Research on Development and Practice of Popular Science Teaching Aid for Programming UAV Based on STEAM Education

Jiaqi Tan, Dezhi Qiu, Zhengliang Li

City College of Huizhou, Huizhou, 516000, Guangdong, China

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Abstract: In recent years, front-line teachers are constantly exploring the teaching mode based on the application technology of robots and drones. However, the current teaching is mainly limited to the teaching of the application technology itself in the traditional mode, rather than using robots and drones as teaching carriers to promote learning and improvement. The cooperative learning and empirical research emphasized by STEAM education are the essential requirements of science and engineering learning. Students are required to help each other, inspire each other and construct knowledge in groups when facing and solving problems. To solve a complex practical problem, it is necessary to rely on the efforts and cooperation of many people. Based on the STEAM education mode and the intelligent modular UAV as the teaching platform, this paper designs a popular science teaching aid for programming UAVs, aiming at cultivating students' programming ability and establishing programming ideas in a programming language with low entry threshold.

1. Introduction

Intelligent robots, unmanned aerial vehicles and other application technologies have been widely concerned[1]. From basic education to higher education, the teaching activities that integrate intelligent robots and drones are widely carried out[2-3]. In recent years, front-line teachers are constantly exploring the teaching mode based on the application technology of robots and drones. However, the current teaching is mainly limited to the teaching of the application technology itself in the traditional mode, rather than using robots and drones as teaching carriers to promote learning and improvement. STEAM education is a major feature of information technology courses. Taking subject learning as the theme of information technology tasks, students are encouraged to apply their acquired information technology skills to other disciplines and fields[4]. Based on STEAM education, national defense education and patriotism education are carried out through the popularization of UAV theory, practice, design and development, and foreign exchange, so as to develop students' core literacy and cultivate all-round development people.

2. STEM education concept

The predecessor of STEM education is STEM education, which adds Art to the original four subjects, including Science, Technology, Engineering, Mathematics and Art in total. This Art mainly refers to the humanities and arts disciplines such as music, art, language and society (Figure 1). STEAM education has the characteristics of interdisciplinary integration, which pays attention to the interest of teaching content, emphasizes learning in situations and pays attention to students' experiential feelings.

STEAM education pays attention to students' interest in learning, and should pay attention to interesting, challenging and realistic issues in the process of learning, so that students can constantly stimulate their interest in learning and gain a sense of accomplishment after completing their learning tasks to maintain their interest[5-6]. The cooperative learning and empirical research emphasized by STEAM education are the essential requirements of science and engineering learning[7]. Students are required to help each other, inspire each other and construct knowledge in groups when facing and solving problems. To solve a complex practical problem, it is necessary to rely on the efforts and cooperation of many people. What students have learned is not only limited

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to exams, but also can solve practical problems in life, enhance students' interest in learning and sense of accomplishment, and also play a good role in promoting students' innovative consciousness and ability.

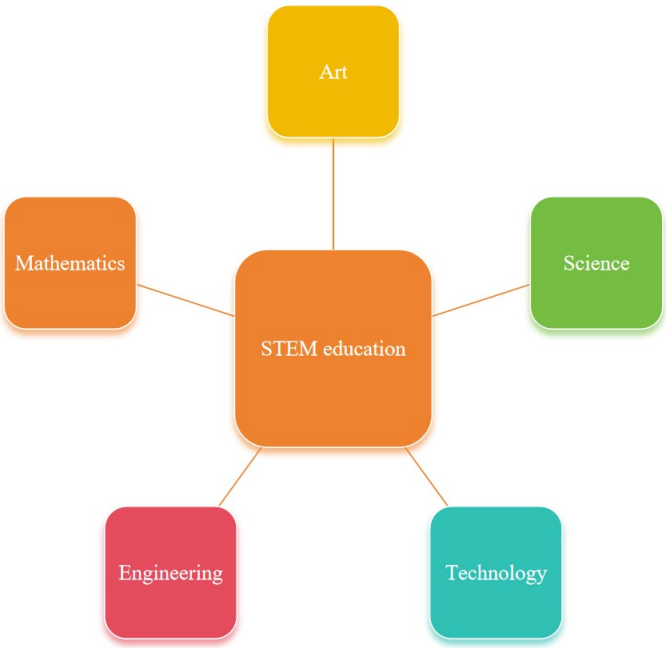

Figure 1 STEM education content

3. Principles of instructional design

3.1. Systematic and scientific principles

In order to better apply teaching theory to teaching practice, it is often necessary to follow certain teaching design principles. Teaching design is a comprehensive and systematic project, which needs to start from the analysis of teaching objectives, learning objects, teaching resources and environment, adopt appropriate teaching methods, design teaching content, and adopt certain evaluation methods to evaluate teaching effect. When designing the popular science teaching aid for programming unmanned aerial vehicles based on STEAM education, the concept of STEAM education, the goal of programming courses, teaching methods, etc. should be linked with the characteristics of learners, and no one factor should be considered in isolation[8-9]. Scientific means that the method used in the teaching process is reasonable, the concept of knowledge presented is correct, and the teaching design theory used is scientific.

3.2. Interest principle

Programming UAV science popularization is one of the ways to implement the educational concept of STEAM, which has a strong interdisciplinary nature, not only covering many disciplines, but also a good platform to promote the continuous development of students in all aspects. Therefore, it can be said that programming UAV science popularization is an interdisciplinary comprehensive education platform. Therefore, we should break down the barriers between disciplines and highlight its interdisciplinary characteristics when compiling the programming UAV science teaching aid, that is, the content of the teaching material should not only be limited to the knowledge of mechanical institutions, but also be combined with the knowledge of mathematics, engineering, human history and so on, so as to expand the scope of students' knowledge and improve their comprehensive quality.

3.3. Principle of situational interest

How to integrate a single maker course with other disciplines to create a STEAM course with maker characteristics has always been a difficult problem for front-line maker teachers[10]. Interest

is the best teacher. Teachers should take into account the principle of interest in the teaching of creative programming courses to stimulate students' interest and enthusiasm in learning. For example, they can teach students to make some simple games and music scores by using Scratch programming software to make students interested in the teaching content. In addition, in the process of teaching knowledge, it should be related to the students' life situation.

4. Development and practice of programming UAV science popularization teaching aid

4.1. Development of popular science teaching aid for programming UAV

4.1.1. Teaching objectives

Programming UAV science teaching aid is based on the multidisciplinary connection model of STEAM education integration to construct the curriculum system. The core teaching goal is to cultivate students' programming ideas and enable students to acquire programming ability. Let students use the teaching cases given by teachers to realize the designated UAV functions. The key point is to learn how to design creative features through hands-on practice, and master the design process and construction skills, so as to cultivate engineering thinking and enhance hands-on ability.

In the context of STEAM education, the goal of programming UAV's popular science teaching aid should not only consider the conventional three dimensions in course goal design, that is, knowledge and skills, process and method, emotional attitude and values, but also consider the decomposition of knowledge points into five parts of STEAM education concept in knowledge and skills dimension design, and there is an inseparable correlation between these five parts. When designing the dimension of process and method, we should also consider the cooperative learning and hands-on practice emphasized by the concept of STEAM education, so that students can learn by doing and improve teaching efficiency.

4.1.2. Teaching aid development

The development of teaching aid should be a process of constant revision. Only by constantly revising every step and every link can the teaching materials have higher quality. Therefore, the revision should not be limited to the development of teaching aid, but should run through the whole development process of teaching aid. The process model of teaching aid development established by the author has three stages, namely, top-level design stage, content design stage and textbook compilation stage, in which the revision of teaching materials runs through the whole teaching aid development process. As shown in figure 2.

There are four main tasks in the top-level design stage: to establish the objectives of teaching materials, to determine the principles of textbook compilation, to determine the mode of textbook compilation and to determine the presentation media of teaching materials. At this stage, the overall planning of textbook compilation is mainly carried out. The task of the content design stage is to determine the knowledge framework of the textbook and the selected cases to explain this knowledge point.

After completing the textbook knowledge framework and case selection, it entered the overall writing stage of the textbook. This study holds that the overall compilation and revision of teaching materials are not independent of each other, but integrated with each other, that is, they should also be revised during the overall compilation of teaching materials. Therefore, the development of teaching aidis a spiral process of continuous improvement, and the revision should not only exist before the output of teaching materials, but should run through the whole development process. Through the continuous revision of each stage, the teaching materials will eventually be improved and published.

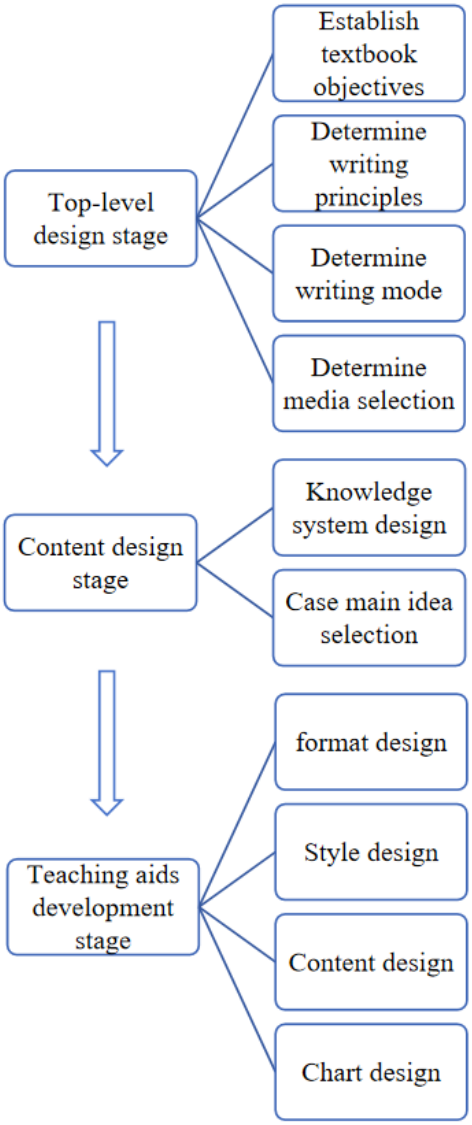

Figure 2 Teaching aid development process

4.2. Teaching content arrangement and practice

4.2.1. Create a situation to stimulate interest

The role of this link is to introduce the course, stimulate students' interest, attract students' attention and experience the situation for the first time. In the teaching practice of this course, an online network teaching support platform, STEAM Maker Education Platform, is used as a platform for Scratch programming learning. The STEAM Maker Education Platform not only provides online high-quality course videos and material resources services for famous teachers, but also solves the current problems of insufficient teachers and courses. It also provides online open source sharing and exchange services for teachers and students' Maker works, which can be further improved in terms of creativity and technology after sharing and exchange.

The programming module can be used for online programming. Students can save the completed programming works on the platform and share them for other peers to learn. Students can exchange views with each other and jointly modify the works to realize collaborative programming. The "programming" module will be used in the links of "detailed explanation, imitation exercise" and "online collaborative programming to complete extracurricular expansion tasks"

4.2.2. Practical learning

Through the screen projection software of mobile phone, the teacher showed the students the searching method of programming block for reading accelerometer and airborne gyroscope of air

block, and demonstrated the simple reading method. On the basis of understanding the basic programming method, students complete the task of self-inquiry: read the acceleration values in X, Y and Z directions and flight attitude from the gyroscope in real time, including heading angle, pitch angle and roll angle. On this basis, the cooperative task is completed: touch induction flight, reading the touch direction according to the accelerometer value, and flying in the opposite direction according to the touch direction.

In the process of STEAM teaching, teachers play the role of a coach at critical moments. Teachers are no longer the only knowledge base, but the promoters of knowledge construction and information consultants. Using 3D creative software to design, 3D printing technology to achieve production, to obtain their own design of plastic components. Using 3D creative software to design the frame, and giving it to professionals for laser cutting to obtain their own carbon fiber frame. After completing the UAV programming, students can learn from each other's personal programming through group members, or post it on the Kitten official website platform, so that more players can give their views on the UAV programming, and then improve and perfect their personal works.

4.3. Evaluation of teaching practice results

After completing all the learning of this course, we should summarize and analyze the students' learning situation and learning effect to verify the effectiveness of this course resource. Understand whether students' comprehensive abilities and qualities such as learning interest, theoretical knowledge, hands-on ability, innovative consciousness and ability of UAV programming have been improved subjectively after learning this set of courses; It is also necessary to interview the teachers to understand the problems encountered by the teachers in the teaching process, summarize the experience and put forward suggestions for improvement, so as to facilitate the subsequent improvement and development of the course.

There are many criteria for evaluating the success of a class, but as a Kitten programming class based on STEAM education, the evaluation criteria should be simply classified as what students have gained in the class. The evaluation of students' UAV programming should not be limited to the classroom summary stage, but should run through the whole process of classroom teaching, so that the evaluation opportunities are diversified. For each course project task, in the "innovation and expansion" link, let the students draw the mind map of expanding the task, and on the basis of collecting the mind maps of the whole class, the teacher will construct a more comprehensive mind map of innovation points. Each innovation point in the model includes basic score and difficulty score, and the mind map drawn by students is graded according to the model.

5. Conclusions

STEAM education is a major feature of information technology courses. Taking subject learning as the theme of information technology tasks, students are encouraged to apply their acquired information technology skills to other disciplines and fields. STEAM education pays attention to students' interest in learning. In the process of learning, we should pay attention to interesting, challenging and realistic issues, so that students can constantly stimulate their interest in learning and gain a sense of accomplishment after completing their learning tasks to maintain their interest. The cooperative learning and empirical research emphasized by STEAM education are the essential requirements of science and engineering learning. Through the knowledge of UAV programming mathematics learned in the creation of works, students can deepen their understanding of the value of information technology in subject learning, promote the integration of information technology in other disciplines and fields, and realize the dual value of information technology as learning object and learning tool.

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