ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202210_5(10).0020

Research on Task-Driven Teaching Reform and Practice Based on Science and Technology Competition

-- Take the Training Course on Mechanical Innovation Projects as An Example

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Abstract

In order to improve the teaching effect of the mechanical innovation project training course and improve the professional ability to cultivate school students to solve complex engineering problems, this paper proposes a project-driven teaching method based on science and technology competition and practice teaching in the mechanical innovation project training course. Based on the Robocon competition theme of the National Robot Competition for College Students, the teaching content was sorted out and reorganized, and different teaching projects and tasks were formulated according to the teaching objectives. Task-driven + online and offline mixed teaching was used to carry out task teachings such as program design, parts processing and control system production, and integrated courses. Ideological and political, through the achievement of different tasks, cultivate students' comprehensive ability in product design, production, assembly, control system production, and debugging. After three rounds of teaching practice, relying on the studio of this school, he led the students to participate in the Robocon competition of the National Robot Competition for College Students. He won many first prizes in the country, effectively improving the students' creative and practical abilities.

Keywords

Mechanical innovation project training; Science and technology competition; Project-based teaching; Task-based teaching.

1. Introduction

In October 2018, the Ministry of Education, the Ministry of Industry and Information Technology, and the Chinese Academy of Engineering issued the "Opinions on Accelerating the Construction and Development of New Engineering and Implementing the Excellent Engineer Education and Training Program 2.0", focusing on improving students' ability to solve complex engineering problems and increasing curriculum integration. Promote implementing case, project-based, and other research-based teaching methods, and pay attention to comprehensive project training [1]. The mechanical innovation project course is a comprehensive training course aimed at cultivating students' comprehensive mechanical design, production, and single-chip control ability. In cultivating practical ability, it should focus on the basic training of innovative design concepts and comprehensive design skills. In contrast, the current mechanical innovation project training course mainly focuses on students' textbook teaching and small production, lacking comprehensive practice of actual cases. Students cannot obtain a complete engineering training process based on problems, problem analysis, program design, production, and debugging, and learning enthusiasm and initiative are also affected. 2-5].

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Robocon, the National Robot Competition for College Students, started in 2002 and is held yearly. The champion team of the competition represented China in the Asia-Pacific University Robotics Competition (ABU Robocon) hosted by the Asia-Pacific Broadcasting Union (ABU). The active participation of young students and the strong support of many institutions have contributed to the healthy development of the competition. The competition has become the most technically challenging and influential robotics competition for college students in China. Participants need to use mechanical, electronic comprehensively, control, computer, and other technical knowledge and means, and after about ten months of production and preparation, use robots to complete the tasks set by the rules. As a high-tech competition platform, this competition has attracted strong interest from college students from the very beginning. By integrating the resources of universities, media, enterprises, and the government, this event has become the most momentous event in China's science and technology colleges, making positive contributions to robotics education and fostering a large number of outstanding talents in China's robotics industry and related fields of technology. Entrepreneurs and engineers [6].

Project-based task-driven teaching is based on completing each specific task as a clue, and the teaching content is subtly hidden in each task, allowing students to ask their questions and solve problems by themselves after thinking and the teacher's advice [7] -9]. Therefore, based on the Robocon competition of the National Robot Competition for College Students, this paper combines the theme of the competition and sets up typical and targeted practical projects and tasks to let students think about the starting point, formulate a solution path, complete the practical operation, and master the understanding through continuous thinking. Problems, problem analysis, and problem-solving methods improve students' ability to solve engineering problems and re-learning.

2. Project-driven Teaching Ideas and Their Advantages

The task-driven teaching idea based on science and technology competition refers to splitting different projects based on the theme of the competition, using these projects to design teaching tasks, task-driven, online and offline hybrid teaching methods, and guiding students to design the overall scheme, mechanical structure design, control system design and production, organize students to display, discuss and improve the plan repeatedly; use 3D software to build models and simulate motion, find structural design problems, and complete virtual prototype production; finally, through 3D printing technology and machining methods, complete some critical parts of the work produced. Cultivate students' comprehensive practical ability and effectively improve the quality of teaching. The teaching implementation steps are as follows

1. Reorganize the teaching content according to the training objectives and curriculum standards;

2. Combine the teaching content and the theme of the competition, formulate the project and task content based on the design process;

3. After-school parts processing, production, assembly, etc.Strengthen work training ability;

4. Inspection, evaluation, and guidance.

3. Specific Implementation Measures

The project-driven teaching reform based on science and technology competitions mainly starts from three aspects: sorting out teaching content, formulating project content, and strengthening work training, effectively improving students' engineering practice and innovation ability.

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3.1. Sort out the Teaching Content

Take the Robocon competition theme of the 20th National Robot Competition for College Students as an example: the theme of "throwing the pot," a traditional etiquette and game in ancient China. The game is played between the red and blue teams. Each team can have up to two robots, "Robot TR" is a manual or automatic robot that can only throw arrows into the pot in the outer zone, and "Robot DR" can both perform defensive tasks in the inner zone and throw arrows in the outer zone. Manual or automatic robot into the jug. Based on the above topics, it is necessary to complete the design and production of two sets of robots. At the same time, two robots need to complete the communication and cooperation, which involves comprehensive ability training in mechanical design and electrical control [10]. By analyzing the above subject requirements, formulate the functional design of the robot mechanical body, the optimal design of the mechanical structure, the establishment and simulation of the 3D model, the drawing of engineering drawings, the processing of parts, and the preparation of the robot cooperative control program, and then design the content of the tasks based on each project. Find suitable ideological and political points, and cultivate talents with both ability and political integrity.

3.2. Develop Project/Task Content

Table 1. Teaching project formulation

Teaching project	Teaching content	teaching method	Ideological and political points	class
Item 1 Functional principle optimization design	Task 1: Optimization of the functional principle of the robot solution Task 2: Modification of the robot function scheme	Project-driven teaching, linking online and offline mixed teaching in the second classroom	Develop a craftsman spirit of excellence	4
Project 2 Mechanical structure optimization design	Task 1: Rational Design of Institutional Selection Task 2: Part selection and design rules	Model inspection Demonstration teaching, cooperative learning, independent learning, and online and offline mixed teaching in the second classroom.	Cultivate innovative practical ability. Improve teamwork ability. Improve job awareness and professionalism.	4
Project 3 3D model building and simulation	Task 1: Sketch Modeling Task 2: Component Modeling Task 3: Build the assembly model Task 4: Robot Motion Simulation	Problem guidance, task-driven, operation demonstration, group discussion	Cultivate students' awareness of principles and rules; national honor and pride.	4
Project 4 Drawing of engineering drawings	Task 1: Sketch the robot assembly drawing Task 2: Drawing of key parts Task 3: Drawing the robot assembly drawing	Demonstration teaching, cooperative learning, independent learning, and online and offline mixed teaching in the second classroom.	Legal awareness and standardized operation	4
Project 5 Parts Machining and Assembly	Task 1: Machining of key parts Task 2: Assembly of key components	Demonstration teaching, cooperative learning, independent learning, and online and offline mixed teaching in the second classroom.	Standard operation, safe operation	8
Project 6 Robot collaborative programming and debugging	Task 1: Chassis Drive Control Task 2: Robotic arm drive control Task 3: Collaborative communication between two robots	Demonstration teaching, cooperative learning, independent learning, and online and offline mixed teaching in the second classroom	Dedicated to work, pragmatic and effective	8

By sorting out the teaching content, formulating the content of the teaching project, as shown in Table 1, and adopting the project-driven method to carry out student-centered learning in

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202210_5(10).0020

practice and practice learning through the mixed method of the online classroom and offline practice teaching Practical teaching practice.

3.3. Strengthen Engineering Training

This article combines the actual situation of the engineering training center of Wenzhou Vocational and Technical College. The school's intelligent manufacturing college has set up a practice session of engineering training for students. Through the practice session, students can complete standard turning, digital turning, general milling, digital milling, wire cutting, etc. Machining equipment operation training, electronic application, mechatronics, and other ability training. Taking into account the typical supporting technologies involved in the science and technology competition, the training content of the mechanical innovation project training course is more complex and in-depth, focusing on improving students' design, processing, assembly, debugging, and after students complete the engineering training specified by the teaching in the metalworking training base. The participating students complete the design, simulation, machining, installation, debugging, and modification of parts processing in their spare time, exercise their ability to think independently, practice hands-on, comprehensive development and teamwork, and cultivate their creative ability. The student training scene is shown in Figure 1.

(a) Operation training of students' machining equipment (b) Application of students' 3D printing equipment

(c) Student electronic application technology training (d) Student robot-making process

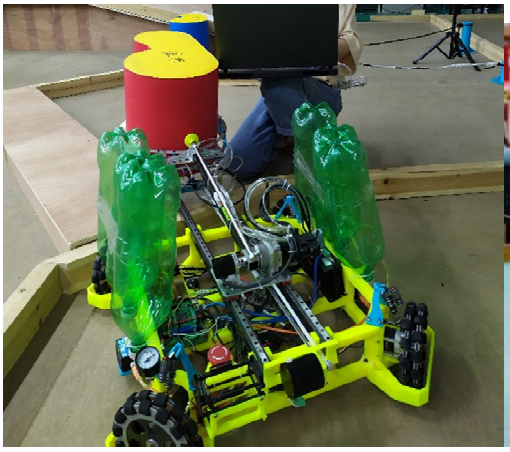
Figure 1. Engineering training

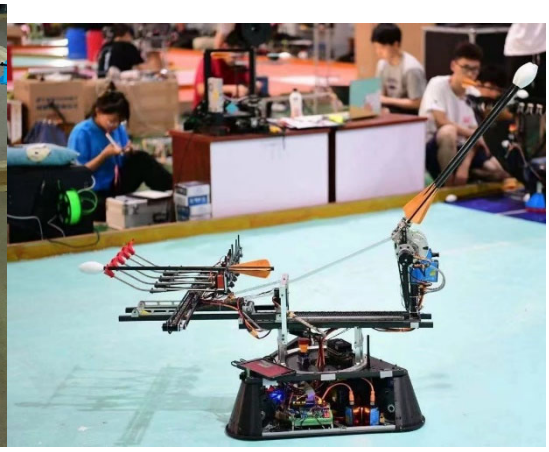
ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202210_5(10).0020

4. The Effectiveness of Teaching Practice

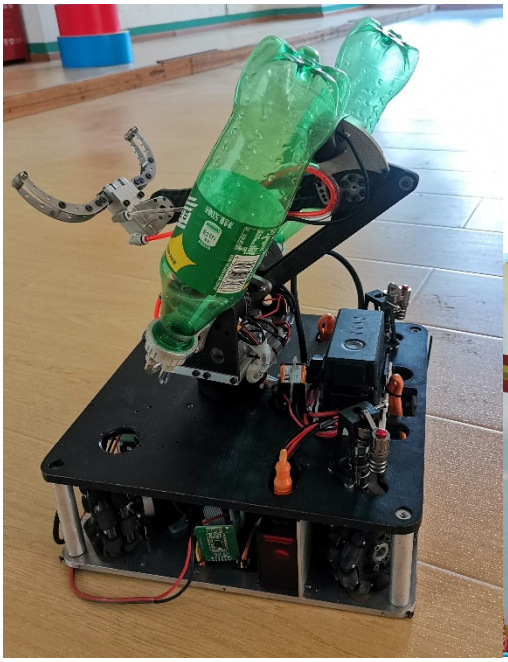
4.1. Student Practice and Works

In recent years, the project has effectively improved students' design and production ability through the above teaching practice. Relying on the master studio of this article, he led the students to participate in the Zhejiang Robotics Competition for College Students and the Robocon Competition of the National Robotics Competition for College Students. The students completed the design and production of many works and achieved effective results. Some works are shown in Figure 2.





(a) Works of the 18th National Robotics Competition for College Students (b) Works of the 20th National Robotics Competition for College Students



(c) Works of the 6th Zhejiang Robotics Competition for College Students (d) Certificate of Merit of the 20th National Robotics Competition for College Students

Figure 2. Part of the competition works

4.2. Teaching Effectiveness

Personalized learning is realized through teacher organization, student grouping, and teamwork; combined with task-driven, online and offline dual-classroom teaching, to cultivate

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202210_5(10).0020

students' craftsmanship spirit of hard work and excellence; mechanical innovation project training courses are based on the theme of science and technology competitions The project drives teaching reform and practice, laying a solid foundation for subsequent discipline competitions, graduation projects, and patent applications. In the past three years, the award-winning participation situation has been subject to competition in Table 2. In addition, students have obtained more than ten patents.

Table 2. In the past three years, the award-winning participation situation has been subject to competition

years	Event name	first prize	second prize	third prize
2019	The 18th National Robot Competition for College Students Robocon	1	0	0
	The 3rd Zhejiang University Robot Competition	0	1	0
2020	The 19th National Robot Competition for College Students Robocon	1	0	0
2021	The 20th National Robot Competition for College Students Robocon	1	0	0
	The 5th Zhejiang University Robot Competition	1	0	0

5. Conclusion

In the teaching of mechanical innovation project training courses, this paper combines scientific and technological competitions and sets up typical and targeted practical projects and tasks to allow students to think independently, work in teams to formulate solutions, complete practical operations, and master the knowledge through continuous thinking. Problems, methods of analyzing and solving problems, as well as the strengthening of practical training for different tasks, improve students' ability to solve engineering problems and re-learning, and inject opportunities for innovative education.

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