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The Application of Positive Case Linked Negative Inquiry Teaching in Structural Mechanics

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Abstract: With the rapid development of the field of Marine and ocean engineering, higher requirements are put forward for the training of professional talents. In the core course of Structural Mechanics, the traditional teaching mode has some problems, such as abstract theory, low participation of students and insufficient training of application ability. In order to solve these problems, this paper puts forward a new teaching model - positive case linking Negative inquiry teaching. By introducing classic positive cases and constructing Negative cases, this model enables students to think critically and solve practical problems on the basis of understanding theoretical knowledge, thus improving teaching effect and students' professional quality.

1. Introduction

Structural Mechanics is an important professional course for the major of shipbuilding and ocean engineering, which aims to train students' ability to analyse and solve the problems of the strength and stability of ship structures. However, due to the strong theoretical content and abstract concept of the course, students are easy to feel boring in the learning process, and it is difficult to effectively master and apply the knowledge. Therefore, it is of great significance to reform the traditional teaching mode and explore more suitable teaching methods to improve the teaching quality of Structural Mechanics.

In recent years, case teaching [1-3] and inquiry teaching [4-8] have been widely used in higher education. Through the introduction of practical cases, case-based teaching enables students to learn theoretical knowledge in solving practical problems, and improves their enthusiasm and participation in learning. Inquiry teaching focuses on cultivating students' independent thinking and problem-solving ability, so that students can discover, analyse and solve problems in the process of exploration. This paper will combine the advantages of these two teaching methods, put forward the positive case link and Negative inquiry teaching mode, and discuss its application effect in the course of Structural Mechanics.

2. Overview of Teaching Mode

2.1 Positive Case Teaching

Positive case teaching is a kind of teaching method that introduces classical cases to make students learn theoretical knowledge in the process of solving practical problems. In the course of Structural Mechanics, the positive case teaching can select representative structural mechanics problems as cases, and make students deeply understand the principles and methods of structural mechanics through case analysis, discussion and problem solving.

The selection of positive cases should be typical, practical and inspiring. Typicality means that the case should be able to reflect the basic principles and laws of structural mechanics. Practicability means that the case should be close to the engineering practice and has certain application value; Inspiring means that the case should be able to stimulate students' thinking and guide students to explore the essence of the problem.

2.2 Negative Inquiry Teaching

Negative inquiry teaching is a kind of teaching method that enables students to develop independent thinking and problem-solving ability in the process of discovering, analysing and solving problems by constructing negative cases. In the course of Structural Mechanics, negative inquiry teaching can design some structural mechanics cases with errors or defects, so that students can find out the problems through exploration and propose solutions.

The construction of negative case should be targeted, challenging and innovative. Pertinence means that the case should be designed for the mistakes or misunderstandings that students are prone to in their learning; Challenging means that the case should have a certain degree of difficulty, which can stimulate students' thirst for knowledge and exploration spirit; Innovation means that cases should be able to guide students to think about problems from different angles and cultivate students' innovative thinking.

2.3 Positive Case Link Negative Inquiry Teaching Mode

The positive case linking and negative inquiry teaching mode is a teaching mode which combines positive case teaching and negative inquiry teaching. By introducing positive cases, the model enables students to learn theoretical knowledge in the process of solving practical problems. At the same time, by constructing negative cases, students can cultivate independent thinking and problem-solving ability in the process of discovering, analysing and solving problems. The positive case and the negative case are complementary and related to form a complete teaching system.

In this model, the positive case and negative case are carefully designed to ensure the quality of the case and the teaching effect. At the same time, it is also necessary to guide students to participate in the process of case analysis and problem solving, and cultivate students' ability of independent learning and cooperative learning. In addition, it is also very important to establish an effective evaluation mechanism to objectively evaluate students' learning results.

3. Teaching Implementation

3.1 Course Design

In the course design stage, teachers need to clarify teaching objectives, teaching content and teaching methods. Teaching objectives should cover three aspects: knowledge, ability and quality,

and focus on cultivating students' application ability and innovative thinking. The teaching content should include the basic principles, methods and applications of structural mechanics, and pay attention to the connection with practical engineering. The teaching method should adopt the teaching mode of positive case link and negative inquiry, and pay attention to the participation and interaction of students.

In the course design, we pay attention to the modularization and hierarchy of the course content. Modularity means that the course content is divided into several modules, each module contains relatively independent knowledge points and practice links; Hierarchy refers to the design of different levels of teaching content and requirements according to the differences in students' learning levels and abilities. Through modular and hierarchical curriculum design, it can better meet the learning needs of students and improve the teaching effect.

3.2 Teaching Implementation Process

In the process of teaching implementation, according to the requirements of curriculum design, teaching activities are gradually carried out. The following are the specific steps of the teaching implementation process:

3.2.1 Case Introduction

First, introduce the background and relevant information of the positive case to students, and guide them to understand the knowledge points and practical applications involved in the case. At the same time, relevant pictures, videos and other materials of the case can be displayed through multimedia teaching means to stimulate students' learning interest and participation.

3.2.2 Case analysis and Discussion

Students will analyse and discuss positive cases under the guidance of teachers. Students can participate in the case analysis process through group cooperation, role play, etc., to deeply explore the principles and methods involved in the case. In the process of discussion, teachers can guide students to raise questions, analyse problems and solve problems, and cultivate students' critical thinking and problem-solving abilities.

3.2.3 Negative Case Construction and Exploration

On the basis of students' full understanding of the positive case, the teacher constructs the negative case and guides the students to explore. Negative cases can be error or defect cases that correspond to positive cases, or they can be other challenging and innovative cases. By exploring problems and proposing solutions, students further consolidate what they have learned and develop independent thinking and problem-solving skills.

3.2.4 Summarize and Reflect

In the final stage of teaching implementation, teachers need to guide students to summarize and reflect. Students can show their learning results and experience by writing case analysis reports and sharing learning experiences. At the same time, teachers also need to evaluate and feedback students' learning results, point out the existing problems and the direction of improvement.

3.3 Examination and Evaluation

In the aspect of evaluation, teachers need to establish an effective evaluation mechanism to

objectively evaluate students' learning results. The evaluation should cover the three aspects of knowledge mastery, ability cultivation and quality improvement, and pay attention to the comprehensive evaluation of students' learning performance and development level. The following are some specific evaluation methods:

3.3.1 Case analysis Report

Students are asked to write case studies to show their learning results and experiences. Case analysis report should include case background, problem analysis, solution and other aspects of the content, focusing on cultivating students' writing ability and expression ability.

3.3.2 Class Performance

Students are evaluated by observing their performance in class, such as participation, quality of discussion, etc. Classroom performance evaluation can reflect students' learning attitude and habits and provide reference for the subsequent teaching improvement.

3.3.3 Homework after Class

Assign homework related to the course content and require students to complete and submit it on time. Homework can help students consolidate what they have learned and develop their ability to solve problems independently. Teachers can understand students' learning situation and existing problems by correcting homework, and give timely feedback and guidance.

3.3.4 Final Exams

The students' knowledge is tested comprehensively through the final examination. The final exam may take the form of a closed-book exam, focusing on the students' understanding and mastery of the course content and the ability to apply the knowledge to solve practical problems.

4. Teaching Effect Evaluation

In order to evaluate the application effect of the positive case linking and negative inquiry teaching mode in the course of Structural Mechanics, the teaching effect is evaluated. The evaluation methods include interview and performance analysis. The following are the specific evaluation results:

4.1 Interview Results

Some students were interviewed to understand their views and suggestions on the teaching mode of positive case-based link and negative inquiry. The interview results show that students generally believe that this model can make them more actively participate in class activities and improve their learning results. At the same time, students also put forward some suggestions, such as increasing the number and types of cases and strengthening the interaction between teachers and students. These suggestions provide useful reference for the subsequent teaching improvement.

4.2 The Analysis Results of the Student's Grades

This paper analyses the students' grades and compares the difference between the traditional teaching mode and the positive case linking and negative inquiry teaching mode. The results show that under the positive case-based link and negative inquiry teaching mode, the students' achievement is generally higher and the excellence rate is also improved. This indicates that this model can promote students' learning and development more effectively.

5. Conclusions

This paper puts forward a new teaching mode, the positive case linking and negative inquiry teaching mode, and discusses its application effect in the course of Structural Mechanics. Through teaching practice and effect evaluation, some valuable conclusions are obtained.

The positive case linking and negative inquiry teaching mode can stimulate students' learning interest and improve their learning effect. By introducing classical positive cases and constructing negative cases, the model enables students to think critically and solve practical problems on the basis of understanding theoretical knowledge. This teaching method is more in line with students' cognitive rules and learning needs, and can improve their learning enthusiasm and initiative.

The positive case linking and negative inquiry teaching mode can cultivate students' independent thinking and problem-solving ability. This model focuses on guiding students to conduct case analysis and problem-solving process, and cultivates their autonomous learning and cooperative learning ability through group cooperation and role playing. At the same time, the model also focuses on cultivating students' critical thinking and innovation skills, so that they can continue to explore and innovate in the process of solving problems.

Positive case linking and negative inquiry teaching mode can improve teaching quality and teaching effect. By optimizing the course design and teaching method, this model makes the course content closer to the practical engineering application, and focuses on cultivating students' application ability and innovative thinking. At the same time, this model also establishes an effective evaluation mechanism to objectively evaluate students' learning results, and provides a useful reference for teaching improvement.

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