

# **A Study on the Project-Based Learning Mode with the Ideological and Political Education for Mechanical Design Course**

**Chunxing Gu<sup>\*</sup>, Tianjian Li, Xiaohong Ding**

School of Mechanical Engineering, University of Shanghai for Science and Technology, Shanghai, China

<sup>\*</sup>corresponding author

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**Abstract:** In recent years, many colleges and universities at home and abroad are actively studying the new practice training mode of engineering education. The Project-based learning (PBL) mode with students as the main body of practice is widely studied. Meanwhile, it is of great theoretical and practical significance for students to establish correct values and outlook on life. Therefore, this paper developed a multi-scale closed-loop feedback PBL mode for engineering courses based on the Ideological and political education (IPE). Developing students' knowledge and ability was focused. Taking mechanical design, the basic course of technology major in engineering colleges, as an example, the way to implement the developed PBL mode with IPE was analysed. It could provide a reference for the new engineering teaching Integration for talent training.

## **1. Introduction**

With the progress of times, the new practical training modes of engineering education are widely explored. Educators in Colleges and universities have carried out reforms and explorations in many aspects. These aspects including curriculum, teachers, teaching materials, facilities and training plans. There are a lot of new practical training modes in engineering education. Among them, the PBL mode was widely employed<sup>[1]</sup>.

The PBL mode mainly relies on the curriculum, and it mainly includes two aspects: teacher teaching and student project, respectively. In generally, the implementation steps include: specifying the project requirements, establishing the project team, determining the project scheme, organizing the project implementation and evaluating the project results. The curriculum led project can help students quickly master the knowledge taught by teachers by using these knowledge in the form of practice. As members of the project group, the students could perform their respective duties. The students' team cooperation ability, project management ability, communication skills and leadership can be effectively exercised.

With the development of science and technology, all kinds of thoughts in the society have been vigorously promoted. The students are easily influenced by some unidentified ideas. Therefore, it is of great theoretical and practical significance to cultivate college students' rational patriotism. Generally speaking, the course of IPE in Colleges and universities belongs to the dominant one, while the professional course introducing the ideological and political content belongs to the recessive one. It is necessary to carry out the recessive IPE in the professional courses, in order to construct an all-sided moral educational system.

The PBL mode is a new practical training mode of engineering education, and the IPE is an important means for moral education in Colleges and universities. This paper would take mechanical design as an example to study the PBL mode with the IPE. A multi-scale closed-loop feedback PBL mode with the IPE would be established. Mechanical design course is a basic course of mechanical engineering. It establishes the theoretical foundation for students to learn the follow-up courses<sup>[2]</sup>. It is necessary to carry out the IPE in the teaching process of mechanical design course for students to establish correct values and outlook on life.

## **2. Analysis of Pbl Mode Based on the Ipe**

The PBL mode with the IPE is a set of problem-based teaching methods designed for different learning situations. In order to successfully finish the PBL project, students must integrate their knowledge of various disciplines and cooperate with the team to solve various problems. In this process of project, the comprehensive ability of students can be improved in all aspects.

The PBL mode with the IPE should have the following characteristics: Firstly, integrating theory with practice. Different from the traditional teaching mode, the PBL mode is a teaching mode which establishes a three-dimensional knowledge system and guides students to solve problems. Secondly, Using multidisciplinary knowledge. The traditional teaching mode separates various disciplines and forms independent knowledge. However, in fact, many problems are complicated and need to be solved by combining the knowledge of multiple disciplines. By using multidisciplinary knowledge, it is helpful to cultivate the ability of student to solve the practical problems. Thirdly, Spontaneous learning. In the whole process of the project, the students should determine their learning objectives by themselves. Then they collect, sort out and research independently, and finally discuss in the team. These behaviors will fully mobilize students' autonomous learning ability. The students can acquire and use knowledge effectively in the process of asking questions, solving problems and finding answers. Fourthly, Invisible IPE. Through the analysis and design of the project scheme, the IPE will run through the whole process of the project. The course with the IPE cultivates students' professional ethics and craftsmanship spirit of striving for perfection.

### 3. A Case Study of Pbl Mode with Ipe

Taking mechanical design course as an example, the PBL mode with the IPE established in this paper is shown in Fig. 1. In the PBL mode with the IPE, the passive teaching mode of “teachers speak and students listen” should be changed, while a new teaching mode of students' active participation, independent cooperation, and innovation should be developed. The comprehensive design of course content is emphasized in the PBL mode with the IPE, in order to cultivate students' ability to solve engineering problems in practical work in the future. The PBL mode with the IPE not only involves the traditional methods of analysis and calculation, but also involves the finite element method. In other words, the development of modern design methods and their applications in the course of mechanical design should be highlighted. In addition, the IPE runs through the whole process of project implementation, in order to cultivate students' professional ethics and craftsmanship spirit of striving for perfection. In fact, the history of nation and mechanical development can be used in the PBL mode with the IPE. They are of great benefit to students' understanding of engineering design process, cultivating national pride and self-confidence.

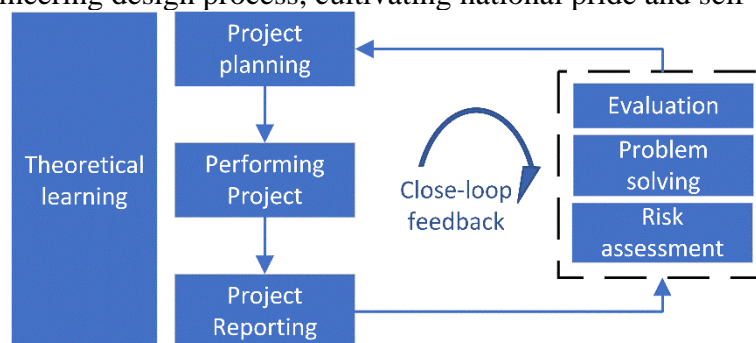


Fig.1 The Overview of the Close-Loop Feedback in the Pbl Mode with the Ipe.

The closed-loop feedback should be used in the PBL mode with IPE. It takes students as the center and emphasizes the functions of the teacher in the project. According to different abilities of students, the project development can be quickly and effectively fed back and the corresponding guidance can be made. Through the process of task planning, task report, task feedback, rescheduling, rereporting and feedback, the problems found in the project can be solved in time. It can help students understand the project better and improve the quality of project.

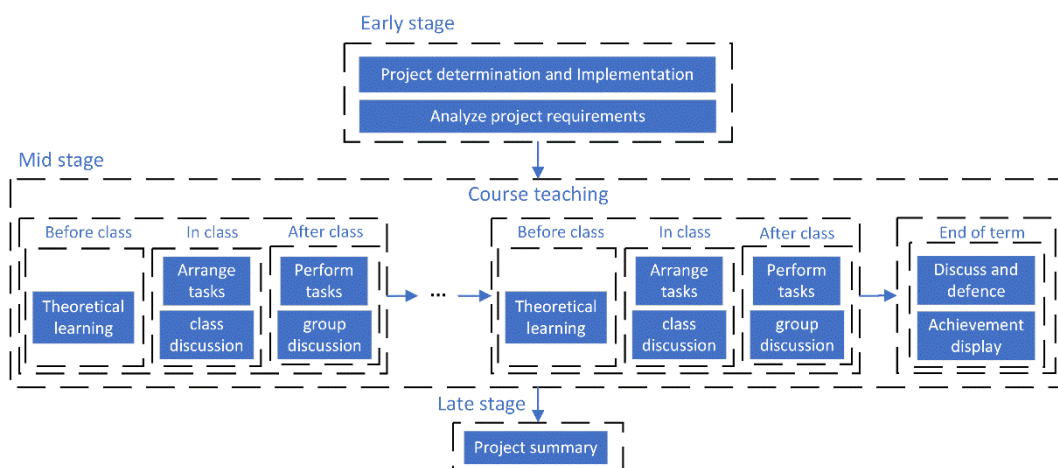


Fig.2 The Overview of the Pbl Mode with the Ipe.

As shown in the Fig. 2, there are three scales in the developed PBL mode with the IPE: project scale, curriculum scale and classroom scale. In the project scale, the students in the class should be divided into several groups. The number of each group is controlled in the rang from four to five. Each group should optimize the combination according to the academic records of other mechanical courses and the proficiency level of computer-aided design and analysis. Secondly, the projects in the PBL mode should mainly come from the practical problems encountered by enterprises and scientific research platforms, and closely related to the course content. The projects designed by teachers should meet the undergraduate ability and have a certain degree of difficulty. According to the project management process, students should analyze the project requirements at first. In the process of project analysis, students take the group as the unit to analyze the content of the project and how to implement it. In this process, the teacher plays a guiding role.

In the curriculum scale, after each team has determined the project plan, the students begin to work together and collect relevant references. Some problems that are crucial to solving should be recorded for the following stage of discussion with the teacher. On the basis of collecting effective references, the students in the group should discuss the problems that can not be solved temporarily in the previous step, exchange suggestions with each other, and record and discuss with the teachers the problems that still can not be solved. In this stage, students should give a preliminary solution to the key problems after cooperation within the group.

After solving the key problems, students should continue to improve the solutions based on the teacher guides and comments. Feedback needs to be passed between students and teachers. In this way, the solutions to the key problems can be revised better. In the final stage, the students of each group will display the project or the finished product of the design. The teachers should organize a jury to evaluate the work of each group comprehensively. Once again, the quality of project can be further improved according to the feedback from the teacher. A closed loop can be formed as shown in Fig. 1. In this process, students would gain a sense of achievement. It would stimulate students' interest in learning and motivation.

In the classroom scale, it is divided into three parts: before class, in class and after class. Before class, it is necessary for students to learn the basic knowledge required in the implementation of PBL mode. It involves the online teaching. By watching the high-quality MOOCs (massive open online courses), students' basic knowledge is consolidated. When in class, the project members should report the weekly work progress to the teacher in the form of class discussion. The teacher is responsible for answering questions, controlling the progress of the project, and identifying the risks of subsequent projects. The project leader should arrange the work tasks of the team members in the next week. After class, the project should be continued, as well as the group discussion.

In addition, different from the traditional PBL mode, the responsibility of teachers is emphasized in the PBL mode with the IPE. It requires teachers to infect students with noble personality and profound theoretical basis. In the process of PBL, teachers should always communicate positive energy with a positive attitude and infect students with their own enthusiasm. Along with the

process of project, students would gradually develop good behavior. The correct ideals and beliefs can be established.

In the PBL mode, the solution of project is not a question of right or wrong, but a question of good or bad. The solution is non-uniqueness. For example, in the design of a shaft hub connection, a lot of connections can be adopted, including the flat key connection, semicircular key connection, pin connection, interference connection, forming connection, etc. Many aspects should be considered in the design process. It results all kinds of possible feasible schemes. The designer should decide which scheme to adopt according to the design task, specific structural requirements, manufacturing conditions, application conditions, etc. The non-uniqueness of the design results (or solutions) can make students understand the PBL mode, and can prompt students to think independently and complete independently. It is not feasible to copy others' answers.

#### **4. Conclusion**

Taking the cultivation of students' knowledge, ability and quality as the center and output as the guidance, a multi-scale closed-loop feedback PBL mode with the IPE was constructed to help students improve their own quality and academic performance. Ideological and political elements can be implied in the whole process of the PBL mode based on the IPE. With the IPE, the PBL mode can effectively improve the students' ability of project management and planning and the ability of analyzing and solving practical problems. This developed PBL mode will provide a reference for the reform and improvement of higher engineering education.

#### **5. Acknowledgment**

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