the course. We should design classroom teaching in a rich form, activate the classroom, and enable students to truly have a sense of ownership, gradually achieve self-awareness and self-improvement. Of course, this also requires the teacher's overall planning and specific design for each class. The “new issues” and “new cases” are as follows:

(1) New questions on the construction of the foundation: What does the foundation look like? What is its height, length and width? What are the issues to be considered in redesigning the foundation?

(2) New problems and new cases in the design and calculation of foundation: What is the function of foundation? How to realize its role? How to design? The new cases introduced are the failed engineering design cases in recent years, such as the foundation of Jiujiang Bridge and the foundation of Jimei Bridge in three provinces.

(3) On the construction of foundation: how to build it? What equipment and technology are used? The new case is Longzhou Lijiang Bridge foundation construction, etc..

Through careful design, classroom teaching becomes an effective communication between teachers and students, giving full play to the problems in the minds of students as the leading, so that the majority of students understand and digest the knowledge in the classroom, which may lead to slower teaching progress, but the improvement of the teaching effect is real, which is the significance of the reform.

4. Implementation of Curriculum Reform

The course has been implemented for two teaching cycles, adhering to the OBE teaching concept, from teaching methods to teaching design, from the analysis of learning situation to supervision and guidance, from course objectives to continuous improvement, from practical ability to innovation training, based on the understanding of the new model of education in the new era, a more comprehensive teaching reform in the “Foundation Engineering” course, summarized as follows for the teaching practice.

4.1 Teaching Reform Initiatives

4.1.1 Teaching design

Teachers of the course team discuss the content of each lesson, teaching methods and approaches, and in the teaching: ① introduce “new problems” and “new cases”, including many typical engineering case studies (involving foundation construction accidents, engineering design accidents, etc.), ② Increase the number of thematic discussions, through which students' understanding and memorization of knowledge points are deepened.③Adding the points of Civic and Political Elements to the curriculum, integrating the Civic and Political Elements into classroom teaching in a “silent” way, and at the same time raising the interest of students and increasing the attractiveness of the classroom. The actual number of typical cases is 5, the number of thematic discussion questions is 12, and the Civic and Political elements of 7 major aspects are utilized.

4.1.2 Teaching process

Course users develop blended online and offline teaching plans, introducing flipped learning into the classroom. Teachers set up a good pre-course task, so that students enter the offline classroom with questions, the classroom content can be summarized in the teaching content, you can ask questions, snatch answers and other ways to understand the dynamics of student learning, and targeted arrangement of exercises, discussion content. Some engineering examples can be arranged after students have a certain foundation. Teachers through a variety of ways, collected the actual engineering cases, around the knowledge point of the timely questions to the students, try to let them through their own efforts to solve the problem, the teacher can also be prompted by the basic ideas. These cases are available for the two schools to share, making the students benefit together.

4.1.3 Assessment process and ability development

① Assignment part: the assessment of the ground work is no longer the traditional individual work, the teacher collects the actual engineering address information graphics and data, the students are divided into groups, each group to complete a homework. The assignment is subdivided, the group is clearly divided into groups, and the completion time is one week after class. For the completion of the situation, the teacher gives evaluation, pointing out the strengths and weaknesses of each group's work, to enhance the students' comprehensive analytical ability, and cultivate students' professionalism from the practical point of view.

② Examination: Develop exam papers based on the course syllabus and objectives, comprehensively assessing students' understanding, mastery, and flexible application abilities.

4.2 Management

First, Conduct academic analysis, investigate and study students' knowledge experience, learning ability, and state of mind analysis. Teachers of cross-campus credit courses have the authority to manage online courses, and they can combine the results of the learning situation analysis with the optimized selection of teaching videos, online exercises and assignments available on the platform to make full use of the online teaching resources without being trapped by the teaching resources or taking up too much of the students' time after school.

Second, Effective supervision of students' online learning progress, the supervision task is assigned to the student way, the supervision duty list is formulated, weekly statistics, the teacher sends the screenshot of the progress lagging behind to the students on duty, so that the students can

supervise the specific classmates, so as to not only alleviate the teacher's task but also give play to the student's spirit of mastery, and the students feel more a sense of responsibility.

4.3 Cultivation of students' creative thinking and innovative design

Teachers should cultivate students' ability to flexibly apply knowledge in teaching, enabling them to achieve integration and mastery of the interrelationships between professional courses, and thus be able to comprehensively apply learned knowledge to solve practical problems.

In order to enhance students' intuitive understanding of bridge foundation engineering, teachers will lead students to visit the college foundation laboratory for each type of foundation, explaining the composition, characteristics, common construction processes, precautions, etc. of the foundation structure. Students will be interested. During weekends, take students to visit typical bridges and explain the design points and key points of bridge structures and foundations.

Famous experts are invited to make reports for students, conduct courses and academic exchanges with students, answer questions and solve puzzles, and the students learn from the reports the experts' rigorous attitude to study and research and their prudent and tenacious spirit of scientific research.

In order to improve students' innovative thinking, students are encouraged to participate in provincial or national competitions to broaden their horizons and enhance their innovative thinking and practical ability. Students won the third prize of the National Transportation Vocational Education Road and Bridge Construction Technology Vocational Skills Competition and the third prize of the National Collegiate BIM Graduation Design Innovation Competition respectively.

4.4 Analysis of course grades and continuous improvement

4.4.1Analysis of course grades

The final grade of the students is an indispensable indicator of the effectiveness of teaching and learning.

Table 1 Statistics on student performance in Foundation Engineering courses

Grade	Excellent and Good	Medium	Passing	Failing
Grade 20	39%	34%	22%	5%
Grade 21	46%	38%	13%	3%

As shown in Table 1, it can be seen that both cohorts had better rates of excellence, fewer failures and an overall normal distribution of grades. Given that teaching in class 21 was the second construction period of this time, it can be seen that the good rate was 46%, which is a further improvement over the 39% in class 20, and the effect of the reforms can be further improved. The number of failures is only 2.

4.4.2 Continuous improvement

It can be seen through the analysis of the course results and the calculation of the degree of achievement that students are generally relatively weak in the basic design and calculation, which should be improved in many ways. In particular, efforts should be made in the derivation of formulas and the deduction of design theory. In the teaching process, the theoretical knowledge should be strengthened and explained, and the key points and difficult problems should be explained and analyzed more, so as to deepen the students' understanding of the theoretical knowledge and better complete the teaching content.

In addition, teachers should also enrich teaching methods, adopt advanced teaching methods,

learn better teaching concepts, do a good job of online and offline blended teaching, a student-centered, enhance students' interest in learning, and improve classroom participation. In order to improve the students' practical comprehensive ability, we should enrich the resources of online resource sharing class, Therefore, students will have a better grasp of the knowledge points in the course.

According to the students' learning situation, teachers use symposiums, seminars, individual communication with students and other forms of timely adjustment of teaching methods and tools, and make adjustments and refinements in teaching.

5. Conclusions

Based on the concept of engineering education and taking “new problems” and “new cases” as the starting point, the teaching reform has been carried out well in the first-class course “Basic Engineering”, and after practice, good teaching results have been achieved, and the students' practical and innovative ability has been enhanced, and their professionalism has been improved, laying a good foundation for future work.

On the basis of the curriculum reform, the teaching experience has been summarized basically, which can be used as a reference for similar courses.

First, The establishment of “student-centered” teaching mode, from various aspects, to guide students to change passive learning to active learning, and effectively touch the students' enthusiasm for learning, only students are willing to learn, and then fundamentally solve the problem of learning motivation;

Second, design natural classroom new problems, collect suitable typical teaching engineering cases that can resonate with students, teaching engineering cases strive to design from the knowledge, ability, cognitive three levels. Teachers gradually cultivate students' sense of responsibility and practical ability as "professional engineers" through more engineering practice cases.

Third, Teaching resources, including teaching videos, should be combined with the training objectives of our students to do exercises, homework, etc., to customize the learning mode for our students.

Fourth, The integration of the elements of course politics can better resonate with students and further enhance their sense of social responsibility, which may not be needed in every class, but can be introduced at the right time to make it appropriate.

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