

Application of STEAM Theory in Robot Teaching

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Abstract. After the 21st century, the demand for comprehensive talents in the United States is increasing. In order to accelerate the country's economic development, STEAM (science, technology, engineering, art and mathematics) talent cultivation strategies have been deployed. With the widespread spread of STEAM education concepts around the world, robots have gradually entered the classroom and become an effective carrier of STEAM education. Robotics education requires a combination of interdisciplinary knowledge and a project-based approach to solving practical problems in life. Under the guidance of project-based learning theory, the teaching model based on STEAM theory can be used to implement robot education more effectively, and it is conducive to promoting the cultivation and comprehensive development of high-tech talents.

Keywords: STEAM theory; robot teaching; teaching model research; project-based learning.

1. Introduction

The term STEAM comes from the United States and was promoted to a national education strategy for K12 in the 21st century with the aim of cultivating innovative talents with comprehensive capabilities. STEAM education is not only an organic superposition of multiple disciplines, but also represents an interdisciplinary integrated education model. As a leader in modern interdisciplinary education, robot education has gradually entered the children's classrooms and classrooms. In 2017, the "New Generation Artificial Intelligence Development Plan" issued by the State Council raised the artificial intelligence and robot education in primary and secondary schools to an important level. In the actual teaching process of robots, educators combine various contents to teach, so that students can not only learn advanced robotics in robot education, but also learn the knowledge of various disciplines. At the same time, through the students' own hands-on practical operation, cultivate their innovative consciousness and ability [1]. It can be seen that robot education conforms to the STEAM education concept and is based on the teaching practice and exploration of this concept.

2. Robot Education under STEAM Theory

STEAM education is called "quality education" in the United States, which can improve students' overall competitiveness and ease employment pressure. The publication and research of STEAM education theory is in line with the development of the times and reflects the demand for talents in the new era.

With the maturity of robotics, the figure of robots began to appear in the classrooms of primary and secondary schools. Education education departments at all levels in China, schools and educators from all walks of life also support and carry out robot education activities in different forms. But in general, there is a lack of systematic research on robot education in China, especially in the first-line teaching process, there are many problems and doubts.

Therefore, from the perspective of STEAM education, it is very meaningful to look at the issue of robot education.

2.1 Core Features

Yu Shengquan pointed out that the integrated core features of STEM education are: interdisciplinary, interesting, experiential, situational, collaborative, design, artistic, empirical and technical enhancement [2]. These characteristics are also reflected in robot education.

Robot education is the carrier of quality education, covering a wide range of fields, and is a representative expression of the intersection of science, technology, engineering, mathematics and

art. It breaks down the barriers between disciplines and emphasizes the integration of interdisciplinary content. The robotics classroom is based on the student's interest and is in line with the students' cognitive rules and characteristics. The gamified classroom has more experience than the traditional classroom. Interesting; in the process of building a robot, students must not only do it, but also immerse themselves in the whole process of learning to actively think. Naturally understand and accept knowledge in the process of experiencing the classroom; Robotics course transforms abstract and boring theory into practical operation, enabling students to learn in real situations and solve practical problems encountered in life; students face different The problem is divided and cooperated, and each team inspires and solves difficulties. The robot classroom includes design works, emphasizing design and artistry, externalizing the learning results and enriching students' creativity.

2.2 Project-based Learning Model

Project-based learning centers on the concepts and principles of disciplines, with the goal of producing finished products and marketing them to customers. It is a new type of inquiry learning model that can use various resources to carry out practical activities in the real world and solve a series of interrelated problems in a timely and effective manner [3].

Project-based learning runs through the entire process of robotics education. The project is driven by a practical problem that motivates students to participate in the event. Students use a multidisciplinary cross-discipline to complete one or a series of works through a variety of cognitive tools and information resources through communication and scientific inquiry. In the process of completing this project, a specific problem situation was created. Students can not only satisfy the interest in robot learning, but also construct knowledge generation, memory and knowledge transfer. The learning model focuses on students, emphasizing students' practical operations, thereby improving their hands-on ability, design ability, inquiry ability and teamwork ability, allowing students to “learn by playing”, “learn by thinking”, “learn by doing” .

3. Robot Course Teaching Design based on STEAM Theory

3.1 Teaching Objectives

The overall goal of robotics education is to develop students' comprehensive STEAM literacy, with a special focus on improving students' innovative abilities, including problem solving, critical thinking, and conceptual understanding.

Knowledge and skills: In the real problem situation, through the exploration of the theme, understand and master the relevant interdisciplinary knowledge, design and produce working models, accumulate life experience, solve practical problems, and enhance the ability to innovate in the actual hands-on operation process. And scientific literacy.

Process and Method: You can use science, engineering, mathematics and other methods to explore the subject of the experiment and complete the project. Find problems and solve problems in cooperation and communication, and draw corresponding rules and conclusions, so as to learn scientific knowledge and scientific thinking processes and methods, and cultivate a good scientific literacy and innovation consciousness.

Emotional Attitudes and Values: Cultivate the scientific awareness of students' courage to explore, patient and meticulous learning attitudes, experience the value brought by applying knowledge, stimulate students' imagination and creativity, and cultivate students' communication and cooperation skills through group research.

3.2 Teaching Content

The teaching content of intelligent robots in primary and secondary schools in China can be divided into two categories after integrating into the STEAM concept: one is the relevant knowledge of robotics, and the main content of robotics courses, including basic knowledge of robots, robot hardware, robot programming, robotics Simple applications and other four aspects. The other part is

related to robot social issues (ie STEAM related content). The contents of these two parts are mutually infiltrated and integrated, and there is no clear dividing line.

Specific to a robot classroom, students need to teach how to use mechanical, electronic, sensor and other devices to build a simple robot model according to the classroom theme project. Through graphical programming, students will be divided into several cooperative groups to complete the specified activity tasks. competition. Understand the scientific principles in this active classroom atmosphere, master the basic structure, use the resources such as the network, complete the writing of the robot program, and realize the specific functions to solve the practical problems.

3.3 Teaching Strategies

Robot education based on STEAM theory emphasizes that students are placed in actual situations for scientific inquiry, and students' divergent thinking and logical thinking are cultivated. Scientific inquiry teaching

Scientifically oriented, robots are used as a vehicle and tool for scientific inquiry, and provide technical support for data collection and processing for inquiry learning [4]. Based on constructivist theory, before the teacher or curriculum concept is put forward, trigger the students' thoughts; encourage students to challenge each other's ideas or concepts; cooperate with each other, respect individuals and division of labor; encourage reflection and analysis, give enough time; respect Use the ideas generated by the students; encourage self-analysis, reorganize your ideas with new experiences and evidence; use the students' thoughts, experiences and interests to guide the curriculum; encourage the use of different sources of teaching information; adopt open-ended questions Guide learning.

3.4 Teaching Evaluation

Emphasize the use of a more open and personalized form of assessment that treats each learner as an autonomous person. As the environment changes, students' behaviors are constantly changing, so they cannot be explained and evaluated simply by causality. In the concept of STEAM education assessment, the most important thing is to truly describe what actually happened in learning activities or teaching activities. Considering the individual values of each student and the impact of the surrounding environment on personal assessment, consider the complexity of things as comprehensively as possible.

The evaluation of robot teaching integrated into the STEAM educational philosophy should focus on the diversity of assessments and the combination of multiple assessment tools. For example, gauges, verbal comments, test papers, and research diaries. Evaluation must form a comprehensive and systematic evaluation system throughout the entire teaching process. In addition to process evaluation and summative evaluation, developmental evaluation should also be paid attention to, in which students' scientific spirit, innovation ability and cooperation ability should be the key evaluation indicators [5].

4. Introduction to Middle School Robot Education Course



Fig. 1 Lego Mindstorms EV3 hardware

This study uses the teaching robot - Lego Mindstorms EV3 (shown in Fig.1): LegoMindstorms is a collection of programmable mainframes, motors, sensors and Lego Technic parts (gears, shafts, beams, bolts). As early as 1986, Lego Denmark and the Massachusetts Institute of Technology (MIT) collaborated on a program called "Programmable Brick". Since then, Lego Mindstorms EV3 has emerged.

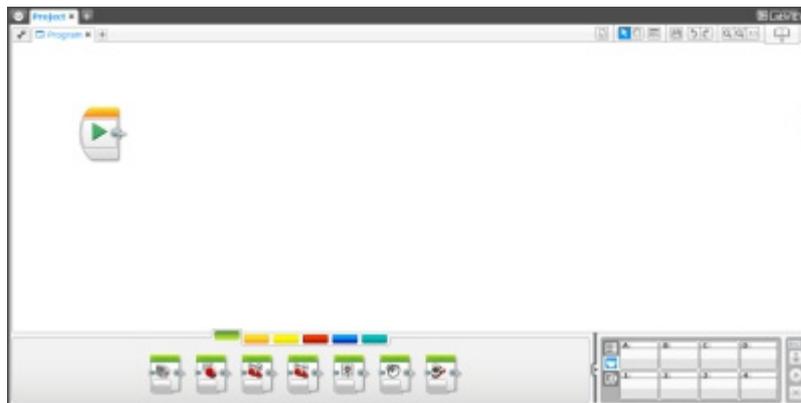


Fig. 2 Lego Mindstorms EV3 software

LEGO MINDSTORMS EV3 is a professional LEGO EV3 programming software (shown in Fig.2), including five types of programming modules: action module, data flow module, sensor module, data computing module and advanced module. Support multiple loop nesting, multiple judgment nesting, support for multi-condition generation; truly support multi-process processing. The software's user interface is a visual module that is very powerful and can be used to design and write various robot actions. Students can realize their creative ideas through project design and logic programming.

The course is divided into three parts according to the content and difficulty of the study, basic II, advanced, each part of 18 lessons, each class 1 hour 30 minutes (2 class hours), a total of 36 class hours. The basic content of teaching focuses on the relevant knowledge and basic principles of robots. On this basis, students are allowed to experience the important role of robots in real life by simulating some real-life scenes. The overall curriculum starts from reality and guides students to solve problems by designing robots and completing related competition tasks.

5. Summary

Science and technology promote education and knowledge changes fate. With the continuous updating of intelligent educational robots, primary and secondary school students have more opportunities to contact and learn related technologies and knowledge of robots. In the information technology classrooms and community activities in primary and secondary schools, more and more robots and programming have appeared. The Lego mindstorms ev3 robot mentioned in this study is a representative of learning-type educational robots developed by primary and secondary school

students. It is also a leader in the robot industry and products. The school-based curriculum developed for this product is of great significance for the sustainable development of intelligent robot education in primary and secondary schools in China [6]. The course's teaching content covers a wide range of topics, comprehensive multidisciplinary knowledge, high interest, practical. At the same time, the course combines the latest and most cutting-edge scientific achievements, and the quality education advocated in STEAM education is also covered, which is worthy of wide application and promotion.

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