The Application of Maker Education in Colleges and Universities

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Abstract. In the context of the Internet plus, Maker Education has attracted more and more attention from all walks of life.Major universities have tried to develop Maker courses and cultivate innovative talents with comprehensive capabilities. In order to stimulate students' sense of innovation and practical creativity, explore the feasibility of Creativity Education in higher education and the mode of practical curriculum, and conduct experimental experiments on product creative design undergraduate students. After completing the basic knowledge of programming knowledge, students design and implement product ideas in a group collaboration manner. At the end of the course, a large number of creative works were obtained. The results of the course show that the creation of maker education in colleges and universities is an effective way to cultivate students' sense of innovation, popularize programming knowledge, and realize design creativity. This course will greatly help the improvement of the comprehensive ability of college students. Colleges and universities should carry out such courses.

The Origin of Maker and Maker Education

The term "maker" comes from the English "Maker", which generally refers to people who, through their own efforts, turn different ideas into reality based on their interests and hobbies. The creators include not only "reinventing hardware" and technicians who develop software, but also artists, designers, educators, and more. With the help of tangible or intangible tools, Maker transforms its own innovative thinking into an innovative entity (creating new things), which reflects the concept of “innovation, sharing, and practice” [1,2]. Maker Education is an effective way to help people master the skills of Maker and realize creative design. It is the golden key to improve learners' self-creation ability and comprehensive ability [3,4].

Smart Hardware Set

In order to successfully carry out the education of classroom creators, emerging educational products such as smart hardware packages have emerged, which consist of open source hardware, sensors and mechanical parts. When using the smart kit, learners build models with other materials such as mechanical parts and cardboard, install sensors with the required functions, and then control the sensors through the compiler to achieve the desired functions. This process involves many processes such as model making, programming and compiling, which stimulates students' innovative thinking and exercises the ability of students to move their brains, thus achieving the purpose of maker education. The Smart Hardware Suite helps learners quickly implement innovative ideas and is very convenient for use in higher education design courses [5,6,7]. In this paper, the intelligent hardware package (based on the Arduino board) for education and teaching practice, as shown in Fig. 1, includes the sensing components used in the smart products commonly available on the market. The device list is shown in Table 1.

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Figure. 1 The smart hardware set

Table 1 High and low settings of predictor variables

3P interface conversion module*1	Photosensitive sensor module*1
Button module *4	Fan module*1
Sound Sensor Module*1	Switch Module*1
Keyboard Array Module*1	Gas Sensing Module*1
LED Module*4	Flame Sensing Module*1
Digital Tube Module*1	OLED12864 display module *1
Buzzer module*1	Alcohol sensing module*1
Human perception module*1	Smoke sensor module*1
Potentiometer Module*1	PM2.5 Sensor Module*1
Soil moisture sensing module*1	Heart rate sensing module*1
Atmega328 main control board & interface expansion module *1	Non-contact Temperature Measurement Module*1
DHT11 digital temperature and humidity sensing module *1	DS18B20 digital temperature sensing module *1
Single beam 144mm*4	Single beam 112mm*4
Single beam 72mm*4	Single beam 40mm*2
Double beam 224mm*2	Double beam 72mm*3
Double beam 144mm*4	Three beam 72mm*2
Motor bracket L-25*1	Drive fixed plate 4mm*2
L connecting piece 1*22 *4	Infrared obstacle avoiding bracket *2
180 degree connector *2	Two-axis servo *1
Coded speed motor 25mm*1	

Maker Course Based on Intelligent

Instructional Design and Curriculum. This teaching activity is carried out among undergraduate fourth-year product design students. They have strong sense of innovation and hands-on practice, but they have a low level of understanding of programming. The course is divided into two phases, a total of 32 hours:

The first stage: the basic teaching link of 12 hours, using traditional teaching methods to help students master the basic knowledge of intelligent hardware, including learning programming language, familiar with the functions of different hardware, etc., and training students' ability to build models through course cases;

The second stage: 20 hours of group practice training, including creative concept and program design, as well as comprehensive analysis, optimization and improvement of the feasibility and complexity of the program inspired by the teacher, and finally completed in physical form and Display creative design [8]

Key Points and Difficulties of the Course. Difficulties: programming, circuit design, model building.Focus: Complete a case study and learn about the general processes and methods of innovative product development.

Teaching Practice Mode. Students are divided into groups of 4-5 people, each of which completes a smart hardware product. Students should play a team spirit and clarify the division of labor and cooperation within the group. The specific division of labor and work include:

Team leader, responsible for the overall implementation of the entire project, reasonable scheduling of work progress and coordination of personnel schedule;

Product designers, understand positioning, clear technical essentials, responsible for product features and shape design, communicate with programmers, match hardware layout and selection.

The programmer is responsible for debugging the open source hardware product prototype and writing the program.

Product marketer, responsible for product packaging and promotion.

In order to give students a comprehensive workout， they can also change roles from time to time, so that students can achieve a special ability.

Results Display and Reporting.

After the creative design, hands-on operation and other aspects, the students' creativity has been transformed into visible works. In addition to the ability to work collaboratively, the students also have the ability to share and communicate.Each group sent representatives to show the works to other students in turn, and summed up the division of labor, creative sources, process steps, structure and highlights of the group, and also explained the confusion encountered by the group in the process of completion, and other The group interacts. In this way, not only the students' organizational coordination ability and language expression ability are cultivated, but also each group is connected and studied together, and the students can also find the works in time to be modified and optimized in the later stage.

In this course of practice, all the teams completed their own creations within the specified date, and a large number of creative ideas emerged. There are smart key hooks, smart pet timing feeders, smart flowering systems, etc. (Fig. 2). Flexible use of various types of sensing components, such as temperature sensors, humidity sensors, led lights, dot matrix components. This Maker course provides students with an understanding of the basics of programming and intelligent hardware, as well as design practices and satisfactory teaching results.

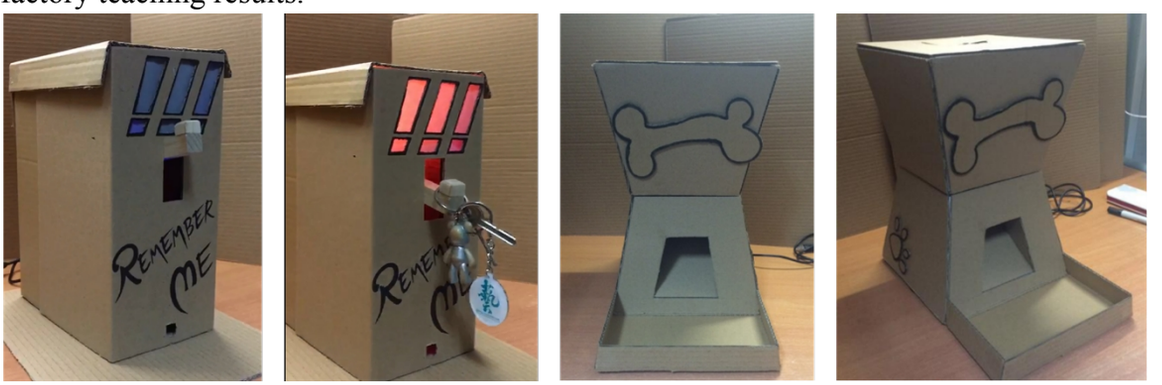

Figure 2. The student work results shoSummary

Maker education is a new form of education that provides learners with innovative thinking and innovative ideas, enhances interaction between teachers and students and external sources of information, enhances students' ability to solve unconventional problems, and enables learners to master innovation and creativity. [9-10]. After the course practice, students learn to think through design thinking, identify user needs and design product models from the perspective of an open source product designer, and mastered the techniques and capabilities of using open source hardware to complete core requirements

and implement conceptual prototypes. The results of the course also prove the necessity and feasibility of the maker education in the higher stage.

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