

ORIGINAL CONTRIBUTION

The Effect of Hands-on Practice on Improving the Innovation Ability of High School Students - Smart Safety Socket

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Abstract— With the development of technology, electricity products are changing with each passing day, bringing many conveniences in people's lives. However, because of the increasing load on the socket, it is easy to produce electrical fires and cause loss of life and property under improper use conditions. This study aims to cultivate the practical ability of higher vocational students to use the knowledge and skills learned, improve the electrical safety of the socket, prevent electrical fires, and protect the lives and property of the people. Based on the safe use of the socket, the development and production of smart safety sockets will be carried out by the teachers and students of the higher vocational electrical engineering and the existing equipment and the relevant curriculum concepts. The features of this product include monitoring the power consumption of the socket, warning and power-off of the over-powered, and remotely controlling the power supply of the socket in combination with the mobile APP program. The study found that through the production of smart safety sockets, students can develop cooperative learning ability. The research also concluded that students could develop independent thinking and problem-solving skills through the production of smart safety socket. The results of this research show that smart safety sockets have practicality and enhance the safety of use. It is evident from the results of this research that students have certain help in the ability to innovate in the process of designing finished products.

Index Terms— Socket, Electrical Fire, Electricity Monitoring, Safety Socket

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I. INTRODUCTION

Creativity and hands-on ability are the key skills that students need to adapt to future society. Cultivating students' core literacy ability is the focus of current education. In particular, vocational education should be oriented to cultivating students' pragmatic and practical ability, and revitalizing the industry as expected by society. The emphasis should be on promoting maker education and emphasizing practical work in primary and secondary education so that vocational students who like hands-on implementation can find self-confidence and manifest their talents [1, 2]. The 21st century is an era of drastic changes. Information technology is rapidly developing and circulating. During this time, innovative thinking, critical thinking, and problem-solving are important basic abilities of future world citizens [3, 4]. In order to achieve the above educational objectives, it is encouraged for vocational electrical engineering students to learn through cooperative learning. Based on professional knowledge and skills, combined with the needs of daily life, intelligent security insertion Research and production of the seat, in addition to exploring and learning, and hoping to provide innovation, The finished product improves the safety of the socket. Taiwan has entered a serious decline of talents as a result of which it will be difficult to compete with other countries [5].

II. RESEARCH MOTIVATION AND PURPOSE

A. Research Motivation

The cause of many fires is the improper use of electrical appliances. Excessive use of extension cords, which causes the use of electricity to exceed the load and results in a surge inline current, or forgetting to turn off electrical appliances after usage results in dangers to life and property. For the above reasons, the researchers sought to invent smart safety sockets. If the power supply is used improperly, it can provide a display, turn on an alarm or forcibly cut off the power supply on the socket, so as to avoid fire and minimize accidents. At the same time, through the Bluetooth communication of the mobile APP program, the function of remote monitoring can increase the convenience of life. In the 21st century, information technology has gradually changed the way of life of human beings. This change has certainly impacted the educational environment as well [6].

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B. Research Purposes

- Effectively prevent electrical fires.
- Increase the security of the socket.
- Develop a "safe socket" with practical value.
- Develop students' cooperative learning ability.
- Develop students' independent thinking and problem-solving skills.
- Enhance students' ability to innovate and invent.

In the era of AI, companies should work more closely with schools to provide students with the latest industry developments, encourage students to do special projects, and enable students to innovate, be creative, carry out research, and develop their capabilities [7, 8]. Education brings advanced technology to the campus, bringing unlimited hope to educators, parents, and students, and improving students' learning outcomes and their motivation for learning [9, 10]. We hope that through information technology equipment and education, students will be guided to take the initiative to learn, find interest, and develop the ability to perform tasks, leading them to cultivate their innovative invention capabilities, create new products, and contribute to human life.

II. METHODOLOGY

The current study adopted an action research approach and used the ADDIE model to plan and implement the program.

- Analysis: Students were grouped according to tasks, and related materials were collected according to their responsibilities to build students' ability to collect and analyze data.
- Design: According to the assigned tasks, the circuits, and programs of "smart safety sockets" to cultivate students' independent thinking ability were designed.
- Development: Students' cooperative learning was promoted through the design and production of circuits.
- Implement: The plan was executed, the spirit of hands-on work was cultivated, and the ability to solve problems was enhanced.
- Evaluation: The finished product was tested, and students' innovative invention capabilities were evaluated through interviews.

This research aimed to use scientific methods, systematic thinking, and operation; regularly followed the steps of analysis, design, development, implementation and evaluation; gradually guided students to participate in and execute the project; and finally evaluated the finished products and the successful implementation of the plan through student interviews and opinion analysis.

III. SMART SAFETY SOCKET ACTION PRINCIPLE AND FINISHED PRODUCT APPEARANCE

A. "Smart Safety Socket" Action Principle

- We used the Hall sensing element to detect the line current. When the line current reached more than 80% of the rated value, the LED light was used to alert the user to pay attention; when the line current reached 100% of the rated value, it was at a dangerous level, and the buzzer sounded an alarm and the relayed action forced the power to be turned off.
- The study also used the mobile APP program to remotely monitor the outlet, make related settings, view the amount of current in the outlet, and turn on the timing function. After the set time was reached, the outlet power was automatically turned on or off.

B. "Smart Safety Socket" Finished Product Appearance

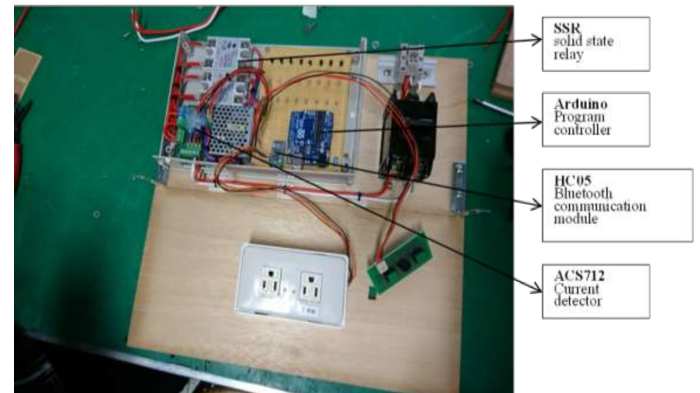


Fig. 1. Internal structure

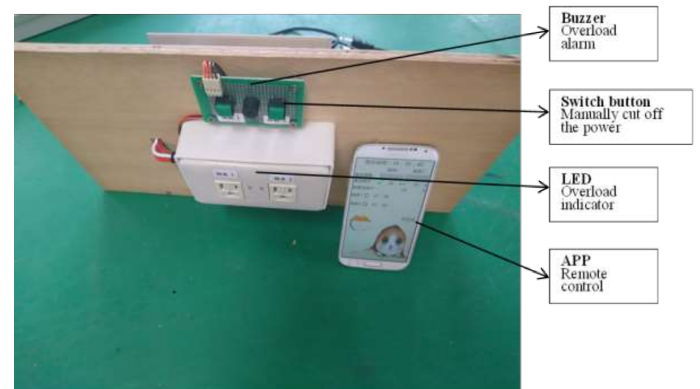


Fig. 2. Eslite appearance

IV. "SMART SAFETY SOCKET" PRACTICAL VALUE

Based on the function of the Smart safety socket, its practical value is summarized as follows:

1. The LED shows the power consumption of the socket to avoid overloading.
2. When the outlet line current reaches a dangerous value, the buzzer will give an alarm, and the relayed action will forcibly cut off the power supply, and indeed maintain the safety of the electricity.
3. A timer can be used to turn the outlet power on or off periodically.
4. It can be combined with the mobile APP program to use the Bluetooth communication function for remote monitoring.
5. The push button switch can be used to turn the outlet power on or off, without the need to remove the electrical plug, which can increase the service life of the socket.
6. The "smart safety socket" is simple in construction, easy to develop into a product and quantify production.
7. The difference between a smart safety socket and a general socket as shown in Table I.

TABLE I
SMART SAFETY SOCKET VS. GENERAL SOCKET

☐	Smart safety socket	General socket
Power consumption display	Yes	No
Overload alarm	Yes	No
Overload automatic power off	Yes	No
APP monitoring	Yes	No
Security	High	Low
Volume	Big	Small
Price	high	low

V. STUDENT INTERVIEW ANALYSIS

In order to understand the effectiveness of students' participation in thematic production, the open-ended topics were discussed in the form of interviews; the interview process is excerpted as follows:

A. Interview Student A

I am responsible for the production of hardware circuits; it is an interesting thing to do it, let me be dedicated to it, in the production process, I often encounter problems, but in the end, they are solved. When the work is completed, it is full of sense of accomplishment; at the same time, it also makes me understand that it is difficult to complete work independently; through this experience, I can understand the value of cooperative learning.

B. Interview Student B

I am responsible for the production of hardware circuits. In the process, I often encounter difficulties. In order to solve the problem, I must consult relevant knowledge and cooperate with theory and practice; let me realize the reason of "learning by doing". However, in the process of design or production, often due to insufficient materials or equipment, it is impossible to present a perfectly finished product.

C. Interview Student C

I am responsible for circuit production and programming. In the process of thinking about problems, I must stimulate my brain, and invisibly add many ideas; I think this will greatly help my ability to innovate and invent; I feel that the school should arrange more courses for thematic production or innovative inventions, so that my practical ability will be enhanced.

D. Interview Student D

I am responsible for circuit production and programming, participate in the production of this smart safety socket; let me understand the importance of electrical safety; I hope to eliminate all electrical fires, and hope that the industry and schools can cooperate so that we can visit or use modern equipment to understand the industry trends.

Consolidate the opinions provided by the student interviews and infer as follows:

- This research can develop students' ability to think independently and learn cooperatively.
- This research can combine theory and practice to guide students to "learning by doing".
- This study found that the production of "smart safety socket" can stimulate students' Brains, improve the ability to innovate in creativity.
- This study found that "smart safety socket" has practical value and

can prevent electrical fires.

- This study found that through the production of "smart safety socket", students can pay more attention to electricity safety.
- This study found that through thematic production, students' learning willingness and learning outcomes can be improved.

In promoting active learning, in addition to the development of scientific and technological tools, teaching innovation and curriculum content activation are more important [11]. Innovative teaching, if combined with industry, can help students to stimulate learning motivation, activates interaction between teachers and students and industry, and helps to demonstrate student implementation skills [12]. It is not enough to rely on the efforts of the school to cultivate talents. It is necessary for the industry and the business community to work together to achieve results [13]. In summary, the promotion of thematic production courses, allowing students to work on their own, not only can increase students' interest in learning, but also enhance their ability to innovate and invent. If students can cooperate with the industry to provide advanced equipment, coupled with the collaborative teaching of the division, better results will be achieved.

VI. CONCLUSION

By making smart sockets, which included the division of labor, setting themes, collecting materials, discussing problems, solving problems, and completing finished products, the team must work together to achieve the goals. The final conclusions are as follows:

1. The study found that through the production of smart safety sockets, students can group by task, work together to complete tasks, and develop cooperative learning ability.
2. The study found that through the production of smart safety socket, students can develop independent thinking and problem-solving skills.
3. The results of this research show that smart safety sockets have practicality and enhance the safety of use. The smart safety socket has the functions of load usage display, overload alarm, forced power off, and a remote control combined with a mobile phone APP.
4. It is found from the results of this research that students have certain help in the ability to innovate in the process of designing finished products.

After the integration of information technology into teaching, the teachers' teaching objectives were gradually transformed into the ability to train students; teachers also discovered that they do not necessarily need to collect information by themselves—in the process of teaching students, they collected various materials from the Internet [6]. While students designed and produced the smart safety socket, they had to constantly think about it, constantly absorb knowledge, constantly innovate and change, and had considerable help for the improvement of their innovative invention capabilities. In the context of the nature of education, educational innovation is an important lesson that cannot be ignored [14]. Whether it's design innovation or inquiry, STEAM learning activities emphasize interdisciplinary, hands-on, trial error, teamwork, problem-solving, and practical application [15]. The process encourages more makers to use more of today's technology to solve problems in real life, thereby improving the whole of society and the environment [16].

VII. RECOMMENDATIONS

The technology and network of the 21st century are developing rapidly and accelerating the pace of internationalization. In response to the changes of the times, innovation and creativity are especially important. Thus, school education should be in line with the trend of the times and should focus on cultivating students' practical ability and opening special production and creative invention courses; Teachers should encourage students to learn from doing. Collaborating on creative ideas and on finishing a creative product is a kind of curriculum model that is beneficial to students as it not only enhances students' creative ability but also develops new things and makes a useful contribution to society. Innovation is the main axis of today's education and a key issue in the reform of vocational education. Thus, education must cultivate high-quality, innovative talents for society and enterprises [12].

For the design and production of the "Smart safety socket", because the equipment, materials, and funds are limited, the finished products are too large in size and inconsistent with economic benefits. Nonetheless, the process was purely focused on encouraging students to work in teams to accomplish special projects. The use of single-chip and other micro-components for research and development, shrinking the size of the finished product, and integrating different parts of the socket will improve its efficiency, improve people's life needs, and create economic value.

Due to the limited equipment and funding of the school, students, could not be given sufficient resources. Excessive restrictions narrow students' ideas and innovations. Therefore, if the industry can provide the support, equipment and collaboration required by the school, this will benefit students much. Teaching is believed to be of great help to students' learning and growth. It also enables students to seamlessly integrate production and learning with the pulse of the industry. Teachers flip the teaching method and encourage students to actively participate in order to improve the learning effect of students and attain the best results in teaching [17].

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Declaration of Competing Interest

The authors declare that they have no conflict of interest.

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