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# Mechanical Comprehensive Practice-The Course Based on Outcomes-Based Education(OBE) Concept and Comprehensive Ability Training

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**ABSTRACT**

The mechanical comprehensive practice course is put forward based on the OBE and the comprehensive ability training, and the mechanical courses are reformed and practiced from the aspects of teaching content, teaching methods and innovative ability training. This course allows students to complete the schematic design, machine design, Processing, manufacturing, assembly and commissioning to form a complete product training process, and gradually develop students' ability to solve complex engineering problems.

***Keywords:*** *OBE, Mechanical Courses, Teaching reform, Comprehensive ability training*

## 1. INTRODUCTION

"Mechanical Comprehensive Practice (MCP)" is a comprehensive practice course for the major of mechanical design, manufacturing and automation, which integrates the theoretical courses, practical courses and comprehensive training segments, and has the characteristics of foundation, engineering and practice. Its teaching quality is directly related to the learning of the follow-up courses, the ability training of students and the achievement of graduation requirements. Our school has achieved good results since the implementation of MCP in 2015, The MCP reform is mainly aimed at the teaching content, teaching methods and the cultivation of innovation ability [1,2]. Students enter the project from sophomore year, from creative idea, scheme design, engineering design, parts design, parts manufacturing to the final assembly of prototype objects, and experience a complete training process of engineering products, aiming to cultivate innovative people in the mechanical field who meet the development needs of innovative countries, have solid basic knowledge, strong engineering practice ability, organizational ability and international vision Only [3].

## 2. REFORM AND PRACTICE OF TEACHING MODE

### *2.1. Adjust and Optimize the Course Content According to the Requirements of Engineering Certification*

In view of the basic, engineering and practical characteristics of the course, we pay attention to the basic theory and skills, and stress the cultivation of practical ability and innovation awareness. In order to adapt to the requirements of the development of the mechanical science, the course content is constantly updated, adjusted and optimized, and the latest international materials, molding technology, green design, product life cycle design and other results are introduced into the classroom. Strengthen the application of CAD technology and CAE technology, put CAM technology into the teaching of mechanical comprehensive practice, and make the application of modern tools integrate into the whole process of course content. The teaching process strengthens the engineering application background. The topic comes from the annual National College Students' mechanical innovation design competition and the National College Students' engineering ability comprehensive competition. A small number of students can choose and refine the self-designed topics of the engineering projects undertaken by the teachers, which makes the theory and practice closely combined, and improves students' interest in learning.

## 3. REFORM AND PRACTICE OF STUDENT-CENTERED TEACHING METHODS

Adopting the teaching method of "Student-centered, Engineering problems-guided", and combining with the Certification standard for Engineering Education, we will strive to promote research-based learning. In the process of teaching, we should expand the content of teaching, strengthen the cultivation of students' ability of independent analysis and problem-solving, and strengthen the cultivation of practical ability and critical thinking.

(1) With "Student-centered, Engineering problems-guided "method, based on the platform of solving practical problems, and in the form of teacher-student interaction and classmate cooperation, the learning knowledge and

research problems are combined. In the stage of project design, we introduce some ideas and methods of case realization to students in the form of case anatomy, and students complete the learning by means of classroom discussion. After class, students search for information for given projects, submit project reports such as problem solutions and design results in the form of group report, and show, reply, discuss and evaluate the above contents in class. In this process, students not only acquire theoretical knowledge, but also cultivate the ability to analyze and solve problems, expression ability and team spirit [4].

(2) The course content is combined with practical engineering problems, and the course group has designed a number of teaching cases. In the process, multimedia, virtual prototype, prototype, products and other means are combined to show the relationship between theoretical knowledge and practical engineering application. Make students understand how to apply their knowledge in engineering practice and how to solve engineering problems. In this way, students can be trained to use the basic principles to solve the "Complex engineering problems" and stimulate their interest and initiative in learning process. At the same time, students are cultivated to use modern engineering tools, analyze problems and carry out engineering design.

## 4. STEP BY STEP, LAYERED TEACHING DESIGN

On the basis of a comprehensive review of the theoretical and practical teaching of the training of mechanical courses in our university, and a survey of more than 10 colleges and universities at home and abroad, the training objectives of students' engineering practice ability are decomposed and implemented in each segment, and the comprehensive practical teaching design is carried out under the guidance of OBE. A comprehensive practical teaching system is constructed, which consists of three stages: scheme design, part design, machining and prototype debugging, and the corresponding teaching scheme is designed. This paper constructs three levels of engineering ability training model, including basic ability, comprehensive ability, innovation and exploration ability. Under the guidance of Professional certification of Engineering Education, we optimize the teaching system, reform the practical teaching mode, and improve the training objectives of students' basic ability and basic ability.

The specific implementation is as follows: in the first stage, the tasks are assigned in groups, and carry out synchronously with the theory of machines and mechanisms. Students submit the design report at the end of the theory of machines and mechanisms. In the second stage, it is carried out simultaneously with the machine design and manufacturing. The part drawings are submitted after four weeks after the machine design course. In the third stage, students complete the parts processing and manufacturing, the assembly and debugging of the prototype according to their actual situation.

Through the systematic and operable mechanical comprehensive training segments, students' comprehensive ability and ability to solve complex engineering problems are trained. After the students have learned many courses, such as mechanics of materials, the theory of machines and mechanisms, machine design, Fundamentals of mechanical manufacturing, tolerance and measurement, CAD, CAE, etc., they are required to apply the knowledge of many courses to solve a practical engineering problem, and make a prototype from scheme design, part design, prototype processing and debugging. In the process of comprehensive training, there are many segments, such as market research, technical and economic analysis, project formulation, project impact on the environment, etc. Students are recommended to use CAD, CAE and other modern tools to solve design, simulation and analysis problems. Students are guided to use the design manual, master the design standards, and select appropriate parameters. 3-4 students as a group complete the design project, and their team spirit and communication and cooperation ability have been cultivated. The design report cultivates the ability of technical document writing, and the defense cultivate the ability of communication and expression. Through the cooperation of the students and the prototype of the design project, the method of achieving the "complex engineering problems" in the professional certification of engineering education is explored continuously.

## 5. MEASURES TO IMPROVE TEACHERS' ENGINEERING PRACTICE ABILITY

The standard of professional certification of engineering education requires that teachers should have enough teaching ability, professional level, engineering experience, communication ability, professional development ability, and be able to carry out engineering practice research and participate in academic exchanges. The supplementary standard for engineering education certification requires that the teachers with enterprise or relevant engineering practice experience account for more than 20% of the total number of teachers engaged in the teaching of this major [5]. However, most of the teachers in the course group stay at school directly after graduation, lacking engineering experience and engineering background. In response to this problem, we have taken a series of measures.

(1) Implement the mentoring system for young teachers. In teaching, young teachers should be trained and guided from the start. In terms of scientific research, young teachers directly participate in the scientific research projects of instructors, and exercise and improve in scientific research practice.

(2) Employing experienced engineers from enterprises and conducting engineering lectures not only bring the latest trends of the industry to students and teachers, but

also make up for the shortcomings of teachers' engineering practice.

## 6. CONCLUSION

Under the guidance of the professional certification of engineering education, this paper puts 12 graduation requirements, such as students' knowledge, ability and quality, into the syllabus of the course one by one, clarifies the contribution of the course content to the graduation requirements, optimizes and adjusts the teaching content. The teaching method of “Student-centered, Engineering problems-guided” is adopted. Through case-based discussion learning and project-based participatory learning, students' autonomous learning ability and problem-solving ability are cultivated. Based on the output oriented practical teaching design, a comprehensive practical teaching system with three levels of schematic design, machine design, Processing, manufacturing, assembly and commissioning has been constructed. This course includes the basic training of mechanical manufacturing, the mechanical innovation design competition with the base of mechanical innovation competition, the national engineering training competition for College Students, the provincial innovation project, the national innovation project and the knowledge in class Learning together, we should strive to achieve the practice of training students to complete the original schematic design, machine design, processing, assembly, and final debugging to form a complete product training process, and gradually develop students' ability to solve complex engineering problems. The course construction, team construction and platform construction are organically combined to promote each other, so as to achieve the requirements of the professional certification of engineering education to the greatest extent.

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