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Reform Measures and Practices in the Multi-directional Cultivation Mode of Civil Engineering

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***Abstract*—To improve the cultivation quality of Chinese higher education, based on analysis of the new circumstance and problems in the Chinese higher education, some reform measures and a multi-directional cultivation mode are introduced in this paper. Taking the professional course of the civil engineering for example, some critical teaching problems existed in the modern Chinese higher education class were analyzed deeply, such as interaction between students and teacher, evaluation methods of the professional course, optimization of course contents, and cultivation of students' creative thinking. Furthermore, after practice, some corresponding measures were proposed to solve the problems mentioned above, such as using the online software, active homework design, and mutual evaluation mechanism. Finally, the new multi-directional cultivation mode of civil engineering is been established.**

Keywords—higher education; teaching reform; multi-directional mode; reform measures

I. INTRODUCTION

In June 2018, the minister of People's Republic of China Ministry of Education, Baosheng Chen, clearly pointed out that it was necessary to reasonably increase the course difficulty on college students at the new era higher undergraduate education conference. The quality of undergraduate education is very important in modern Chinese higher education. In order to improve the undergraduate cultivation quality, it is necessary to make the Chinese undergraduate education return to the original common sense [1]. Therefore, how to improve the teaching methods, how to cultivate students' self-study ability, and how to expand the contents of the course are all focused by higher education teachers. In this article, focusing on the problems mentioned above, some effective reform measures are proposed in the undergraduate education with taking the civil engineering major for example. And it is meaningful to establish a new multi-directional cultivation mode of civil engineering in order to improve the undergraduate cultivation quality.

II. CURRENT SITUATION OF UNDERGRADUATE EDUCATION IN CHINESE COLLEGES AND UNIVERSITIES

The New Chinese Higher Education Situation

1) Change in course periods:

Since the modern Chinese higher education emphasizes on the fundamental knowledge, many professional course periods are reduced. However, the necessary contents of professional course are still kept originally. It makes both teacher and students nervous in learning undergraduate courses.

2) Change in cultivation aim:

In recent years, Chinese higher education developed rapidly. The higher education changed from the elite education to the mass education. Based on this new situation, some famous Chinese university tried to establish the graduate college to accomplish students' cultivation [2]. The change in cultivation aim also brings some teaching problems to teacher and students.

3) Change in undergraduate students:

Most of present undergraduate students are born in 2000s. So, they have some special characters such as strong desire for knowledge, different learning habits, and lower passion on the traditional class learning. On the other hand, many teachers only focus on the explanation of the professional key points in the books and do not concern how to use the professional key points [3]. Therefore, the traditional teaching thought and pattern should make some improvements according to the change in undergraduate students.

III. REFORM ON THE ESTABLISHMENT OF MULTI-DIRECTIONAL CULTIVATION MODE WITH TAKING CIVIL ENGINEERING MAJOR FOR EXAMPLE

From the analysis in the current Chinese higher education situation mentioned above, some effective measures must be taken to make some improvements in Chinese higher education cultivation. We all know that the whole higher education cultivation includes many parts. So, how to establish an effective higher education cultivation mode is every higher education workers' aim. The civil engineering belongs to engineering major. In order to make some improvements in the higher education cultivation, we select civil engineering as the representative of reform and try to make some improvements in its class teaching and other key parts. And finally, a multi-directional cultivation mode of civil engineering major from course teaching to course evaluation has been established.

A. Optimization in the Course Contents

Since the course periods decreased, every course has no enough time to explain in class. So, with the teaching practice, a combination method of class teaching and online teaching has been put forward.

Although the online teaching method is not a new concept in higher education, this method usually separates from the traditional class teaching method. For example, contents of one professional course are often divided into two parts: one is for class teaching, the other is for online teaching. The relationship of two parts is isolated. According to our research, it is had better combine the two methods into the same content illustration. In the practice, class teaching can be used to explain the basic knowledge and the expand knowledge can be used by online teaching method in the same content. This pattern can make the basic knowledge and the expand knowledge keep complementary to each other. It also arouses the students' interest in learning this course.

B. Reform in the Course Teaching Methods

1) Using the PAD(Presentation-Assimilation-Discussion) Class:

The concept of PAD (Presentation-Assimilation-Discussion) class is presented by Prof. Xuexin ZHANG in the Fudan University [4]. The key idea of this method is to allocate half of the class time to teacher's presentation and the other half to students' discussion. The presentation and discussion are separated so that students can have one week in between for self -paced and individualized assimilation. The corresponding learning assessment emphasizes formative evaluation and takes diversified learning needs into consideration. Results from pilot testing indicate that this new method enhanced students' active learning and produced good learning effects. The PAD class is worthy of further testing and spreading as it may be a classroom teaching method suitable to the conditions of Chinese universities [5].

2) Interaction tools between teacher and students:

The traditional interaction tool between teacher and students is language in the class. But the interactive effect is not fit for the modern higher education. As the smart mobile phone is common for students, we also can improve our interaction tools by the smart mobile phone. Padlet is the new effective interaction tool based on the smart mobile phone. Padlet is just like a website. In the class, teacher can select some meaningful topics to publish on the Padlet by the smart mobile phone. And then, students can take part in the topics discussion on the Padlet by the smart mobile phone. Also, teacher can read these discussions and revise them. According to the practice, to select a proper topic is the most important thing in the interaction. A proper topic must attract students to share their thoughts and similar in their daily life. Proper using of interaction tools can improve the class teaching quality definitely.

3) Establishment of the professional course website:

Undergraduate students do not focus on the class teaching any more. They are eager to obtain much more knowledge about the professional course by other ways. Just like what mentioned above, many professional course periods are reduced. That means we do not have enough time to explain each key concept in class. According to our teaching practice, to establish a professional course website is an effective way for us. As a college teacher, to collect professional course information is a daily preparatory work for the course. So, why do we publish this information for students by an effective way? We all know that cultivation of students' self-study ability is very important. Absolutely, we can establish a professional website and put some concepts which students can comprehend easily on it. We can put many course sources or information such as pictures, videos, words, or voices on the website. Subsequently, we can explain some key complicated concepts in class. And other concepts which students can comprehend easily can be put on the professional website. In this way, on one hand, students can train their self-study ability. On the other hand, students can keep course learning after class in their leisure time. Simultaneously, we also can solve the shortage of course periods to some extent.

C. Reform in the Course Evaluation Method

The evaluation method of course is too simple. No matter basic course or professional course, the evaluation method prefers the final exam. This situation results in an unsatisfactory phenomenon. Most of students only focus on the last final exam and do not care daily learning. This situation also results in that some diligent students' learning enthusiasm disappeared. With our research and practice, we can reform our course evaluation method by the following ways:

1) Increase of procedure homework:

If we want our students know that to keep progress in our daily learning is important, we must make them know that course scores are composed of two parts: daily usual scores, and final exam scores. How to evaluate the daily usual scores? With our research and practice, reasonable procedure homework assignment is an effective way. The reasonable procedure homework is not to assign some ordinary calculations or questions. Two characters of the reasonable procedure homework are very important: one is basic, the other is implicational. The reasonable procedure homework should arouse students' learning enthusiasm and practice hands-on ability. For example, to grasp the key points of floor plan is very important for civil engineering students. So, we can assign

them to draw their dormitory by themselves. During the drawing, they can comprehend the key points of floor plan deeply.

2) Design of Cooperative homework:

If we want to arouse students' learning enthusiasm, we must give them chance to finish some works with the knowledge what they learned by themselves. So, the cooperative homework is an effective way to achieve this aim. Cooperative homework can not only help students comprehend the knowledge deeply but also help them to learn how to cooperate together. According to our practice, we can select a typical knowledge point at first. Then, we should design a cooperative homework with considering the typical knowledge point. After that, we can divide the students into some groups. Each group maybe has five or six students. Students belonged to one group must finish the cooperative work by themselves. During this procedure, students can learn cooperation and overcome difficulty together with a team. So, cooperative homework is meaningful not only in knowledge but also in cooperation for students' growth.

3) Establishment of mutual evaluation mechanism between students:

In the traditional way, course evaluation is the unique work which only belongs to teacher. Students only can finish their homework and wait for their scores. To inspire students' enthusiasm for learning, why not try to give student a chance to evaluate their homework? That means the establishment of mutual evaluation mechanism. The mutual evaluation, also known as peer review, is based on the consideration and judgment of the learner's level, value or quality of the learning works or performance of other learners with similar abilities [6]. Introducing students' mutual evaluation mechanism in homework can arouse students' learning enthusiasm [7]. Mutual evaluation between students is not leaving the teacher away. Mutual evaluation means that the basic authority of the evaluation is transferred from the teacher to the student. And the teacher still needs to comment on the final evaluation result. The purpose of establishment of mutual evaluation mechanism is mainly to change the student from passive thinking to active thinking and enhance their enthusiasm in learning.

D. Implementation of CDIO Mode in Course

In 2014, a multinational research group which was composed of four universities (including the Massachusetts Institute of Technology and the Royal Swedish Institute of Technology) has pronounced an education mode. They named the mode as CDIO (Conceive, Design, Implement, and Operate) [8]. The basic idea of this mode is for students to learn how to comprehend knowledge and solve the actual problem. The training program of CDIO mode is divided into two parts: theoretical teaching system and practice teaching system; but the most prominent problem is the theory course teaching. Traditionally, teacher pays more attention to teach more knowledge, also hope their students can grasp more knowledge. For this purpose, homework is also used to train students to understand the concepts that were usually used to enhance the application of theoretical knowledge and problem-solving ability. In general, the basic requirements of curriculums can be achieved for students to learn the knowledge; but the requirements on ability and training are not enough. After learning these courses one by one, students' knowledge is accumulating, but the effective methods are lack for the ability training. In a long period, students pay attention to knowledge accumulation, to do a lot of exercises. However, due to the lack of theoretical application in the actual practice ability, their practice ability dose not be improved simultaneously.

Therefore, in order to improve the practice ability and innovation ability for undergraduate students, in addition to experiment and practice teaching reform, it is important to pay more attention to the reform of the theory teaching and the mode of graduation design. Especially, the theory curriculum dominates the training program. It is the key factors in personnel training. One of the reasons of neglecting ability training is the lack of effective implementation in teaching. The introduction of CDIO education style lets the ability training is able to implement.

According to the CDIO's philosophy of education teaching, students' ability must be paid more attention during the course teaching. Therefore, in the processes of lessons preparing and teaching, we carry out such idea as "not only imparting knowledge but cultivating students' comprehensive ability". Heuristic and discussing teaching modes were used to cause the students' positive and independent thinking. For some examples, teachers try to found practical engineering prototypes. Then, with the help of teaching aids, pictures or video, every class was taught according the following steps such as the problem analysis, model simplification, problem solution and discussion. This process regards a real problem as a reference. It not only improves the students' interest in learning effectively, but also strengthens students' perception of the actual project, finally enhances their ability to solve practical engineering problems.

If we want to make students implement and operate, we should give them a platform at first. According to our practice and research, the professional academic competition is an effective way to achieve this aim. In CDIO education, the environment and opportunities ought to be constructed for students to obtain knowledge initiatively. At present, the main way for students to learn is to do simulation exercises. The present way of "experience the whole process of problem-solving training" changes the learning style that students only do simulation exercises. It also improves the ability of solving practical problems. Students gradually transfer from only doing simulation exercises to enable to solve practical problems.

Taking the civil engineering for example, we design a professional academic competition: the paper design competition. In this competition, teacher only restricts the constraints of basic circumstance and give students freedom to think and design. Then, in order to test the quality of paper bridge model, some loads are given to each paper bridge model. The constraints of basic circumstance are shown in Fig.1. The loading scene of competition is shown in Fig.2.

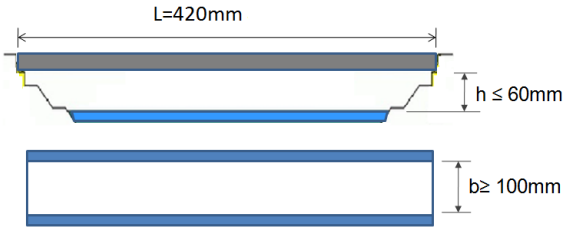

Fig. 1. The constraints of basic circumstance

Fig. 2. The loading scene of competition

During the present reformation performing, some practical engineering problems, which were related to the curriculum theory, were increased as routine homework. They were helpful for students to obtain the opportunity of contacting the real engineering problems. The perceptual knowledge was increased from the complete problem-solving process for students. Students can understand the theory and curriculum knowledge correctly, obtain the upgrade of multi abilities, and change the single mode of learning and rigid mode of thinking. The present teaching mode also stimulates the students' interest in learning, improves students' learning initiative. Students can find problems in practice; improve the sense of innovation in solving problems. Thus, they have more expectations for increasing the opportunity of practice.

With the research and practice, we establish a multi-directional cultivation mode of civil engineering, which is shown in Fig.3. From this multi-directional cultivation mode of civil engineering, we can see reform in every key stage of the cultivation. The multi-directional cultivation mode is an effective way to solve the modern cultivation of civil engineering.

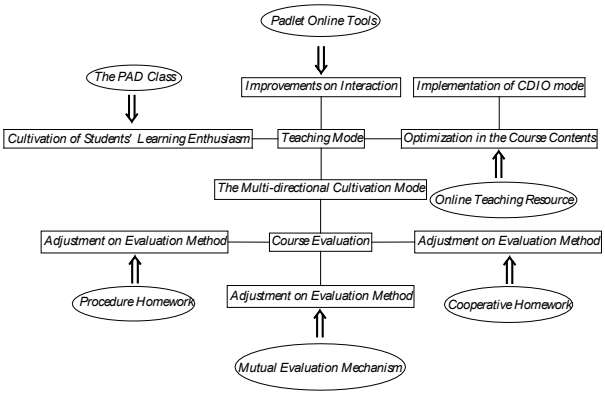

Fig. 3. The multi-directional cultivation mode

IV. Conclusion

With analyzing current situation of undergraduate education in Chinese colleges and universities, some effective reform measures have been proposed to improve the quality of higher education. And finally, the multi-directional cultivation mode of civil engineering has been established. With the research and practice, some conclusions can be drawn as follows:

1) Optimization in the course contents is necessary.

2) Reform in the course teaching methods is effective and useful.

3) Change in the course evaluation method can arouse students' enthusiasm.

4) Implementation of CDIO mode in course can help students to learn implement and operate.

5) The multi-directional cultivation mode can help us to achieve cultivate students effectively.

The reform and practice of the higher education and cultivation mode is meaningful. In order to keep our quality of higher education arising, we should constantly improve our thinking, and to explore a continuously optimized and positive talent training for higher education.

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