Region-Educational Research and Reviews, 2024,Volume 6, Issue 12
DOI:10.12238/rerr.v6i12.3013
ISSN Online:2661-4634
ISSN Print:2661-4626

Exploration of the Practical Teaching Reform of the Project Teaching Method in the Basic Mechanical Design Course based on the Fischertechnik

Jian Huang, Zhijian Wan*, Qinyun Huang

Industries Training Centre, Shenzhen Polytechnic University, Guangdong Shenzhen 518055

Abstract: With the development of vocational education undergraduate construction, in view of the problems existing in the teaching of mechanical design basic course, the knowledge structure system of the course is optimized, the design principle of innovative project teaching is proposed, the "double main line" structure of theoretical knowledge unit and innovative design project is established, and the Fischertechnik model is applied to the practical teaching of the course. Practice has proved that the teaching method of the Fischertechnik model project has achieved good teaching effect, which provides a beneficial exploration for the practical teaching reform of the basic course of mechanical design.

Keywords: mechanical design basis, Fischertechnik, practical teaching, teaching reform

Introduction

In 2019, the State Council issued the *20 Articles of Vocational Education*[1]. With the deepening of the construction of vocational education undergraduate, it is necessary to carry out the reform of the basic mechanical design course practice teaching.

1. The problems of the basic mechanical design course

The course "Fundamentals of Mechanical Design" is an important professional foundation course for nearly mechanical majors, which is mainly taught to students in the first semester of sophomore year. The course mainly introduces the working principle, structural characteristics, basic design theory and calculation methods of commonly used mechanisms and general-purpose parts, etc[2].

1.1 Lack of students' rational understanding of course content

This course is an important course for the transition from a theoretical and systematic basic course to an engineering and practical specialized course. The teaching mode of the course is usually teacher-centered, the teacher teaching process is a single method and lack of effective means of display, students are difficult to understand the principles and methods of mechanical design, and they do not know how to apply the knowledge they have learned[3].

1.2 Insufficient hands-on skills of students

The teaching content focuses too much on theoretical knowledge and lacks of practical operation, which makes it difficult for students to apply what they have learned to the design and production of mechanical equipment.

1.3 Insufficient motivation of students to learn

The content of this course is abstract and obscure. Students lack autonomy and enthusiasm for learning the course[4]. The assessment and evaluation of the course is relatively single, unable to fully detect the degree of mastery of the knowledge and skills of the students.

2. The content of Fischertechnik 's innovative project-based teaching reforms

The Fischertechnik was invented by the German inventor Dr. Arthur Fischer[5]. It contains a large number of commonly used mechanical parts, such as connecting rods, gears, cams, sprockets, shafts, racks, synchronous belts, etc., which can be combined to build a variety of commonly used mechanisms of the motion model. In addition, the Fischertechnik model also contains motors, sensors, controllers, air pumps, cylinders, solenoid valves and other electromechanical components, as shown in Figure 1.

Figure 1 Fischertechnik Electromechanical Components

2.1 Design principles of Fischertechnik 's innovative project-based instruction

In the context of undergraduate vocational education, the course "Fundamentals of Mechanical Design" should focus on cultivating students' mechanical design ability and innovation ability. Therefore, the following principles should be followed when designing the Fischertechnik Project-based Practical Teaching Program:

2.1.1 Principle of combining theory and practice

The theoretical part of the basic mechanical design course content is relatively large, students have difficulties in understanding the abstract concepts. Fischertechnik model can be easily assembled plane four-bar mechanism, gear drive mechanism, cam drive mechanism, screw drive mechanism and other models.

2.1.2 Principle of combining innovation and professionalism

The project design should not only highlight innovation, but also be close to the actual situation of the profession. Six Fischertechnik innovation design projects were finally designed, including a bionic robot dog, a garage gate railing, a model of an internal-combustion engine, an oscillating fan, an alcohol sterilizer, and a lifting elevator. Each Fischertechnik Innovation Design project consists of several chapters of knowledge points, students can carry out the Fischertechnik Innovation Design project after learning the corresponding chapters.

2.1.3 Principle of combining guidance and inspiration

The Fischertechnik Innovation Design Program process consists of five parts:

(1) Do what?

Firstly, the tasks and requirements of this Fischertechnik Innovation Design project are clarified, and students are guided to think about the relevant scenarios with the set theme. For example, to carry out the oscillating fan project, students think about the types of oscillating fans in life and the way of oscillating action.

(2) How?

Students need to think about what kind of mechanism combinations can be used to realize mechanical motion. For example, the forward motion of the bionic robot dog can be achieved with a crank rocker mechanism, as shown in the

figure 2.

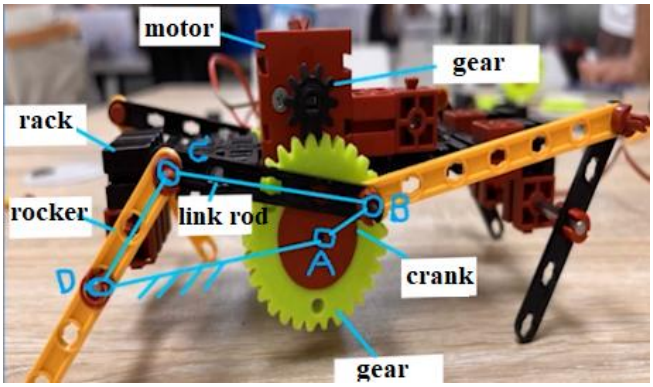

Figure 2 Bionic Robot Dog

(3) Getting Started

Students started to build the Fischertechnik model in groups, with the group leader dividing the tasks among the group members, 2 for assembly, 1 for wiring, 1 for programming, and 1 for explanation.

(4) How about

After model construction in the specified time, the group leader explains the mechanical structure, electrical components, working principle, programming code of the completed work, and then carry out mutual evaluation and scoring of the group. Finally, the teacher reviews and scores the works of each group, analyzes the strengths and weaknesses of each group's works.

(5) Thinking Outside the Box

The part is a way to cultivate the students' mechanical innovation design ability. For example, the garage gate project how to realize the effect of the car to the gate raised, the car away from the gate down, the student works as shown in the figure 3.

Figure 3 Garage Doorway Gate

Through these five parts of the content to carry out, not only stimulate students' enthusiasm for learning, but also improve the students' willingness to learn independently.

2.2 Effectiveness of the implementation of project-based teaching

Classes 1 and 2 of Mechanical 23 of the College of Mechanical and Electrical Engineering were selected as the pilot subjects of the project-based teaching method of Fischertechnik Modeling, while Classes 3 and 4 were adopted as the control group with the original teaching mode. Students' learning feedback on carrying out the curriculum project-based

reform was collected by means of questionnaires.

Table 1 Teaching feedback questionnaire statistics

Classes	Self-directed learning capacity	Creative thinking skills	Practical ability	Satisfaction with Teaching Effectiveness
Mechanical 1	86.3%	90.9%	93.2%	95.5%
Mechanical 2	87.2%	84.6%	89.7%	92.3%
Mechanical 3	75%	62.5%	60%	77.5%
Mechanical 4	66.7%	59%	51.3%	76.9%

It can be seen that the project teaching method using the Fischertechnik model has greatly improved the students' independent learning ability, innovative thinking ability and practical operation ability.

3. Conclusion

In this paper, for the mechanical design foundation course students' learning initiative is not strong, hands-on practical ability is weak and other problems, carried out the project-based practical teaching reform based on the Fischertechnik. By optimizing the knowledge structure system of the course, the "double main line" structure, which integrates theoretical knowledge unit and innovative design project, is established, the Fischertechnik model is applied to the theoretical and practical teaching of the course, which provides a useful exploration for the reform of practical teaching of the basic course of mechanical design.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Xinhua News Agency. The State Council issued the "National Vocational Education Reform Implementation Plan" [J]. Education Development Research. 2019; (3): 77.

[2] Wang WM. Reform practice of Basic Course of Mechanical Design in Higher Vocational Colleges based on OBE concept[J]. Use and Maintenance of agricultural machinery. 2024; (5): 153-156.

[3] Zhao B, Ding Y. Application of online + offline mixed Teaching in Basic Course of Mechanical Design[J]. Papermaking Equipment and Materials. 2023; (10): 212-214.

[4] Gui J, Luo ZH, Zheng JM. The application of project Teaching Method in the basic course of Automotive machinery[J]. Automotive education. 2024; (1): 197-201.

[5] Fan XD, Ying WJ, Li YP. Application of Fischertechnik creative combination model in the teaching of basic course of mechanical design for near machine majors[J]. 2017; (12): 95-97.

About the author

Jian Huang (1988 -), male, Han nationality, Lecturer, Master of Engineering, research direction: Mechanical design, etc.