

# Discussion on mixed teaching mode of Foundation of Mechanical Control Engineering under OBE concept

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**Abstract.** The development of modern science and technology has put forward higher requirements for classroom teaching mode and teaching quality. Applying network information technology to classroom teaching and cultivating scientific and technological talents in line with the new engineering background is a challenging problem in current engineering education. The "Foundation of Mechanical Engineering Control", which combines mechanics and control science, is a key course for mechanical students to integrate disciplines. Guided by student-oriented and goal-oriented OBE concept, the teaching mode is innovated and mixed online and offline teaching mode is adopted for teaching implementation, which greatly improves classroom efficiency and achieves the goal of talent training.

**Keywords:** New engineering; Discipline integration; OBE concept; Mixed teaching.

## 1. Introduction

At present, the fourth industrial revolution marked by artificial intelligence technology will bring human society into a new era of data science, and the form and content of education will usher in structural changes. In the context of the rapid development of the global manufacturing industry, emerging technologies such as intelligent manufacturing, cloud computing, artificial intelligence and robots are widely used in the production field, which can greatly improve production efficiency and ensure product quality. At the same time, the demand for talents in the manufacturing industry is gradually favoring high-quality compound talents with excellent practice and innovation ability. This puts forward higher requirements for the cultivation of talents. To reform the training mode, we should start from each course of the curriculum system, change the curriculum mode and improve the curriculum value.

"Foundation of Mechanical Control Engineering" is a comprehensive course integrating mechanical discipline and control discipline, and it is an important professional course in the curriculum system of training mechanical automation talents. The characteristics of the course are relatively abstract, and the content involved is very extensive, almost involving all the mathematical knowledge, dynamics knowledge and electric power knowledge that students majoring in mechanical engineering have learned before learning this course. Learning mechanical engineering control theory can strengthen students' comprehensive understanding of mechanical systems, master the application of cybernetics in the field of machinery, and cultivate students' ability to comprehensively apply what they have learned.

## 2. Curriculum status

"Fundamentals of Mechanical Control Engineering" is a difficult comprehensive course. Based on classical control theory, the course focuses on the requirements of "stability, rapidity and accuracy" of the control system. The mathematical model establishment of the system, the time corresponding analysis of the system, the frequency characteristic analysis of the system, the stability analysis of the system, the performance index and correction of the system are successively learned in this course. Because the constants of the course are abstract, students often have difficulty in understanding and have a psychological weariness of learning.

Under the background of digital and network era, students have a high degree of dependence on electronic products. The phenomenon students playing mobile phones in class and not listening to

the teacher is becoming more and more serious. It is difficult to pull students from mobile phones back to the real class under traditional classroom teaching mode. At the same time, students can receive more information under the background of the information age, which also provides convenience for students to learn knowledge. The timeworn knowledge is no longer favored by students.

### **3. Discussion on mixed teaching mode under the guidance of OBE concept**

OBE concept is an educational concept that is results-oriented and uses reverse thinking to construct curriculum system [1]. Under the guidance of the OBE concept, goal-oriented and student-centered teaching methods should be continuously improved to cultivate new engineering talents who can meet the requirements of modern industry [2].

Albert Einstein once said, "The essence of undergraduate education is not to learn many facts, but to train the brain to think." In the student-oriented teaching process, it can fully exercise students' thinking ability and stimulate their interest in learning

The application of mixed teaching mode enables students to participate in classroom interaction through the network, which has been widely used in classroom teaching and plays an important role in all aspects of teaching. It not only provides teachers with convenient knowledge sharing mode and student management mode, but also greatly facilitates students to learn anytime and anywhere. The online platform makes the knowledge visualized and easily accepted, and strengthens teacher-student interaction and communication. The barrier between teaching and learning is broken, and the barrier-free learning channel is established. A relatively perfect network teaching platform has been established for this course. On this basis, teachers and students have a good interaction and communication platform to improve the learning efficiency.

#### **3.1 The establishment of teaching objectives**

The formulation of teaching objectives under the OBE concept should fully consider graduation requirements and students' ability. It should clearly focus on the final learning results, and fully consider the content of knowledge, ability and emotion in the formulation of learning objectives in each chapter, so as to help students learning knowledge, developing ability and improving their realm. For example, in the chapter of mathematical models of systems, the goal of competence is to master the knowledge in this chapter and be able to apply the knowledge to establish mathematical models of mechanical and electrical systems. The emotional goal is to be willing to learn, to explore actively, and to cultivate students' spirit of scientific exploration.

The teaching objectives of this course and the teaching objectives of each chapter have been clearly published on the network teaching platform as the guiding content. In the mixed teaching mode, students are assigned to preview the guiding content of the network teaching platform before each class, which can make students clear about the learning content and pay attention to the test method of the results, and help them cooperate with the teacher to complete the learning objectives of each step.

#### **3.2 Implementation of the teaching process**

Under the guidance of the OBE concept, the student-oriented teaching idea should be fully embodied in the teaching process, and the design of the teaching process should fully mobilize the subjective initiative of students, so that students can explore in interest and learn in exploration.

##### **3.2.1 Pre-class session: posing questions and arousing interest**

Before class, the learning task has been arranged through the network platform to guide the students to prepare for the purpose of solving the problem. For example, before learning the chapter of the time corresponding analysis of the system, some first-order systems and second-order systems are firstly given to the students. And then students are assigned to list transfer functions and

summarize them, and answer questions such as "what is a first-order system" and "what is a second-order system". Through self-study and summary, students can gain a deeper understanding of this concept.

### 3.2.2 Classroom session: imparting knowledge, summarizing and discussing

In class the teacher explains the response of first-order system and second-order system subject to typical input signals. Then guide students to summarize the response characteristics of each system subject to different input signals and analyze the significance of each response parameter. For example, the adjustment time of the first-order system indicates the speed of the system response. The rise time, peak time, maximum overshoot, adjustment time, and oscillation number of the unit step response index of the second-order system have their respective meanings. Combining with the practice, this paper puts forward a class discussion question: Analyzing the crowd response during earthquake from the perspective of system response. Hold class discussions in small groups and appoint representatives to speak. The occurrence of an earthquake can be regarded as an input signal, and the crowd is a system. The reaction behavior of the crowd can be treated as the response. Let students put forward their own cases and conduct their own analysis, which is beneficial for the students to understand the meaning of the response and the meaning of each parameter.

### 3.2.3 After class session: practice and application

Timely sharing of learning results after class can increase students' sense of achievement in learning and complete the emotional goals of learning. The exercises for each chapter are arranged and submitted through the network platform, and the discussion topic of exercises after class is published at the same time. Students can discuss and ask questions freely in the topic to improve homework participation and completion.

Since the contents of this course can be realized through Matlab software, it is also a very meaningful work to reproduce the content of each chapter by using Matlab software after class. It can improve students' understanding and application ability of the knowledge points of this course, and stimulate students' interest in learning. Taking the textbook project "CNC linear motion table position control system" as an example, students who have the ability to learn can simulate training through Matlab or other programming software and share it with students through the online platform. Students' innovative competition works are introduced for analysis and innovation, so as to realize the application of classroom knowledge. For example, students' award-winning work "Film laying device based on machine vision" is taken as an example to guide students to analyze and improve its control system, so as to realize the application of knowledge.

## 3.3 The mining of ideological and political elements

In order to train more talents with all-round development of morality, intelligence, physical fitness, and cultivate qualified builders and reliable successors for the cause of socialism with Chinese characteristics. In the learning career of students, each course undertakes the task of ideological and political education and is a foothold for cultivating qualified successors of socialism [3].

The textbook used in this course is the "Basis of Mechanical Engineering Control" edited by Academician Yang Shuzi. Before class, the deeds of Academician Yang Shuzi will be introduced to the students first, and the students will be guided to learn the scientific research spirit of Academician Yang Shuzi. Academician Yang Shuzi is also a promoter and practitioner of traditional Chinese culture. He requires his doctors to memorize the first seven chapters of Lao Tzu and the Analects before the defense of doctor's degree. Through this matter, students realize that traditional is also advanced, and the wisdom of the Chinese nation can still guide us to continue to move forward after sedimentation during thousands of years.

The germ of cybernetics appeared in China as early as two thousand years ago, and at the same time the south-pointing car is a kind of open loop automatic regulation system. The water transport

instrument was used as a kind of closed-loop automatic regulation system during AD 1086-1089. Qian Xuesen, a famous Chinese scientist, published the book *Engineering Cybernetics* in 1954, which applied control theory to engineering practice. The study of these cases can increase students' national pride and inspire students' spirit of fighting for the great rejuvenation of the Chinese nation.

### 3.4 Evaluation and feedback of learning effect

Diversified teaching evaluation can promote students' learning habits. With students as the main body, we should fully consider the individual differences of students, adopt a diversified evaluation system and allocate a reasonable proportion to promote the achievement of teaching results. Teaching evaluation is composed of ordinary scores and final exam scores. Ordinary scores include classroom performance scores, online platform resource learning scores, classroom interaction, online discussion, chapter tests and homework scores, etc.

Teaching evaluation can not only measure the learning effect of students, but also is a feedback of the teaching effect. Under the guidance of the OBE concept, the teaching process can be adjusted and improved with the results to form a closed-loop teaching system. The whole teaching process feedback improvement system is shown in Figure 1.

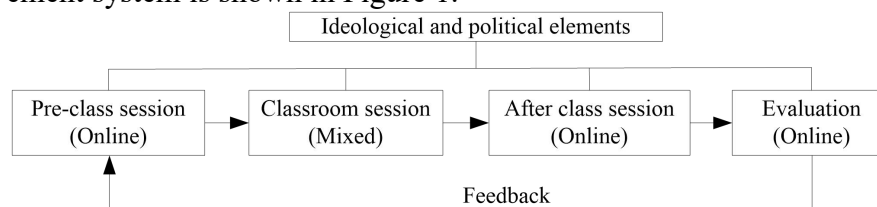


Fig.1 Feedback-improvement system of the mixed teaching process

## 4. Summary

Guided by the concept of OBE, the mixed teaching mode of "Foundation of Mechanical Control Engineering" course is researched, which is designed from the setting of course objectives, the implementation of classroom teaching, and the consolidation after class, so as to realize the purposes of learning anytime and anywhere, retaining learning traces, expanding learning content, and facilitating communication. The students' learning effect and the teacher's teaching effect are measured by various evaluation methods, and the teaching process is further reflected and improved with the result as the guide. Through the exploration and implementation of this teaching mode, students' interest in learning has been significantly improved. On the other hand, team spirit and learning ability of the students have been cultivated, and they can establish correct values and world outlook in the learning process. While cultivating students, teachers' self-cultivation and teaching ability have also been significantly improved, forming a benign closed-loop system to promote the common progress of teachers and students.

## References

- [1] Long Dengyan. Curriculum reform for the course of "fundamentals of mechanical design" based on Outcome-based Education concept [J]. *AGRICULTURAL ENGINEERING AND EQUIPMENT*, 2022(12), 49(6): 56-57.
- [2] Li Xinghua, Sun Ye. Teaching reform and exploration of integrating "OBE concept + Curriculum ideology and politics" into "Fluid Mechanics" course [J]. *HEILONGJIANG EDUCATION(Research and Evaluation of Higher Education)*, 2022(3): 55-57.
- [3] Wang Xiaomei, Du Changkun, Wen Cheng, et al. Exploration and Practice of Course Ideological and Political Education in Fundamentals of Mechanical Control Engineering [J]. *EDUCATION AND TEACHING FORUM*, 2021(9): 97-100.