

Unveiling the Aesthetics of Glass Product Innovation: A Journey into the Extraction and Application of Cultural Heritage Elements

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DOI: <https://doi.org/10.30880/ahcs.2024.05.03.006>

Article Info

Received: 8 July 2024

Accepted: 19 September 2024

Available online: 30 December 2024

Keywords

Glass Product Innovation, Cultural Heritage, Aesthetics, Visual Elements

Abstract

Nowadays, China's cultural creative industry is booming. However, glass product design in China is heavily influenced by Western culture. Adding more Chinese cultural elements to the appearance innovation of glass products can make glass products more in line with local aesthetic standards and increase cultural identity. This research adopts the method of qualitative research to explore the method for incorporating cultural heritage elements into glass products. First, 100 glass products with cultural heritage elements in today's market are investigated and collected. Then, the ten most representative glass products are identified by SETIG factor analysis for case analysis and analyzed according to the three main aesthetic characteristics of color, shape, and decoration. It is found that the visual elements of cultural heritage can be extracted from the three aspects of shape, color, and decoration and can be transformed by the method of composition. The further method of this research can be through the investigation of the symbolic meaning of visual elements, and these semantic variable values can improve the added value of glass products.

1. Introduction

In 2009, China's first professional plan, Cultural Industry Revitalization, was examined and approved by the Executive Meeting of the State Council, which took the cultural creative industry as the main focus of development, marking the rise of the cultural creative industry as the national strategic industry (Lu & Zang, 2022). This underscores the growing importance of cultural value addition in the creative industry. More specifically, the cultural creative industry in China has been on the rise since 2009 and is an emerging industry that has been given great importance in China (Liu, 2019). According to a survey of 68,000 enterprises in cultural and related industries, in the first quarter of 2022, the enterprises mentioned above achieved operating revenue of 2,697.3 billion yuan, an increase of 5.0% over the same period of the previous year, calculated on a comparable basis. More detailed information on the development of the cultural creative industry in China is shown in Fig. 1 below. These figures show that China's cultural creative industry is still in the rising stage of development. Thus, the cultural industry has become part of the country's economic backbone, shaped the globalization perspective, and offers an emphasis on the industry that impacts the cultural aspects of Chinese society. On the other hand, China is currently in a critical period of integrating and colliding with various cultural creative thoughts at home and abroad. Therefore, the emphasis on developing cultural resources containing unique cultural genes and values gradually increases (H. et al., 2022).

	Absolute amount (100 million Yuan)	Year-on-year growth (%)	Proportion (%)
total	26973	5.0	100.0
By industry category			
News information service	3183	6.7	11.8
Content creation and production	5916	10.1	21.9
Creative design service	4186	1.0	15.5
Channel of cultural communication	3150	7.9	11.7
Cultural investment operation	105	4.4	0.4
Culture, entertainment and leisure services	218	-6.4	0.8
Culture-assisted production and intermediary services	3629	2.5	13.5
Production of cultural equipment	1530	8.1	5.7
Cultural consumption terminal production	5057	1.6	18.7

Fig. 1 Operating revenue of enterprises in cultural and related industries above designated size in the first quarter of 2022(Source: National Bureau of Statistics website)

Moreover, the industry increasingly uses glass material because of its unique properties. People are no longer solely driven by material pursuits; cultural pursuits have become an integral part of the high-quality development of human society. Therefore, the research on extracting and applying visual elements of cultural heritage in glass product design is timely and crucial in enhancing the aesthetic value and impact of glass products (Sun et al., 2022). Under the background of the fast growth of China's cultural creative industry mentioned above, glass creative products face both opportunities and challenges in China's current rapid economic transformation. With the development of modern industry, glass has become a ubiquitous and readily available material. It also challenges the survival and development of glass product design to a certain extent. Faced with the emerging new industrialized technology and consumers' changing aesthetic tastes in China, which has been thought of as a phenomenon of economic transformation, glass product design also needs to find breakthroughs.

2. Problem Statement

Woodham (1997) believes that future product design will take humanity and aesthetics as the main trends, and technology will promote and improve the process rather than dominate the design process. Innovation is the primary driver of organizations today. Creativity is the starting point for any innovation, and design is the process of turning creative ideas or concepts into reality(Stamm, 2008). As suggested in the literature review, the closer we get to product design, the more earnestly we must consider culture as a source of innovation, a theme of subsequent sections. On the other hand, the design of glass products in China lacks innovation in incorporating local cultural elements. This is partly due to the Western influence of glass materials in historical development. Glass containing barium and lead emerged as early as the Western Zhou Dynasty. In ancient China, glass was regarded as the exclusive goods of aristocrats because of its material characteristics and technological difficulty. Ancient China took advantage of the inherent properties of materials as a more precious material medium, especially jade(Labatt, 2018). From ancient times, artisans working in glass absorbed and responded to foreign influences and adapted techniques from other crafts, creating glass products that we now consider distinctively Chinese. However, the number of glass artisans in China rapidly decreased due to globalization and modernization. Until the Qing Dynasty, China's glass products began to flourish. Xue Lu pointed out in his "Glass Art of Qing Dynasty in China" that local glass art and technology in China were not the mainstream arts and crafts until the peak period of glass craftsmanship in the Qing Dynasty. The glass art of the Qing Dynasty in China was produced under the dual influence of Western practices and indigenous recipes. Moreover, the alternation from agricultural to industrial civilization in China took time, leaving its cultural heritage less time to be considered and conserved. Industrialization and globalization cause cultural homogeneity and destroy diversity heterogeneity by neglecting or denying cultural characteristics or reducing them to general acceptance. Therefore, there is a need to apply China's cultural elements to promote brand consciousness and creativity in the modern glass product industry. My research question is excavating and transforming cultural heritage elements into glass product design to elevate the aesthetic value of glass products.

3. Literature Review

3.1 Cultural Creative Products

According to the latest UNESCO document, "International Flow of Cultural Goods and Services 1994-2003", cultural goods are the products provided by cultural industry activities, divided into two categories: cultural goods and cultural services. Cultural creative products incorporate cultural elements and products with distinct characteristics. However, their particularity lies in the value of cultural connotation, which indirectly affects the product's added value (Zhao, 2020). Liu Guanzhong, a professor at Tsinghua University and vice president of the China Industrial Association, pointed out that there are "two legs" when it comes to cultural creative products, "one of which is the protection of cultural heritage so that future generations can see what our ancestors once lived like. Another is the revitalization of cultural heritage, which is to let the patterns and elements handed down by ancestors take root and sprout in the soil of today's life to represent today's life". Another definition of culturally creative products accepted widely in China from BAIKE is that they rely on intelligent people through their unique innovative means and product design methods to use cultural heritage resources, combined with product design, to increase the added value of products. Although there are many definitions for cultural creative products, they all focus on one core concern: cultural resources and their values. Thus, with improved quality and production processes, cultural products can be value-added products that could help increase products' aesthetic value and meet people's spiritual demands.

The cultural creative industry is booming, and the successful example of the UK has inspired many countries to integrate their cultural heritage elements into product design and commercialize their own culture (Y.-H. et al., 2020). At present, China is also following this trend. With the development of China's economy, the development trend of cultural creative products has become increasingly essential and obvious. Consequently, contemporary creative products are primarily associated with cultural heritage elements in the Chinese consumer market. This is because innovative design involves elements considered relative to Chinese traditional culture, and most enterprises and designers in China consider the cultural approach towards developing products and their design. However, cultural products require special skills, which only people who know the product know how to produce. This is because understanding China's cultural creative products is profound, mainly regarding cultural heritage elements and the perception of its uses. The cultural creative industry in China has become a leading transformative industry with the potential for increased sales both at home and globally, as it is primarily known for its unique cultural elements and product designs that have shaped the artistic creativity that forms the unique Chinese designs in its products.

Designers often use logical thinking to explain the connections between different things and try to create new products. Hsu et al. (2011) propose four stages to design cultural and creative products. The four stages are identification (telling the story), investigation (setting the goal), interaction (writing the analysis), and implementation (designing the product). L. Zhang & Hu (2019) propose that local cultural elements can be extracted and applied from the following three steps: abstraction, reconstruction, integration of tradition, and modernity. Based on memes extracted from Liao Dynasty ceramics and Roland Barth's second-order theoretical framework of semiotic meaning, Zhu & Cheng-lein (2020) construct a design method for cultural products, explore the extensive cultural meaning of memes, and apply it to the design of cultural products.

As mentioned above, these scholars have programmed the design of cultural creative products from the view of designers' logical reasoning. However, cultural creative products are challenging to abstract at a lower level as an emotional additive. Therefore, Khalid & Helander (2004) propose a step-by-step approach to the design of such products, that is, identify customer needs through survey, measure affective responses to significant needs, integrate customer needs and affect data in conceptual design interface, and evaluate the intended product use and purchase of the product. In addition, in terms of the application of specific product design, X. Zhang & Wen (2020) take 19 historical buildings as research samples, use the questionnaire analysis results, excavate the designers' perceived image of local culture, summarize the emotional image of architectural and cultural elements, obtains the evaluation of image scale, and divides the perceived image of local culture into three emotional factors. Moreover, these results further put forward the model flow of the early development stage of cultural and creative products, which is helpful for this research. Based on their research data, they improved the process or model applicable to cultural creative products. Cultural elements can be extracted from different levels and perspectives during these stages. It declares that correctly extracting and transforming cultural elements is a barrier to developing creative cultural products, which needs to be studied and verified with further research.

3.2 Definition and Classification of Cultural Heritage

The definition of cultural heritage is constantly changing as the world's conservation field evolves. A concise and helpful definition for this research is this: Cultural heritage can be inherited, material or immaterial, with historical, cultural, symbolic, social, or aesthetic value (Paschalidou et al., 2022; Vecco, 2010). According to UNESCO, the definition of cultural heritage is very broad, including tangible and intangible cultural heritage. The former focuses on monuments, object collections, archaeological discoveries, etc. The latter can be found in UNESCO's 2003 Convention for the Safeguarding of the Intangible Cultural Heritage, which can be classified according to five aspects. As mentioned earlier, this definition is not final. Scholar Higgins put forward the

characteristics of two kinds of cultural heritage. Tangible heritage is the characterization material, including both artificial and natural environments. In contrast, intangible heritage is practice, performance, expression, knowledge and skills, and the associated utensils, objects, cultural relics, and cultural spaces (Higgins, 2022). In other words, the difference between the two can be understood in this way: Material cultural heritage refers to the precious cultural relics, historical buildings, and classical gardens of various historical periods in the museum. Intangible cultural heritage refers to the primary forms of activities and performance of people in ancient society, as well as ancient people's understanding, knowledge, transformation, and traditional skills of nature. According to the definition of UNESCO and the expressions of these scholars, it is proposed that Chinese cultural heritage be classified from the following levels to continue the subsequent research better. Regarding intangible heritage, Chinese cultural heritage is classified into four aspects: a) Knowledge and Traditional skills, b) Legends, c) Performances and Arts, and d) Traditional festivals. Meanwhile, tangible cultural heritage is classified as e) ancient architecture and gardens, f) cultural landscapes, and g) mausoleum heritage. The proposed Chinese cultural heritage classification can be seen in Fig. 2 below.















Proposed classification of cultural heritage applicable to the characteristics of cultural and creative products											
Intangible cultural heritage 非物质文化遗产						Tangible cultural heritage 物质文化遗产					
Name	Example	Icon	Name	Example	Icon	Name	Example	Icon	Name	Example	Icon
a) Knowledge and Traditional skills 知识和传统技能			c) Performances and Arts 表演艺术			e) Ancient architectural and garden 古典建筑及园林			g) Mausoleum Heritage 历史文物		
b) Legends 传说			d) Traditional festivals 传统节日			f) Cultural landscapes 文化景观					

Fig. 2 Proposed Classification of Chinese Cultural Heritage

3.3 Understanding Cultural Heritage Attributes and Glass Products Innovation

Understanding cultural heritage attributes will help clarify the relationship between culture and product design, thus accelerating concept development. M.-Y. Hsiao et al.(2018) take the Pierce triangle symbol as the basic meaning. In his design process, the cultural and genetic characteristics are simplified, the symbolic part is preserved, and the appearance is simplified to approximate the geometric block. He added the cultural gene into the cultural products, forming a new cultural design method named "The cultural gene triangle." It can be seen that the design theory behind cultural creative products has various types due to the different positions of scholars. Generally, design guidelines are formulated from consumer demand, cultural content, and design theory perspectives. This is because compared with the functional orientation of several decades ago, as mentioned in the previous literature review, China is currently in vigorous development of the cultural creative industry, and the consumer market attaches more importance to products with cultural and aesthetic characteristics. The design trend not only lies in the function and manufacturing of products but also pays more attention to the conservation and connection of cultural heritage and the realization of life value. Many design concepts have gradually emerged in the design field.

Thanks to advances in technology, innovation is more accessible to implement. Future industrial design should pay attention to humanistic aesthetics. Norman(2007) also proposed that successful product design should emphasize product applicability, practicality, and aesthetics, among which emotion is the most critical factor. The aesthetic value of the product can accomplish the emotional design concept. Consequently, the purpose of design gradually focuses on humanization, considering consumers' feelings when using products. The essence of cultural and creative product design is to integrate cultural elements into products through innovative design techniques, and users can obtain cultural elements through observation and experience of products to achieve cultural transmission. In this process, the product's bearing of cultural elements and the user's bearing of the product are the keys to achieving cultural transmission and also the core of the success of cultural and creative product design. In this research, he put forward the transmission model of cultural products. He analyzed several ways of combining and transmitting cultural elements of products and different ways to bring different experiences and feelings to people.

Concerning the main components of product design, many different points of view have been expressed(Goffin, 2000; Kumar et al., 2015; Noble & Kumar, 2010). Generally speaking, a distinction is made between two components: (1) visual design, such as color, shape, and decoration, and (2) Utilitarian design. Although the latter component, utilitarian design, pays more attention to the actual benefits that a product may give. For most observers, visual design is probably the element closest to the meaning of design. This is because the human perception system includes sight, the essential element of emotional symbols. Visual design is driven by form and the desire to communicate value to consumers without interacting with the product. At first, Product designers usually determine product shapes based on functionality and productivity, but nowadays, they pay more attention to the aesthetic value of the products. Aesthetics attributes constitute the interface

between the product and the user, affect the quality of the product, personality, use mode, and other sensory aspects, and play an essential role in the user's product experience.

4. Methodology

The qualitative method of this study includes a literature review, initial observation of glass products with cultural heritage elements, identification of representative glass products, data collection, and data analysis. Through the case study, the details of the glass product with cultural elements are described, and the artistic characteristics of the visual components of glass products with cultural elements are presented, highlighting the variables of color, shape, and decoration. According to this approach, the researchers will collect the most relevant information on the most dominant visual image information of glass products to analyze the relationship between visual-level elements of cultural heritage in China and glass products' aesthetic attributes. Since examples provide a clear illustration of the combination of glass products and cultural heritage, the case study of this study selects a suitable "object" to validate the combination path between the two. Select existing cases that meet the several criteria. According to the research design, a comparative analysis of the application of elements in ten cases is carried out to identify designers' understanding and application of cultural heritage elements. The whole project flow chart can be seen in Fig. 3 below.

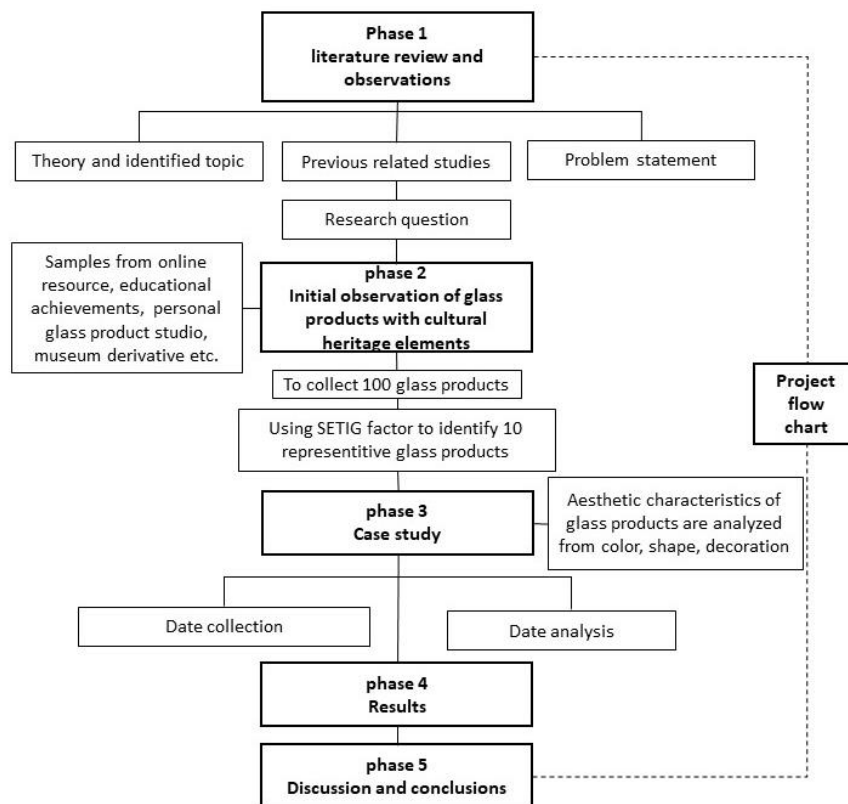


Fig. 3 Research design

At first, after a literature review and observation, the researcher will investigate China's cultural heritage according to the proposed classification method. This investigation can be seen in Fig. 4. More specifically, regarding world heritage, China has 56 world heritage sites, including 38 cultural heritages, 14 natural heritages, and four dual heritages. The preliminary classification of 42 heritage sites with cultural attributes includes eight heritage sites, seven heritage sites in urban spaces, 12 cultural landscapes, five mausoleum heritage sites, and nine ancient towns. On the other hand, China is rich in intangible cultural heritage resources. For example, traditional festivals such as the Spring Festival and the Dragon Boat Festival, traditional handicrafts such as paper cutting and clay sculpture, and traditional operas such as Beijing Opera and Kunqu Opera. Based on the data from the China Intangible Culture website, as of December 2020, China had a total of 42 items included in the UNESCO Intangible Cultural Heritage List, including six oral traditions, 12 performing arts, 9 Social practices, rituals, 12 festive events, and 19 items concerning knowledge. In addition, there are 1,557 national-level intangible cultural heritage representative projects in the list of China's national intangible cultural heritage representative projects, which are counted one by one according to the declared regions or units, with a total of 3,610 sub-items. In order to confirm and protect the same intangible cultural heritage items inherited in different regions or held by different communities and groups, the national list divides intangible

cultural heritage into ten categories, of which the names of five categories were adjusted in 2008 and are still in use today. Further understanding of the classification of Chinese cultural heritage will help researchers to collect glass product design cases with cultural heritage elements from institutions, individual studios, and museum derivatives, which will further increase the effectiveness of data collection.



Fig. 4 An investigation of China's cultural heritage according to the proposed classification method

Next, Initial observations of glass product design incorporating Chinese cultural heritage elements were made by research to collect data for further research. Field research includes a wide variety of methods, first-hand observational visits from the perspective of specific research needs, conducted in natural settings, and a large body of literature is available to guide researchers in conducting field research. This study will conduct fieldwork in China to examine representative and well-manifested Chinese cultural glass products. It will contain resources such as websites, glass art studios, glass product exhibition halls, and glass product factories in the relevant areas. Observation and recording, first-hand information, photography, and photo collection are essential means of preparation. Based on the compilation and classification of glass product designs with cultural heritage elements, the researcher identified 100 glass products embedded with Chinese intangible and tangible cultural heritage elements. Initially, these examples were classified by the elements embedded according to the cultural heritage classification made by previous research, as shown in Fig. 5 below.

Initial observation of glass products design with Chinese cultural heritage elements 对具有中国文化遗产元素的玻璃产品设计进行初步观察

非物质文化遗产 Intangible cultural heritage	a) Knowledge and Traditional skills 知识和传统技能	
	b) Legends 传说	
	c) Performances and Arts 表演艺术	
	d) Traditional festivals 传统节日	
物质文化遗产 Tangible cultural heritage	e) Ancient architectural and garden 古典建筑及园林	
	f) Cultural landscapes 文化景观	
	g) Mausoleum Heritage 历史文物	

Fig. 5 Initial observation of glass products design with Chinese cultural heritage elements

4.1 Identification of Representative Glass Products

According to the literature review, glass product innovation based on cultural heritage elements can be defined as the innovation of glass products by integrating visual-level elements of cultural heritage into aesthetic characteristics. Since cultural identity is an essential factor in innovation centered on cultural heritage elements, SETIG (social, economic, technological, ideological, and geographical) factor analysis can provide a fundamental understanding of glass product design and help select representative glass product designs. The research used this method to identify ten representative glass products with cultural heritage elements to conduct further research. These ten glass products come from personal studios, the educational industry, and museum derivatives. They are a) Glass Mosaic of Tang Dynasty Ladies, b) Suzhou Garden Lamps, c) Glass Shadow Puppets, d) “Dan Qing Qian Li” Study Supplies, e) Calligraphy Decorated Glass Clock, f) Cartoon Zongzi Glass Paperweight, g) Yin Yang Gourd Glass Decoration, h) Plum Blossom Goblet, i) “Ji Shou Long” Pen Holder, j) Oracle Weather Bottle. The identification of representative glass products with cultural heritage elements can be seen in Fig 6 below.






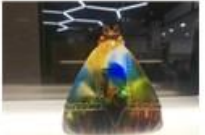




SETIG Factor and Representative glass products with cultural elements	
<p>Social Factors</p> <ul style="list-style-type: none"> -The government advocates a cultural and creative economy, and people prefer products that fit their own cultural identity and characteristics. -Educational institutions have opened courses related to product design and increased the training of cultural and creative personnel in the content. -With the rise of individual design studios in economically developed areas, more and more people are participating in the industry of cultural and creative products. -Museums and cultural heritage management units have set up special derivative products companies, and their products are generally loved by people. 	 <p>A: Glass Mosaic of Tang Dynasty Ladies</p>  <p>B: Suzhou Garden Lamps</p>
<p>Economical Factors</p> <ul style="list-style-type: none"> -With the development of economy and handicraft industry, the increase of personalized demand makes glass used to make daily products with more practical and cultural characteristics. -The rise of the creative economy has led to the development of diversified glass products, making the daily use of glass products more characteristic. 	 <p>C: Glass Shadow Puppets</p>  <p>D: "Dan Qing Qian Li" Study Supplies</p>
<p>Technological Factors</p> <ul style="list-style-type: none"> -The development of traditional dewaxing technology makes full use of the smooth characteristics of glass, and also gives greater freedom to artistic creation. -The glass Mosaic technology has also been absorbed and borrowed by Chinese artists, and the subject matter has also been localized. -Hot melt technology is also widely used in the creation of glass products because of its easy operability. 	 <p>E: Calligraphy Decorated Glass Clock</p>  <p>F: Cartoon Zongzi Glass Paperweight</p>
<p>Ideological Factors</p> <ul style="list-style-type: none"> -The early aesthetic thought can be embodied in ancient architecture, traditional drama costumes, and traditional gardens. -Various ideas in ancient China have gradually influenced the fundamentals of Chinese cultural characteristics, reflected in the myths and legends, written materials and cultural heritage relics. -Taoism takes the idea of immortals as its core, which expresses people's expectation of long life and better enjoyment of earthly happiness. The Chinese people have always put "longevity" at the top of all blessings (the order of Chinese folk's "five blessings" is: "longevity, happiness, noble, health, many children"). -Confucianism is rich in content, from the individual point of view, there are benevolence, justice, propriety, wisdom, faith, forgiveness, loyalty, filial piety, brotherhood and so on. 	 <p>G: Yin Yang Gourd Glass Decoration</p>  <p>H: Plum Blossom Goblet</p>
<p>Geographical Factors</p> <ul style="list-style-type: none"> -From the regional distribution of glass raw materials, East China and North China are the most concentrated areas of production capacity. -Nine glass characteristic regions and industrial clusters exist in Zhejiang Province, Shanxi Province, Shandong Province, Anhui Province, Jiangsu Province, Hebei Province, etc. -The cluster distribution of creative industries is further evident, and the Pearl River Delta, Bohai Rim, and Yangtze River Delta, represented by Guangzhou, Beijing, Shanghai, and other places, are the three poles of the development of domestic creative industries. -Chinese cultural heritage is widely distributed in basically every region. 	 <p>I: "Ji Shou Long" Pen Holder</p>  <p>J: Oracle Weather Bottle</p>

Fig. 6 Identifying representative glass products with cultural heritage elements

4.2 Case Study

After identifying the representative glass products, the researcher continued to analyze the sources of cultural heritage elements of these ten glass products and compared the extraction and application processes of color, shape, and decoration from the level of visual elements. Take d) “Dan Qing Qian Li” Study Supplies as an example. The analysis of cultural heritage elements is shown in Fig. 7 below. The proposed case decomposition steps can be seen in Fig.7(a). The first step is to investigate the background of cultural heritage, which can be seen in Fig. 7(b), followed by the step to seek the tangible manifestations of intangible cultural heritage in Fig. 7(c). Then, the cultural elements of cultural heritage from the visual level are extracted in Fig. 7(d). Finally, to composite visual-level elements to cultural code in Fig. 7(e).

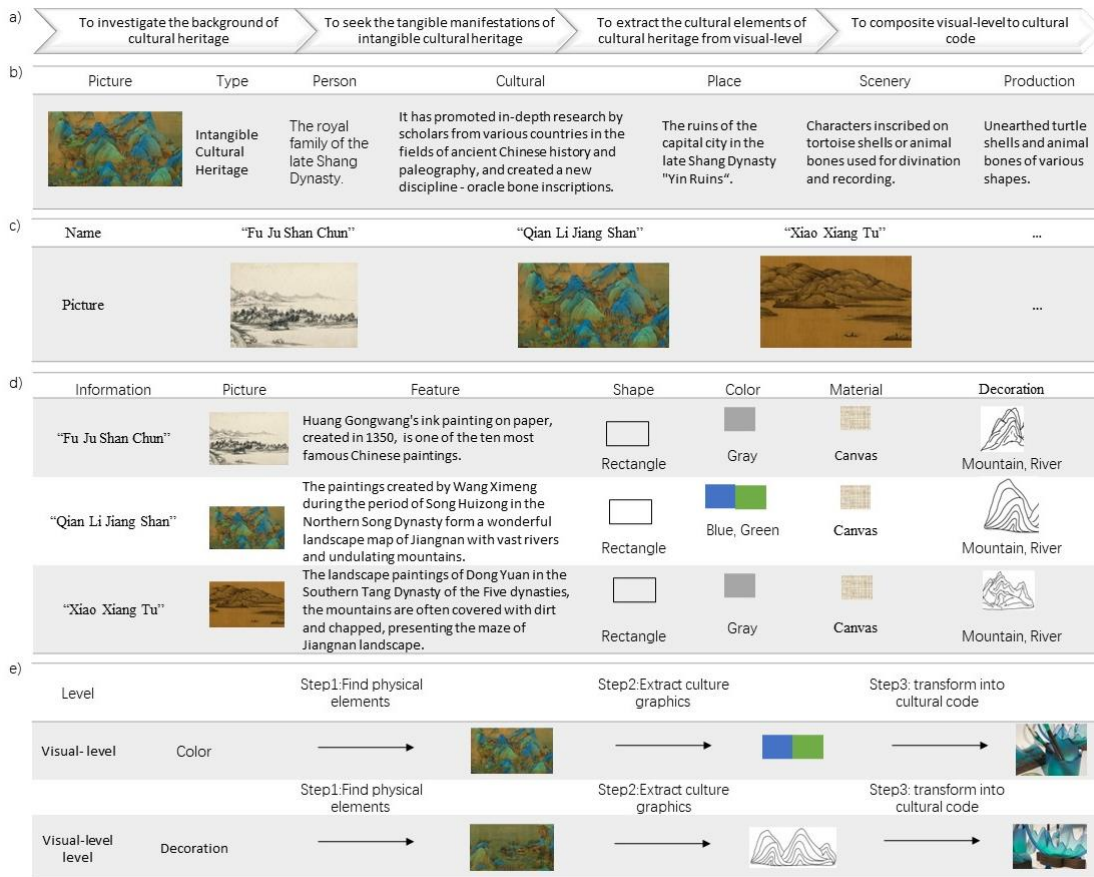


Fig. 7 Analysis of cultural heritage elements (a)Proposed case decomposition steps; (b)An Analysis of the Cultural Context of the "Qian Li Jiang Shan"; (c)An analysis of the visual-level cultural elements of the "Qian Li Jiang Shan"; (d)The conversion process of cultural codes behind "Dan Qing Qian Li" study supplies

In conclusion, the product draws on the visual-level elements of cultural heritage. It borrows the shape of the mountain from the Palace Museum's collection "Qian Li Jiang Shan" and the decorative elements of the water pattern in the picture. Moreover, the ancient people's unique technique of expressing mountains and rivers with blue and green is also borrowed. The most unique use of blue and green and its transition color in the whole study supplies is also the main appearance characteristics of this product set on the aesthetic level. It can be said that the extraction and application of color, shape, and decoration make the combination of Chinese cultural heritage elements and glass products more comprehensive so that people's association and imagination when using this product is closer to cultural heritage and improves the user's psychological suggestion. The whole extraction and application process in the "Dan Qing Qian Li" Study Supplies can be seen in Fig. 8 below.

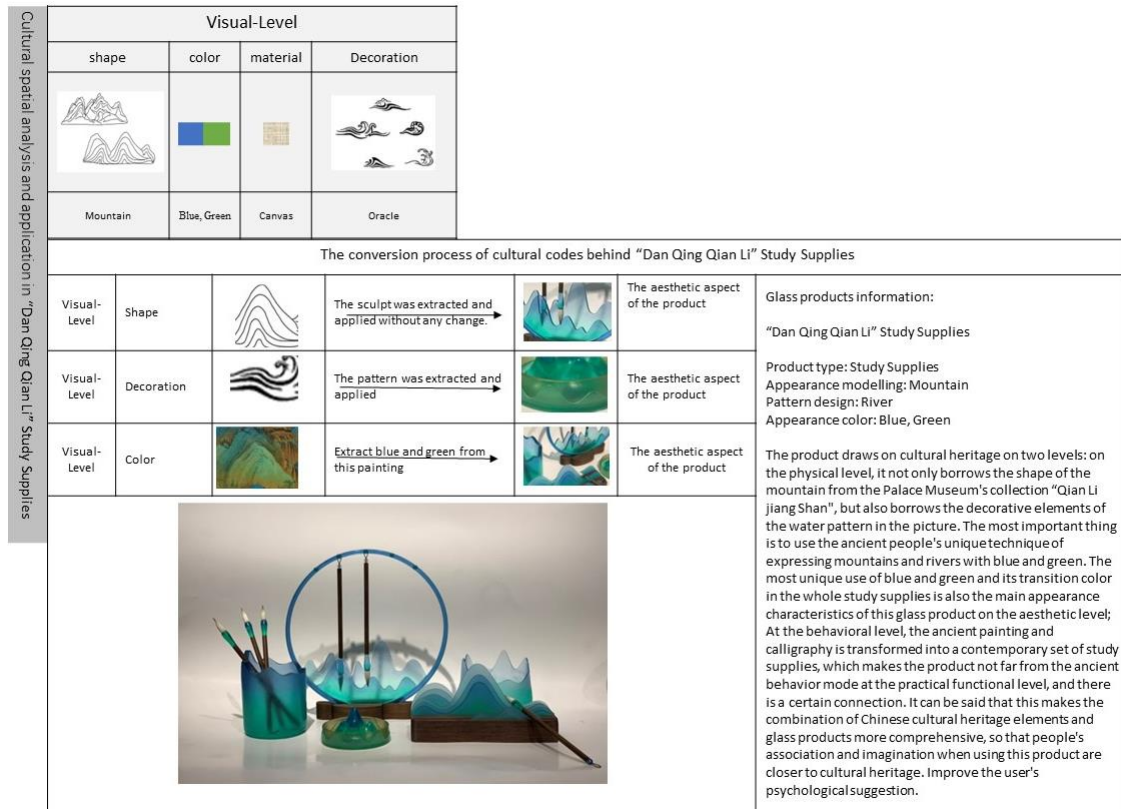


Fig. 8 The whole extraction and application process in the "Dan Qing Qian Li" Study Supplies

5. Results and Discussion

	Name	Picture	Cultural Heritage	Picture	Shape	Color	Decoration
Case 1	Glass Mosaic of Tang Dynasty Ladies		Museum's Collection of Tang Dynasty Ladies		Rectangle	Red, Black, Green	Tang Dynasty Ladies
Case 2	Suzhou Garden Lamps		Suzhou Garden		Pavilion, Tower, House	Red, Gray, White	Traditional Chinese patterns such as clouds
Case 3	Glass Shadow Puppets		Shadow Puppets		The abstract form of a male figure.	Red, Yellow, Blue, Green, Black	Traditional Chinese patterns such as flowers, grass, clouds, phoenix.
Case 4	"Dan Qing Qian Li" Study Supplies		Museum's Collection "Qian Li jiang Shan"		Rectangle	Blue, Green	Mountain, River
Case 5	Calligraphy Decorated Glass Clock		Chinese Calligraphy		Rectangle	Orange	Calligraphy
Case 6	Cartoon Zongzi Glass Paperweight		Dragon Boat Festival		Triangular pyramid shape	Green, Yellow	Zongzi texture
Case 7	Yin Yang Gourd Glass Decoration		The legend of the Eight immortals crossing the sea		Gourd	Orange	Traditional Chinese patterns water
Case 8	Plum Blossom Goblet		Museum's Collection of Plum Blossom Pattern Silver Cup		Five-petal plum blossom	Gold, Orange	Plum blossom
Case 9	"Ji Shou Long" Pen Holder		Imperial Palaces of the Ming and Qing Dynasties in Beijing		"Long"	Golden	Scale
Case 10	Oracle Weather Bottle		Oracle Bone Inscription		"Si Fang Feng"	Yellow	Oracle

Fig. 9 Extraction and application of visual-level elements of cultural heritage in identified 10 cases

Using the same process of analyzing and applying visual elements of cultural heritage to glass product design, the researchers analyzed ten representative glass products identified. Each glass product sample is analyzed according to visual-level components such as shape, color, and decoration. The results are shown in Fig. 9. In the 10 cases of glass products with cultural heritage elements, except for the elements of Yin Yang Gourd Glass Decoration and Plum Blossom Goblet, which did not directly apply the visual-level elements, the others all exited

the extraction and deformation of the shape, color or pattern in the cultural heritage. The reason for this is that the reception of visual information accounts for 70% of the information received by human beings, and the application of visual-level elements is one of the most direct ways to make people feel the visual charm of cultural heritage.

It is obvious why the Yin Yang Gourd Glass Decoration product fails to draw on the shape element of cultural heritage. In this cultural heritage, the concept of Yin and Yang belongs to the category of ancient Chinese philosophy. It is a generalization of the properties of related things or the opposites existing in a thing. It can represent the attribute division and movement changes of two related and corresponding things or phenomena, as well as the attribute trends and movement rules of two aspects corresponding to each other inside the same thing. Therefore, finding a direct connection between this concept and visual elements is hard. Nevertheless, this glass product still tries to reflect this concept through the virtual reality of artistic composition. This is not as straightforward as the direct reference of other glass products. Therefore, further empirical research is needed on users' perceptions and feedback of this product. In addition, there is no extraction and application of cultural heritage shape elements found in the Plum Blossom Goble, which is more due to the consideration of product function. In ancient times, people used to serve wine in wide-mouthed vessels, but nowadays, they prefer a more elegant way of drinking. Therefore, the shape of the Plum Blossom Goble is not similar to the ancient cultural relic. As seen from this glass product, functionality is given priority, and shape is prioritized to serve function. It can also be said that although this glass product fails to draw on all cultural heritage elements at the visual level, it maintains a connection with the behavioral factors in the cultural heritage at the functional level, strengthening the integration between this product and cultural heritage at another level. When users use this product, they can be closer to the behavior of ancient people. However, there are few studies in this area, and it is worth more time for researchers to study in the future.

6. Conclusions

With changes in consumption and demand and an aversion to the homogenization of industrial products, stylistic and culturally distinctive products tend to monopolize aesthetic interest more quickly. This research will open new doors for product design innovation while allowing cultural heritage elements to be incorporated. When Chinese glass product design faces the impact of technological modernization and foreign culture, it has distinct cultural characteristics while adopting this innovation method.

This study takes the analysis of the cultural heritage visual elements analysis as the basis and attempts to extract cultural elements through color, shape, and decoration, respectively. The initial observation of 100 glass products was from education, personal workshops, and museum derivatives. Finally, this study sampled 10 glass products with detailed analysis, collected data about applying the visual elements of cultural heritage, and obtained the universal law of applying cultural heritage to glass product design innovation. The case study results show three primary forms of applying cultural heritage elements to glass products: composition of shape, transformation of color, and application of decoration. It has been found that the design of glass products on the market today is more common in applying elements at the visual elements level, and cultural elements can be conveniently reflected in shape, color, or decoration. There is less conversion in the behavioral level of cultural heritage. No consensus has been formed, while the expression of cultural genes in product functions at this level can gain more general interest and better market feedback.

The integration of cultural elements into product design is a trend. A systematic analysis of the extraction and application of cultural heritage elements into glass products can fill the gaps in the theoretical field. Therefore, it can contribute knowledge to product designers and researchers, cultural heritage conversations, and writers who study the issue in China.

Globalization and social transformation can increase the threats to cultural heritage (Godwin et al., 2022). China currently pays attention to the conservation of Chinese traditional culture in many ways, and creative cultural products are one of the essential ways. The 2003 UNESCO Convention noted the importance of cultural heritage as a significant driver of cultural diversity and sustainable development. Strengthening the protection, development, and utilization of the cultural heritage can help enhance the Chinese cultural identity. Thus, this research can help policy to promote the protection of cultural heritage and its inheritance. This research is also significant in China's cultural creative industry. It will assist designers in considering various visual components of cultural heritage elements blended in product design and using this way to improve their product innovation.

Acknowledgement

The authors would like to express our highest appreciation to the Palace Museum, the National Library of China, Wang Sanmao Glass Studio, and Glass Workshop for providing case studies. The authors would also like to thank Wang Sanmao and Zhu Zhixuan for their case studies and technical support.

Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Author Nurul 'Ayn Binti Ahmad Sayuti, Author Qingfeng Liu; **data collection:** Author Qingfeng Liu; **analysis and interpretation of results:** Author Qingfeng Liu, Author Nurul 'Ayn Binti Ahmad Sayuti, Author Hong Chen; **draft manuscript preparation:** Author Qingfeng Liu, Author Hong Chen. All authors reviewed the results and approved the final version of the manuscript.

References

- Godwin, K. V., Kusi, A. M., King, S. R., & Navrud, S. (2022). Valuing Intangible Cultural Heritage in Developing Countries. *Sustainability*, 14(8). <https://doi.org/10.3390/su14084484>
- Goffin, K. (2000). Design for Supportability: Essential Component of New Product Development. *Research-Technology Management*, 43(2), 40–47. <https://doi.org/10.1080/08956308.2000.11671340>
- Higgins, N. (2022). Changing Climate; Changing Life—Climate Change and Indigenous Intangible Cultural Heritage. *Laws*, 11(3). <https://doi.org/10.3390/laws11030047>
- Hsiao, M.-Y., Lee, Y.-L., Hsueh, P.-C., & Tseng, Y.-L. (2018). A New Creative Method “The Cultural Gene Triangular” application in Cultural Products Design. 2018 1st IEEE International Conference on Knowledge Innovation and Invention (ICKII), 37–40. <https://doi.org/10.1109/ICKII.2018.8569151>
- Hsu, C.-H., Lin, C.-L., & Lin, R. (2011). A Study of Framework and Process Development for Cultural Product Design. In P. L. P. Rau (Ed.), *Internationalization, Design and Global Development* (Vol. 6775, pp. 55–64). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-21660-2_7
- Khalid, H. M., & Helander, M. G. (2004). A framework for affective customer needs in product design. *Theoretical Issues in Ergonomics Science*, 5(1), 27–42. Scopus. <https://doi.org/10.1080/1463922031000086744>
- Kumar, M., Townsend, J. D., & Vorhies, D. W. (2015). Enhancing Consumers' Affection for a Brand Using Product Design. *Journal of Product Innovation Management*, 32(5), 716–730. <https://doi.org/10.1111/jpim.12245>
- Labatt, S. M. (2018). *Glass as Ink: Seeking Spontaneity from the Casting Process* [Ph.D.]. <https://www.proquest.com/docview/2204744897/abstract/F1124B8115934AA2PQ/20>
- Liu, Y. (2019). Basic Theory Study on Cultural Creative Industry. 1515–1517. <https://doi.org/10.2991/iccsh-19.2019.331>
- Lu, Y., & Zang, W. (2022). Emotional design and research of museum cultural and creative products. *Footwear technology and design*, 2(16), 99–101.
- Noble, C. H., & Kumar, M. (2010). Exploring the Appeal of Product Design: A Grounded, Value-Based Model of Key Design Elements and Relationships*. *Journal of Product Innovation Management*, 27(5), 640–657. <https://doi.org/10.1111/j.1540-5885.2010.00742.x>
- Norman, D. (2007). *Emotional design: Why we love (or hate) everyday things*. Basic books.
- Paschalidou, E., Fafet, C., & Milios, L. (2022). A Strong Sustainability Framework for Digital Preservation of Cultural Heritage: Introducing the Eco-Sufficiency Perspective. *Heritage*, 5(2). <https://doi.org/10.3390/heritage5020058>
- Stamm, B. von. (2008). *Managing Innovation, Design and Creativity* (2nd edition). Wiley.
- Sun, Y., I-Wen, W., & Lin, R. (2022). Transforming “Ritual Cultural Features” into “Modern Product Forms”: A Case Study of Ancient Chinese Ritual Vessels. *Religions*, 13(6). <https://doi.org/10.3390/rel13060517>
- Vecco, M. (2010). A definition of cultural heritage: From the tangible to the intangible. *Journal of Cultural Heritage*, 11(3), 321–324. <https://doi.org/10.1016/j.culher.2010.01.006>
- Wang, Y.-H., & Ajovalasit, M. (2020). Involving Cultural Sensitivity in the Design Process: A Design Toolkit for Chinese Cultural Products. *International Journal of Art & Design Education*, 39(3), 565–584. <https://doi.org/10.1111/jade.12301>
- Woodham, J. M. (1997). *Twentieth century design*. Oxford Paperbacks. <https://books.google.com/books?hl=zh-CN&lr=&id=2AIs03ujCqkC&oi=fnd&pg=PA7&dq=20th+Century+Design&ots=wtAwfqyldn&sig=RLsyuMoQe1FE1xzPEijxw7z1C-M>
- Zeng, H., & Yang, L. (2022). The Innovation and Development Path of Cultural and Creative Industries in Anhui Province, China: Nvivo12-Based Policy Text Analysis. *Computational Intelligence and Neuroscience* : CIN, 2022. <https://doi.org/10.1155/2022/6202746>

- Zhang, L., & Hu, F. (2019). Analysis of the Design of Cultural and Creative Products from the Perspective of Regional Culture. *IOP Conference Series. Materials Science and Engineering*, 573. <https://doi.org/10.1088/1757-899X/573/1/012071>
- Zhang, X., & Wen, K.-H. (2020). A Model Process of Integrating Context of Local Culture for Pre-Development Stage in the Design of Cultural and Creative Products—Using Macao's Historical Buildings as an Example. *Sustainability*, 12(15). <https://doi.org/10.3390/su12156263>
- Zhao, C. (2020). Research on Cultural and Creative Product Design System Based on 3DP Technology. *Journal of Physics: Conference Series*, 1648. <https://doi.org/10.1088/1742-6596/1648/4/042097>
- Zhu, Y., & Cheng-lein, T. (2020). Construction and Application of the Design Method of Cultural Products Based on the Meme of Liao dynasty ceramics. *E3S Web of Conferences*, 179. <https://doi.org/10.1051/e3sconf/202017902016>