


Article

A Design Thinking-Based Study of the Prospect of the Sustainable Development of Traditional Handicrafts

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Abstract: Traditional handicrafts have a time-honored history and tremendous cultural value in China. However, even with the strong impact of globalization and consumerism in recent years, design-oriented scientific thinking and sustainable development models are not yet available. Based on Stanford Design Thinking, this study explores the prospect of the sustainable development of traditional handicrafts. First, a literature review and analysis were conducted to show that design science, as a bridge between natural science and humanities, aims to improve the important methods and research tools for the sustainable development of traditional handicrafts. Then, we studied ceramic product design via workshops. Methods such as action research, expert questionnaires, and factor analysis were adopted to establish 24 “indicators of the sustainable value of handicraft design” and four value dimensions, namely, “material and innovative value”, “handicraft and cultural value”, “empirical and local value”, and “sharing and interactive value”. Next, an experimental method was employed to make design product prototypes according to the design-thinking procedure. These prototypes were measured and evaluated with the indicators to form an evaluation report. In addition, the exploration of the sustainable development of traditional handicraft design also contributes to the establishment of a sustainable development model of design thinking. It was demonstrated that scientific design is the current trend and future of the sustainable development of traditional handicrafts. Finally, this study put forward five dynamic thinking methods and design strategies, providing the most direct methods and theoretical evidence for the sustainable development of traditional handicraft design. Finally, taking design thinking as the sustainable design framework, five dynamic thinking approaches were proposed: Thinking with the body, thinking with the mind, thinking with the heart, thinking with the hands, and thinking with the soul. Five design strategies were also proposed: Enquiry learning, values education, future problem solving, experiential design, and appropriate assessment. These approaches and strategies provide the most direct method and theoretical basis for the future of sustainable design regarding traditional Chinese handicraft products.

Keywords: design thinking; handicraft; sustainable development; value indicator

1. Introduction

The future of design science has become increasingly dependent on the innovation brought about by the use of scientific tools and thinking [1]. As a bridge between natural science and human science, design has the advantage of sustainable development. According to Norman, the experiment and research methods of social and behavioral science are not applicable to the solving the complicated problems facing us today [2]. Design thinking is a methodology system that offers ways to innovate. Aiming to continuously enhance people’s life quality, design thinking provides guidance on creative design and practices for cultural approaches. Scientific design methods based on design thinking can not only provide designers with more effective, diverse, and scientific-practical methods but

also guide how the traditional craft develops. As one of the key factors for the development of design, craft is of great significance to value innovation. Serving as a cornerstone in design, craft in designers' eyes is a sublimation from handicraft to mind-craft. Design and craft complement each other. Specifically, craft is the basis and connotation of design, whereas design is the manifestation and future of craft. Handicraft manufacturing represents a kind of design thinking and process that has existed since human beings first began to make products with their hands. With the improvement of crafts, handicraft products have undergone constant enhancement and application, which in turn has facilitated the lasting development of crafts. The value and methods of handicraft products have become the foundation of design. Therefore, it is practical that this study should define process design and action research against such a background. Integrating design technique into traditional handicrafts can not only deliver more cultural connotations in response to current demand for products but also explore new opportunities and models for sustainable development concerning traditional handicrafts. Nevertheless, there are differences in experience, method, and problem-solving ability among practitioners in the making of handicrafts. How to make full use of the scientific tools and strategies of design and discover the sustainability of traditional handicrafts to enrich design thinking and instinct is an issue that must be discussed.

1.1. Research Background and Motives

Due to social development and technological progress, people have entered an era of spiritual demand in which they pursue meaning and experience through material demand [3]. The goal of the future designer is to be inspired in different ways to create more products, services, and experiences that are conducive to a better life for human beings, thus having a large and important influence on society [2]. The design firm IDEO believes that future designers should be skilled at drawing inspiration from various fields and creating new value for customers as well as introducing environmental factors into their innovative work [4] in order to realize the sustainable development of nature, humans, and ecology [5]. Traditional handicrafts are an expression of culture, which are characteristic of aesthetics, practicality, locality, and refinement, and contain diverse values covering technology, art, and collection [6].

At the core of the United Nations' (UN) 2030 Agenda are 17 Sustainable Development Goals (SDGs) [7]. The aim of the SDGs is to secure a sustainable, peaceful, prosperous, and equitable life on earth for everyone now and in the future. The UN has emphasized the future planning of culture, education, and innovation many times. The industries with high additional value and enhanced economic productivity should be developed through innovation in cultural diversity. Productive activities and innovation should be improved to further activate local cultures and product innovation. Moreover, technological development, research, and invention should be supported for industrial diversification and a higher additional value for commodities [8]. Communication coverage should be widened to maximize the supply of the Internet services [7,8]. Greater efforts should be made to further safeguard world cultural and natural heritage sites. Sustainable consumption and production models should be employed to enhance the role of local cultures and products in green economy industries like sustainable tourism and to achieve sustainable management and efficient use of resources by 2030. Therefore, a direct path to sustainable development is to change our behaviors and thinking. The sustainability discussed in this research indicates to maintain the sustainable operation of traditional craftsmen, develop cultural creative products with local cultural identifiability and constantly improve the creating process and craftsmanship through innovation and design and referring to modern design thinking mode while conserving the ecological and humanistic environment, thereby getting profit to promote economic status and maintain cyclic development mode.

There has been a long history and splendid culture of traditional ceramic handicrafts in China. In the past, ceramics was not only a practical tool for the production and livelihood of the underprivileged but also a symbolic and ceremonial ritual instrument for the nobility. It had both functional and spiritual significance [9]. In the development of traditional handicrafts, scientific methods and experiment

and testing processes were unavailable in product making, and the practitioners lacked relevant education and training [2,10]. Crafts and apprenticeships were adopted for the making of traditional handicrafts, and in most cases, it was nothing but the duplication of traditional handicrafts and the artistic expression of traditional elements. In terms of handicraft value, handicraft innovation can be used to teach related technologies, but the thinking of handicraft value and the development direction of traditional handicrafts are not yet clear, and some handicrafts with high intrinsic value are becoming less popular [11]. In handicraft innovation, external handicraft value is mostly considered in terms of pleasantness and pure appreciation and lacks the thinking dimension of combined artworks and social life in practice [12]. Second, affected by globalization and consumerism, handicrafts have been commercialized, whereas “efficient production” centered only on “interests” has resulted in a shortened product lifecycle and fostered a disposable consumption life culture. Third, the reduction in intergenerational communication and dialogue has threatened the survival of traditional culture [13]. The cultural heritage of a particular region has been separated from the country and region, disrupting the transfer of handicraft skills and knowledge [14]. For instance, traditional Chinese crafts such as ceramics, paper-cutting, and knitting, requires a considerable amount of time and effort to exercise and practice in order to produce high-quality and culturally compatible works with meticulous attention to detail. The time required for such knowledge and experience accumulation varies from years to decades. The research team visited and interviewed the ceramic handyman Wang Xinghu for four hours on 19 November 2018, who had spent ten years running his own ceramic studio after four years of studying ceramics at the Ceramic Institute. He said that the origin and manufacture of many traditional handicrafts were inherited and developed in the countryside or rural areas of China. However, as rural areas have become more urbanized, an increasing number of young people have chosen to abandon the craftsman life characterized by monotony, repetitiveness, and idleness, causing a dilemma where only older people have consummate traditional craft skills. What further complicated the picture was the failure of craft to attract the interest and attention of young people. According to our investigations, over 50% of respondents did not know much about traditional craft production. Therefore, the traditional handicraft industry requires attention and protection.

Traditional ceramic craft has high cultural value, product value and innovation significance in the contemporary design. For example, ceramic handicraft creation can cultivate the unified knowledge and action ability of designers and stimulate the interactive experience of body and nature, while practical creation can provide the designer with a ceremonial feeling [15] and enable them to experience the beauty of labor, creation, and practice in ceramic production [16]. It focuses on the things people create by learning from nature and helps in the discovery of diverse cultures [17]. In addition, it can serve the local economy, community, culture, and ecology and create material conditions for green consumption. The traditional ceramic craft design not only contributes to the product making and inspiration of future designers but also plays an important role in helping people understand, protect and carry forward traditional handicraft culture [18].

1.2. Research Method and Purpose

Sustainable development is the essence of the Yin and Yang myth in oriental philosophy [19] and the paradigm of traditional Chinese handicraft value. The sustainability mentioned in this research is first reflected in the design method. The development and future of traditional Chinese handicrafts require scientific design tools and models. By introducing a modern design thinking method, it is possible to explore a set of methodologies that is conducive to the sustainable development of traditional handicrafts; in the design thinking process, exploring sustainability in traditional handicraft products not only makes traditional culture a source of inspiration for modern design but also helps to evaluate and measure the pros and cons of sustainable design in conventional handicraft products. Only by absorbing the essence of national culture will China be able to distinguish itself against fierce global competition [20], and giving full play to Chinese wisdom is a core topic of China’s design development. Previous designs focused on distinguishing between scientific design methods and

traditional making of handicrafts. The design process was either as objective as scientific experiments, which would lead to observation results, or the same as craft and apprenticeship training, which would lead in future to the traditional duplication of products [21]. Hence, the development of traditional handicraft design was greatly limited.

As for the research method, this study conducted a literature review to analyze and figure out the feature, content, and application foundation of design as the “third wisdom” of natural science and humanities and design thinking as an important scientific method and research tool. Then, action research, an expert questionnaire, and factor analysis were used to explore the sustainable value of traditional handicrafts. After that, the experimental method was employed to design and make a prototype in the product design workshop, and this prototype was measured according to the development model of design thinking to form an evaluation report (Figure 1). This study mainly adopted the natural experimental method, and the designed products are ultimately applied to life. With the setting of daily life, we conducted a study on the sustainable design of traditional handicraft products after controlling and creating specific conditions, by design. In this way, such an experimental method is closer to the actual production of the craftsman and the daily life of the user, combined with the advantages of both the experimental method and the observation method. The hypotheses of this study are as follows: (1) As a scientific practical tool and a thinking method, design thinking is sustainable in improving the design process of traditional handicrafts. (2) Traditional handicrafts have sustainable value. (3) A design thinking model can not only quantify and evaluate the value of traditional handicrafts but also sustainably optimize them.

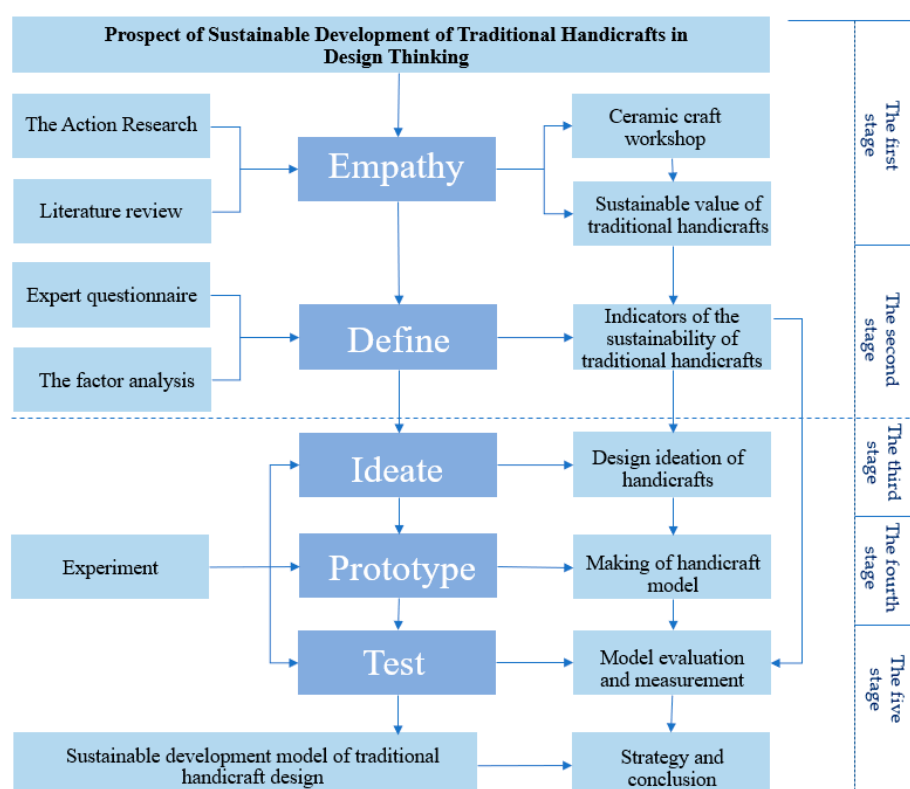


Figure 1. Research steps and framework.

The research objectives of this study are as follows: (1) To use design thinking to propose a sustainable development model of traditional handicraft design. (2) To establish the sustainable value indicators of traditional handicraft design through the empathy and definition of design thinking. (3) To probe into strategies for the future sustainable development of traditional handicrafts through the formation of design thinking, the making of a prototype, and testing and evaluation. As an

exploratory and experimental study, this paper aimed to probe into the role design thinking can play in activating the modernization of traditional handicraft culture and explore its future development. This experiment carried out a themed design, production, and demonstration of products methodically and pertinently in a real handicraft workplace, with an attempt at drawing and accumulating more experience and experimental data for the sustainable development of traditional handicraft products.

2. Relevant Studies

Through a literature review, this study analyzed the features and development trend of design as a scientific, creation-oriented, and new interdisciplinary subject. Only by accurately defining its properties and features will we be able to adopt better research methods for an effective exploration of the sustainable development of traditional handicrafts. The evolution of design is closely related to craft, and the preservation and innovation of handicrafts provide necessary practical and theoretical support for the methodology of design science. In this section, we explore the importance of scientific methods and tools in activating traditional handicraft development, and meanwhile sort out and discuss the relationship between science, humanities, design, and crafts, with the hope that the connotation and future value of traditional craft in design can be found in rationality and sensibility.

2.1. Features of Design Science

Science, humanities, and design have different properties [22]. Natural science observes the objective world in a quantitative way and explores its logic of necessity through deduction and reasoning. Humanities interprets human experience in a qualitative way and analyzes the logic of probability through induction and comparison [23]. Design synthesizes the best intentions and purposes of human beings and stresses appropriateness under the restriction of reality [2]. The American design theorist Victor Papanek defined “design” as “consciously and intuitively practicing meaningful order” [24]. He emphasized that design is not only a result of reason and analysis but also requires intuition and integration ability [19]. Papanek saw the power and influence of design. William McDonough proposed learning from nature, put forward the concept of “nutrient management” in Braungart’s and his Cradle to Cradle design [25], and carefully conceived design sustainability from the time of product design. The imitation of natural materials and handicrafts in sustainable development is the only way to achieve the circulatory development of the production–consumption system [4]. Sustainable design refers to consciously imitating the visible patterns and relationships in nature and to design works that can provide locals with the necessary food, fiber, and energy (Figure 2).

The essence of science is procedure, and the so-called scientific method is something that enables us to repeat experiments and allows others to duplicate the process and obtain the same conclusion. The objective of future designers is to acquire experience through inspiration and create the products, services, and experiences that will improve human life, so as to generate enormous and significant influence. According to Norman, the experimental method of design science should be a method that can help people find and recognize “appropriate” conditions and “inspiration” for design in a simple and convenient way. Scientific research methods, reliable research procedures, relevant leaders and experts must be included to develop adequate sensitivity to statistical variation and experiment deviation. Norman believed that design is exploration-oriented, immediate, and timely, and is supposed to generate some results within several hours or days. Usually, designers would obtain the expected inspiration and direction through a test and evaluation involving 5 to 10 people if some objects were tested. However, attention must be paid to the impact of the bias of experiment participants and the testing procedure on the test [2]. In summary, traditional Chinese handicraft culture has the value and significance of science and humanities, embodied in the cultural identity of its nation. It is necessary to design scientific tools and methods to explore and define its sensibility value. Only in this way, combined with the design and production of designers, can it be recognized and used by people today. This process represents both the perseverance and a derivation of traditional culture, the juncture where traditional handicrafts beam with revitalization and vitality. In such a

context, design science acts as a critical bridge and link between them. In the following parts, the Stanford design thinking process was introduced to explore the future development of traditional handicrafts based on the design science methodology proposed by Norman.

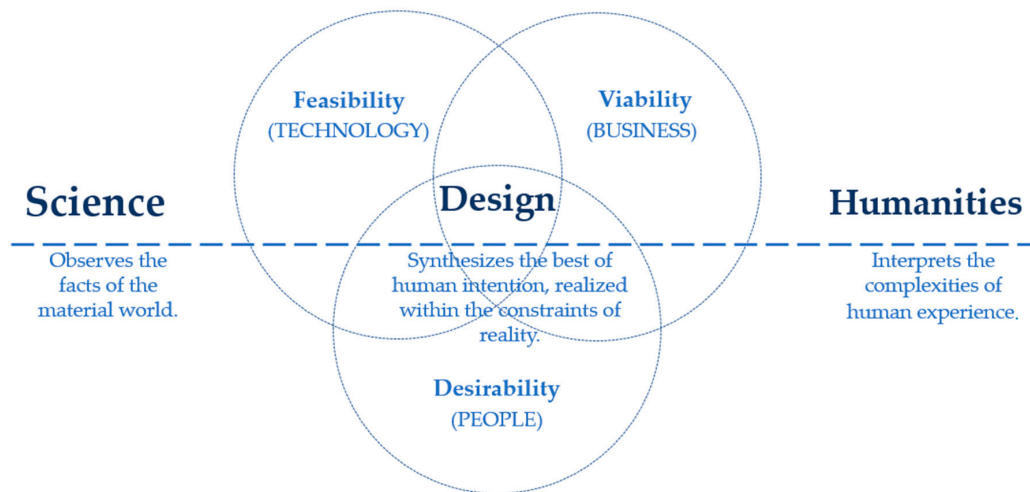


Figure 2. Design: As a third culture, design sits between the two poles of science and the humanities and is at the heart of questions related to feasibility, viability, and desirability [22].

2.2. Design Thinking

Design thinking is a widely applied scientific training method designed to improve creativity [26]. In 1969, the Nobel Prize winner Herbert Simon wrote a groundbreaking article entitled “The Sciences of the Artificial” [1]. It was about design method and introduced the design thinking model. In the early 20th century, the Hasso Plattner Institute of Design at Stanford University developed it into a scientific methodology, and it soon prevailed across the globe. Design thinking comprises five stages, namely, Empathize, Define, Ideate, Prototype, and Test, and is one of the fastest ways to improve creativity [27]. Human-centered and user-oriented, it considers consumer needs and adopts models and visualizations to solve complicated problems. In design thinking, design is an iterative cycle featuring repetitive operations. It entails continual prototyping, testing, and refinement [2,23] (Figure 3).

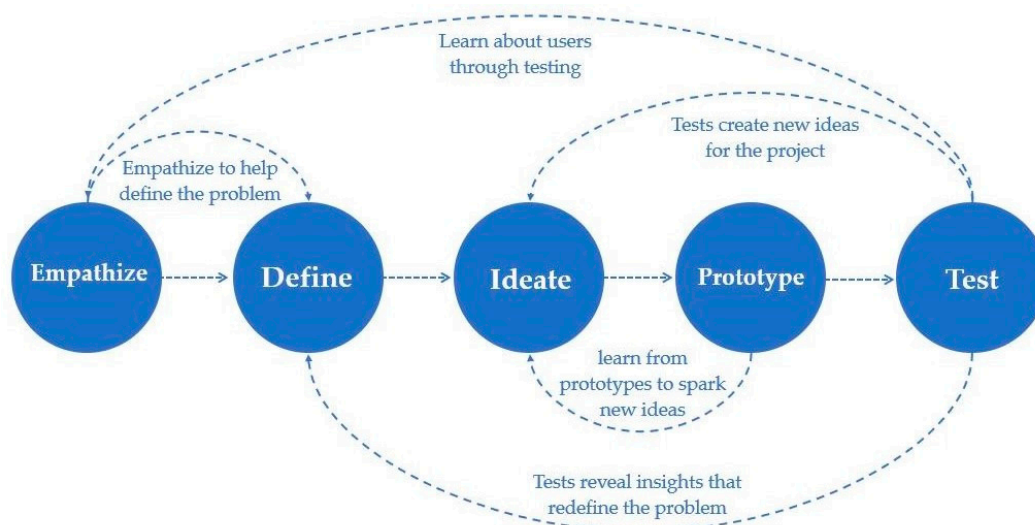


Figure 3. Proposed five-stage design thinking model: A non-linear process (Teo Yu Siang and the Interaction Design Foundation).

If design thinking is introduced to the innovation of traditional handicrafts, designers will be able to analyze problems in a more comprehensive and logical way and develop a clear thinking structure and framework. Unlike rational thinking, design thinking places more emphasis on “perceptual analysis”. Professor Ho said that design innovation requires not only design thinking but also dynamic thinking [6,23]. Perceptual analysis emphasizes such analysis and design concepts as people-centred, whereas the latter mainly focuses on “how to” design. In dynamic thinking, these five parts (thinking with the body, thinking with the mind, thinking with the heart, thinking with the hands, thinking with the soul) complement and multiply with each other progressively, making it redolent of the wisdom of Chinese philosophy. Hence, craft plays a vital role in the process of design. The sense of touch through the fingers is connected with brain nerves and using their fingers can stimulate designers’ brain nerves and deepen their understanding of materials and texture, and thus improve their evaluation of value and significance. In addition, design and craftsmanship also share a great many identical objects and elements. For example, they both end up producing physical objects and finished products for daily use or satisfying psychological and spiritual needs. They are both processed and designed by craftsmen or designers. They both need a shaped design method or production process, in which the feeling and meaning that products reflect needs to be delivered.

2.3. Relationship between Design and Craft

Craft plays an essential role in design. For designers, it is the transition from handicraft to mind-craft [6]. In the Design Family Tree drawn by David Walker in 1989, craft was taken as the core and foundation of design development [28]. When people start to use tools and create things, the craft becomes the germination of human creation. In this germination, the design is defined as a human purposefully and intentionally conducting production activities. Design is ubiquitous, whereas craft is the connotation and basic value of design. The development of design science is like the growth of a tree: Craft works as the trunk in the Design Family Tree, and different disciplines, skills, and methods are connected through craft roots, making craft the foundation of design and creation as well as the source of inspiration. In addition, craft is a cultural medium which is ubiquitous in different craft forms, such as calligraphy, pottery, sculpture, thatching, embroidery, and jewelry.

According to Ho, future designers will use their hands, bodies, brains, mind, and emotions in the design process [6,23]. This would activate their wisdom and bring them inspiration. Such methods as drawing, making, modeling, and evaluating are needed to convert materials into products. Finally, products become the crown of the Design Family Tree through industrial definition, and the crown includes various modern outcomes that meet the material and spiritual needs of human beings, such as image, industry, fashion, architecture, and engineering. In the development of design, art and science are like air, sunshine, and water, constantly nurturing the tree of design. The process not only involves the evolution of design but also shows the continual advancement of design education (Figure 4). In the development and growth of the Design Family Tree, we can see that design and craft complement each other. Craft is the basis and connotation of design, whereas design is the manifestation and future of craft. The use of design science in traditional handicraft can not only add more cultural connotations and ethnic significance to current demand for products but also offer more opportunities and models for the sustainable development of traditional handicraft.

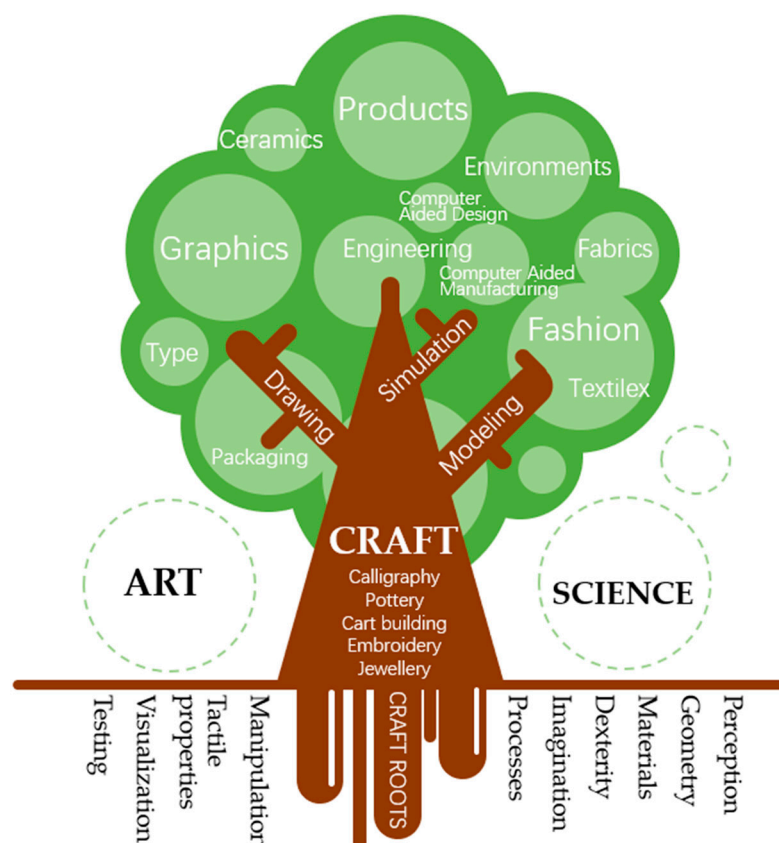


Figure 4. Design Family Tree [28].

2.4. Traditional Craft Value

Craft is the concrete presentation of culture. As a part of traditional Chinese handicraft and folk culture, ceramics boasts a long history of development and a broad cultural influence. The craft includes not only physical objects but also craftsmen and users. The person is the main body of the craft. The value innovation of craft culture is the embodiment of craft value improvement for people. From creativity to innovation to entrepreneurship is the development trend of modern people; people of different eras have different values [29].

Maslow proposes in his hierarchy of needs that production, life, living, and ecological needs are the expression of the most basic circulatory systems and values of human beings [6]. Thinking about what is enough requires examining how many material needs and desires of human beings are satisfied [19]. Design is a tool to understand people's needs and desires and to create niche and lifestyle tools. As different economic periods have different niches, a niche in the past was an innovative value, whereas value innovation is a current requirement. As Chinese ceramic craft has evolved over thousands of years, its manifestations vary between dynasties. For instance, the lead-glazed sancai (three-color) ware prevailed in the Tang Dynasty; ceramic products represented by Jun ware, Ru ware, and Ge ware in the Song Dynasty enriched the variety and were later held in particularly high esteem. During the Yuan Dynasty, Jingdezhen, which gradually became the pre-eminent center for producing porcelain, produced blue and white porcelain that has enjoyed wide popularity. That aside, it is the Qing Dynasty that witnessed the peak of Chinese cinematic craft where the craft technology was also the most complex and exceptionally rich. On the one hand, the development of ceramics in different dynasties was limited by the financial resources and technology of the time. On the other hand, it was mainly influenced by the physiological, psychological, and spiritual needs and desires of people for products. For example, the humanistic thoughts of the Song Dynasty had a substantial impact on generating a need for ceramics. Ho presented four forms of value paradigm [23]. The first is

the value of materials, in which value and price complement each other, whereas cost and function are the strategies influencing their development. The second is the value of communication. In the era of symbolic consumption, a brand is composed of symbolic meaning and the value of symbolic consumption. Its value lies in the process of information transmission through coding and decoding, which convey their own identity and enhance the value. The third is the value of experience required by people in an experience-based economy [3], which refers to the creation of scenes and the shaping of memories. The fourth is the value of spiritual design, which refers to a comfortable, harmonious, and sacred feeling created by culture and creativity (Figure 5).

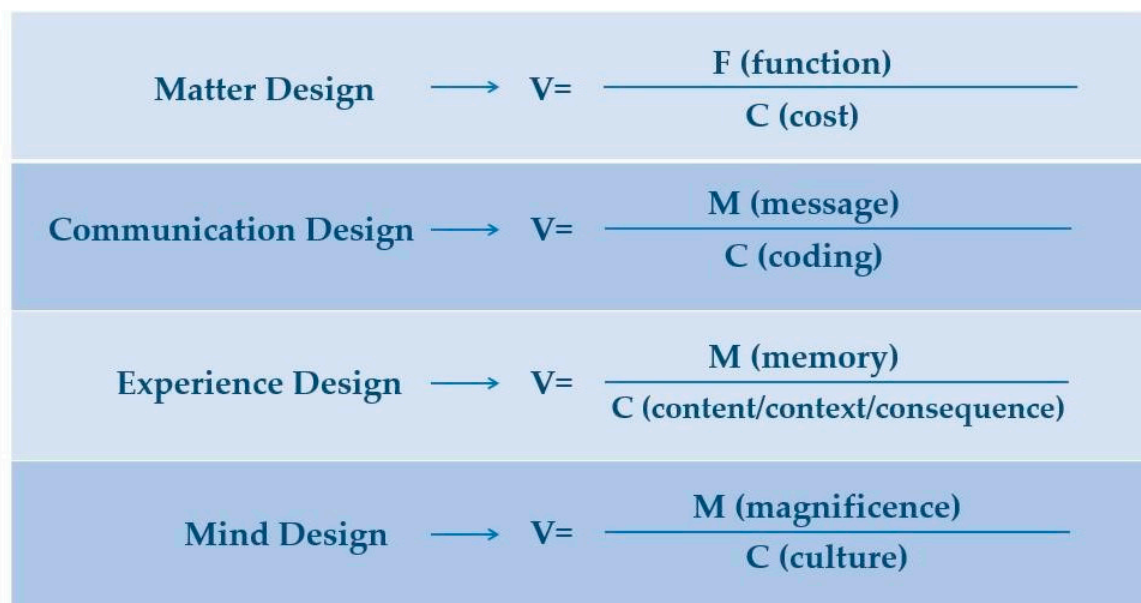


Figure 5. Innovation in design value [6].

In addition to green value, traditional handicrafts also contain social, economic, cultural, educational, local, and environmental values. For example, restoring the culture refers to forming the cultural value from the emotional memories generated by long-term use, as opposed to a disposable culture, and representing sustainable value [12]. In the construction of local characteristics, traditional handicrafts emphasize the explicit characteristic of “local production and local consumption”, which serve as important mediums for establishing local cultural identity and external cognition. Miyazaki suggested that the ultimate path of environmentally friendly materials will point to the earth [30,31], where a design with traditional handicraft value originates from nature and reflects the personality and creativity of the designer, thus embodying the conceptual value of “minor production and moderate use” [12]. Ho indicated that traditional handicraft value includes skill value, practical value, aesthetic value, economic value, environmental value, cultural value, educational value, symbolic value, community value, and self-cultivation value [32]. Chen mentioned that handicraft creation is based on the wisdom and experience accumulated by human beings, who produce the daily necessities through their dexterous hands and materials from nature under the guidance of aesthetics of life. The handicrafts have spiritual value, including practical spirit, local spirit, inheritance spirit, work spirit, quality spirit, original spirit, and humanistic spirit, and daily handicraft design strategies have been proposed accordingly [33].

Handicraft aesthetics represent the essence of sustainable culture, and aesthetic forms echo sustainable design [19]. The pursuit of beauty is the value demanded of human beings at the spiritual level and refers to maximizing sustainable value without producing excessive waste. Calcined ceramic containers were an important technological innovation and a prerequisite for the agricultural revolution.

The “next best use” of containers is now being promoted, and sustainability of the circulatory system is increasing.

2.5. Construction of Traditional Handicraft Value Indicators

The education philosopher G. J. J. Biesta proposed that current education operates in the “measurement era”, that the education value depends heavily on measurement criteria, and that the contents of assessment tools should receive more attention [34,35]. For example, after establishing sustainable knowledge architecture, it is necessary to perform tests and make improvements [36]. The indicator is the measurement tool established by “the symbolic representation of one or more inputs, processes or results according to different needs” [37]. A sound indicator system should be theoretical, hierarchical, diversified, and integral [38,39]. The “indicator” referred to in this study serves to assess, and its effects are examined, through detailed indicator criteria [40]. From the above, the construction of value indicators can fully reflect the characteristics and rationality of traditional handicrafts and sustainable design. Moreover, it can meet the needs of educational innovation, innovation objectives, learner vision, designer experience, product information communication, and interpretation.

3. Design Thinking-Based Exploration of the Internal Factors of Handicrafts

According to the research objectives, this study discusses the sustainability of thinking-based design of traditional handicrafts. The issue can be divided into two parts: The exploration of the internal factors of products and the design expression of external factors. This part focuses on the internal factors or the significance and value of handicrafts for human beings. It involves the first and second phases of design thinking. Different research methods were used for a specific study on the design of a ceramic handicraft workshop. The research lasted from March to October 2018.

3.1. Research Framework and Design Procedure

With the emphasis on the prospect of the sustainable development of traditional handicrafts in design thinking, this study took design thinking as the fundamental theory and adopted the five-stage research method to analyze the practices of the workshop. In the first stage, “Empathize”, the action research and literature review were used to collect and summarize information about the sustainable development value of the design of traditional ceramic handicrafts in the workshop according to the research objectives. Emphasis was placed on the collection and analysis of existing information. In the second stage, “Define”, the expert questionnaire and the exploratory factor analysis were adopted for the dimension reduction and focus of the special sustainability of handicraft design to form several dimensions and rename them to create factor contents and indicator evaluation items. Focus was placed on the consistency of all the experts’ opinions on the issue to reduce error. In the third stage, for “Ideate”, which involved design and experiment, young designers in the workshop were instructed to finish design ideation through brainstorming, draw themed drafts, and make a preliminary description of products on the basis of the construction features and the evaluation indicator items. In the fourth stage, “Prototype”, the ideation in the previous stage was combined with practice to form the preliminary design prototype. In the fifth stage, “Test”, the indicators of sustainable value of the design of traditional handicrafts in the second stage were used to test and evaluate the design prototype in the fourth stage to analyze the inspiration of sustainable design and demonstrate the theoretical, systematic, evaluative features, and diversity of the indicators, so as to establish a sustainable development model of traditional handicraft design.

3.2. Phase 1: Empathize Section Title

According to Stanford design thinking, designers need to think with their body in this phase, where they have a comprehensive and specific understanding of design contents and tasks and develop empathy and resonance. The research objective of this study was to achieve the design expression of sustainable materials, cultures, forms, and experience through the practice of sustainable design of

traditional Chinese ceramic handicrafts. By doing so, the author aimed to demonstrate the different problem-solving method of design thinking proposed by Norman and how to quickly locate and recognize the “appropriate” conditions and “inspiration” for design. Through the different practice and innovation steps in the ceramic craft workshop, the author defined the contents of practice, including practice object, practice procedure, design theme, design form, and implementation time.

3.2.1. Contents of Workshop Practice

- (1) Experimental subjects: The experiment subjects were 30 future designers in product design, including 11 males and 19 females. They were divided into groups of 3–5, so that the 30 students were divided into 6–10 groups. Gender, age, class, and department were randomly distributed. In addition, two professional ceramic artists, two ceramic production assistants, and three design instructors guided the completion of practical ceramic design innovation. The materials used in the experimental process were the same, whereas the practical environment and production time were fixed. In addition, the themes were constituent parts of improving internal validity.
- (2) Practice procedure: Craft is usually closely related to culture, environment and cognition and is expressed through different signs, cultures, and symbols. (a) Investigation in the early stage: Design objective and background, the distribution of design task letter, and information collection. (b) Practice in the mid-term stage: Start workshop in the ceramic factory, become familiar with the environment, use tools, observe and touch materials, coil cement bars, roll cement board, mold and repair pottery, glaze and practice exercise. (c) Practice designing and drafting the theme products and making prototypes and models according to the learning task letter. (d) Design practice in the later stage: Interaction and communication, design making, design formation, and pottery firing. (e) Stage of conclusion: Naming of products, exhibition, design review, and design report.
- (3) Design theme: The Chinese Culture of 24 Solar Terms was officially included in the UN Intangible Cultural Heritage List in late 2016. The 24 solar terms have humanitarian and aesthetic value, social sustainable value, practice and innovation value, and scientific development value in the sustainable development of culture [41]. The Chinese culture of solar terms is a representative cultural tradition as well as representing an urgent need for design innovation and development. Therefore, the theme of the ceramic handicraft, “Cultural Products of Chinese 24 Solar Terms”, was taken as the final design result of the workshop.
- (4) Design form: The making was dominated by teamwork, and the design products were ceramic handicrafts like water and incense utensils and lamp cabinets. The products were themed after each one of the 24 Chinese solar terms. Finally, the design products were evaluated by experts of different domains. Meanwhile, the products became the prototype objects to be tested in the fifth stage of design thinking.
- (5) Implementation time: The workshop in this study was an experimental ceramic one. According to Norman’s proposal that design should be exploratory, immediate, and timely, and should lead to results with a design influence within a short time, so according to the curricular requirements for design students, the workshop was set to last for three weeks (or 21 days) from June 9 to 29, 2018.

3.2.2. Strategy and Implementation

The enquiry-learning strategy of UNESCO’s Education for Sustainable Development (ESD) was adopted in this stage [42]. This study found that the emphasis of enquiry learning is exploration. First, designers could access relevant information and literature and analyze and summarize potential problems and the solutions to some solved problems. Second, they could consult the experts and practitioners of relevant fields and refer to the expert interview or questionnaire to understand the main problems and possible solutions in the most efficient way. Third, the participatory observation could be employed to understand the intentions and motivations of the observed without excessively

distracting from them. Finally, they could walk onto fields and indulge themselves in a physical environment, so as to have an in-depth analysis of the main problems and empathize with others (Table 1).

Table 1. Empathize stage: sustainable value data of traditional craft product design.

Strategy	Method	Source	Source Data	Sustainable Value
Enquiry learning	Literature collection	Historical literature, monographs, databases	"Picture explaining the Kao Gong Ji" [43], "Chinese ceramic history" [44], "Ceramic Aesthetics and the National Characteristics of Chinese Ceramic Aesthetics" [45]	Material recycling, life cycle, tool reuse, heritage knowledge, cultural change, natural cycle, national spirit, cultural diversity
	Expert interview	Production, learning, research experts	Interview with 2 professors from Quanzhou Institute of Technology and Art in Fujian, 2 professors at Jingdezhen Ceramic University, Quanzhou Dehua White Porcelain Craft Master, 1 expert in tea culture ceramics in Pantu Town, Zhangzhou, 1 expert of Jingdezhen Ceramic Art Research Institute	Connected with the palm of your hand, applied ability, critical thinking, environmental awareness, green consumption, waste, healing, versatility, process strategy, communication skills, problem-solving skills, cross-disciplinary skills, critical thinking
	Participatory observation	Observer, worker, craftsman, designer	Visiting Yifan Kiln, Pantu Town, Zhangzhou, Quanzhou Arts and Crafts Institute, Jingdezhen Ceramic Art Research Institute	Real situational contact, group cooperation, participation, integrated design, creation of new forms, low pollution production, regional economic development, network sales, modern technology
	Field investigation	Practitioners, stakeholders, local residents	Putuo Town, Zhangzhou, Fujian, Quanzhou Dehua White Porcelain Factory	The original materials, experience, traditional hand tools in the region, the sense of acquisition, inspiration, people sharing, cooperative spirit, cultural forms of regeneration, observation of nature, initiative

Empathy is vital for human-oriented design thinking, so future designers should throw away their bias and assumptions through empathy and participation before designing. In this stage, the above strategies were adopted to collect a large amount of information about the creation features, conditions, innovation, and sustainable value of traditional ceramic handicrafts, and this information could be used for the next stage. The work in this stage was done in Pantu Town in Zhangzhou City, and it included early-stage observation, visits, investigation, and summarization of the ceramic handicrafts of tea culture.

3.3. Phase 2: Define

In this phase, the information collected in the empathize phase was defined for analysis and observation. In the process, values education and the strategy of thinking with the mind were used by the future designers. In a broad sense, value refers to the positive meaning and usefulness that an objective entity offers a subjective entity [46]. Values indicate the cognition, understanding, judgment, and choice based on the mind of a human and is a kind of thinking or orientation for a human to understand things and distinguish good from bad. Aside from directing motivation, it reflects a human's cognition and demand. The core of design thinking is to reconstruct problems in a human-oriented way. Defining problems, seeking significance, and discovering value are extremely important for designers in design science.

For traditional handicrafts, it is especially important to find out the value of the sustainable development and innovation of handicrafts. In such value definition, the first step is to make an evaluation of existing problems according to the establishment of empathy and the experiential learning analysis in the preview step. In this stage, scientific technologies and tools like statistics and formulas can be adopted to achieve more effective analysis and research. The defined value can be taken as the measurement criterion and indicator of the prototype in the later stages. To obtain a higher level of reliability and validity, the expert questionnaire or the expert Delphi method can be used in this stage to appraise and select the existing materials.

3.3.1. Indicator Screening

According to the relevant research in Section 2, the design of handicraft products requires the designers to possess a certain understanding and mastery of the sustainable value of handicrafts. Although the works should bring the basic functional requirements of users, the difference in the value of works and the transmission of cultural codes should be emphasized. In this study, we believe that it is necessary to include the opinions of multiple experts due to the diverse professions that comprise the field. Therefore, according to Weimer and Vining (1992), the technical indicators for selecting the experts are “analysis” and “politics” [47,48]. The plan was to select experts from practical industry, academic departments, and design research institutes.

This study adopted the purposive sampling method, and 60 expert questionnaires, paper-based and Internet-based, were distributed. In total, 53 questionnaires were retrieved, and 7 questionnaires were deleted as they were incorrectly filled in or incomplete; 45 questionnaires were valid for the study. The tested experts included 27 males and 18 females, including 12 undergraduates, 17 masters students, and 16 PhD candidates. The experts consisted of creative directors and designers from design companies, experts from cultural institutes, design research experts from graduate schools, and so on. The questionnaires were compiled into the Likert five-equivalent questionnaires and sent to experts for the questionnaire survey.

3.3.2. Level Construction

Through the two-stage selection of expert indicators, this study finally constructed the sustainable design value indicator hierarchy. The research results and analysis are as follows. In the first stage, through discussion of the literature and the preliminary expert assessment results, the indicators with inappropriate or repeated attributes were deleted [38,49,50], and 30 indicators were selected and classified by experts. Next, the mean (M) and standard deviation (SD) of the 30 value indicators were used as the judgment basis, and the indicators with lower expert consistency were removed. Next, the α coefficient check method of the item analysis was used to select the indicators. In this study, the internal consistency reliability of the expert questionnaire items based on the 30 indicators was verified. An α value greater than 0.7 indicates high reliability [51–53]. The Cronbach’s α of the test was higher than 0.70, which shows that the expert questionnaire items exhibit high reliability. The 30 indicators with sustainable handicraft product design value were: Environmental friendliness, green material, vitality, local lifeforms, green consumption, low waste, integrated design, innovation, handicraft, low pollution, inheritance, cultural identification, healing, recycling, inspiration, national spirit, local culture, sharing, online sales, reference, cooperation, cultural diversity, multi-function, observation, communication, imagination, cross-field, originality, experience, and practice. The 30 indicators were re-interpreted and compiled into the questionnaire and then submitted to the experts for a formal survey in the second stage of the expert questionnaire method.

In the second stage, 45 valid questionnaires from academic, industrial, and research experts were retrieved. After the data were recovered, the study conducted a reliability and validity analysis and an expert indicator review, in which the indicators with non-conforming measurement standards and repeated expression were deleted from the original 30 indicators. Finally, 24 indicators were retained. Factor extraction and dimension naming were then performed by factor analysis in order to construct the hierarchy of “sustainable value items of traditional handicraft product design”. Concerning the measurement tools used in this study, factor analysis was carried out using the principal component method and the maximum variation axis method (varimax). The results included a total of four factors, the cumulative explanatory variation was 78.903%, the Kaiser–Meyer–Olkin (KMO) value was 0.847, and the Bartlett’s sphericity test was 1103.917, which reached significance (significance was 0.000). In total, four factor dimensions were extracted (Tables 2–5).

Table 2. Kaiser–Meyer–Olkin (KMO) and Bartlett’s test accreditation in phase 2.

KMO and Bartlett’s Tests		
Kaiser–Meyer–Olkin sampling appropriateness measure		0.847
Approximate chi-squared distribution		1103.917
Bartlett’s sphericity test	Degrees of freedom	276
	Significance	0

Table 3. Explains the total variation in phase 2.

Component	Total Explanatory Variation								
	Initial Inherent Value			Retrieval Square and Load			Rotary Square and Load		
	Total	Variation%	Cumulative%	Total	Variation%	Cumulative%	Total	Variation%	Cumulative%
1	14.793	61.637	61.637	14.793	61.637	61.637	5.461	22.753	22.753
2	1.74	7.252	68.889	1.74	7.252	68.889	4.912	20.466	43.219
3	1.398	5.824	74.713	1.398	5.824	74.713	4.842	20.176	63.395
4	1.006	4.19	78.903	1.006	4.19	78.903	3.722	15.508	78.903

Table 4. Exploratory factor analysis in phase 2.

Rotary Component Matrix a				
	Component			
	Factor 1	Factor 2	Factor 3	Factor 4
Handicraft products use environmentally friendly materials	0.856	0.228	0.21	0.224
Handicraft products have green vitality	0.815	0.228	0.236	0.324
Handicraft products are innovative	0.702	0.39	0.156	0.19
Handicraft products produce low pollution	0.652	0.393	0.161	0.27
Handicraft products produce as little waste as possible	0.648	0.356	0.403	0.163
Handicraft products have environmentally friendly functions	0.605	0.433	0.361	0.322
Handicraft products lead green consumption	0.592	0.476	0.468	−0.019
Handicraft products are inherited	0.359	0.764	0.179	0.375
Handicraft products have cultural codes	0.269	0.753	0.391	0.171
Handicraft products can be recycled	0.465	0.734	0.264	0.223
Handicraft products are traditionally handcrafted	0.262	0.671	0.148	0.189
Handicraft product manufacturing process heals the body and mind	0.423	0.666	0.256	0.431
Handicraft product manufacturing process stimulates inspiration	0.418	0.642	0.225	0.409
Handicraft products are based on the craftsman experience	0.134	−0.005	0.855	0.205
Handicraft products serve as intergenerational communication means	0.224	0.42	0.712	0.264
Handicraft products reflect the local culture	0.275	0.296	0.683	0.39
Handicraft products reflect the local lifeforms	0.481	0.227	0.674	0.051
Handicraft products embody the craftsman’s imagination	0.236	0.378	0.652	0.463
Handicraft products embody original craftsman thinking	0.148	0.368	0.644	0.525
Handicraft products originate from integrated designs	0.533	0.325	0.604	0.014
Handicraft products can be used for online sales	0.18	0.18	0.237	0.813
Handicraft products can be used for practical experience	0.165	0.382	0.145	0.677
Handicraft products can be shared by people	0.564	0.183	0.212	0.677
Handicraft products are of referential significance to modern technology	0.232	0.228	0.551	0.62

Retrieval method: Principal component analysis; Pivoting method: Kaiser normalized maximum variation method;
a: Converged and rotated in nine iterations.

Table 5. Convergence validity and differential validity in phase 2.

	Convergence Validity		Distinction Validity		
	AVE	Factor 01	Factor 02	Factor 03	Factor 04
Factor 01	0.493	0.702			
Factor 02	0.499	0.836	0.706		
Factor 03	0.480	0.762	0.757	0.693	
Factor 04	0.491	0.709	0.736	0.762	0.701

3.3.3. Naming of Sustainable Design Value Indicators

This study aimed to assess the sustainable value of handicraft design and named the four dimensions formed by factor analysis as “material and innovative value”, “handicraft and cultural value”, “empirical and local value”, and “sharing and interactive value”, after considering the content of indicators based on the indicator extraction (Figure 6). The first level (goal level) of the assessment indicator hierarchy was constructed, and the second level (objective level) was the detailed assessment indicator dimension for sustainable value design.

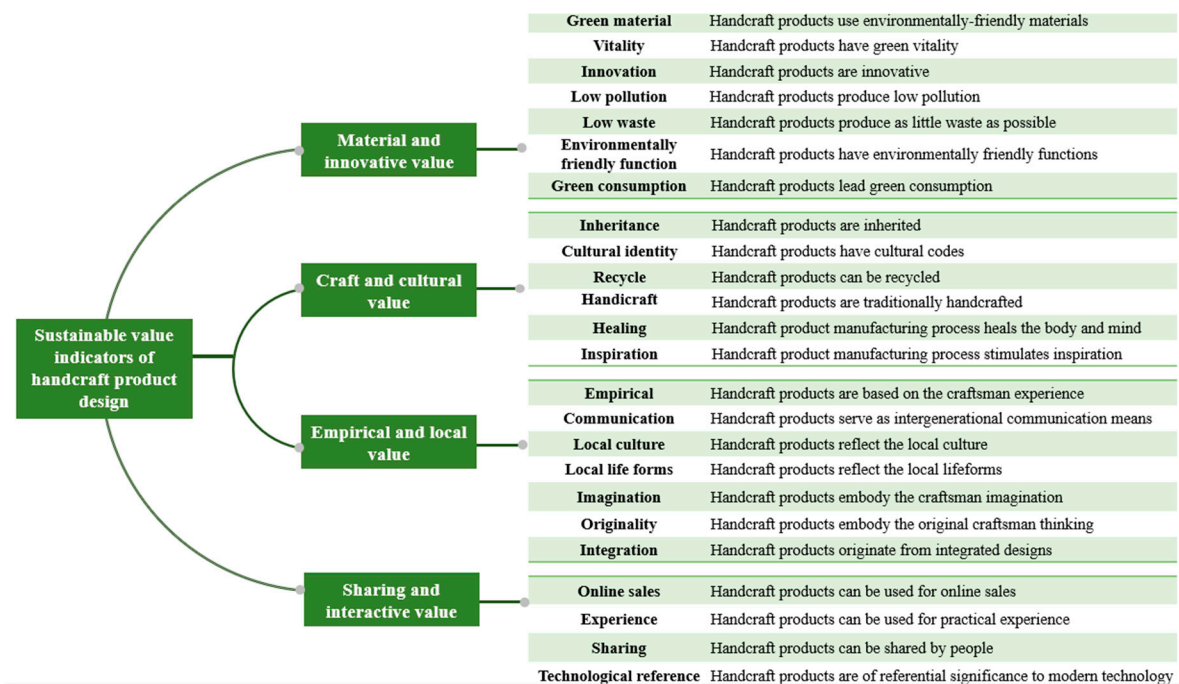


Figure 6. Sustainable value indicators for handicraft product design and four facets.

We note four major dimensions of this study. First, the traditional handicrafts are mostly made of natural materials, which have certain vitality and vigor. In the continuous innovation and development process, low-pollution and low-waste environmentally friendly functions and usage habits are accumulated. Second, both skills and experience of traditional handicrafts are passed down through practice to future generations. The handicraft works have a strong cultural identity, and their accumulated handicraft tradition has healing effects for people today and is instructive for modern design. Third, the valuable experience accumulated by generations has been inherited, which has promoted intergenerational communication, enriched and activated the local culture, and released unlimited imagination and creativity into its lifeform and civilization genes. Finally, with the progress of technology and society, handicraft works can be economically transformed on virtual or physical platforms to promote new demand, enabling people to share their harvest and joy in the experience economy. At the same time, excellent handicraft skills serve as a reference for technological development and become a new paradigm.

4. Design Thinking-Based Design and Evaluation of Handicrafts

According to the research framework and design procedure, the previous section discussed the sustainable value of the internal design factors of traditional handicrafts in design thinking. This section will deliberate on the design expression of products. Norman believed that design is exploratory and imperfect and involves how to make some influence and obtain some inspiration quickly. This chapter

focuses on three stages of design thinking, namely, “Ideate”, “Prototype”, and “Test”. In these three stages, designers design creative and sustainable ceramic products.

4.1. Phase 3: Ideate

In this phase, designers can break all restrictions to give their creativity and imagination full rein to develop as many new ideas as possible. In the phase of empathy, the needs of the persons concerned have been understood, and the intrinsic value and expert opinions have been analyzed and refined in the phase of define. In this phase, it is necessary to put forward specific problem statements or design criteria. A future problem-solving strategy is used in this phase, with emphasis on thinking with the heart. Emotion must be invested, and team members can think about problems from different angles. Creative skills like brainstorming, focus group, and the KJ method can be employed. The solutions were based on the inspiration stimulation, free thinking, and problem extension.

As for the sustainable design of traditional Chinese handicrafts, innovation is the best way to achieve sustainable development. New inspiration and the thoughts and ideas to be expressed can be obtained from culture, material, craft, experience, local elements, and interactive experience through innovation. For example, in the traditional handicraft design experiment of this study, different teams produced and designed their products based on the same theme, in which the inspiration was derived from Chinese poetry, proverbs, folklore, and stories. Therefore, different teams extracted different elements for designing crafts. China highlights both the tangible and intangible value of products and contexts. To equip products with the Chinese spirit of “truth”, designers can not only take pattern, color, texture, structure, and function into consideration but also redevelop and make handicrafts with traditional cultural features from such aspects as cultural signs, symbolic meaning, emotional experience, aesthetic value, and mental inspiration. The theme of this practical design was “Sustainable Cultural Products on 24 Chinese Solar Terms”. Based on team production, there were 6 products, comprising water appliances (b1–b3) and incense appliances (a1–a3), named by inspiration source, and design, introduction to the process, and design instructions. First, a1 drew the material of their story scene chiefly from Chinese solar terms. The design was expressed in the selection of decorative patterns, demonstrated by mysterious color, the lightning symbol, and so on. The main inspiration of a2 originated from Chinese Zen thought. The design focused on shape and color, where the circle represents perfection, harmony, and moderation, and cyan embodies the traditional feeling of elegance, freedom, and nature. Next, a3 was inspired by Chinese poetry. The design extracted index elements from poetry and expressed it with modern design techniques. By adopting different ceramic manufacture techniques, its shape possesses both the traditional Chinese symbolic meaning and cultural symbols. For example, an older man symbolizes longevity and fishing symbolizes a free and unstrained lifestyle. Next, b1 was inspired by the essence of Chinese characters. The design was expressed in shape, color and decoration by association and imagination. Then, b2 was inspired by the proverb, in which it projected the related image elements onto objects. Then, for inspiration, of b3 was derived from poetry of the Song Dynasty. The artistic conception imprinted in poetry was transformed into images, by which it interpreted auditory beauty and visual beauty through the author’s association, metaphor, and imagination (Table 6).

Table 6. Design description of works themed by the 24 Chinese Solar Terms—Wakening of Insects.

No.	Name	Source of Creation	Design Description	Design Performance	Producer
a-1	Thunderstorm Incense Stand	Mysterious and secluded atmosphere in the thunderstorm night at the Wakening of Insects	The stand is shaped by the mud plate-shaping method and hollowed-out style into a cylinder with a diameter of 6 cm and a height of 7 cm. The flash, fading peach flowers, and leaving birds are applied to show the feelings of fading and restoration. The stand is purple with red peach flowers and brown sprays.	Shape, decoration, color, symbol, symbol	Lin's Team
a-2	Green Fuming	Green refers to the spring brought by the Wakening of Insects, and Incense refers to the soft touch brought by the incense	The leaves on the stand set off the early spring and highlight the scene at the Wakening of Insects. The simple non-angular shape is modeled after the porcelain in the Song Dynasty to present a mild, tranquil, and austere feeling.	Shape, color, decoration	Chang's Team
a-3	Sentiment Fish Incense Stand	Fishing poem concerning the 24 Solar Terms	After the Wakening of Insects, the weather gets warmer. The fish starts moving and seeks food while the fishermen start fishing. The mud sheets are curled and stacked in the mud plate-shaping method to highlight the handicraft creation features and the consistency between shape and function.	Craft, shape, color, structure, symbol, cultural code	Huang's Team
b-1	Beginning of Insects	The Wakening of Insects is also called the Beginning of Insects. The insects come to life while trees and flowers start growing	It represents everything coming to life when spring arrives. It is 16 cm high, and the petal edges, carved leaves, and grasshopper are applied figuratively.	Shape, color, decoration, symbol	Chang's Team
b-2	Peach Hopping	Peach trees are in full blossom at the Wakening of Insects	The works are shaped by mud strips into a 13 x 13 x 7 cm rectangle. The peach flower, fish, thunder, and frog elements are employed to increase the fun and embody infinite vitality.	Craft, shape, decoration, structure	Lin's Team
b-3	A Woman with Closed Eyes	From the poem written by Fan Chengda in the Song Dynasty about a beautiful girl in the cloudy and slightly thundering Wakening of Insects	At the Wakening of Insects, a spray of red apricot blossom has already reached over the wall. Deep in the misty rain, there is a sorrowful girl yearning for the return of her husband. The works are shaped by the casting method. It has a diameter of 20cm and a height of 12cm. The sketch of the girl image sets off her mood at the Wakening of Insects	Shape, color, decoration, cultural code, form beauty	Huang's Team

4.2. Phase 4: Prototype and Making

In this phase, the design team made many rough and simple products or prototypes with special value to test the solutions proposed in the previous phase. This phase is the phase of thinking with the hands in a real sense, and an experiential design strategy was adopted, so that everyone would experience product making and material, craft, and media interaction. Prototypes can be shared and tested in the team or among the designers of other sectors. This is just the phase of experimental formation, and it aims to find out potential solutions to the problems defined in the previous three phases. By the end of this phase, the design team will have a deeper understanding of the internal limitations of products and existing problems and gain a more comprehensive perception of user behavior, thoughts, and feelings in their interaction with the finished products. In this ceramic product design, each workshop member tried his/her best to make ceramic products related to the Chinese 24 solar terms and strived to underline sustainability through the theme, content, and sign. Although sustainability is an abstract concept that is hard to express, continual focus was placed on what was designed thanks to the direction of values in the phase of empathy (Figures 7 and 8).

**Figure 7.** Prototype and making.

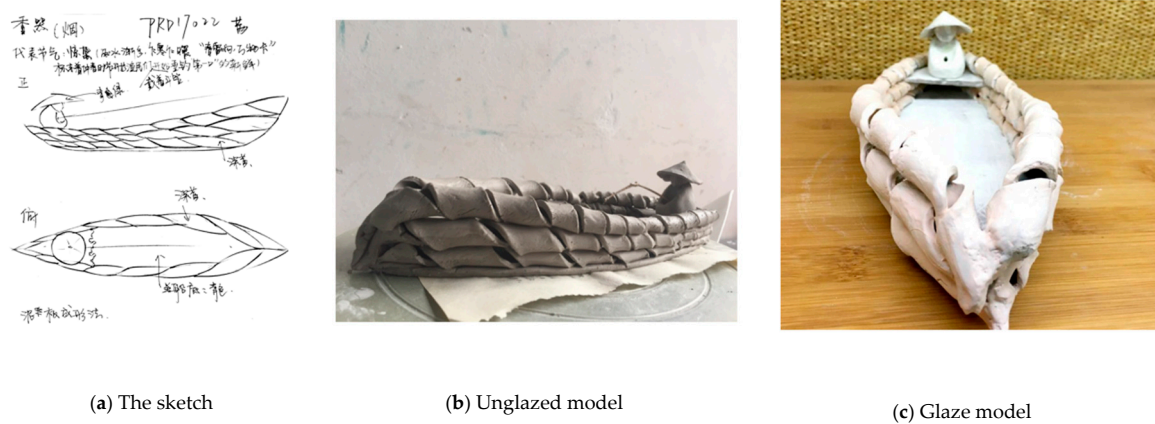


Figure 8. The test and evaluation.

4.3. Phase 5: Test and Evaluation

In this phase, the prototype is measured and the appropriate assessment strategy is implemented. The assessment tool is the value scale made in the second phase. According to Norman, testing is the best approach to the exploration of design science. Usually, the expected influence of design can be obtained when a target object is tested and assessed among 5 to 10 people. In this phase, designers think with their souls to feel design and obtain new inspiration. To improve the accuracy and reliability of testing, specific groups or interested persons can be chosen for the test. The experts who are interviewed for opinions and suggestions in the first phase can also be tested, which will lead to more accurate test results.

This phase is the last in the five-phase model, but it is also a process of repetitive operation. The results in the test phase are often used to redefine one or more problems, to show the use conditions, to understand the thinking, behaviors, and feelings of users, and to lead to empathy.

4.3.1. Test Preparation and Process

The sustainable value assessment indicators of handicraft product design constructed in this study were used to assess the water appliances and fragrance appliances themed on “The Chinese Culture of 24 Solar Terms”. According to the academic, industrial, and research expert criteria, the expert library chose six experts, including two traditional handicraft production experts, two design experts, and two education research experts to score the six pieces of work according to the 24 sustainable value assessment indicators of handicraft product design from 1 to 10 points. A higher score indicates that the product design complies more with the content of this indicator. Before the assessment process, experts had to read the design background of the product and other related information (Figure 9).

This study assessed ceramic handicraft prototypes with the same theme and different forms, and the 24 assessment indicators were applied in the measurement (Figure 10). The following results were obtained. First, regarding the average score (A) of a single piece: b-3 Girl at the Wakening of Insects (7.2) > a-3 Sentiment Fish Incense Stand (7.19) > a-2 Green Fuming (6.82) > a-1 Thunderstorm Incense Stand (6.69) > b-1 Beginning of Insects (6.56) > b-2 Peach Hopping (6.53). Second, regarding the scores of a single piece, a-1 scored higher in handicraft (8.7), cultural identity (8.2), imagination (8), and experience (8) indicators and lower in technological reference (5) and vitality (5.8) indicators. Third, a-2 scored higher in the handicraft (8.5) and cultural identity (8) indicators and lower in the originality (5.3) and vitality (5.7) indicators. Fourth, a-3 scored higher in the inspiration (8.5), healing (8.3), handicraft (8.3), cultural identity (8.2), and imagination (8.2) indicators and lower in the technological reference (6) indicator. Fifth, b-1 scored higher in the handicraft (7.7) indicator and lower in the low waste (5.5) and technological reference (5.8) indicators. Sixth, b-2 scored higher in the handicraft (7.8), originality (7.7), and healing (7.7) indicators and lower in the technological reference (4.8), integration (5.3), and experience (5.7) indicators. Seventh, b-3 scored higher in the inspiration (8.7), originality

(8.3), innovation (8.2), empirical (8), and handicraft (8) indicators and lower in the low pollution (6) indicator. Eighth, the indicators with the highest scores among the six pieces of work were handicraft (8.17), cultural identity (7.64), inheritance (7.33), and inspiration (7.33), whereas indicators with the lowest overall score were technological reference (5.67), integration (6.08), and vitality (6.17).



Figure 9. The tested prototypes. (a-1) Thunderstorm Incense Stand, (a-2) Green Fuming, (a-3) Sentiment Fish Incense Stand and (b-1) Beginning of Insects, (b-2) Peach Hopping, (b-3) A Woman with Closed Eyes.

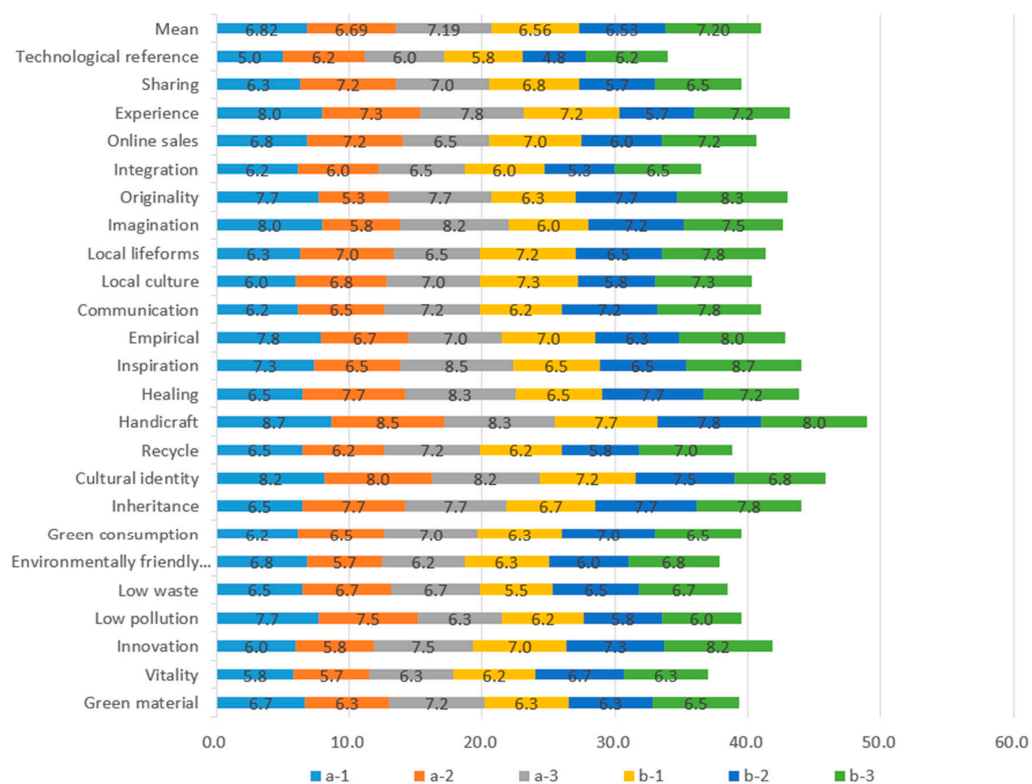


Figure 10. Scores of design works in 24 sustainable value indicators.

This study adopted the “material and innovative value (A1)”, “handicraft and cultural value (A2)”, “experience and local value (A3)”, and “sharing and interactive value (A4)” as the first level (goal level) to analyze the six pieces of ceramic design work (Figure 11). First, the means (M) of the ceramic design works in the four dimensions were sequenced: Handicraft and cultural value (7.38) > Experience and local value (6.85) > Sharing and interactive value (6.56) > Material and innovative value (6.51). Second, the score of a-3 in the handicraft and cultural value was the highest (8.03), and the score of b-2 in the sharing and interactive value was the lowest (5.54). Third, regarding the score of material and innovative value, the score of a-3 was the highest (6.74) whereas the score of b-1 was the lowest (6.26). Regarding the score of handicraft and cultural value, the score of a-3 was the highest (8.03), whereas the score of b-1 was the lowest (6.78). Regarding the score of experience and local value, the score of b-3 was the highest (7.62), whereas the score of a-2 was the lowest (6.31). Regarding the score of sharing and experience value, the score of a-3 was the highest (6.81), whereas the score of b-2 was the lowest (5.54).

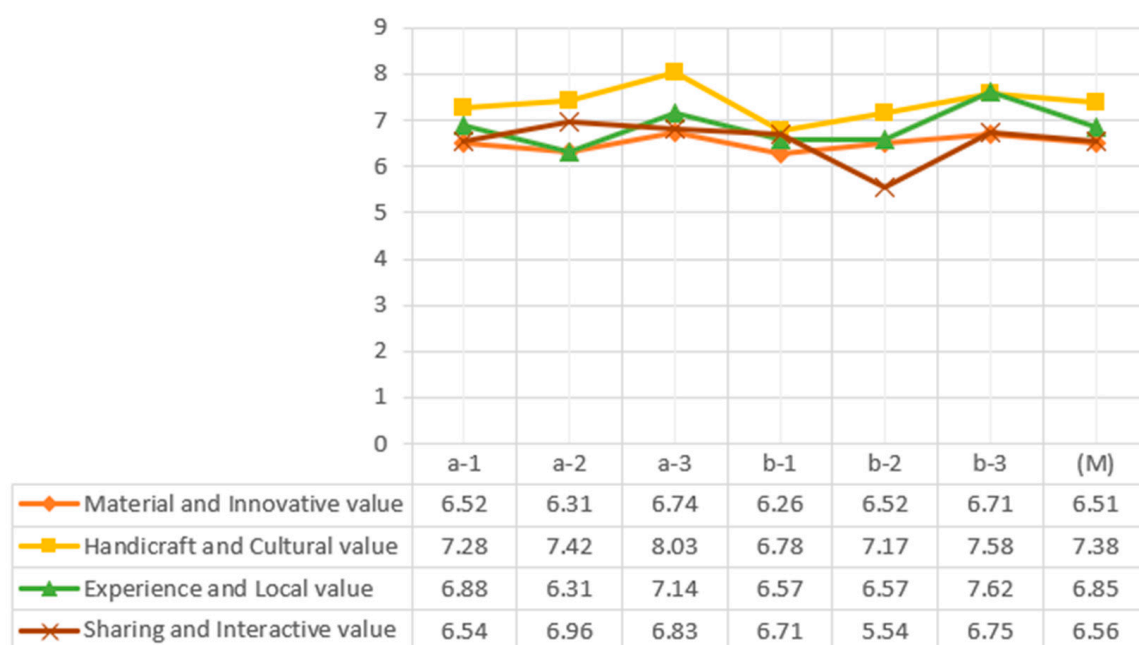


Figure 11. Scores of design works in four sustainable value dimensions.

4.3.2. Evaluation of Measurement Results

Through the above test preparation and testing process, the research used 24 “permanent design value indicators of process product design” to evaluate the design prototype after data analysis. This study included the assessment results from the interviews and data analysis of academic, industry, and research institute participants. First, the overall assessment score of b-3, Girl at the Wakening of Insects, is the highest, whose understanding and interpretation of the theme of the Wakening of Insects was inspired by ancient Chinese poetry. It embodied the spiritual pursuit and portrayed a special sense of picture and story through a combination of character image and product appearance, which connected the emotional factor in traditional culture with modern people. This shows the importance of human factors in the sustainable value of culture. Second, in the six pieces of work, the handicrafts contained the practical experience and production techniques of the producer, directly reflecting the creativity and imagination of the works. Cultural identity is the understanding and recognition of groups that share the same cultural background and perception of their culture. The continuous accumulation and inheritance of culture have formed a new cultural, ecological circle. In this ecological civilization, not only craftsmen can create better craftsmanship through modern production, which is in line with modern people’s usage and aesthetics, but also consumers can find products which meet their needs at

a physiological, psychological, and spiritual level, hence rejuvenating the traditional handicrafts. The core of sustainable value is accumulated and passed down. Third, based on the analysis of indicators with lower scores, in the current economic environment, the attitude of master inheritance and practical handicraft innovation towards sustainable value conforms to the expert opinion that the technical and economic standards are dominant while the ecological and environmental sustainability will not be considered. At present, because the value model changes, the former functionalist, self-sufficient, and distributed traditional handicrafts require new motivation and demand in order to develop their sustainable value through new changes. Finally, factors affecting the quality of design products include physiological sensory value, psychological emotional value, and spiritual inspiration value. Sustainable design exists to coordinate people, things, and the environment at an incremental value level. Introducing the concept of sustainable value to the design practice of the future designer has prospective significance, but the process of practice, accumulation, and internalization is required to directly reflect sustainable value in the design works.

After data analysis, the design prototype was evaluated as follows: First, the four values of the works were comprehensively analyzed, and the scores of “handicraft and cultural value” were the highest, indicating that the current functions, application environment, and economic utilization of handicrafts highlighted their own accumulated cultural gene and cultural value and were in line with the idea proposed by Professor Ho that “With the rise of the value paradigm in the new economic era, people pursue and yearn for cultural value” [32]. In contrast, the scores of “material and innovative value” were the lowest due to the stereotyped impressions of traditional ceramic products: From soil to ceramic, and then back to soil. Therefore, some designers thought that “the shape of ceramics is just soil” and will be caught in the “fixed handicrafts” phenomenon similar to the “fixed design” in design creation, thereby hindering sustainable handicraft innovation and development.

Second, the scores of a-3, named Sentiment Fish Incense Stand, in the material and innovative value, the handicraft and cultural values, and the sharing and empirical value were high for the following reasons: First, the use of handicrafts and materials. The producer used porcelain clay to make mud strips and combined its rice ear form with the image of a fishing boat, which not only reflected the seasonal characteristics of the “The Chinese Culture of 24 Solar Terms” but also conveyed the harmonious cycle of people and nature and the concept of sustainable development. Second, the inspiration from a fishing poem concerning the 24 solar terms, which embodied both a sense of picturesque and a spiritual core of Chinese culture, thereby contributing to product creativity. Third, the consistency between the function and the artistic conception of the incense appliance. The fisherman is fishing on the boat. The fishing rod in his hand and the incense serve as mutual rhetoric. The incense and the fishing are full of spiritual content and adopt metaphorical and metonymic design approaches.

Finally, the Pearson correlation coefficient was used to express the extent of the correlations among the four values, and it is concluded that there is a significant positive correlation between the material and innovative value (A1) and the handicraft and cultural value (A2), and that there is a significant positive correlation between the handicraft and cultural value (A2) and the empirical and local value (A3). This practice innovation presents a certain validity and reliability for widespread applications (Table 7).

Table 7. Pearson correlation analysis of design works.

Pearson Correlation		
A1		
A4	Correlation coefficient	0.112
	<i>p</i>	0.833
A3	Correlation coefficient	0.79
	<i>p</i>	0.062
A2	Correlation coefficient	0.907 **
	<i>p</i>	0.013
A2		
A4	Correlation coefficient	0.48
	<i>p</i>	0.335
A3	Correlation coefficient	0.914 **
	<i>p</i>	0.011
A1	Correlation coefficient	0.907 **
	<i>p</i>	0.013

** $p < 0.01$.

4.4. Model and Summary

In summary, this study is an exploratory piece of research on the prospective sustainable development of traditional handicraft design according to the method and procedure of design thinking. In the design thinking method, dynamic thinking and design strategies were proposed for designers. In the “Empathize” phase, strategies like thinking with the body and enquiry learning were used to gain a comprehensive and specific understanding of the sustainability of handicraft design and design tasks, with the aim of generating empathy and resonance. In the “Define” phase, strategies like thinking with the mind and values education were adopted to seek the significance of the sustainable development and innovation of handicraft design and provide evidence for the value assessment of existing problems. The definition phase is extraordinarily crucial. At this stage, the key to finding the sustainable value and significance of traditional crafts for modern design is to distinguish between traditional handicrafts and modern design products. For example, traditional handicrafts are often handmade art, and the products are unique and unitary, with each piece featured in its own artistic expression and content, whereas modern design products are often mass produced and mechanized. Nonetheless, as the development of society and the economy has witnessed the rise of the service economy and the experience economy, customized product design forms have captured more and more consumers where more experience and benefits were drawn from traditional crafts. At the same time, the boundary between handicraft and modern design products has become increasingly blurred, which requires us to attach importance in drawing lessons from traditional handicraft to define the value and significance of modern design products with due caution. In the “Ideate” phase, strategies such as thinking with the heart and future problem-solving were adopted to invest emotion in the ideation of handicrafts, and free thinking was combined with the design methods to offer solutions. In the “Prototype” phase, strategies such as thinking with the hands and experiential design were employed, and each design team member made rough and simple ceramic handicraft prototypes which reflected specific sustainable values for the testing of the solutions. In the “Test” phase, strategies such as thinking with the soul and appropriate assessment were adopted to test and evaluate the sustainable value of the design prototypes of ceramic handicrafts, and the conclusion was that they had the “inspiration” and “influence” that are expected in design. In addition, it is also a process featuring repetitive operations, problem redefinition, and the generation of new empathy. This process not only leads designers to discover the value of sustainable development of traditional handicrafts but has also demonstrated and established the sustainable development model of design thinking,

providing methods and theoretical evidence for the sustainable development of traditional handicraft design (Figure 12).

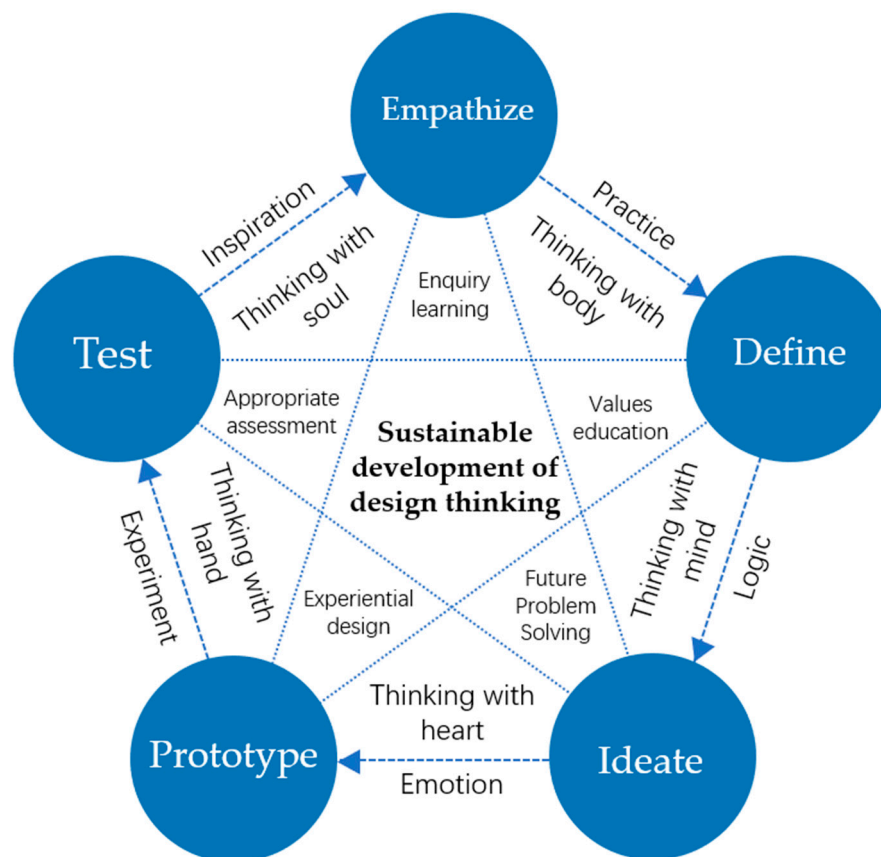


Figure 12. Sustainable development model of design thinking.

5. Conclusions

Based on design thinking, this study examined the prospect of the sustainable development of traditional handicraft design. First, a literature review and analysis were conducted to show that design science, as a bridge between natural science and humanities, aims to improve the important methods and research tools for the sustainable development of traditional handicrafts. Craft is a core element in the development of design, and its value innovation is an inevitable trend that should not be ignored. A ceramic handicraft design workshop was introduced according to the five stages of Stanford design thinking—(1) Empathize, (2) Define, (3) Ideate, (4) Prototype, and (5) Test. Action research, an expert questionnaire, and factor analysis were adopted for the design of ceramic handicrafts. After that, 24 sustainable value indicators of handicraft design were obtained, and four value dimensions were established, namely, “Material and innovation value”, “Craft and culture value”, “Experience and local value”, and “Sharing and experience value”. The study found that Define is the most important of the five steps of design thinking. This step can not only discover the value and significance of traditional craftsmanship for a modern design but also primarily prepare for the development and evaluation of sustainable products. Second, the experimental method was used, and 30 college students of meta-products explored the sustainable value of handicrafts according to the procedure of design thinking and then used their imagination and creativity to make products sharing the same theme, texture, and requirements. Of all the products, six pieces were selected as prototypes and were measured and evaluated with the sustainable value indicators of handicraft design to form an assessment report. According to the findings, culture accounts for a large proportion in the sustainable value of products of this kind, and a human-oriented spirit is very important for makers and users

in the expression of theme. Meanwhile, recognizability refers to the understanding and acceptance of culture among people sharing the same cultural background and perception and is the core of sustainable value. Aside from physiological senses, other factors that influence design products include mentality, emotion, and inspiration. Sustainable design strengthens the coordinating force among humans, objects, and the environment in the dimension of value. Besides, the sustainable development model of design thinking was established on the basis of the exploration of the sustainable development of traditional handicraft design. The following dynamic thinking methods were proposed: Thinking with the body, thinking with the mind, thinking with the heart, thinking with the hands, and thinking with the soul. Five strategies, namely, enquiry learning, values education, future problem-solving, experiential design, and appropriate assessment, were proposed according to the UNESCO ESD theory. This study has provided methodological and theoretical evidence that can be repetitively experimented on and duplicated for the prospective sustainable design of traditional handicrafts.

As exploratory research of design science, this study also has limitations and deficiencies. First, the reference materials and subject background information were limited. Compared with natural and social sciences, the development and research methods of design science are under continuous exploration and definition; in particular, traditional technology is mostly the product of practice and experience accumulation. Therefore, there are some difficulties in the sustainable exploration of craft product designs based on design thinking, such as the lack of data or insufficient concentration. Secondly, China's vast territory and rich traditional cultural content have imbued many conventional handicraft products with different attributes, which also posed limitations on the research. Because different craft products have different contents and attributes, there are restrictions when selecting objects for research. For example, the research experts were mainly ceramic technologists, research-oriented experts, and academic experts, thus making commercial-application experts in the sample limited. Thirdly, restricted by research time, funding, and experimental subjects, limitations also lie in time linearity as well as the testing and experimentation of different populations. Hereby, we proposed some follow-up research recommendations and possible directions. Chinese culture is profound and sophisticated, and traditional handicrafts are the crystallization of the accumulated experience and wisdom of Chinese artisans. Therefore, different research methods and experimental designs can be tried in different kinds of craft research, and craft culture can be explored in more depth and from multiple angles in the future. Subsequent research could add commercialization or market feedback, and research regarding such topics could measure and evaluate the works of a single designer horizontally, and could also conduct experimental research on different types of works made by different designers. In short, we hope that this research acts as a starting point to inspire future study to approach the design and application of traditional craftsmanship culture with more scientific tools and methods.

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