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Teaching Reform for Engineering Mechanics Course under Application-Oriented Creative Talents Training

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Abstract. This paper investigates and discusses the current situation, necessity of teaching reform, teaching mode, and improvement of teaching system and teaching method in the Engineering Mechanics course to meet needs of cultivation of excellent talents in the field of civil engineering. Several improvements in teaching Mechanics are proposed to provide a new approach to cultivating application-oriented creative talents with excellent working abilities for the Engineering Mechanics course, aiming at the improvement of teaching quality.

Introduction

As an important foundation course in civil and architectural engineering, Engineering Mechanics is related to the following advanced courses including structural mechanics, reinforced concrete structure. [1-2] This course plays an irreplaceable role in training students to possess a good scientific quality, engineering application ability, and innovation ability. After reformed for many years, curriculum content system has been basic and universal. However, based on the objectives and integrity of different disciplines, the course emphasizes on instructing theoretical knowledge, and ignores to cultivate the abilities of students to analyze and resolve various practical issues in the engineering projects.[3-4] According to the characteristics of the new training program, the course hours gradually reduce and the contents of the course do not decrease.

This paper summarizes and investigates current situation, necessity of teaching reform, teaching mode, teaching content, content order adjustment, and improvement of teaching system and teaching method in the engineering mechanics course based on the authors' teaching and testing experience. [5-7] Several suggestions on teaching reformation are proposed to share and discuss with all colleagues so as to explore the establishment of an application of civil engineering undergraduate talent training mode, the new, to the relevant research and exploration, Student-centered, teacher-led engineering mechanics curriculum reform of teaching new models and new system.

Current Situation

Teaching and Learning. In the traditional teaching process of Engineering Mechanics, instructors concentrated on teaching, and neglected the development of "people". All students stayed in a passive position to learn what the instructor offered, and students have been accustomed to the passive studying method[8]. Because of the decrease of class hours, teachers often provided the knowledge points, problem-solving methods, and the problem-solving process to students, and students have been accustomed to the passive reception of knowledge, and they have little time to think of knowledge.

Teaching Mode. As a strong theoretical course, the teaching mode is that the instructor explain the knowledge on the blackboard and students complete homework. The traditional teaching mode is the primary teaching method [5-6]. The teaching mode has several advantages, but also possesses some shortcomings. The teaching mode which is lack of the interaction between students and instructors emphasizes on teaching and ignores the active participation of students to a certain extent. Therefore, students understand the knowledge, but cannot solve the problems.

Exploration of Teaching Methods. On the one hand, teaching in Engineering Mechanics focuses on the systematization and integrity of the curriculum[9]. On the other hand, teaching makes over emphasis on providing services for the follow-up courses. Most teaching reforms focus on the research of teaching contents and learning methods, and ignore the application of the course on the actual engineering projects. As a result, students often treat the course as a theoretical course with complex and numerous formula, and have been afraid of learning the knowledge. They generally believe that learning is useless and they are not able to use what they have learned.

Necessity of the Reform of Engineering Mechanics

Adapting to the Demand of Excellent Civil Engineer of Applied Civil Engineering and Satisfying the Requirement of Teaching Standard for Undergraduate Course of Civil Engineering. Engineering mechanics theory teaching and experimental teaching content from the actual project bring benefits to more disciplines and students year by year. It plays an irreplaceable role in the implementation of quality engineering and satisfies the basic requirements of engineering mechanics courses in the instructional professional teaching standard of undergraduate course of civil engineering.

People-oriented Urgent Needs. It not only promotes the coordinated development of knowledge, ability and quality to meet the needs of economic construction, scientific and technological progress and social development, but also helps broaden the new teaching concept in the engineering mechanics, changes students learning methods, and implements the student's dominant position.

Comprehensive Quality-based, Application-based Educational Philosophy of the Full Expression. In the implementation of application-oriented personnel training education, the society needs both the theoretical level of research-oriented talents and a large number of integrated application-oriented talents. Comprehensive quality-based and application-based method is teachers-students-schools-social aspects of common concern, and is the specific requirements to meet the new period of China's economic and social development of civil engineering specialty integrated application talents in the limited time. In the engineering mechanics, a new concept of teaching and learning should be adopted. It is not only a direct decision on the students 'comprehension of various courses, but also has a profound influence on the cultivation of students' engineering consciousness.

New Teaching Mode to Explore the Theoretical Content of life, Diversified Teaching Methods, Experimental Teaching Innovation, Application-Oriented Quality of Multi-Faceted

The new teaching mode refers as the simplified content of the theory, the diversified teaching method, the innovative teaching, and the application-based quality cultivation in many directions to meet talent's specific requirements, as shown in Fig. 1.

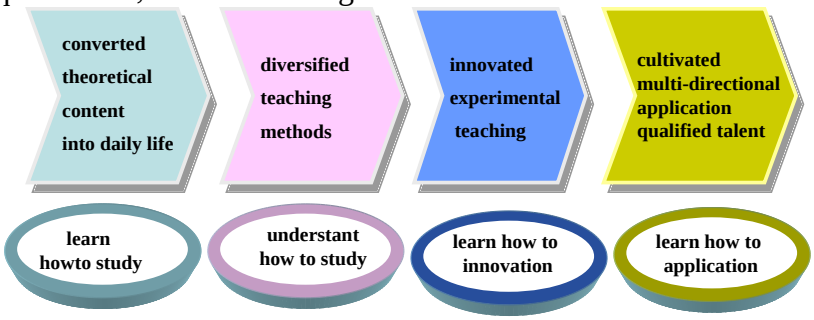

Figure 1. Multi-directional teaching model

Engineering Examples into Teaching, Theoretical Content more Life. Teachers should start with some intuitive and vivid practical engineering problems related to daily life, and guide students to establish a connection with the theoretical content[10]. Then teachers put forward and qualitative elaboration of the basic concepts and theories of mechanics, as shown in Fig.1. Teachers help students to turn the hazy perceptual knowledge to scientific rigorous theory and help the students to think from

a special rise to the general cognitive laws[11]. Teachers should stimulate students' enthusiasm and interests in learning and let students learn actively. So, students learn a solid knowledge, participate in the classroom high, enhance the quality of mechanical culture, and will be familiar with the relevant professional courses in the future convergence of knowledge.

Student Participation, Teacher-Student Interaction, Teaching Methods Diversification. Practical engineering and scientific research projects are the sources of engineering mechanics theory teaching and experimental teaching content[12]. Various teaching methods (Internet+ CAE) are supplemented by the teaching of blackboard writing, highlighting the strengthening of computer-aided design technology, to make full use of various research methods Project, practical practice, etc., to explore deeper laws of mechanics, extracurricular scientific and technological innovation activities and services for the industry to provide effective teaching resources for students.

Explore Ideas, Experimental Teaching Innovation. Testing teaching is an important part of cultivating students application ability in civil engineering. It is important to change the traditional experimental teaching ideas and modes, and to actively explore the characteristics of engineering mechanics curriculum experimental teaching new methods, new ways and new experimental teaching system. This requires to build an idea: student-centered; two levels: required and selected; two platforms: the actual operation of experimental platform and mechanical simulation experimental platform; four modules: the basic demonstration type, integrated design, research and innovative simulation model of experimental modules; four open: time, space, content, process open experimental teaching new model. Based on the advanced experience of the brothers and universities, two courses of experimental class civil engineering materials, engineering mechanics are organically integrated into a comprehensive experimental system. The role of mechanics in professional courses and position is highlighted to form the overall characteristics of curriculum teaching and learning.

Education in Learning, the Best Use of the Situation, Application-Oriented Quality Training Multi-Faceted. The teacher is the leader of the student's quality and ability cultivation. The teachers should have the educational idea of keeping pace with the times, the reasonable knowledge structure of erudition and specialization, the unique personality quality and the flexible teaching art to carry out teaching and research activities and to give theoretical content with new ideas and vitality. Students who want to be a qualified engineering and technical personnel must start now, learn to acquire the basic knowledge of engineering science methods, develop scientific thinking and behavior, and develop a dedicated work ethic and practical work. Therefore, students will learn and apply innovation. Teaching gradually exercises students to form a reasonable knowledge structure, with a comprehensive scientific and integrated consciousness, with strong adaptability and high engineering quality, to use the mechanical method of scientific research and practical problems to solve the problem, help to expand students of employment and competitive strength.

The Establishment of the Entire Program of Assessment Forms. Engineering mechanics assessment traditionally used one-time final examination, which is not conducive to the evaluation of students' comprehensive ability. Therefore, the traditional form of assessment is changed to increase the mid-term examination links and increase the usual results in the proportion of the total score. The usual assessment can be used in operations, classroom questions, discussions, reports, experimental operation and the stages of testing and other forms. In the proposition methods and content, a unified proposition is adopted. Teaching and examination are separated. Teachers grade the exams together and use unified scoring standards. Too much rote and simply apply the formula are avoided to strengthen the reflection of students knowledge, ability, quality of the subject. And pay attention to handle the basic requirements and understanding, analysis, synthesis, calculation, textbook knowledge and experimental content of the weight. Through the reform of examination, examination methods, so that the curriculum in stages to achieve the teaching objectives, change one-time, the end of the examination for the whole program assessment form, the whole program assessment as a means of guiding students thinking.

Teaching Students in Accordance with their Aptitude, Exploring the new Teaching System of Scientific Stratification, Rational Grouping, Differentiating, Setting Goals, Combing Knowledge, Integrating Evaluation

Carefully planned for each class, teachers should be the good speaker, actor and host and other roles. According to different levels of students based on the results of the previous semester, the expected level of learning, etc., through the rational design, the students are divided into three levels.

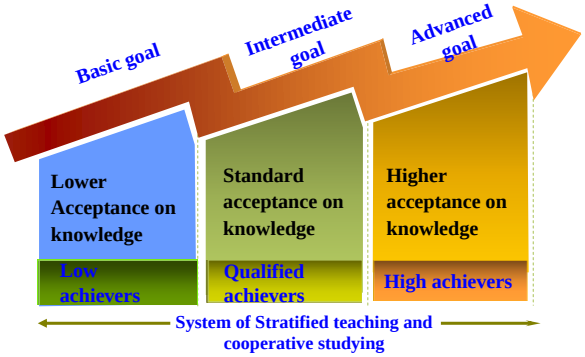

Figure 2. Three-level teaching

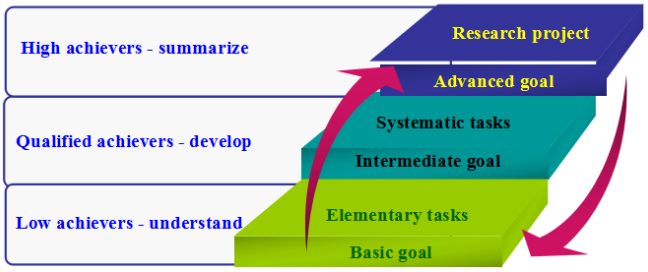

Figure 3. Three-level evaluation

In accordance with the above principles, the development of basic goals, medium goals, enhance the objectives of the three levels of teaching objectives, as shown in Fig. 2. In accordance with the requirements of three levels and three objectives, students work in three levels to set, as shown in Fig. 3. Multiple evaluation really become an effective means of promoting students to promote the implementation of the teaching objectives of all students to make progress.

Optimizing the Course Content and Exploring the New Teaching Method of Heuristic Self-learning Combining Heuristic Teaching with Students Self-study

Differentiating students in accordance with their learning abilities and using specific teaching strategies can not be overemphasized. With the help of the essence of teaching students according to their aptitude and the characteristics of cooperative learning, this paper not only focuses on the making different level of students to get , but also pays attention to the interaction between students themselves, shown in Fig. 4. Furthermore, three teaching modules have been divided in order to break through those old thinking patterns and inspire innovative ideas from the existing life experience, perceptual knowledge and basic theory, shown in Fig. 5. Furthermore, three teaching modules have been divided in order to break through those old thinking patterns and inspire innovative ideas from the existing life experience, perceptual knowledge and basic theory.

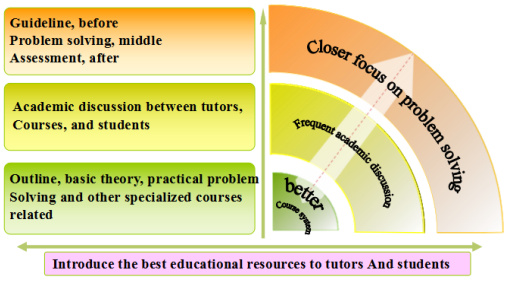

Figure 4. Independent study

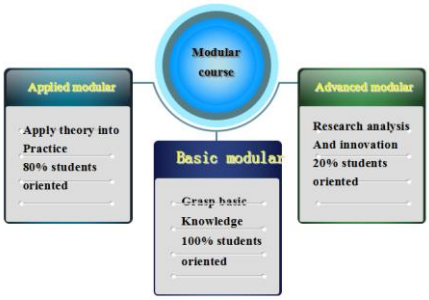

Figure 5. Model-based teaching

Summary

Engineering mechanics teaching reform should combine the curriculum in the teaching plan in the status with role of professional characteristics and the content of the relevant courses of mutual integration and penetration. Finally, the formation of relatively complete and more coordinated system is obtained to create an integral part of the overall optimization of professional teaching plan.

Students of different levels have different levels of development to make construct interaction between teachers and students and the perspectives of teaching atmosphere.

Research result plays teachers leading role and student's main body role and promotes the development of student's knowledge, ability and quality, so that students can understand that the engineering project is courses of engineering mechanics. Contacting basic theory and the engineering practice to achieve both teaching and learning, and ultimately improve the quality of teaching.

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