Research on the Application of Project-Driven Teaching Mode on the Blended Instruction of Mechanical Design Fundamental

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Abstract—In the context of engineering education professional certification, in view of the objective demand of higher education teaching mode reform, the project-based teaching method and the blended instruction method are organically integrated and combined in the teaching process of mechanical design fundamental, therefore realizing the learning of project-guided course content and forming each small specific project of study and practice. On this basis, through the mixed teaching means, the necessary theoretical guidance for the effective completion of the project is provided. This study organically combines common projects in engineering practice with teaching contents, and make full use of network teaching resources, to improve the learning effect and let the student learn to study and analyze, learn to cooperate with people, learn to summarize, learn to generalize and draw inferences from one example, and finally achieve the purpose of living learning and using. The practice results of the pilot class fully tested the timeliness, feasibility and effectiveness of the project-driven teaching model in the blended instruction of mechanical design fundamental.

Keywords—project-driven teaching mode; blended instruction; integration of methods; mechanical design fundamental

I. INTRODUCTION

At present, the traditional teaching mode is widely used in Chinese universities and colleges namely teachers teach according to textbooks and syllabus, it causes the student's subjective study initiative is poor. In recent years, with the emergence of new education models such as flipped classroom, how to enable students to grasp the theoretical knowledge and apply it in practice flexibly has been paid more and more attention by experts and scholars [1-3]. With the concept of innovation into all aspects of society, improving the innovation ability of college students is an urgent task for college teachers. To improve students' innovation ability, new teaching methods should be pushed into the school teaching schedule, and the teaching work should be promoted by scientific and innovative theories [4].

In view of the above objective needs of the higher education teaching mode reform, the implementation of project-based teaching method plays an important role in the teaching process. This is the inevitable requirement of quality education reform, which is not only conducive to cultivating students' practical ability, but also achieves the unification of theoretical teaching and practical activities [5]. In the actual teaching process in the past, the trial project-based teaching method did not reach the expected effect due to the influence of various factors, and it did not fully reflect the role of project-based teaching. The purpose of this project research is to effectively improve the effectiveness of project-based teaching method. By integrating the concept of flipped classroom into the method of project-based teaching, the defects in project-based teaching can be made up and the level of project-based teaching can be improved [6-9].

The project-driven blended teaching method advocated in this study is dominated by comprehensive practice projects and assisted by theoretical teaching, which has changed the traditional teaching mode for teachers. This new teaching mode is to break the limitation of chapter in textbooks, so that students can master knowledge and improve practical ability in comprehensive projects. It will certainly play a great role in the future college teaching and promote the great development of China's college education.

II. SPECIFIC MEASURES FOR IMPLEMENTATION

A. Project Content Planning

The project-driven blended teaching method advocated in this study is a teaching concept that breaks the limitation of textbook chapters and takes integrated practice projects as the dominant position, to let students acquire knowledge from

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practice and proactively acquire theoretical knowledge driven by the knowledge demand of the project. The selected comprehensive practice project is the classic gear reducer design. Based on this project, each chapter of mechanical design fundamental is thought guided and decomposed step by step, so as to form a more specific small project, namely the theoretical support point, as shown in Fig.1.

![Project thought map of the course content](image)

Based on the design of gear reducer for the comprehensive practice project, before the implementation of the curriculum design, the teacher needs to complete the following work: arrange students into groups and assign comprehensive project tasks to the student project team, set the completion requirements, achievement, method and time for each small project. By using the practical teaching conditions such as open laboratories and innovation laboratories in colleges and universities, project learning and practice are carried out with students as the main body. In the teaching process, teachers shall provide necessary experiments and guidance, formulate detailed grading rules, control process assessment, and evaluate students' specific learning projects upon completion or organize experts to review. For excellent project works, teachers should provide guidance for students to apply for awards or patents, so as to encourage students' enthusiasm in engineering practice. Finally, students will apply the theoretical knowledge of this course or other courses in the design process of the comprehensive project gear reducer. To meet the needs of the project, students acquire theoretical knowledge by consulting materials and teachers, so as to achieve the goal of enabling students to learn theoretical knowledge in practice, and make students to form the overall concept of comprehensive application of textbook knowledge and improve their engineering practical ability.

B. Measures for the Implementation

There are about 16 chapters in the course of mechanical design fundamentals, includes springs, couplings, gear reducers, etc. The content of teaching materials can be explained by task-driven method. After the teaching of each chapter is completed, one or two small projects are designed for interspersed teaching, so as to exercise students' engineering practice ability. When the theoretical content of the book is finished, the design of gear reducer, the established project-based teaching guide project, can be carried out in practice, so as to achieve the purpose of cultivating students' hands-on ability through the comprehensive use of the two teaching methods. Taking the freedom of planar mechanism in the course as an example, the implementation process of a small learning project is shown in Fig.2.

Before entering the content of this part, students are first assigned a small project -- schematic drawing of mechanism motion of jaw crusher and calculation of its degrees of freedom. The knowledge required to complete this small project is numerous and detailed, so the relevant knowledge
points should be designed into three tasks before mastering this part of content, namely to understand the representation method of the component and the motion pair, master the schematic drawing of mechanism motion, and master the calculation of the degree of freedom of the mechanism and the conditions for the mechanism to determine the motion. After receiving the project, students may not know how to start, but in order to complete the established project, we must first drive students to master the above three tasks, because these three tasks are interlinked, from simple to difficult. In the process of the completion of the three tasks above, the acceptance of knowledge by students is no longer simply listening to lectures, reviewing and doing homework, but under the organization and guidance of the teacher, through the analysis and discussion of the task to be completed, clear what is the problem to be solved, what knowledge needs to be applied, and find out what is the learned knowledge and what is the new knowledge, so as to find the way to solve the problem.

When students return to the course design project after completing the above tasks, they will find that the project design is not as difficult as before. At this time, the teacher guides the students into the implementation of the project, and asks them to observe the mechanism model of the jaw crusher and the shaping machine, analyze its movement path, determine the active parts and the passive parts, draw the mechanism diagram and calculate its freedom degree with the knowledge mastered in the task driving, and determine whether the mechanism movement is determined. In order to let the student fully grasp and consolidate, the teacher then gives some other similar projects, or on the crusher project slightly increase the difficulty. For example, students' knowledge was consolidated through shaping machine mechanism motion schematic drawing and degree of freedom calculation and internal combustion engine mechanism motion schematic drawing and degree of freedom calculation. Finally, teachers summarized students' project completion, so as to give a reasonable evaluation.

C. Matters Needing Attention

In the implementation process, the selection of project is the key to meet the relevant requirements in the syllabus, cover the basic knowledge points stipulated in the syllabus, and closely link all parts of them, so as to better meet the characteristics of vocational skills teaching. In addition, no matter how difficult the project is, the project itself should be a small system as a whole, the design of the project should be moderate in difficulty and highlight the combination of theory and practice, and therefore teachers must deeply understand and understand the spiritual essence of these two teaching methods. Second, the teachers must familiar with knowledge of the course, skilled grasp the classroom teaching, organize and guide the student according to the teaching rules, and perform the reform in teaching practice, after the first difficult, interlocking, gradual teaching method, through the design and implementation of project of the course, to cultivate higher real practical abilities of technical talents.

A good course textbook will make the teaching effect get twice the result with half the effort, so it is also very important to choose the right course textbook. Teachers had better be able to write their own textbooks that are suitable for students and have strong practical ability. At present, most commonly used course textbooks do not include the content of detail drawing, which is not conducive to the cultivation of students' practical ability. Mechanical students' drawing ability is the basic engineering ability, in the process of drawing students
need to consult the relevant design manual, familiar with the selection of various parts of the criteria and drawing, so as to cultivate students' hands-on ability. The sample questions in the course textbooks should be adapted to the training objectives, and should be designed to enable students to better understand, understand and consolidate the relevant knowledge they have learned. The textbook of mechanical design fundamental should include computer-aided design, because the emergence and development of computers have promoted the rapid development of the mechanical industry. Design methods related to CAD have been widely used among designers in factories and enterprises. In order to combine the knowledge learned by students in school with the actual design of enterprises, the content of CAD should be properly incorporated.

In the process of learning, every student wants to be affirmed by teachers and classmates, therefore in the project-driven teaching method, it is quite important to evaluate students reasonably. In the process of project implementation, teachers should not only focus on the innovation of excellent students, but also encourage the progress of other students. Teachers should praise and encourage students' progress, and strengthen the interaction and communication between teachers and students, so as to fully mobilize students' interest in course learning. In addition, the instructor should evaluate the project completion of the students on a case-by-case basis. For a student with poor foundation, if he can complete the task correctly, the teacher should give him excellent grades. For a student of medium grade, who can complete the task correctly and think deeply at the same time, the teacher should also give a high evaluation. Specific students need specific treatment, so as to maximize the enthusiasm of students to learn.

III. CONCLUSION

The project-driven teaching method is integrated into the blended teaching mode and designed effectively. This integrative method makes full use of online teaching resources, and enables students to preview and review independently after class to get familiar with the knowledge to be learned. In addition, the method also enables teachers to save class time to carry out effective activities when implementing project-based teaching, so as to relieve the time pressure and provide better project-based teaching for students, thus improving the learning effect of students.

The common projects in engineering practice and teaching content are organically combined, and the project-driven teaching method is integrated into the mixed teaching method of the professional basic course mechanical design fundamental. In this way, students can learn to learn and analyze autonomously, learn to cooperate with others, learn to summarize, learn to generalize and draw inferences through the completion and summary of each project task, and finally achieve the purpose of flexible learning and flexible application.

Through the teaching practice of one semester, the passing rate of the final examination of the course mechanical design fundamental of the pilot class with the project driven mixed teaching method was as high as 81.65%. The pilot class’s pass rate was 13 percentage points higher than that of the class without the project driven mixed teaching method. In addition, the study enthusiasm and initiative of students in the pilot class are obviously outstanding, which is reflected in more active classroom atmosphere, higher attendance rate, better homework completion, and the increased number of students participating in scientific research training or innovation and entrepreneurship competition. In conclusion, the experimental results fully prove the timeliness, necessity and effectiveness of the new teaching method advocated by this research.

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