



# Research on Chinese Traditional Handicraft Education Expansion Model Based on STEAM

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**Abstract.** Nowadays China has some problems with the application of STEAM education. STEAM education in China have its limitations: A(Art) is always detached from STEAM, falling into a secondary position, which does certainly adverse to the exploration of creativity and the improvement of comprehensive ability. Besides, since Chinese traditional handicrafts have profound humanistic heritage and cultural connotations, they could be used as high-quality teaching resources, but lack the educational forms and teaching contents that meet the demands of the era and are easily accepted by the public. Especially for traditional handicraft teaching, due to the one-sidedness of teaching content, the passive nature of teaching methods and the conventional non-cooperative teaching form, participants can only experience the production process in a short period, but lack awareness of the history and diversity of traditional crafts. We put forward the research and practice of the STEAM class extended curriculum with the theme of traditional handicrafts based on the STEAM education framework. From the four dimensions of knowledge, ability, thinking and innovation, the participants' ability to innovate and apply traditional handicrafts are significantly enhanced, thereby we could gradually improve the participants' individualized perception of traditional handicrafts. provide time-oriented and cultural teaching contents for STEAM extended curriculum in China, new development ideas, and models for current traditional handicraft teaching. This paper takes Cantonese Porcelain as an example to explore the STEAM extended curriculum. We designed and organized the intelligent handicraft innovation workshop, and systematically discussed how to design the teaching content and education practice based on the multi-level extended education model of STEAM education framework.

**Keywords:** STEAM · Traditional handicraft · Cantonese porcelain · Education model

## 1 Introduction

With the advancement of modern science and technology, STEM education has been difficult to meet the needs of diverse talents in modern society [1], which gave birth to a comprehensive quality education concept: STEAM. To a certain extent, STEAM education has achieved some accomplishments in China, but it has a few critical

problems: Teaching content requirements become more diversified while the current teaching contents are still homogenized, lacking interest, diversity, pertinence, as well as the STEAM research and practice for traditional handicraft education.

Because of the late start of steam education in China, most of the teaching practice takes the education of developed countries of the west as the template [2], and the teaching content has the tendency of convergence, lack of innovation, ignoring the importance of education localization. The workshops and tutoring classes organized by most of China's training institutions are usually only labeled with STEAM [3], and they do not achieve the teaching effect of discipline integration. Generally, courses focusing on rational thinking, such as programming education and robot production. In the future research and educational practice, how to develop the STEAM education system and teaching content with Chinese characteristics is the goal and direction of our research.

At present, traditional handicraft workshops mainly focus on short-term practical teaching, so that the students could understand the knowledge about traditional handicraft, learn the cultural background of traditional handicrafts, and practice the production process [4]. As a result, the participants' creative practice is only counterfeit of traditional form, which cannot make them truly understand the cultural connotation of traditional handicrafts, and it is difficult to stimulate the imagination and creativity of them.

Therefore, we use STEAM education methodology to provide scientific and effective solutions to the problems existing in traditional handicraft teaching, and use traditional handicrafts as a high-quality teaching resource to enrich the teaching content of STEAM. Based on the STEAM education framework, we integrate interdisciplinary integrated teaching content, project-oriented teamwork teaching forms, and self-inquiring teaching methods and refine the teaching level by dividing the participants' cognitive depth of traditional handicrafts: knowledge (creating knowledge connections), competence (thematic embedding), thinking (multidisciplinary integration), innovation (interdisciplinary application), and value (personalized cognition). This results in a multi-level, multi-dimensional traditional handicraft extended education model. Based on this, the teaching content of traditional handicrafts was re-planned, and a scientific teaching process was constructed to gradually improve participants' cognitive depth of traditional handicrafts, thereby enhancing participants' ability to innovate and integrate traditional handicrafts.

## 2 Development Status of STEAM Education in China

STEM is a course for American students who have gradually lost interest in science and engineering knowledge. It aims to cultivate technology-oriented talents through the comprehensive teaching curriculum design of science, technology, engineering and mathematics [5]. However, due to the rapid development of social economy in recent years, along with the continuous generation of diversified talents, technical talents can no longer meet the demands of the new age [6]. Empirical studies have shown that art education can improve students' creativity, critical thinking, collaboration and interpersonal communication skills, in addition to improving cognitive ability, spatial

reasoning, abstract thinking, divergent thinking [7]. Therefore, in the development of STEM education practice research, art courses have been added. Since then, the STEAM education concept has been popular in the United States, South Korea, the United Kingdom and other countries and areas [8].

Until 2016, STEAM Education was mentioned in the “Thirteenth Five-Year Plan for Education Informationization” in China, and it was valued and supported by the development of science and technology education; The 2017 Compulsory Education Primary School Science Curriculum Standard advocates the interdisciplinary learning approach of STEM education; In 2018, the China Academy of Educational Sciences released the “China STEM Education 2029 Action Plan”. The Ministry of Education has issued a curriculum standard for various subjects in the general high school (2017 edition), and similar educational concepts to STEAM appear in the curriculum standards of multiple subjects. Provincial and municipal education in Shanghai, Jiangsu, Shenzhen and other regions have included STEAM education in local education priorities [9].

It can be seen that China’s implementation standards for STEAM education are constantly being refined and specified, and the implementation strategies, application scope and practice forms are gradually improving and moving toward a systematic and standardized path. In contrast, China is not paying enough attention to STEAM education. It only appears in the relevant regulations of science and technology education [10], but has not been included in the relevant policies of national development. STEAM education lacks artistic integration in the practice of China, with STEM as the main teaching content, which taking the imitating the teaching practice of western developed countries as the main source of the subject and ignoring the importance of localization of education.

### **3 The Status of Traditional Chinese Handicraft Education Model**

With the development of history, traditional handicrafts have been inherited and developed. It are not only practical in daily life, carrying crystallization of laborers’ wisdom, but also have good artistic quality [11]. It has formed a unique cultural connotation through the precipitation of years, and is a precious cultural heritage and a quality teaching resource. However, the following problems exist in its teaching (Fig. 1):

Teaching content: Through practicing in the short-term workshop, the students can get a preliminary understanding of the traditional crafts and experience the production process. Teaching method: Using the traditional teaching method, the passive knowledge input model leads to low knowledge conversion rate and poor learning effect. Teaching form: The main form of craftsman teaching and public participation in learning practice [12], which emphasizes the teaching method of individual learning and lack of communication with others and collaborative project learning experience.

From the perspective of the participants: most of the teaching focus of the workshop is on technical training and creative practice [13], which pays insufficient attention to the students’ cultural literacy, theoretical speculation and innovation ability. It does



**Fig. 1.** The scene of traditional craft teaching

not meet the demands of talents in modern society, so it is difficult to mobilize the interest and motivation of participants for long-term learning. From the organizer's point of view: this procedural [14], stereotypical teaching method is difficult to mobilize the interest and learning motivation of contemporary young people. It lacks initiative and inquiry to learn traditional handicrafts, so it is difficult to achieve the original intention of promoting the traditional handicraft culture.

#### **4 Multi-level Teaching Method Based on STEAM Education Frameworks**

On the one hand, China's STEAM education urgently needs to explore the content of Chinese traditional culture and cultivate innovation application talents with scientific and humanistic literacy [15]. On the other hand, traditional handicrafts need to combine the advanced teaching concepts in the modern context, explore innovative education models to improve students' participation degree, creativity and the ability to solve problems, and students' knowledge of traditional handicrafts.

With the widespread application of STEAM teaching philosophy in teaching practice [16], it provides a new direction for traditional handicraft education model. STEAM education aims to cultivate innovative talents with interdisciplinary thinking skills. It has the characteristics of problem-oriented, interdisciplinary learning and group collaboration [17], which makes up for the gap between traditional handicraft teaching and modern talent demand. Moreover, based on the STEAM education framework to build a multi-level education model, this model gradually improves the cognition of traditional handicrafts in multidisciplinary integration and interdisciplinary applications.

According to relevant literature research, the current domestic STEAM education is still in its infancy, so it is necessary to make full use of valuable traditional Chinese cultural resources to explore more high-quality teaching content and extended courses.

In the training of students' thinking model and the edification of Chinese traditional excellent culture, students' scientific thinking is developed to promote the development of students' comprehensive ability [18]. Therefore, this expansion model mainly solves the following problems:

- (1) Exploring the content of STEAM's focusing on Chinese localization characteristics and strengthening the influence of traditional culture, improve the use of participants' humanistic literacy and comprehensive ability.
- (2) Based on the STEAM education framework, we expand and innovate the traditional handicraft education model, and use STEAM comprehensive learning content, team-based teaching forms and independent inquiry learning methods to improve curriculum participation, knowledge conversion rate and learning efficiency, thereby enhancing the cognitive depth of traditional handicrafts.

### 4.1 STEAM Education Framework

- (1) The Education target level: guided by lifelong learning, is a holistic and long-term educational goal. The constantly changing social development process makes education not limited to imparting specific subject knowledge and application methods, but through the training of learning thinking, the ability and awareness of lifelong learning should be cultivated to adapt to the evolving social needs [19].
- (2) The integrative level aims to encourage participants to apply interdisciplinary and interdisciplinary knowledge comprehensively to solve problems encountered in projects through practical project-oriented teamwork practices, thereby improving the ability of problem solving and overall application.

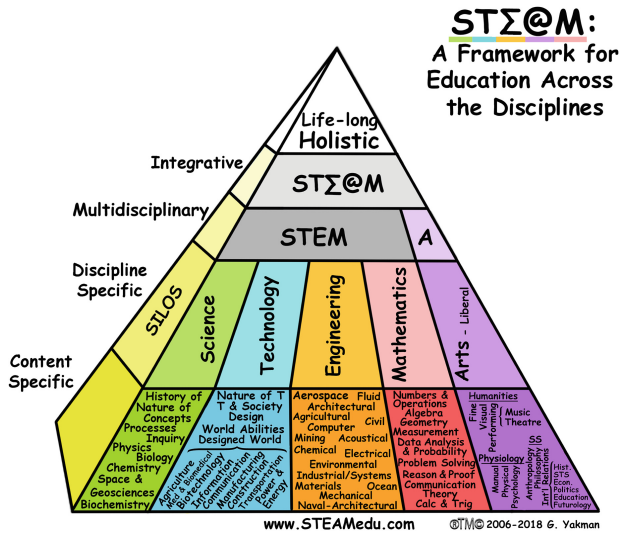


Fig. 2. STEAM education framework (Source: STEAMedu.com)

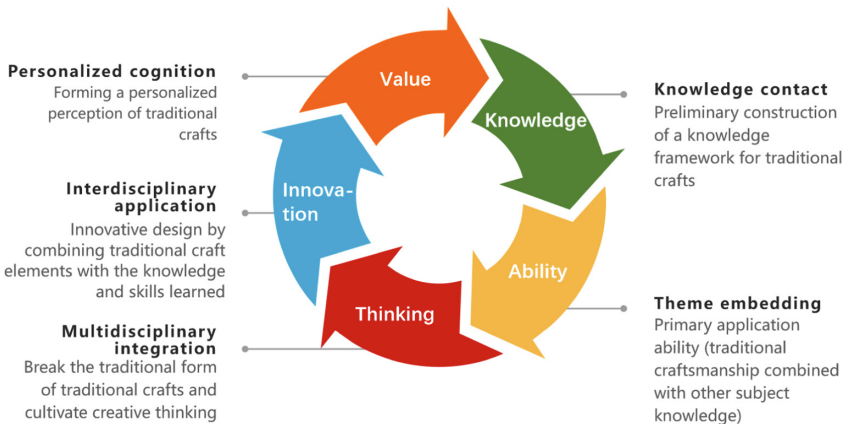
(3) Multidisciplinary level (Meaning of the Art not only refers to narrow concepts such as aesthetics and crafts, but also includes music, humanities, language arts, etc.): It is the application of multidisciplinary knowledge. Organize the study of two or more subject areas by surrounding the same subject, but maintain their independence between disciplines [20]. In the collaborative design of teamwork, the enjoyment/interestingness of the classroom is improved, and the teamwork ability, communication skills and comprehensive application ability of the participants are cultivated.

(4) Discipline Specific level: Enrich the teaching of other subjects with the theme of a certain subject. This theme should have rich connotations, diverse forms and era value.

(5) The specific content level is the design of the specific content of the teaching activities, aiming at how to create knowledge links between disciplines (Fig. 2).

### 4.2 The Construction of Traditional Handicraft Education Model Based on STEAM Education Framework

Based on the STEAM education framework, the teaching of other disciplines is enriched with traditional handicrafts. Due to the artistry, practicality and complexity of traditional handicrafts, based on the cognitive depth of traditional handicrafts, the teaching content is divided into five levels (Fig. 3):



**Fig. 3.** Traditional handicraft education model based on STEAM education framework

(1) Specific content level- knowledge: The analysis of the complex and lengthy information of traditional handicrafts is organized into several categories to help participants build a knowledge framework of traditional handicrafts, so that they can adequately understand and master the knowledge of it.

(2) Discipline Specific level- ability: In the embedded teaching of traditional handicrafts and other subjects, the content and technology of other disciplines are used to increase the learning and application forms of traditional handicraft content.

(3) Multidisciplinary level- thinking: Integrate traditional craftsmanship with teaching content in multiple disciplines to create connections between different disciplines. Breaking the traditional form of traditional crafts, participants can be aware of the connection between traditional crafts and multidisciplinary knowledge, and cultivate participants' dynamic, flexible and creative thinking.

(4) The integrative level- Innovation: Participants flexibly use traditional craft elements and creatively design by combining traditional craftsmanship elements with the knowledge and skills they have learned, which gives the traditional handicrafts a new form of creation that adapts to the needs of the age.

(5) Education target level - value: Through step-by-step teaching content, participants can learn by doing and think by learning, grasping knowledge in practice to form a personalized cognition of traditional handicrafts.

Such a multi-level expansion model of traditional crafts bases on the STEAM education framework. It combines constructivism, problem-based Learning, and student-centered self-inquiring teaching methods. Therefore, the participants gradually improve the cognitive depth of traditional handicrafts in a diverse, compelling and dynamic learning environment.

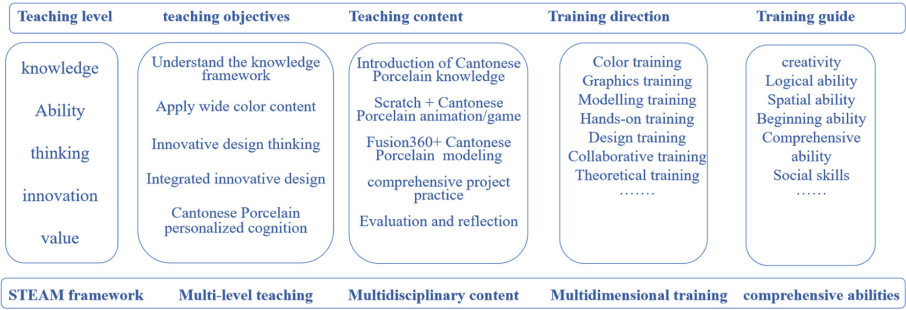
## **5 A Preliminary Study on the Extended Education Model with Cantonese Porcelain**

Combining geographical advantages, resource advantages, and team expertise, we launched a four-week (32 class hours) workshop on smart handicraft innovation, With the theme of Cantonese Porcelain (Cantonese Porcelain is an prominent representative of traditional Chinese handicraft and is listed as the second batch of intangible cultural heritage), in Nov. 2018. The project is widely supported by the school, the Guangzhou Municipal Government and folk artists in the Guangzhou Social Science Planning Project (2018GZMZYB17).

There have 28 students from undergraduate and graduate students of different majors at the Guangdong University of Technology.

### **5.1 Set Teaching Objectives**

This smart handicraft innovation workshop combines Cantonese Porcelain and smart technology to enable participants to improve the cognitive depth of Cantonese Porcelain and cultivate the comprehensive ability of the students through integrative learning methods and featured teaching content in the intelligent interactive lamp design project with Cantonese Porcelain as the element (Fig. 4).



The highest goal: gradually realize the personalized cognition of Cantonese Porcelain

Fig. 4. Teaching system diagram based on traditional craftsmanship multi-level education model

### 5.2 Course Design Based on Multi-level Education Model

Based on the STEAM education framework, the traditional handicraft multi-level extended education model builds a teaching process from basic knowledge, professional skills learning, and practice linkage and reasonably planned the teaching content of Cantonese Porcelain, thereby gradually increasing the participants’ cognitive depth of Cantonese Porcelain and improving the level of comprehensive application of participants in practice (Fig. 5).

Course structure of multi-level extended teaching mode	Knowledge	Preliminary introduction of Cantonese Porcelain knowledge	Preliminary establishment of Cantonese Porcelain knowledge system
		Scratch interface introduction and software operation	
		Trace the colorful pattern with scratch	
	Ability	In-depth study of Cantonese Porcelain knowledge	Use constructivist learning theory to deeply understand and master the knowledge of Cantonese Porcelain
		Scratch professional skills operation	
		Create a colorful animation/game with Scratch	
	Thinking	Cantonese Porcelain's element application, familiar with fusion360 interface	With the support of creative tools, break the traditional design thinking and establish creative thinking
		Fusion360 professional skills	
		Lighting design with wide color theme	
	Innovation	Cantonese Porcelain's element application	Adopt project-oriented teamwork to enhance the cognitive depth and comprehensive ability of Cantonese Porcelain
		3D printing, ceramic printing, laser engraving and other molding techniques	
		Lamp model making, intelligent interactive mode design, product improvement	
	Value	The formation of Cantonese Porcelain's personalized cognitive system	Form a personalized perception of Cantonese Porcelain in teacher evaluation, student mutual evaluation, and self-evaluation
		The formation of a personalized evaluation system for project works	
		Report project results (self-assessment / mutual evaluation)	

Fig. 5. Intelligent craftsmanship innovation workshop multi-level education model course structure



### Knowledge Level

According to the content of Cantonese Porcelain, it creates links with other disciplines, enriches the content and form of teaching, and provides students with a variety of optional learning contents to enhance their participation and interest in learning.

We systematically organized and summarized the information of Cantonese Porcelain, which was finally summarized into six aspects: history, crafts, tools, patterns, colors, and modeling. Moreover, each part of the brief introduction and representative pictures made into teaching cards, which is convenient for students to intuitively and efficiently grasp the knowledge structure of Cantonese Porcelain. In addition, students can also get more information about the part by scanning the QR code on the teaching card (Fig. 6).



**Fig. 6.** Students use the teaching card to learn the colorful knowledge in class

Lesson 1–2: In classroom teaching, teachers will guide the students to use the education cards distributed before class to learn more about Cantonese Porcelain. In addition to studying in class, students can also use their spare time to study online. Lesson 3–4: After introducing the interface and basic operation of a programming software Scratch, the students were asked to draw a Cantonese Porcelain pattern as a class-exercise. When using programming software to draw, students need to arrange and plan the pattern drawing and generation methods reasonably.

By creating a knowledge link between Cantonese Porcelain and Scratch programming, students can also exercise their logical, mathematical, and reasoning skills while creating art.

### Ability Level

After having the most basic understanding of Cantonese Porcelain, we will enrich the content of other disciplines with the theme of it, so that students can deepen their understanding of Cantonese Porcelain while learning technical skills.

In this stage of instructional design, we chose Scratch visualization programming software, which can be operated by beginners without the foundation of computer language, so that students can quickly familiarize themselves with the operation and create programming works in short term. Research has proved the importance of visual programming language to instructional design, which is very helpful for logic ability, mathematical thinking, artistic creation and understanding of history [21].

Lesson 5–8: The teachers encouraged the students to use the elements of Cantonese Porcelain to create animations and games using Scratch. In the elaborately design of the animation, students can only design the background, soundtrack, lines, characters, etc. after extensive research on Cantonese Porcelain. The content of 9-10 lessons is the study report of the above-mentioned exploratory projects, which are mainly divided into four parts: design concept, design process, design display, design self-evaluation and reflection. During the period, the teacher will evaluate from multiple dimensions, such as the work of the students, the production process, and the thinking process.

Compared with the traditional education model, the basic knowledge of Cantonese Porcelain is usually based on the teaching method, which is difficult to attract students' interest in learning. We combined Cantonese Porcelain with visual programming, and students independently explored its knowledge to make animations/games. Therefore, transforming passive indoctrination learning into active exploratory constructivist learning can improve learning interest and learning efficiency. During the reporting process, students communicate with each other to improve the breadth and depth of understanding of Cantonese Porcelain in the collision of ideas.

### **Thinking Level**

According to the artistic characteristics of Cantonese Porcelain, combined with the display form and manufacturing technology of modern technology, students are encouraged to break through the traditional forms and use creative thinking to innovate the expression of it.

Fusion360 supports top-down parametric modeling technology, which can adapt to frequent modification of products, and applies to the conceptual design stage of products, providing technical support for the creative implementation of the students. Fusion360 combines multidisciplinary knowledge such as mathematics, technology, and art to train students' logical thinking, spatial thinking, and creative thinking. In addition, it can improve the ability of cognition(knowledge), emotion (attitude), and psychomotor (skill) [22].

The teaching content of the 11–16 class is the skill learning of Fusion360. After the students can master the 3D modeling technology, the teacher asks the students to design the lighting modeling. Lesson 17–18: The teacher will answer questions for the students, check the team's project progress, suggest appropriate perspectives, and guide the problem -solving direction. The content of the 19–20 class is to report the final design plan and project implementation plan. The teacher will advise on the aesthetics, achievability and rationality of the project model.

As a guide for learning, not a decision maker, the teacher will give the students room to think and explore. As the leader of the project, the students will estimate and arrange the project's design orientation, strategic goals, implementation plan, and project results, so as to cultivate students' integral and systematic thinking.

### **Innovation Level**

In the design of intelligent interactive lamps, each group is required to flexibly use the Cantonese Porcelain elements to combine the knowledge and skills learned to carry out innovative design.

As a rapid prototyping technology, 3D printing is a personalized creation tool with "design thinking", expanding more shapeable modellings, giving students a broader

space for creation and imagination [23], which is an indispensable technical support for application innovation.

Lesson 25–28: Students try to use a variety of molding techniques to create a similar lamp model, after 3D model modification, determining molding technology, material selection, component printing, assembly completion, model improvement. Lesson 29–30: Students combine the product’s styling and design concepts to design the intelligent interaction mode of the lamp.

Due to the different conditions and environment, the theoretical knowledge accumulated by the students and the actual application exists a gap. Therefore, there may be many problems in the project, whether the shape can be realized by using existing molding technology, whether the model material is appropriately selected, whether the structural design is stable, and whether the wiring design is reasonable etc. This requires students to communicate with each other in the team, weigh the pros and cons to get the best solution to improve the students’ ability to solve problems and comprehensive application.

### Value Level

In the project design, through the in-depth teaching content guidance and project-oriented team practice, the understanding of Cantonese Porcelain is gradually deepened, so that the students can achieve personalized cognition of Cantonese Porcelain.

The content of 31–32 class hours is the summary report of the design of Cantonese Porcelain intelligent interactive lamps. Rethinking the process and results of the project, through the teacher evaluation, student mutual evaluation and self-evaluation, the students establish a personalized evaluation system for the works in the exchange of ideas, thus forming a personalized cognition of Cantonese Porcelain.

## 6 Results

In the workshop, students are required to use their imagination and creativity, apply their knowledge and skills, and carry out innovative design with the theme of Cantonese Porcelain.

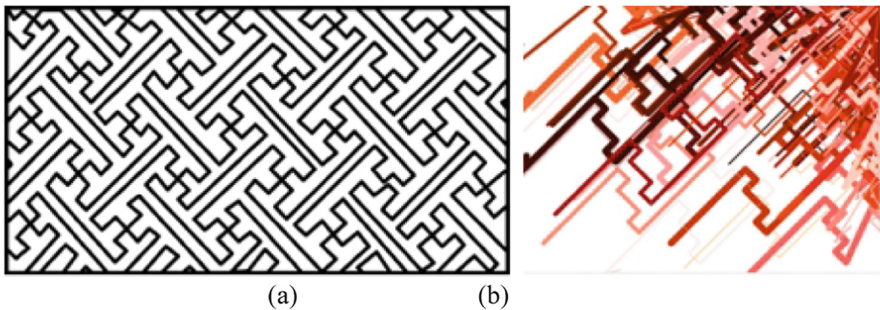


Fig. 7. (a) Wanzi Jin (original pattern of Cantonese Porcelain), (b) Creative graphic

Figure 7(a) is the Scratch creative graphic re-artified by the students, based on the Wanzi Jin. What can be seen from the comparison in Fig. 7 is that through the change of the form, reconstruction of organizational methods, and the reorganization of units have made Wanzi Jin modern and contemporary.

This exercise will transform the intuitive learning method into a rational composition analysis, which will enable the students to more accurately understand the composition of the Cantonese Porcelain pattern in the programming of the reproduction pattern, and it is easier to grasp the constituent elements and connotations of the pattern in essence.



Fig. 8. Screenshot of the student game works

After a preliminary understanding of Cantonese Porcelain, the teacher asked the students to make games or animations with the theme of it. Each team selects projects based on their interests: a one-minute animation showing the history of Cantonese Porcelain, an educational game according to the production process of Cantonese Porcelain, a program to customize the mobile phone case.

Shown in Fig. 8 is the game created by the students. Game makers needed to think about how to turn the production process into a complete and interesting game experience through arranging reasonably so that players can learn from playing: through every level of the game, they can know the tools and production process of Cantonese Porcelain (Fig. 9).

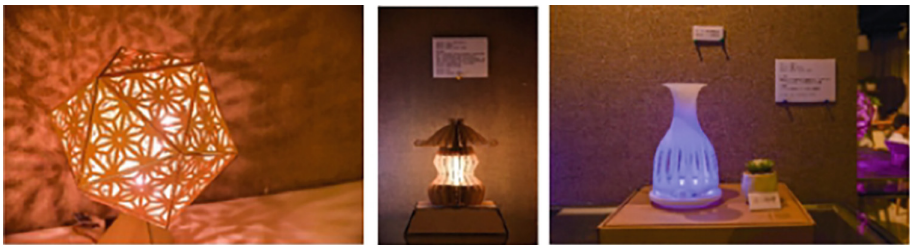


Fig. 9. Student lighting works

In the practice of integrated projects, the teacher asked the students to design a smart interactive lamp with the theme of Cantonese Porcelain. The students completed the entire design process in the form of a group: basic skills learning, determining the theme, program design, program screening, model making, lamp interaction pattern

design, product display and reflection. In the process, the students' ability to solve problems and the depth of cognition of Cantonese Porcelain are enhanced.

Compared with the traditional education model, the workshop's lighting works are more diverse, more expressive, more creative and expressive (Table 1).

**Table 1.** Comparison of traditional model and multi-level education model

	Traditional teaching model	Multi-level expansion teaching model
Teaching content	Experience the production process	Combining the content of multidisciplinary knowledge with the theme of Cantonese Porcelain
Teaching process	Master explanation, practical operation, comment exchange	Create knowledge connections, topic embedding, multidisciplinary integration, interdisciplinary applications, personalized cognition
Teaching form	Teaching form	Self-inquiry form
Work form	Counterfeit of traditional Cantonese Porcelain styles, such as porcelain plates	Combine the diverse forms of modern technology, such as computer programming images, games, animation, smart lighting
Teaching achievement	Hands-on ability, color ability, creative ability	Hands-on practical ability, color ability, creative ability, Logical thinking, spatial thinking, problem- solving ability, Comprehensive ability, etc.

Conduct targeted interviews with classmates after each class: We conduct research on interest, mastery, and satisfaction regarding teaching content, teaching style, and teaching methods. In addition, research on the use of teaching tools and opinions on teaching arrangements can be summarized. The results of the interviews can be summarized as:

83% of the students agreed with the teaching content of Cantonese Porcelain combined with Scratch, Fusion360 and smart interactive lamp design and considered very interesting and novel; 91% of the students said that the group-cooperative teaching form helps to communicate with each other to learn and solve problems; 75% of the students agreed with the student-centered independent inquiry learning in the workshop; 83% of the students said that they have their own opinions and evaluation criteria for the evaluation of Cantonese Porcelain works; 75% of the students said that they had a new understanding of Cantonese Porcelain after studying in the workshop.

## 7 Conclusion

Based on the comparison of the traditional education model with the extended course education model and the post-class interviews and the observer's records of the class indicate: In the practice of the project with the theme of Cantonese Porcelain, this

model can provide students with rich learning content and learning forms. It can enhance the students' interest and enthusiasm for learning, improve the learning experience and learning efficiency, and be recognized and loved by the students. Through interdisciplinary teaching content and cross-disciplinary learning experience, participants can flexibly use the colorful elements to carry out innovative design and integrated project practice to develop participants' ability to comprehensively apply knowledge in various fields to solve problems and deepen their understanding and cognition of Cantonese Porcelain.

This paper introduces in detail the teaching practice process of the intelligent handicraft innovation workshop with the theme of Cantonese Porcelain, and provides a reference path for the development of STEAM extended curriculum with Chinese characteristics, which provides a practical reference for the teaching of traditional handicrafts. However, there is still no authoritative evaluation standard for the teaching results of this workshop. It is difficult to prove that this model is conducive to improving students' ability to solve problems and comprehensive ability.

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