The Mixed Curriculum Reform of Mechanical Design Basis Based on OBE Concept

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Abstract. OBE concept is the mainstream trend of the development of higher education in the new era. To change the traditional teaching method of Mechanical Design Basis for a long time, This paper carries out a mixed curriculum teaching reform based on OBE concept, establishes a teaching mode guided by ability training, with "online independent learning" & "offline flipping" & "process assessment" & "ability assessment" as the main line, fully mobilize students' time in the second classroom and give full play to the advantages of group cooperative learning, and adopt diversified assessment forms. Uses information platform software to connect the three stages before, during and after class, Through the implementation of PAD teaching and cooperative learning, students can truly become the center of the classroom. Creates corresponding teaching situations, explore "differentiated teaching". Through the integration of course teaching, scientific research and discipline competition, remarkable teaching achievements have been achieved, and the purpose of teaching reform has been achieved.

Keywords: Outcome based education · OBE · Presentation-assimilation-discussion · PAD · Cooperative learning · Differentiated teaching

1 Introduction

The professional certification system of engineering education is a quality assurance system to achieve international mutual recognition of engineering education. Its core idea is to put the results based education, student-centered and continuous improvement mechanism teaching ideas through the whole process of talent training. The outputs of Outcome based education result oriented education include the learning outcomes of training objectives (outputs of professional education), graduation requirements (outputs of students' learning), curriculum objectives (outputs of curriculum teaching), etc. The implementation of OBE education concept in the education and teaching process can promote the continuous improvement of engineering education quality, cultivate students' sense of responsibility and professionalism, which is crucial to improve the quality of engineering talent training [1–3].

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As a platform course of Vehicle Engineering, Mechanical Design Basis is the foundation of subsequent professional courses and plays a connecting role in the professional training curriculum system. Contrast with the teaching innovation requirements of adapting to the new era and new form to create "golden lessons", The curriculum team summarized years of teaching experience and found the following problems: (1) Traditional classroom cramming teaching is the main method. The efficiency of classroom learning is not high. The students lack enthusiasm for learning. They know only a little about knowledge and cannot understand it well;(2) The course lacks modern and comprehensive engineering teaching cases, and the disconnection between theoretical learning and practical engineering practice is not conducive to cultivating students' engineering awareness and engineering practice ability; (3) The course assessment method is relatively simple, which is not conducive to the examination of students' comprehensive ability;(4) The application of information based teaching methods in curriculum teaching reform needs to be improved, especially in the construction of new media or education and learning platforms (Such as Rain-Class and Learning APP) hybrid courses.

2 Teaching Design Based on OBE Concept

In order to meet the demand for innovative talents in the new era, this paper takes the course Fundamentals of Mechanical Design of Vehicle Engineering and Transportation (Urban Rail Vehicles) of Tianjin University of Technology and Education as the research object.

The course team reconstructs the objectives, contents, forms and assessment standards of this course Based on OBE concept, and clarifies the course objectives:(1) Master the basic knowledge, basic theory and basic skills necessary for mechanical design; (2) Cultivate students to establish a correct design concept and have a certain sense of innovation; (3) The students receive engineering training of comprehensive practice by using hands and brains; (4) Cultivate students' ability to undertake corresponding mechanical design analysis and solve practical problems, and develop quality awareness and standard awareness.

Wu Yan, Director of the Department of Higher Education of the Ministry of Education of the People's Republic of China, pointed out that online and offline courses, when developed to a certain extent, become mixed courses that blur the boundaries. Flipped classroom is an effective strategy for online and offline mixed teaching [4]. In order to change traditional cramming teaching, A mixed curriculum reform is constructed, which should establish a teaching mode guided by ability training, with "online independent learning" & "offline flipping" & "process assessment" & "ability assessment" as the main line, fully mobilize students' time in the second classroom and give full play to the advantages of group cooperative learning, and adopt diversified assessment forms. The corresponding teaching design implementation approach is shown in Fig. 1.

Taking the design and manufacture of a multi material handling machine car as a comprehensive case by flipping the classroom, students can not only master the basic theoretical knowledge and design ability of mechanical design, but also cultivate students from the ability of communication, teamwork, expression and leadership, thus improving their comprehensive quality.

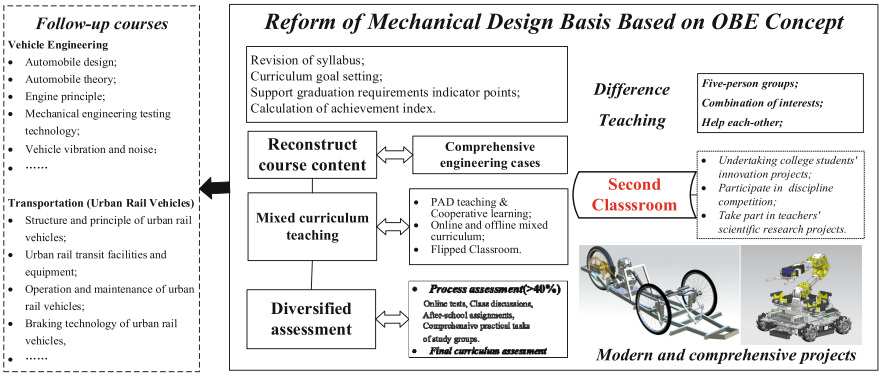

Fig. 1. Reform of Mechanical Design Basis Based on OBE Concept

3 The Practice of Mixed Curriculum Teaching Reform

3.1 Presentation-Assimilation-Discussion (PAD) Teaching & Cooperative Learning

To Explore the reform of "student-centered" teaching practice, The initiative of classroom learning is handed back to the students by using the PAD teaching & Cooperative learning [5]. Which gives full play to individual independent learning, group discussion, teacher guidance and Q&A, encourage students to actively study, and cultivate students' organizational communication ability and sense of competition and cooperation. The grouping principle of cooperative learning is "five people in a group, combining interests and helping each other".

The course teaching design is composed of three links (Fig. 2): Before class, During class and After class: Before class, According to the teaching objectives and requirements of the course, teachers should prepare PPT, China University MOOC curriculum resources and teaching difficulties for students to learn, and release them to the WeChat group of study leaders and the Rainclass platform in advance. The group leader should organize members to preview and complete the homework tasks assigned by teachers; During class, Classroom presentation and group discussion fully reflect the essence of PAD teaching mode, while group learning, group discussion and class communication reflect the idea of cooperative learning; After class, Students review and consolidate the knowledge learned in the class by drawing a mind map, At the same time, Comprehensive tasks with certain challenges will be assigned to students and solved by giving full play to the advantages of group learning.

3.2 Online and Offline Mixed Curriculum

To implement the teaching concept of "student centered and teacher led"[6, 7], The curriculum teaching team explores the online and offline mixed curriculum of the deep integration of information technology, new media technology and classroom teaching. Rainclass & Tencent Conference & WeChat were selected as online teaching tools, Pre

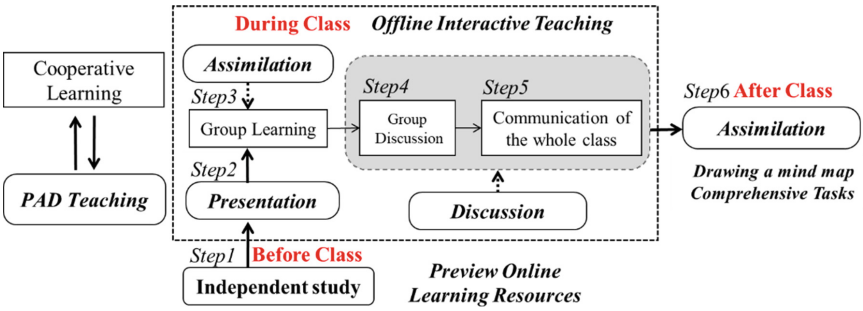

Fig. 2. PAD teaching & Cooperative learning

class guidance and knowledge point preview are mainly recorded and broadcasted. With the help of Love Course online teaching platform, China University MOOC platform, etc. The preview micro video and guidance case resources selected by the teacher are pushed to the students to encourage them to give play to their subjective initiative to preview in advance and carry out autonomous and research-based learning.

Situational teaching and interactive teaching are mainly used for offline teaching. The teachers of the curriculum team optimized the teaching design, integrated the teaching resources, and implemented the inquiry teaching based on the creation of situations, inspiration, cooperation and communication, and reflection and improvement. During the teaching process, the teaching class will be divided into several learning groups to facilitate the organization and implementation of cooperative learning, And students can go out of the classroom to enter the project case scene, create the corresponding teaching situation, effectively improve students' interest in learning, and thus improve students' ability to solve practical problems. Teachers enable students to find problems, think deeply and finally solve problems through participation in discussion, cooperation and other ways, so that students become the center of the classroom and achieve the effect of flipping the classroom in theoretical and experimental courses.

Due to the limited time in class, it is necessary to leave some room for students to play after class, so the homework left for students should allow students to think independently, so that students have a lot of space to play their own, realize the OBE teaching Concept, focus on student development, and improve the ability to solve problems as the core.

3.3 Practice of Difference Teaching Method

Differentiated teaching is based on the students' personality, interests, hobbies, strengths and personal development plans, and develops corresponding curriculum contents and teaching programs to teach students in accordance with their aptitude [8]. Table 1 shows the questionnaire and its analysis of students' differentiated teaching needs in the 2021 academic year. Based on the analysis of the survey data, the teaching classes (60 students) are divided into the following four categories: academic enterprising (mainly for

postgraduate entrance examination), innovative practice (mainly for engineering practice), comprehensive mobile (giving consideration to both learning and practice), and basic learning (mainly for curriculum standards).

According to the category, a mixed research and cooperative learning group is constructed based on the ratio of 1:1:1:2. Academic enterprising students help most students achieve the course objectives. Students with willingness, ability and energy are cultivated from the innovative practice category and comprehensive mobility category by opening advanced comprehensive expansion projects in the second classroom. Cultivating students' team cooperation ability to undertaking college students' innovation projects, innovative practical ability to participate in provincial or national discipline competition and engineering application ability to take part in teachers' scientific research projects.

It is an efficient teaching method to strengthen the integration of machinery and electronics, information, and artificial intelligence technology by using modern and comprehensive cases [9]. For four consecutive years of course practice teaching, the one-time pass rate of students' final exam has gradually increased. Guided students to complete the several National Innovation and Entrepreneurship Training Program and achieved outstanding results in discipline competitions.

4 Diversification of Curriculum Assessment Methods

The final examination paper can no longer evaluate the students' learning effect comprehensively, so it is imperative to change the single form of the final examination to evaluate the students' learning effect [10]. The assessment method based on OBE should be a combination of process assessment and final curriculum assessment, which mainly assesses the learning achievement of students under the corresponding curriculum objectives. More attention should be paid to the comprehensive evaluation of students' practical ability, application ability and innovation ability.

The percentage of process assessment scores shall not be less than 40%, which is composed of online tests, in class discussions, after-school assignments and comprehensive practical tasks of study groups. The final course evaluation is mainly based on improved examination papers, which are divided into two categories: theoretical knowledge test and advanced ability task. Theoretical knowledge test focuses on subjective questions, which is used to check the students' mastery of the basic knowledge of the course; Advanced ability task is open, and there is no standard and unified answer. It strengthens the examination of engineering background and practical ability, Therefore, Advanced ability task aims to expand students' design and innovation ability, truly reflect the teaching effect and quality of the curriculum, promote the continuous improvement of the curriculum, and form a virtuous circle. It is worth mentioning that the final course evaluation also takes into account the equivalent conversion of other achievements according to a reasonable mechanism, such as students' participation in academic competitions, research projects, innovation projects, patents and papers, to fully reflect the comprehensive evaluation of students' knowledge, attitude, ability, teamwork, etc.

Table 1. Investigation and analysis of students' different needs

No.	Questionnaire content	Research results and percentage			
1	Have you ever won a scholarship?	YES		NO	
		20.00%		80.00%	
2	Do you think you usually study attitude?	Active		Passive	
		44.00%		56.00%	
3	What is your graduation goal?	Postgraduate study	Direct work	Indeterminacy	
		33.00%	35.00%	32.00%	
4	Have you ever participated in a subject competition?	Participated	Inexperienced but willing	Inexperienced	
		20.00%	30.00%	50.00%	
5	What do you think of your learning ability?	Strong	Medium	Average	
		20.00%	50.00%	30.00%	
6	Do you have team work experience?	Experienced	A little experience	Inexperienced	
		33.00%	55.00%	12.00%	
7	How do you think you usually think?	Linear	Divergent	Innovative	Comprehensive
		35.00%	37.00%	15.00%	13.00%
8	What are your main sources of learning consultation and information?	Accumulated at ordinary times	Provided by the division commander	Network resource	Library
		18.00%	25.00%	31.00%	26.0%
9	Are you interested in learning the course ?	Strong	Medium	Average	
		33.00%	50.00%	17.00%	
11	Do you think you have a strong desire for extracurricular expansion in the second class?	Strong	Medium	Average	
		20.00%	40.00%	40.00%	

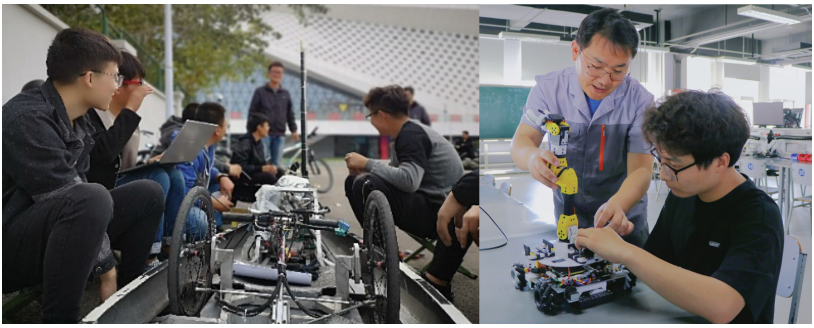

Fig. 3. Modern comprehensive case products

5 Conclusion

The mixed curriculum reform of mechanical design basis based on OBE concept can be summarized as optimizing knowledge, strengthening ability and internalizing quality, which is innovative, high-level and challenging. Teaching practice for years shows that Student-centered research-oriented teaching is constructed, Students can not only master the theoretical basis of mechanical design, but also acquire the ability of good expression and teamwork, critical thinking and judgment, innovation and lifelong learning. In addition, the curriculum team will also make continuous improvement on the curriculum reform, and create a "golden curriculum" through circular iteration.

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