

Chapter 74

Study of Demonstration Center for Driving Interest Based on Independent Experiment and Exploring Innovation

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Abstract To improve students' innovative thinking and practical ability, this work bases on the constructional platform of demonstration center for driving interest, independent experiment, and exploring innovation. And through the implementation of the experiment curriculum continuum beyond the subject and the class border, this paper focuses on the innovative test platform in civil and mechanical fields. The management platform includes six parts of experimental teaching platform carrying out practical activities of undergraduate research in four of the trinity; school Dean's Office, Youth League Committee, College, Center, experimental instructors and group leaders. And further, the experimental teaching platform formed featured by Holographic perspective of "center-college-school-enterprise" four layers to facilitate undergraduates' interaction. The platform system gives full play to the role of the experiment teaching in developing innovative ability for a better adaption to the requirements of cultivating the advanced application talents.

Keywords Way of inquiry · Teaching system · Subject boundaries · Holographic vision

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74.1 Introduction

With the progress of science and rapid development of economical globalization, the world market economical system has basically formed. Human being goes into a society of economy and learning. Facing this times change, many countries reexamine the idea of higher education. They carried out a series of education reforms named “training of learning ability”, “cultivation of innovative talents”, and “CDIO engineering education” [1]. Our country has entered into a new period toward the overall modernization and building the innovation. A country becomes prosperous and strong only if he owns a multitude of high quality talents and changes the traditional training mode by exploring the new personnel training mode.

Experimental teaching is essential in engineering undergraduate teaching and also an important way in consolidating theoretical knowledge, in training students’ practical ability and in developing the students’ innovative thinking [2]. With the deepening of the reform in China’s higher education development, the expanding recruitment of students scale, the broadening of professional content, and the gradually perfecting of course system, the original experimental teaching system, content, method, and conditions cannot meet the requirement of modern engineering teaching and talents training anymore. It also restricts the teaching reform and the further development, which have a direct impact on the quality of teaching and talent training. The program treats “enhance experimental teaching and strengthen practice teaching, promote theory instruction, emphasize ability training, improve teaching quality” as the goal. Through the construction of the center focusing on students and the experimental system and platform centering on training students’ ability, including system, content devices (hardware platform), teaching materials and evaluation system, change the old way of passive acceptance through doing a large number of exercises and advocate the new way of actively participating in inquiry [3]. Above all are aimed at changing the traditional concept of the experimental teaching attaching to the teaching theory, forming atmosphere of complementary between theory teaching and experiment teaching. The most fundamental essential is to guide students learning actively and improve their comprehensive quality on innovative thinking.

74.2 Construction of Mechanical Experimental System and Platform Featured by the Way of Inquiry and Innovation

Based on the progressive relationship among the discipline knowledge system, the experiment teaching content and resources are integrated, which is designed to reform the technology experiment attached to the theory course experiment. This will take the lead the experiments combination of “theoretical mechanics”,

“material mechanics”, “fluid mechanics”, “engineering mechanics”, “architectural mechanics” experiments, and “structure vibration test analysis” in the national civil and mechanical field. It also opened the independent comprehensive experimental course named Engineering Mechanics Comprehensive Innovation Experiment. This course would not need to rely on theory course entirely any more. Students can choose experiment contents and schedule. They can also set experimental design freely.

The comprehensive experimental course reflects a reasonable structure for the engineering technology experiment content in civil and mechanical field. It acts the application of fundamental mechanics concept, the theory, method in the daily life, and the engineering practice as the guidance, involving civil engineering, the manufacturing of machinery, electricity, aerospace, supplies, toys magic, fashion acrobatics, and many other fields. The key of progressive experiment systems is that students design the experimental schedule independently and have their own test actively [4]. So this can not only cultivate the students’ practice ability in integrated application, but can also practice their holographic ideas and views by promoting their understanding and application in class content. The system belongs to continuum form on experiment course.

Comprehensive experimental course goes beyond the border line between subject and curriculum, which gives students more autonomy and sense of responsibility. The system allows the students to select and organize experiment according to their own interests, requirements, and specialty. The institution bases on self control and self guidance, which provide a good environment for fostering innovative ability in experimental activities [5].

74.3 Expanding Innovation Experimental Project Through the Innovation Idea to Construct the Multi-Level Experimental Teaching System

The system aims to set up different levels on experiment content, which will gradually guide students to learn autonomously, cooperatively, and inquire actively. The experiment topic is given in the way of theory and homework [6]. This allows students to choose experiment content according to their own interests, requirements as well as their goodness. Meanwhile, they can also carry out experiments according to characteristics of the experiments. It is believed that the system guide students to grasp the methods to design and research practical problems. It will lead the student to research and innovate based on practical problems from simple to difficult level through the stratified experiment settings, especially for the design of innovative experimental subject. And also it realizes the optimization on experimental system including of basic experiment, technical experiment, and professional experiments) and structure type consisting of demo test, verification test, designative test, and researching test). The result of this

setting is to broaden the students' view and roads to acquire knowledge actively and further to raise the students' comprehensive quality.

The center of mechanics laboratory (Fig. 74.1) gathered the applications of basic mechanics theory and method in daily life and engineering practice under one roof. It layout the experimental contents in the following five modules, such as the statics, the kinematics, the dynamics, the strength theory as well as the dynamic test analysis, which involved civil engineering, manufacturing of machinery and electricity, aerospace, supplies, toys magic, fashion acrobatics, and many other fields [7]. Such classification demonstrates not only the diversity of practical problems but also the huge effects on the theoretical applications in practical problems [8].

For students of liberal arts, science, and engineering, they should make use of different vivid forms to analyze the innovated application of modeling, composition, color, calculation, experiment, applications, video, and text. The new platform provides all these sources to enlighten students of the lower grades. It tried to reveal that innovative pyramid is attainable as long as someone observe carefully and learn using his heart by many kinds of common cases. This approach will inspire learning interest of these students and provide them with a basic platform of the talent.

For the senior students, the system encourage them to carry out the practice of entrepreneurship education through some simple operation named "training project". In addition, the innovation laboratory is open any time and is available for students who are interested in researching subjects and researching on colleague students' innovation fund projects.

For the selected subjects of postgraduates, the system brighten their vision and supply more rich and colorful contents for local services. Meanwhile, it indicates that profound mechanics knowledge and the keen insight is very important to solve problems in engineering. Nowadays the accumulated experience to solve practical

Fig. 74.1 Mechanics laboratory



problems is also a great treasure in the circumstances of the new materials, technology, system and application, methods emerging endlessly.

This open mode broke the border of traditional subject, and formed the holographic vision system of experimental and practical teaching. So students' have an unprecedented enthusiasm to participate in the experimental learning. Their learning ability, team cooperation ability, expression ability, creative ability, and other comprehensive ability take a good exercise by identifying and solving problems.

74.4 Perfect Management System

The reform of management system and operation mechanism is the organizational safeguard of the experiment teaching. So researching and implementing the scientific and practical management system and operation mechanism will ensure the normal business operates smoothly. These research contents are connected and interdependent. They promote and coordinate each other in their implementation. The experimental center realized the teaching by network and established laboratory platform of information management covering hardware and software. And it also created personal learning environment for the students' independent experiment. The management system includes six parts of experimental teaching platform. They are School Dean's Office, Youth League Committee, College, Center, experimental instructors, and group leaders. For example, the school dean's office issued the Teaching Opening Laboratory Management Method of the Yantai University and the Laboratory Open Fund Management Method of Yantai University. The ministry of public works announced the Planning Implementation Scheme on Traction Target of Yantai University. The Youth League Committee released the colleagues' innovation fund management method of Yantai University. The mechanics experimental center implied the mechanics experimental center open management method. These formed the experimental teaching platform of "students-center-college-school" highlighted holographic vision, which can give full play to the dynamic role of experimental teaching in the innovation ability training. The measure can make the experiment teaching better adaption to the requirements of advanced application talents.

74.5 Playing a Model Radiation by School-Enterprise Cooperation and Officer-Officer Interaction

Because the system focused on the concept of independent design to provide the experimental resources based on specific problems and not on the verification of some certain knowledge, it realized that teaching and scientific research promote

each other by the way of operation mechanism and management. These improved efficiency of teaching and score great successes in recent years. For example, the multifunctional experimental machines and structure mechanics experiment machine that the center has the independent intellectual property rights have been awarded three national invention patents, four patents for utility model. The results still extend the application to other 37 universities; for instance, Tongji University and Harbin Industrial University (Weihai district) besides completing our own experimental teaching tasks (Fig. 74.2).

The colleagues took part in all kinds of activities in science and technology and rewarding fruitfully. For example, one team won the special award (the second place) for Group Corporation in the First National Basic Mechanics Competition in 2010; three special award for individual; seven prizes for personality. Then they participate in the Zhou Peiyuan Mechanics Competition and earned the first place for four years among the universities in Shandong province. And they won the first prize for one item and two second prizes when joined in the three-dimensional national contest on digitizing innovation design and the national college students' advanced graphics skills and innovation contest. Our students took part in the National College Students' Contest on energy conservation and emission reduction getting the first prize and honorable mention. Recently, they awarded the first prize and a second prize in the contest of national college students' innovative mechanical design as well.

The significance of scientific research cannot be neglected. It promotes the teaching level and raises the quality of experimental research. It also cultivated many outstanding teachers from the platform in recent years; for instance, the national outstanding teachers, mechanical excellent teachers, teaching masters from Shandong province, young and middle-aged expert with outstanding contribution Yantai, excellent teachers of Yantai University, and so on. These teachers' works also made a great amount of achievements. For example, they won the first prize for one item in Shandong province excellent teaching achievements; won a second prize for one item, the third prize for six items. The teaching achievement of postgraduate education achieved the second prize for one item as well as the third prize for two items. The center was awarded the demonstration

Fig. 74.2 Multifunctional experimental machines



center of engineering mechanics in Shandong province and the team in charge of the center was named the provincial innovation teaching team on the construction mechanics. The curriculums series including of theoretical mechanics, material mechanics, and engineering mechanics taught by these members was awarded classic curriculum at the provincial level.

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