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SUSTAINABILITY EDUCATION ON INTANGIBLE CULTURAL ASSETS: A STUDY OF THE FEASIBILITY OF INTRODUCING STEM EDUCATION THEORY TO THE TRANSMISSION EDUCATION ON INTANGIBLE CULTURAL ASSETS

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Abstract

This study explores the feasibility of introducing STEM education theories to the transmission education of intangible cultural assets. Firstly, the study adopted the in-depth interview method. We invited six intangible cultural preservationists and two government personnel who participated in the Transmission Education Program. These interviewees were asked to discuss Taiwan's current intangible cultural asset preservation and transmission education program. Secondly, the study invited five university instructors specialized in cultural heritage preservation, science education research, STEM education research, craft design, and cultural and creative industry design to explore the feasibility of introducing STEM theories to various types of intangible cultural heritage education.

The study revealed that the STEM education concept could be integrated into all levels of the intangible cultural asset transmission education framework. Moreover, STEM theory is suitable for the education discourse and curriculum planning concerning intangible cultural assets and the development of teaching materials.

Keywords: *STEM, Intangible Cultural Assets, Educational Transmission, Sustainability*

1. Introduction

Cultural assets are the historic trace of cultural development and the embodiment of the collective memory of a region or country. In the modern globalized world, local cultural assets can become the core of a country’s soft power economy in developing tourism, culture, and education. The policies and concrete efforts of a national government to preserve cultural assets show how much respect they have for the local culture [1].

Cultural assets may consist of tangible and intangible cultural assets. UNESCO defines tangible cultural assets as architectural monuments, memorials, underwater ruins and cities, submerged shipwrecks, paintings, statues, and coins. Intangible cultural heritage includes oral traditions, performing arts, and rituals [2].

The main reason for the disappearance of intangible cultural assets is the transformation of the modern market and the change in consumers’ lifestyles. Many of the technologies used in the

production of daily crafts in the early days have been replaced by the rapid manufacturing of industrialized and automated everyday products.

In Taiwan, many intangible cultural assets are preserved amongst professional craftspeople, and as they age and pass away, these intangible cultural assets are at risk of disappearing. Despite such a challenge, the Taiwan Ministry of Culture (MOC) has launched the "National Cultural Heritage Preservation Award" in 2009 to encourage individuals, organizations, and corporations to participate in the preservation of cultural assets actively and to reward those who have made outstanding contributions to the preservation or promotion of cultural heritage. In addition, MOChas implemented various measures, such as the video recording of intangible cultural assets, publication of personal biographies, and transmission education. MOC hopes to preserve the invaluable intangible cultural heritage properly. Regarding the transmission of intangible cultural assets and the promotion of education, if MOCcan introduce contemporary educational concepts and help traditional arts and crafts to be retransformed by modern educational strategies and become various educational resources, it should open a wide range of future development possibilities for the transmission of intangible cultural assets [3, 4].

This study attempted to explore the feasibility of introducing STEM education theories to intangible cultural assets heritage transmission education. We invited intangible cultural heritage preservationists who had participated in the Intangible Cultural Heritage Preservation and Transmission Program as the focus of in-depth interviews in the hopes of gaining inspiration for creating innovative educational strategies for craft heritage from their valuable experiences.

2. Literature Review

2.1. STEM and Taiwan's Education Policy

The National Science Board proposed the Science, Technology, Engineering, Mathematics (STEM) education strategy in 1986, which is a cross-disciplinary approach that integrates the four STEM disciplines [5, 6, 7].

In 2008, Professor Yakman of Virginia Tech University proposed the STEAM education strategy model as she suggested that STEM education should be introduced with more art-related educational content. The Art that Yakman referred to includes not only art and design, but also the humanities, society, philosophy, history, language, and other humanities disciplines [8, 9]. Yakman has proven the possibility of linking art education and science education [10, 11].

In 2019, the Ministry of Education of Taiwan released the "Curriculum Guidelines of 12-Year Basic Education." The design of this curriculum is in line with the STEAM education concept that emphasizes students' capability to achieve cross-disciplinary learning and integration. The learning categories are divided into eight areas: mathematics, language, arts, social studies, natural science, integrated activities, health and physical education, and technology. It enables students to integrate their learning experiences and develop core literacy and lifelong learning skills effectively [12, 13]. This shows that the STEAM education strategy has emerged as a common educational approach in

Taiwan and is a significant factor in teachers' curriculum design and students' learning, as well as in assessing students' learning ability when applying for admission to higher education.

2.2. Education on Intangible Cultural Assets

After the First World War, industrial production technologies flourished in various countries, causing people to reflect on the preservation and protection of traditional assets. In 1931, the First International Congress of Architects and Technicians of Historic Monuments was held in Athens, Greece. An official document on historic preservation and monument restoration was promulgated in 1932 in the Athens Charter, which was the first official international document on historic preservation and restoration. Later, in 1964, the Venice Charter was published by the Second International Congress of Architects and Technicians of Historic Monuments; in 1972, the Convention Concerning the Protection of the World Cultural and Natural Heritage was adopted by UNESCO; and in 1999, the International Charter for Cultural Tourism was proposed by the International Committee for Cultural Monuments and Historic Places (LCOMOS) at its annual meeting. These are all important international statements on the definition, preservation, revitalization, and even the promotion of the industries of tangible and intangible cultural assets [14, 15].

The definition of cultural heritage in the Cultural Heritage Preservation Act in Taiwan [13] refers to tangible and intangible assets with historical, artistic, scientific, and other cultural values. When dealing with the preservation and transmission of intangible cultural assets, it is not just a public matter in the field of culture but also a cross-ministerial consideration of resource integration. Article 12 of the Cultural Heritage Preservation Act states that "in order to undertake cultural heritage preservation education, the competent authority shall coordinate with education agencies of every level to ensure school curricula of every level cover cultural heritage preservation." Since the promulgation of the Cultural Heritage Preservation Act in 1982, the Ministry of Education in Taiwan has initiated native education programs and cultural creativity courses in the national basic education curriculum. In 1983, the National Elementary School Curriculum Guidelines were announced, emphasizing the implementation of native education, introducing a curriculum of "native teaching activities" for grades three to six of elementary school, and offering a curriculum of "native art activities" and "knowing Taiwan" at the national junior high school level. The National Elementary School Curriculum Guidelines aim to introduce students to the cultural environment of Taiwan and highlight the significance of the local education curriculum [16].

Presently, the strategies of the intangible cultural asset education in the school system focus on craft education, arts education, and aesthetic education. This study believes that the diversity of intangible cultural assets extends beyond "arts education" to other areas of education, such as mathematics, science, physics, chemistry, electronics, and health.

3. Methodology

3.1. Research Process

This study was conducted in two stages. In the first stage, we conducted in-depth interviews with intangible cultural asset preservationists (hereinafter referred to as living national treasures) who had participated in the Intangible Cultural Heritage Preservation and Transmission Program and those who had implemented the transmission program. The purpose was to clarify the current situation and model of intangible cultural asset education and transmission in Taiwan. The second stage of the study was conducted through a meeting of experts. We invited experts from the fields of cultural asset preservation, science education research, STEM education research, craft design, and cultural and creative industry design to discuss the feasibility of introducing STEM theory to intangible cultural asset transmission education.

3.2. Study Method

This study chose to interview respondents who were registered as intangible cultural assets (living national treasures) by the MOC in the first stage of the study. To consider a broader field, three categories of traditional performing arts, traditional crafts, and important preservation techniques and conservators were included in the selection process. Considering the physical condition of the living national treasures and their willingness to be interviewed, a total of six living national treasures and two cultural asset preservation and transmission program staff were invited to participate in the in-depth interviews in the first stage of the study, and the interviewees are listed below (Table 1).

Table 1. Interviewed Respondents

Registration Category	Preservation Projects for Cultural Heritage Conservators
Traditional Performing Arts	Nanguan Music Conservators
Traditional Crafts	Lacquer Art Conservator
Traditional Crafts	Bamboo and Rattan Craft Conservators
Traditional Crafts	Silk Tapestry (or Kesi in Mandarin)
Significant Preservation Technologies and Preservationists	Traditional Hand Puppet Costumes, Headgear, and Props Production Techniques Conservator
Organization	Title
Bureau of Cultural Heritage, Ministry of Culture	Deputy Director General
Bureau of Cultural Heritage, Ministry of Culture	Division of Traditional Arts and Folklore

1 The study's interview outline for interviewing the living national treasures

- The intangible cultural assets' development history in Taiwan
- The process, techniques, tools, and characteristics of the creation of intangible cultural assets
- Current experience in the promotion and transmission of intangible cultural assets
- Facing changes in the education market, how to deal with students from different ethnic groups

2. The outline of the interview with the public sector staff who implemented the transmission program

- What is the core spirit of promoting intangible cultural asset preservation and heritage education in Taiwan?
- What is the current implementation of the Intangible Cultural Asset Preservation and Heritage Transmission Education Policy? And how are they promoted?
- What is the role of the Cultural Heritage Bureau in the Transmission Program? Who are the relevant stakeholders, and what are their relationships?

The interviews were conducted from February to August 2021, and each respondent was interviewed for about two hours. The interviews were recorded by audio recording; afterward, the interviews were typed into verbatim transcripts for analysis. Three professors with backgrounds in educational research, cultural heritage and cultural studies, and STEAM game design were invited to be the coders of this study, and the analysis was conducted at three levels: open-ended coding, axial coding, and selective coding. Based on the results of this study, the "Framework for Education on the Transmission of Intangible Cultural Assets" was proposed in the first stage of the study.

In the second stage of the study, five university instructors in the fields of cultural asset preservation, science education research, STEM education research, craft design, and cultural and creative industry design were invited to participate in an experts' meeting to explore the feasibility of incorporating STEM theory into intangible cultural asset transmission education. The study is based on Piaget's cognitive development theory and explores how STEM education strategies can be applied to the education of children of different age groups [17].

4. Data analysis

4.1. Implications of the Intangible Cultural Asset Transmission Education

This study analyzed the in-depth interviews of six living national treasures and two staff members of the cultural heritage preservation and transmission program using the grounded theory method. During the process, the results were gradually organized into three stages: open coding, axial coding, and selective coding. The results of the study enabled the proposal of a "Framework of intangible cultural asset transmission education" (Figure 1).

The framework of intangible cultural asset transmission education indicates five components of intangible cultural asset transmission education, namely "Naturalistic Observation and Analysis," "Aesthetic Competency Development," "Tool and Technique Practice," "Reflection, Inspiration, and Creation," and "Artwork Presentation/Exhibition." Under each component, there are three to

four subcomponents that signify the important educational content of that component.

From the perspective of STEM education theory, the "Naturalistic Observation Analysis" component is a starting point not only for various types of artistic creation but also for developing students' natural science analysis skills in relation to the natural environment, materials, and ecology. The "Aesthetic Competency Development" component focuses on competencies related to art, aesthetic sense, evaluation, and analysis. Moreover, it also includes the knowledge system for market demands and craft development. The "Tools and Technique Practice" component highlights the learning of various crafts, while the tools and procedures of different crafts can be covered in different types of STEM education programs. The "Reflection, Inspiration, Creation" component is centered on how the participants can accumulate, integrate, and internalize the components of the previous components, and present their perspectives and creative aspirations. Finally, the "Presentation/Exhibition" component involves the presentation of various types of crafts or performing arts that require interaction with the audience to complete the work. This component also involves different types of STEM education projects.

4.2. Discussion on the Feasibility of Introducing STEM Education Theory to Intangible Cultural Asset Transmission Education

Based on the first stage of the study, five university professors were invited in the second stage of the study to discuss the feasibility of incorporating STEM education theories into intangible cultural asset transmission education in an experts' meeting. The results of the experts' meeting showed that the education of different cultural heritage indeed bears the STEM educational concepts.

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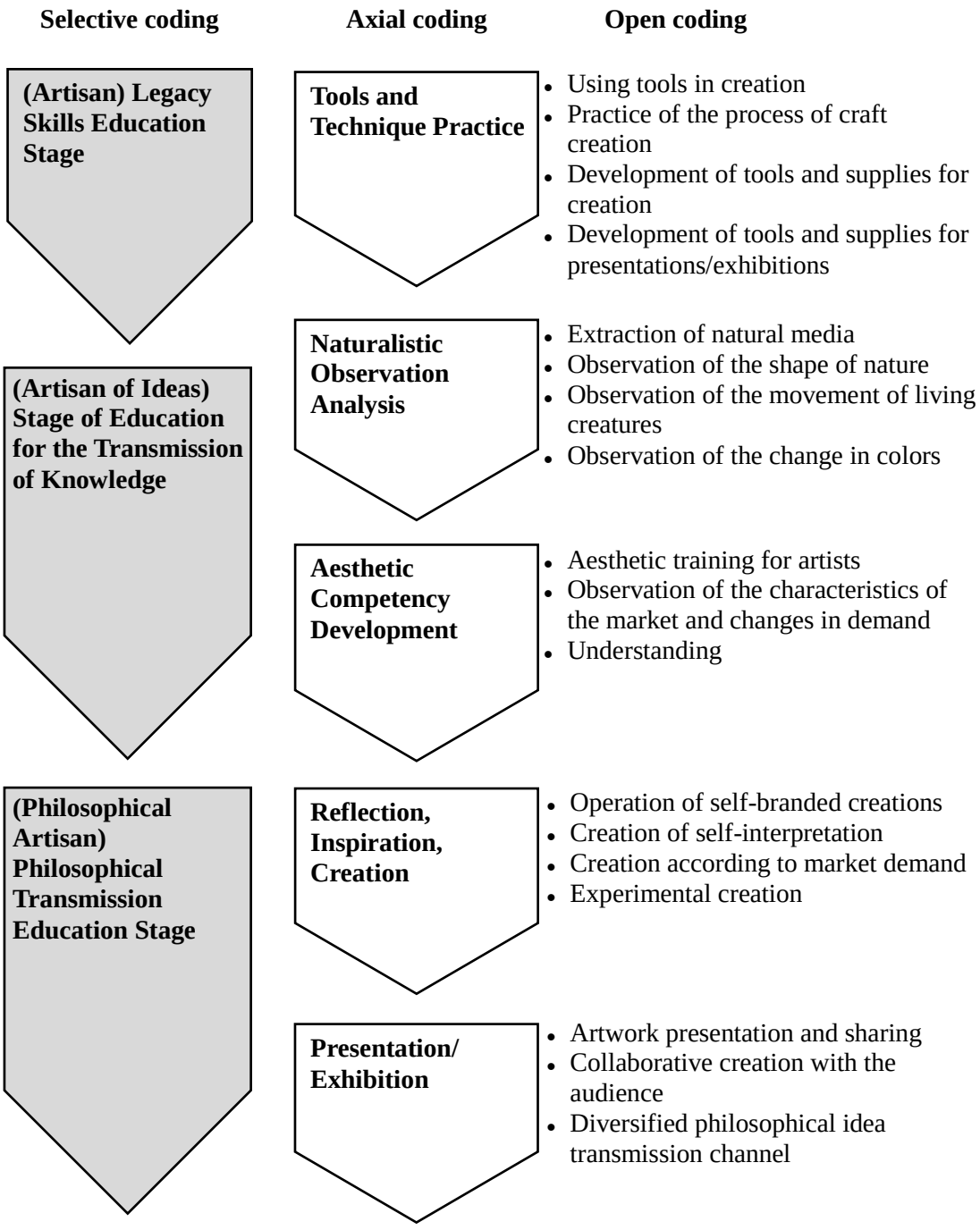

Figure 1. Framework of Intangible Cultural Asset Transmission Education

Cultural heritage crafts that allow for “Science” education include lacquer art. Lacquer art uses natural lacquer from the lacquer tree. The chemical reaction caused by the lacquer when it is exposed to the air makes the color of the original milky white lacquer gradually change to dark brown. In addition, the lacquer art itself can be used for applying color to the surface of various media and coating materials. The relationship between various materials and the lacquer, the coating of lacquer, the mixing of colors, and the use of multiple materials in the process of applying

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color, such as seashells and gold foil, are all closely related to natural science and chemical reactions.

There are cultural heritage crafts with “Technology” and “Engineering” education embedded in them. Technology and engineering competencies may seem to be the domain of modern education, but in fact, the traditional crafts have made extensive use of both. In regard to the field of “Engineering,” for instance, the roof, eaves, beam-column, Dougong (architraves,) windows, and doors of temple buildings, as well as the carved decorations on the buildings, all involve the knowledge of materials, mechanics, structure, and engineering. As for the categories of intangible cultural assets explored in this study, “Technology” and “Engineering” are closely related to the performance stages of the hand puppet theater and Nan Guan opera. The hand puppet structure is related to mechanical engineering (Figures 1 and 2) for the performance theaters today have combined lighting, sound effects, and stage special effects, that present the intangible cultural assets in a revolutionary way.

There are cultural heritage crafts that allow for “Mathematics” education. Of the intangible cultural assets examined in this study, the processes and techniques of three crafts—Bamboo Weaving, Kesi (Silk Tapestry in Mandarin), and Embroidery—are closely related to mathematics. Bamboo Weaving has more than ten types of weaving techniques, including herringbone weaving, cross weaving, threading, popping, and twisting (Figures 3 and 4). Kesi is a weaving technique used in the Taiwan weaving industry that is specially made for the export of kimonos to Japan, and there are more than ten weaving techniques, such as knotting, hooking, lifting, looping, and winding. Embroidery is a complex technique that uses needles and threads together. The techniques include Running Stitch, Split Stitch, Outline Stitch, Straight Stitch, Satin Stitch, Slanting Stitch, Couching Stitch, Couching Basket Stitch, and more than ten other needle techniques.

These techniques can be used in different and simple mathematical calculations to present various weave patterns and three-dimensional shape variations, which can be flexibly used to plan and design multifaceted and multi-level mathematical courses.

Figures 1 & 2. The Taiwanese hand puppet conservationist introduced the mechanism of the hand puppet and the techniques of manipulating the puppet, which are associated with the fundamental knowledge of mechanical engineering.

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Figures 3 & 4. Interview with Taiwanese bamboo and rattan weaving technique conservationist, demonstrating mathematical logic in the weaving process.

5.Conclusions

Intangible cultural asset preservation is the accumulation of national cultural memory and knowledge transmission, which includes the educational structure of the knowledge of cultural assets, the awareness and concern for cultural assets, and the technical learning of cultural asset techniques. In response to the decline of intangible cultural assets, the Taiwanese government has been promoting the transmission program for over 30 years. However, the transmission program has emphasized the passing on of the lifelong skills of the living national treasures to art students. Though the program has achieved the goal of passing on the skills of the living national treasures, art apprentices will still face the challenge of market acceptance after completing their training. The main reason for the disappearance of intangible cultural assets stems from the changing needs of modern life. When the consumer market as a whole no longer values the products and artworks produced by traditional techniques, it poses a major challenge to the transmission of intangible cultural assets.

We believe that education on the transmission of intangible cultural assets, such as traditional crafts, important technologies, and performing arts, should be considered in the context of modern educational theories, especially in the face of the technological generation, where popular science education has become a key educational axis in many countries.

In this study, we explored the feasibility of introducing STEM education to the various domains of intangible cultural assets. The results of this study showed that such cross-disciplinary educational integration is a feasible educational model. The six types of intangible cultural assets in Taiwan initially explored in this study do not represent all categories; rather, there are more categories that are worth exploring and studying individually. We further suggest that future educational studies can create more modern educational curricula and materials on intangible cultural assets, such as traditional crafts, significant technologies, and performing arts, based on STEM education theories to foster the opportunities to contribute to the goal of sustainable development in the transmission of intangible cultural assets.

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