

Innovative Design of Bamboo Weaving Products - Perspective from Hunan Province

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ABSTRACT

The development of innovative model for bamboo weaving products in Hunan is needed since there is no rules to follow that can be used as a unified point of references. The objective of this research is to investigate, to determine and to assess the innovative model for bamboo weaving products in Hunan. In term of the methodology of the studies, a variety of different literature and current models were integrated to highlight the variation in consumer responses to the visual form of the product. Through a research project employing a mixed-methods approach, work began on how crafts-people and designers elicit these responses. Interviews with craftspeople, designers and consumer surveyors played a key role in this process. The findings indicate that this model is not only replicates the previous model created for the consumer response, but also incorporates new perspectives and insights. It also provides a more comprehensive model of innovative design that places Hunan's bamboo woven products within an aesthetic framework and describes activities other than design that are important in shaping the shape of the product.

Keywords: *Bamboo; Design Thinking; Form; Innovation; Weaving*



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1 INTRODUCTION

Bamboo weaving belongs to the traditional art and is one of the six types of weaving in China. It is a form of creation using bamboo as a material and a variety of living and production utensils and handicrafts made through certain weaving processes (Yao & Zhang, 2011). Approved by the State Council, weaving was included in the second batch of national intangible materialised heritage catalogue in 2008 (Liu et al., 2023). And Hunan Province is an important bamboo production area with very rich bamboo resources. Hunan bamboo weaving carries the "gene" of traditional folk crafts, bamboo culture, spirit and national aesthetic value. Only by innovating the product design, expanding the function of the product and creating the cultural product design can Hunan bamboo weaving products be invincible in the market competition. Hunan bamboo weaving should not only stay in people's memory, but also enter into people's modern life, cater for modern consumer concepts, develop in inheritance, and improve in innovation.

Each culture is the product and expression of the unique life history of its subject, with its own meaning and value of existence (Hall, 2007). The indomitable and upright qualities of bamboo are also in line with the elegant and graceful temperament of the Chinese literati, and bamboo weaving products are by their very nature the external physical expression of Hunan's intangible culture (Luo et al., 2020). Not much design work has been done to directly study bamboo weaving, and this part mainly refers to the monographs of traditional crafts design literature. "Research on Chinese Traditional Bamboo Weaving Design", which focuses on the possible new value of Chinese traditional bamboo weaving as a source of inspiration for traditional weaving design (2010) especially for modern Chinese industrial design. Hu Fei's "Exploration of Traditional Chinese Design Thinking Patterns" is a theoretical and practical book that combines methodology, examples, and ancient Chinese, Western and foreign cultures (Wang, 2017). The author collated the evolution of Chinese culture and traditional design through some Chinese traditional products, and some of the summarised design methods and design thinking see (Abidin, Sigurjonsson, et al., 2008) have great inspiration for the innovative design of bamboo weaving products. Hunan bamboo weaving should not only stay in people's memory, but also enter into people's modern life, cater for modern consumer concepts, develop in inheritance, and improve in innovation (Li et al., 2023).

2 METHODS

Based on the historical development of bamboo weaving in China, this paper extracts the bamboo weaving cultural elements at the consumer level, discusses the design ideas and models of Hunan bamboo weaving products, transforms the design practice; and verifies the effectiveness of the design model through craftsman and designer cognition, returns the bamboo weaving process to the public eye, and summarizes a more detailed reference methodology (Yun et al., 2022; Zhang & Zhou, 2022), so as to provide new enlightenment for the creative transformation of traditional bamboo weaving products and the inheritance of traditional handicrafts, and finally serve the design of traditional handicraft products and the inheritance and dissemination of regional culture.

2.1 Objective of Study

- OBJ1: To investigate the characteristics of traditional bamboo woven products, the design elements of bamboo woven product cultural elements are summarized and analysed.
- OBJ2: To determine on the design transformation of traditional bamboo weaving and construct the innovative design mode of traditional bamboo weaving.
- OBJ3: To assess the feasibility and effectiveness of the design model, to ensure the matching degree of innovative products.

2.2 Research Questions

- RQ1: What are the innovative design elements of the cultural elements of bamboo woven products?
- RQ2: How to select, extract, transform and reshape the cultural factors in the innovative design?
- RQ3: How to verify the feasibility and effectiveness of design patterns?

In what follows, this session will report on the results and analysis of these two data collection activities, including sampling, instrumentation, and detailed instrumentation (Lias et al., 2020; Zainal Abidin et al., 2021). Through these reports, we can gain a deeper understanding of the characteristics and problems of the research subjects and provide more robust support and guidance for the innovative design of bamboo weaving products in Hunan to promote the development and prosperity of the local bamboo weaving industry.

The research methodology used in this study aims to provide a comprehensive understanding of the innovative design model, particularly in the initial conceptual design stage of the decision-making process (Toyong & Abidin, 2021). It operates within a naturalistic exploration framework that considers

the flexibility of emergency design and uses purposeful sampling to ensure that the data collected is representative of the population under study (Jacobsen & Berg, 2021). The study used semi-structured interviews and group analysis to analyse the material collected, including audio recordings, images and videos (Zainal Abidin et al., 2009). These data were then transcribed and written up as reflective notes and sketches, as well as photographs and collected activity materials.

The framework of this research is based on the stages of the Design Research Methodology (DRM) (Blessing et al., 1998). The DRM emphasizes several factors: The need to formulate success as well as measurable criteria (for example, the role of the Criteria definition stage is to identify the aims that the research is expected to fulfil, as well as the focus of the research project); the need to focus Descriptive Study I on finding the factors that contribute to or prevent success; the need to focus the Prescriptive Study on developing support that addresses those factors that are likely to have most influence; and, finally, the need to enable evaluation of the developed support (Descriptive Study II).

The design research methodology framework shown in Figure 1 describes the development of product models for this research work. Criteria for the success of the research are derived both from theoretical statements and from observations of design practice (see. Description I of the phenomenon studied constitutes the basis for a Prescription), which in turn affects the phenomenon. Description II shows this impact. Depending on the outcome, a better description of the phenomenon is achieved (Description I again), or a new prescription is formulated for the synthesis and problem-solving of the design process.

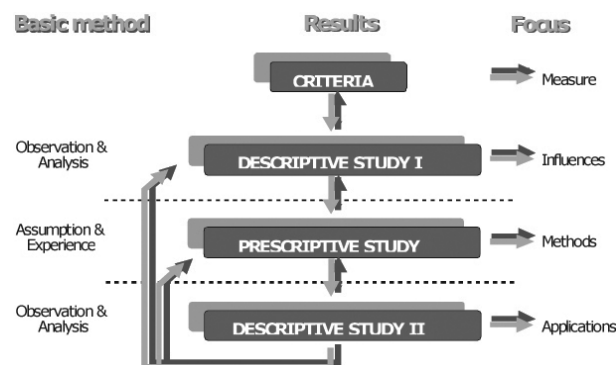


Figure 1 A Design Research Methodology framework (Adapted from Blessing, Chakrabarti, & Wallace, 1998)

Design research methodology is derived from knowledge produced through design research, scientific research on design, cognitive psychology, and practical experience (Beitz et al., 1996). The analytical strategy employed in this study involved thematic analysis at different stages and levels of the research, including coding and categorisation and identifying patterns and themes emerging from the data. Overall, this research approach allowed for a detailed examination of the decision-making process at an early stage of conceptual design, which is critical to understanding the factors contributing to successful innovation. By utilising a naturalistic exploratory framework and purposeful sampling, this study captured a wide range of data, ensuring that the findings represented the population under study. In addition, the analytical strategy employed in this study allowed for a nuanced understanding of the complex themes and patterns that emerged from the data, thus providing valuable insights into the design process.

2.3 Research Design

A research design can link the research questions to the data and thus better answer the research questions (Abidin, Bjelland, et al., 2008). By combining the results of qualitative and quantitative research, the characteristics and patterns of innovative design models for bamboo products can be derived, providing

scientific guidance and reference for the design and development of bamboo products and improving the market competitiveness of bamboo products. Qualitative and quantitative research complement each other and can analyse problems at different levels and perspectives, improving the credibility and reliability of the research (Zainal Abidin et al., 2009). Therefore, it is essential to adopt both qualitative and quantitative analysis methods to construct innovative design models for bamboo woven products (see Figure 2).

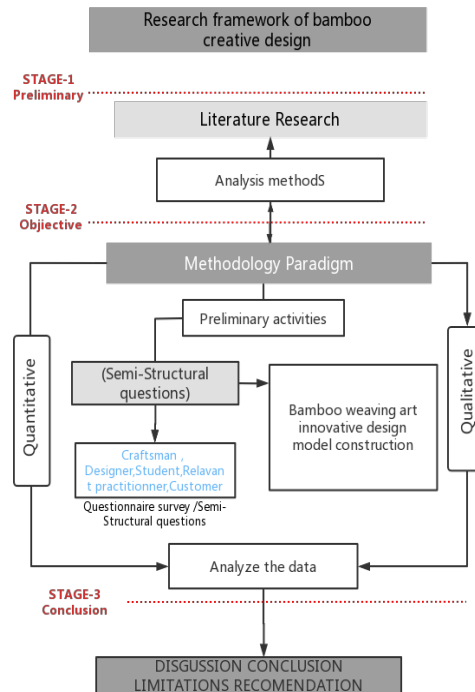


Figure 2 Research flowchart

For the quantitative part, a sample size of at least thirty was found to be acceptable (Erdos & Morgan, 1970; Leavy, 2022) twenty to twenty-five respondents were used for the qualitative inquiry part for this research project. In qualitative inquiry, no general rules have been set with regard to sample size, but depends on what is deemed to be required from case to case depending on method of inquiry (Creswell & Miller, 2000; Gergen et al., 2015; Mayan, 2016). Quota sampling was used for the survey and snowball sampling, also known as chain referral sampling, was used for the video observation (virtual and physical). Quota sampling was chosen because it is more specific when dealing with the sizes and proportions of sub-samples, as in the sub-groups here that helped reflect corresponding proportions in the population (Blessing & Chakrabarti, 2009). Using quota sampling also helped the researcher identify participants based on selected criteria. Snowball sampling, which is considered a type of purposive sampling (Patton, 2014), was used to find and recruit “hidden populations” that are not easily accessible to researchers through other sampling strategies. This method allowed an approximate constructing of the “social network” by building up a social structure from a set of individuals and organizations connected to the hidden population. Moreover, this method of sampling was done because of a difficulty for the researcher to get an access in industries since all companies involved in this research classify their styling department as a prohibited area to other people (Bellagambi et al., 2020).

3 FINDING ANALYSIS

3.1 RQ1 - Finding Analysis: Design Elements of The Cultural Elements

3.1.1 Analysis of Cultural Factors

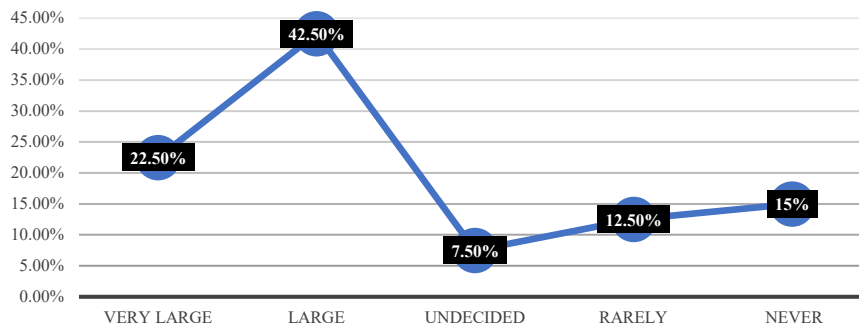


Figure 3 Influence of Hist. & Cultural Background on Bamboo Product Design

Findings analysis: Based on the data (see Figure 3), Most of the respondents believe that the historical and cultural context of bamboo products influences product design. Among them, 42.5 % of the respondents believe that this influence is significant, while 22.5% of the respondents believe that this influence is very significant. In addition, 15 % of the respondents believe that historical and cultural context has no influence on design, 12.5 per cent believe that the influence is very small. In summary, most of the respondents believe that historical and cultural background has an influence on the design of bamboo products. This suggests that designers need to consider the influence of historical and cultural factors when designing bamboo products.

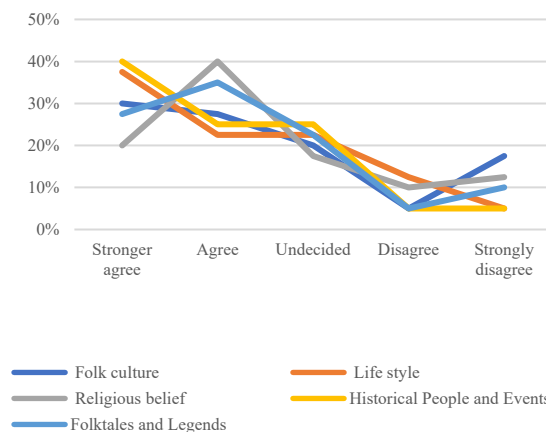


Figure 4 Historical and cultural elements in bamboo product design.

Findings analysis: Based on the data (see Figure 4), the following conclusions can be drawn: In the design of bamboo products, it is historical figures and events that are considered to best reflect historical and cultural characteristics, with 40% strongly agreeing. followed by lifestyles, with 37.5% strongly agreeing. Folk culture and folk tales and legends were also considered to be important aspects that could reflect historical and cultural identity, with 30% and 27.5% strongly agreeing respectively. Religious beliefs were considered to be the least important aspect of historical cultural identity, with only 20% strongly agreeing.

3.1.2 Analysis of Design Factors - Analysis Around the Bamboo Product Design Itself

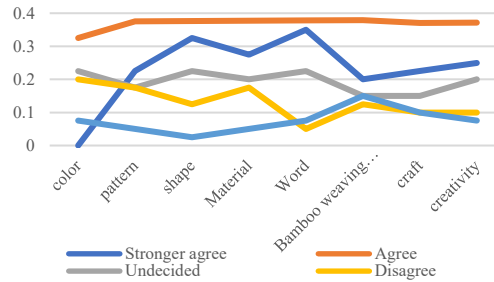


Figure 5 The importance of the innovative design factor of bamboo weaving products

Findings analysis: Based on the data (see Figure. 5), we can draw the following conclusions: Colour was the most important aspect in product design for respondents, with 75% agreeing or strongly agreeing. Pattern and shape were also more important design aspects, with 60% and 62.5% agreeing or strongly agreeing respectively. Creativity and style were also important aspects for respondents, with 62.5% and 57.5% agreeing or strongly agreeing respectively. Of all the aspects, text was the least important, with only 65% agreeing or strongly agreeing. In summary, designers need to focus more on aspects such as colour, pattern, shape, creativity and style in product design. At the same time, textual aspects of design can be reduced appropriately.

3.1.3 Analysis of Design Factors - Analyse the Design Market Factors of Bamboo Weaving Products

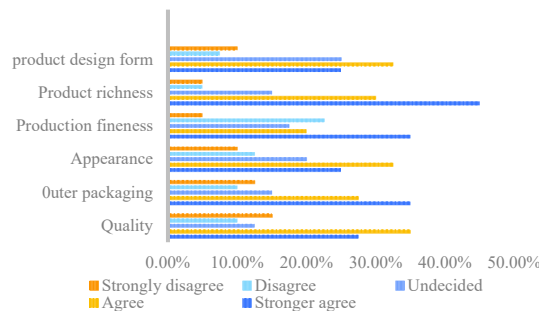


Figure 6 Analysis of the modelling design elements of bamboo weaving products.

Findings analysis: Based on the data (see Figure 6), we can conclude that Product richness is the most important factor in the innovative design of bamboo products, with 45% of respondents strongly agreeing with this. 2. packaging and production fineness were the next most important factors, with 35% of respondents strongly agreeing that each of these factors was important. 3. craftsmanship and colour were also considered important, with 32.5% and 35% of respondents agreeing respectively. 4. Product design form and product appearance were more equally important among the respondents, with around 30% agreeing that these two factors were important. 5. Quality was one of the least important factors, with only 27.5% of respondents strongly agreeing.

3.1.4 Analysis of Design Factors - Analysis of The Artistic Characteristics of Bamboo Products

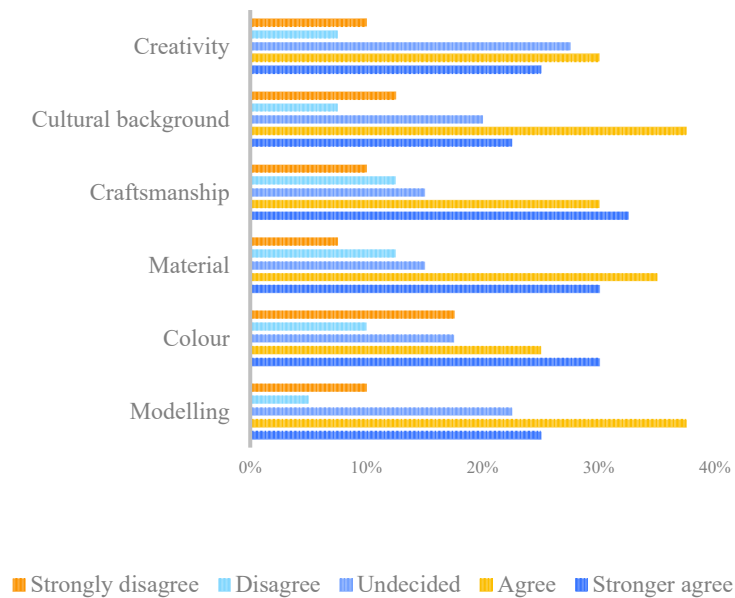


Figure 7 Influence of design factors on the artistic characteristics of bamboo weaving

Findings analysis: Based on the data (see Figure 7). In terms of shape, a relatively high proportion of people (62.5%) strongly agreed and agreed, indicating that shape has a relatively strong influence on the artistic character of Hunan's bamboo products. In terms of colour, a relatively high proportion of people (55%) strongly agreed and agreed, indicating that colour has a strong influence on the artistic character of Hunan's bamboo products. In terms of materials, a high percentage of people (65%) strongly agreed and agreed, indicating that materials have a strong influence on the artistic character of Hunan's bamboo weaving products. In terms of the production process, a higher proportion of people (62.5%) strongly agreed and agreed, indicating that the production process has a greater influence on the artistic characteristics of Hunan's bamboo weaving products. In terms of cultural background, a higher proportion of people agree and strongly agree, at 60%, indicating that cultural background has a greater influence on the artistic characteristics of Hunan's bamboo weaving products. 6. In terms of creativity, a higher percentage of people agree and strongly agree, at 55%, indicating that creativity has a greater impact on the artistic characteristics of Hunan bamboo weaving products. To sum up, for the artistic characteristics of Hunan bamboo woven products, shape, colour, material, production process, cultural background and creativity all have a certain influence, among which, material and production process have a greater influence.

3.1.5 Analysis of Design Factors - Analysis of Competitive Product Factors

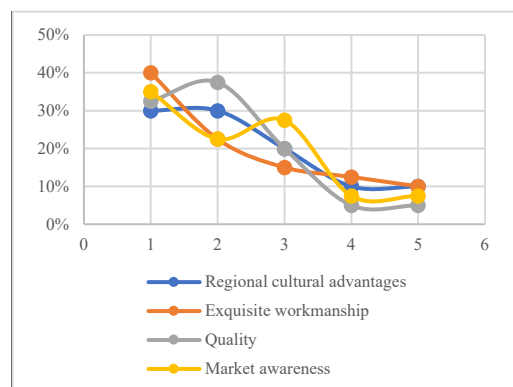


Figure 8 The competitive factors of bamboo weaving products in Hunan.

Finding analysis: Based on the data (see Figure 8). Exquisite craftsmanship is the most important factor that respondents consider to make Hunan bamboo weaving products competitive in the international market, with 60% of respondents strongly agreeing and agreeing. Regional cultural advantages and market awareness were also cited as factors for Hunan's competitiveness in the international market, with 60% strongly agreeing and 57.5% agreeing respectively. Respondents' recognition of the quality of Hunan bamboo weaving products as competitive in the international market was relatively low, with only 32.5% strongly agreeing or agreeing. Regarding the competitiveness of Hunan's bamboo woven products in the international market, 20% were unsure.

3.1.6 Analysis of Design Factors - The Importance of Analysing Technical Features

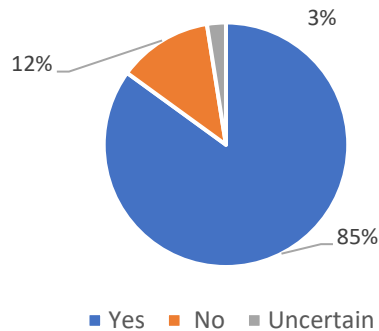


Figure 9 The importance of technology for bamboo woven products.

Finding analysis: Based on the data (see Figure 9), 85% thought that the combination of technical and cultural features could best reflect the characteristics and charm of bamboo woven products in their design, 12.5% chose no, and 5% chose undecided. Thus, the majority of respondents believe that the combination of technical and cultural features is important for the embodiment of the characteristics and charm of bamboo woven products.

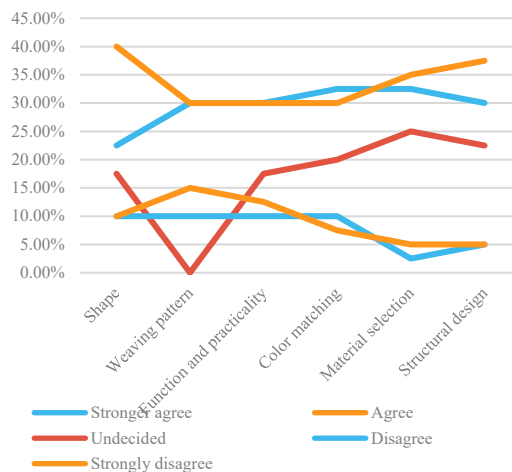


Figure 10 The technical features for the design elements of bamboo woven products.

Findings analysis: Based on the data (see Figure 10), the participants were somewhat divided in their views on the technical features of bamboo woven products that could be innovated or improved. Among them, shape structure and material selection were considered as features that could be innovated or improved, with 22.5% and 32.5% of participants strongly agreeing respectively. In terms of weave patterns, functional utility and colour schemes, on the other hand, participants' opinions were more evenly distributed, with no clear dominant view. It should be noted that a certain percentage of participants had a negative attitude towards the innovation or improvement of the above features, especially in terms of material selection, with 2.5% of participants strongly disagreeing. Therefore, when making technological innovations or improvements to bamboo woven products, it is necessary to take

into account the opinions of participants and market demand, and avoid over-reliance on innovation or improvement of one feature to the neglect of other aspects of demand. Therefore, in the production of bamboo woven products, emphasis should be placed on modern and technological innovations in weaving techniques, material selection and pattern styles.

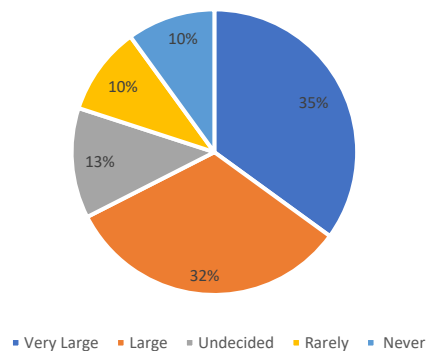


Figure 11 Analysis of the quality and aesthetics of technology for bamboo weaving designs.

Findings analysis: Based on the data (see Figure 11), 35% of the respondents think that the technical features of bamboo woven products have a very big impact on the quality and aesthetics of the products, 32.5% think they have a big impact, 10% think they have very little impact, 10% think they have no impact at all and 12.5% are not sure. Overall, the majority of respondents believe that the technical features of bamboo woven products have some influence on the quality and aesthetics of the products, with a high proportion of respondents believing that they have a large and very large influence.

3.2 RQ2 - Finding Analysis: Innovative Transformation of Cultural Elements and Design Elements

3.2.1 Innovative Design Transformation

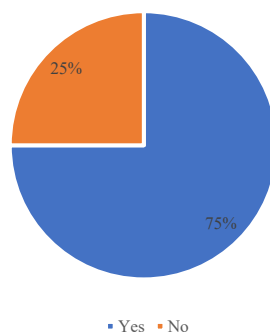


Figure 12 Understanding degree of bamboo weaving craftsmen on the transformation of innovative design factors of bamboo weaving products.

Findings analysis: Based on the data (see Figure 14), the following conclusions can be drawn: Among these participants, constituting 75%, demonstrated comprehension of the process involving the selection, extraction, transformation, and reimagining of cultural and design elements within innovative design. Conversely, accounting for 25%, indicated a lack of familiarity with this process.

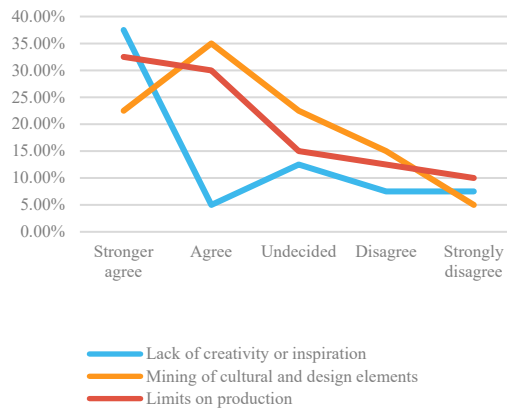


Figure 13 Analysis of the problems existing in the transformation process of bamboo weaving design.

Findings analysis: Based on the data (see Figure 13), the following conclusions can be drawn: The predominant obstacle encountered by respondents in establishing model innovation revolved around a deficiency of creativity or inspiration, as affirmed by 37.5% who strongly endorsed this perspective, while 35% expressed agreement. Subsequently, production constraints emerged as the subsequent major challenge, with 32.5% in strong agreement and an additional 30% expressing concurrence. The aspect of integrating cultural and design elements was perceived as relatively less significant by participants, garnering strong agreement from only 22.5%, along with 35% in agreement. The conspicuously limited proportions of both strong disagreement and disagreement across all options underscore a notable level of acknowledgment of these challenges among respondents.

3.2.2 Innovative Elements

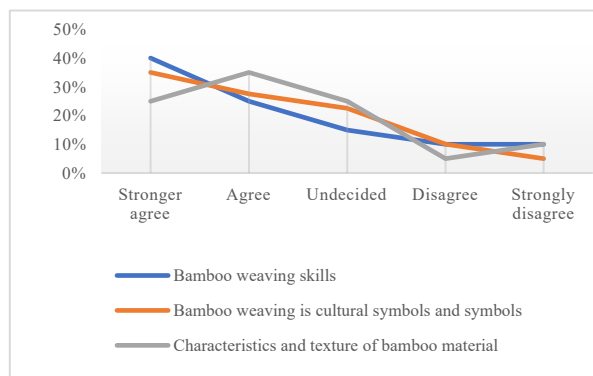


Figure 14 Analysis of the importance of innovative elements in design models.

Findings analysis: Based on the data (see Figure 14), bamboo weaving techniques were the most common cultural and design element that respondents chose to extract and transform when creating innovative designs, with 40% strongly agreeing with the choice of bamboo weaving techniques. Secondly, bamboo cultural symbols and emblems were also a popular choice, with 35% strongly agreeing with its selection. The characteristics and texture of the bamboo material, on the other hand, was the least frequently chosen element by respondents, with only 25% strongly agreeing with its choice.

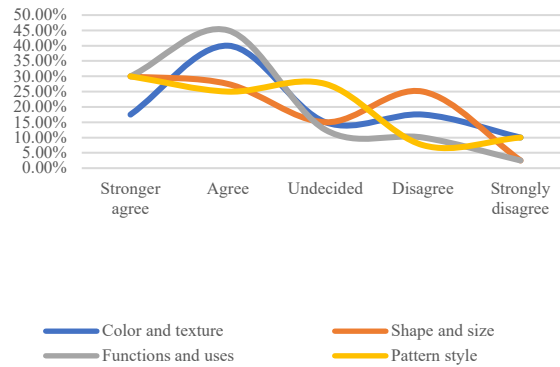


Figure 15 Analysis of the importance of transformative elements in bamboo product design.

Findings analysis: Based on the data (see Figure 15), it can be seen that colour and texture, shape and size, function and use, and pattern style were all considered to be the elements most likely to generate model innovation in terms of selecting, extracting, transforming and reinventing cultural and design elements. Of these, shape and size, function and use, and pattern style were considered to be relatively more important elements, receiving a high proportion of agree and strongly agree options. Colour and texture, on the other hand, although also considered important elements, received relatively low proportions and may require more exploration and research.

3.2.3 Analysis of the Transformation Method of Innovative Model Design

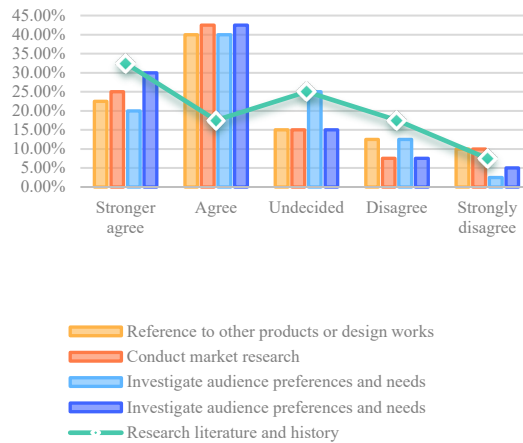


Figure 16 Analysis of the importance of innovation model design transformation methods (1)

Findings analysis: Based on the data (see Figure 16) show that the most common methods and techniques used by participants to select and extract cultural and design elements were conducting competitive product analysis and design trend research, followed by referencing other products or design works and conducting market research. Methods and techniques for researching literature and history as well as investigating audience preferences and needs were chosen relatively infrequently.

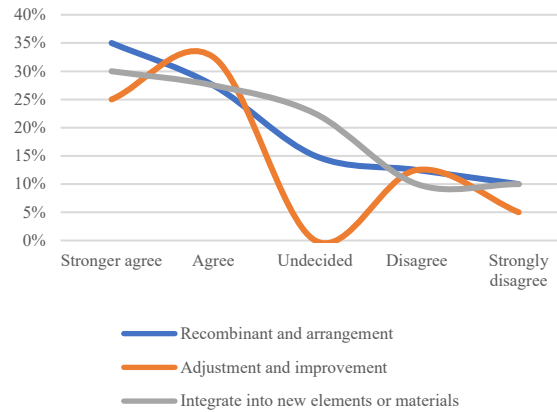


Figure 17 Innovation model design transformation methods (2)

Findings analysis: Based on the data (see Figure 17), it can be seen that the most common method chosen by respondents for transforming and reshaping to create a model innovation was 'reorganisation and arrangement' at 35%, followed by 'incorporation of new elements or materials' at 30%. This was followed by 'incorporating new elements or materials' at 30%. In terms of 'adjusting and improving', the choice was more evenly split at 25%. At the same time, the proportion of 'unsure' options was also high, at 15-25%. It is therefore important for designers to have a better understanding of the needs and cultural context of their users in order to innovate and transform.

3.3 RQ3 - Finding analysis: Innovative Design Model Validation

3.3.1 The Importance of Innovative Design Model Verification

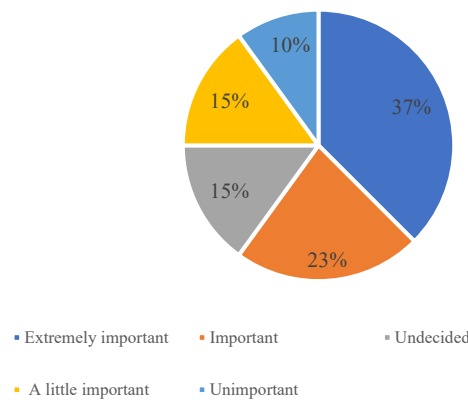


Figure18 The importance of innovative design model validation

Findings analysis: Based on the data (see Figure 18), it can be seen that 37.5% thought it was very important to verify the feasibility and validity of the innovation design model, 22.5% thought it was important, 15% were unsure, 15%thought it was somewhat important and 10% thought it was not important. It can be seen that the majority of people think that verifying the feasibility and validity of the innovation design model is important or important.

3.3.2 Innovative Design of Model Verification Methods

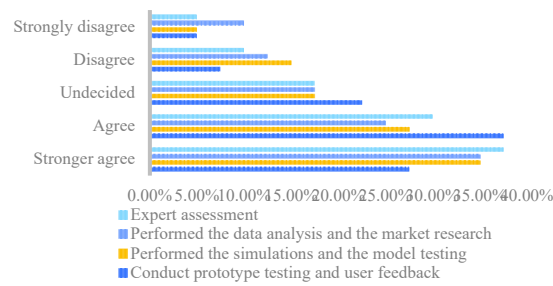


Figure 19 Method 1 for innovative design model verification.

Findings analysis: Based on the data (see Figure 19): Conducting prototype testing and user feedback was the most popular method of verifying the feasibility and effectiveness of innovative designs, with 27.5% strongly agreeing and 37.5% agreeing. Conducting mock-ups and model testing was also a common method of verifying the feasibility and effectiveness of innovative designs, with 35% strongly agreeing and 27.5% agreeing. Conducting data analysis and market research was also a common method of validating the feasibility and effectiveness of innovative designs, with 35% strongly agreeing and 25% agreeing. Expert assessment was also a method of verifying the feasibility and effectiveness of innovative designs, but was relatively less popular, with only 37.5% strongly agreeing and 30% agreeing. Overall, conducting prototype testing and user feedback were the most popular methods, while conducting simulation and model testing, data analysis and market research were also commonly used.

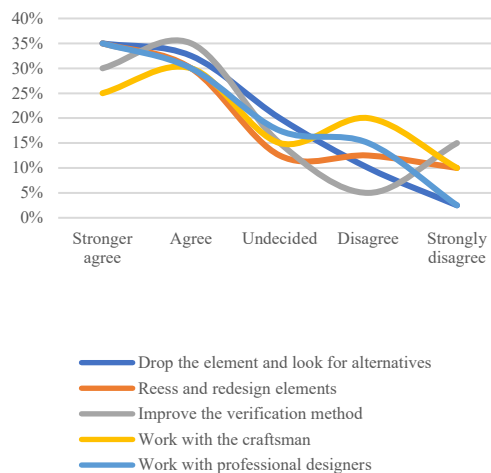


Figure 20 Approaches to the validation of the innovative design model

Findings analysis: Based on the data (see Figure 20), it can be seen that when a cultural or design element was not feasible in the innovative design, the main approaches taken by the participants to solve the problem were the following: Abandon the element and find an alternative: 35% of the participants strongly agreed or agreed with this approach. Re-evaluate and redesign the element: 35% of participants strongly agreed or agreed with this approach. Improve the validation method: 30% of participants strongly agreed or agreed with this approach. Working with craftspeople: 25% of participants strongly agreed or agreed with this approach. Working with a professional designer: 35% of participants strongly agreed or agreed with this approach. In summary, dropping the element and finding alternatives and working with professional designers were the main approaches taken by the participants, with working with craftspeople being the least popular approach.

4 RESULT AND DISCUSSION

4.1 The Factors Influencing the Bamboo Weaving Design

Craft culture is closely related to the economy, technology, politics, customs, art, aesthetic style and national culture of society and the times, and is reflected through the culture of making things in different times. A study of the literature on bamboo weaving shows that the culture of bamboo weaving covers a wide range of topics, including bamboo cultivation, bamboo processing, bamboo use, bamboo appreciation, bamboo singing and bamboo painting, which are part of the culture of bamboo craft (Zhao et al., 2022; Zheng & Zhu, 2021). The cultural elements discussed in this section refer mainly to the craft culture of bamboo weaving production, i.e. the craft culture of bamboo weaving. The craft culture of bamboo is part of the bamboo culture, a community of material and spiritual activities such as weaving, making and using bamboo and all the cultural wealth created by the traditional people in their productive lives, using bamboo as a carrier. The analysis of the connotation factors of bamboo weaving products in the data from the interviews led to the following factors influencing the design of bamboo weaving products in Hunan. Based primarily on questions and exchanges between consumers, bamboo weavers and designers, the following factors were derived regarding the formation of important factors influencing bamboo weaving products. The following eight factors were collated to influence the design elements: practicality, replicability, inexpensiveness, formulaic, roughness, localness, simplicity, and similarity with difference, each based on the results obtained from the survey findings (see Figure 21).

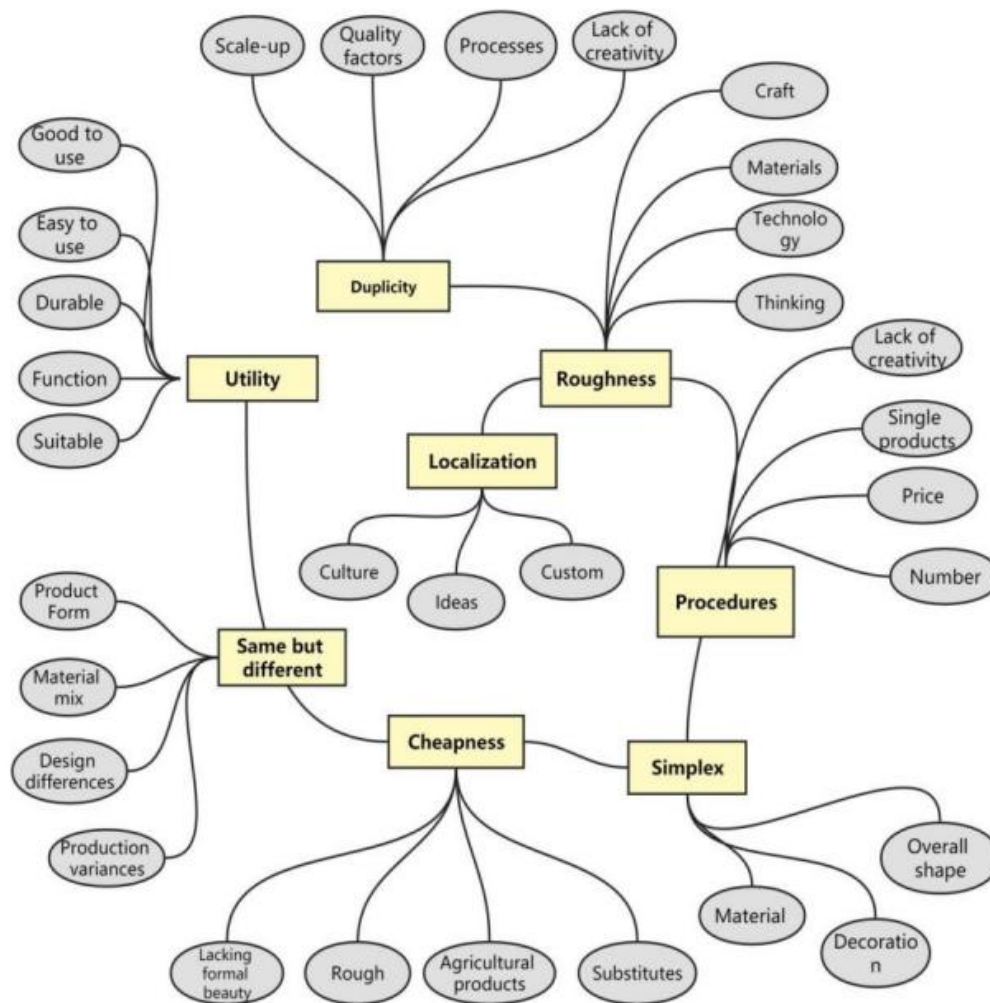


Figure 21 Analysis of factors influencing the design of bamboo weaving products in Hunan

4.2 The Symbolic Hierarchical Analysis Model of Bamboo Woven Cultural Design

In bamboo product design, we need to analyse design factors starting from the macro level and gradually refine them. However, the form in which design factors exist is usually ambiguous, which poses certain difficulties in practice. Hierarchical analysis provides an effective way of solving such ambiguity and macroscopic problems. Through the decomposition process of hierarchical analysis, we are able to break down the ambiguous macroscopic research object into specific design features and, by comparing the features with each other, obtain the importance of each element in relation to the overall research object (Abidin, Sigurjonsson, et al., 2008; Zainal Abidin et al., 2021). These more important elements are often the design factors of the object of study. In the analysis of bamboo product design, we can use hierarchical analysis to determine the importance of different design factors through the quantification of design factors in questionnaires and the analysis of important information from interviews, so that we can better understand the impact of design factors. Firstly, the target culture of the bamboo woven product is taken as the object of study and then broken down into specific design feature elements, such as the bamboo weave process, traditional cultural elements and innovative design. Through the relative comparison and weight distribution between these feature elements, we can determine the degree of importance of each feature element to the design of the target culture.

The bamboo weaving process may play an important role in bamboo products, traditional cultural elements may reflect regional characteristics, while innovative design can give the product a unique personality. By applying hierarchical analysis, we are able to quantify the importance of these design elements and thus provide a scientific basis for design decisions for bamboo products. The design features, including colour features, form features, technical features and connotation features, obtained from the previous data analysis in Chapter 4 were compared and ranked. (See Figure 22 for model construction)

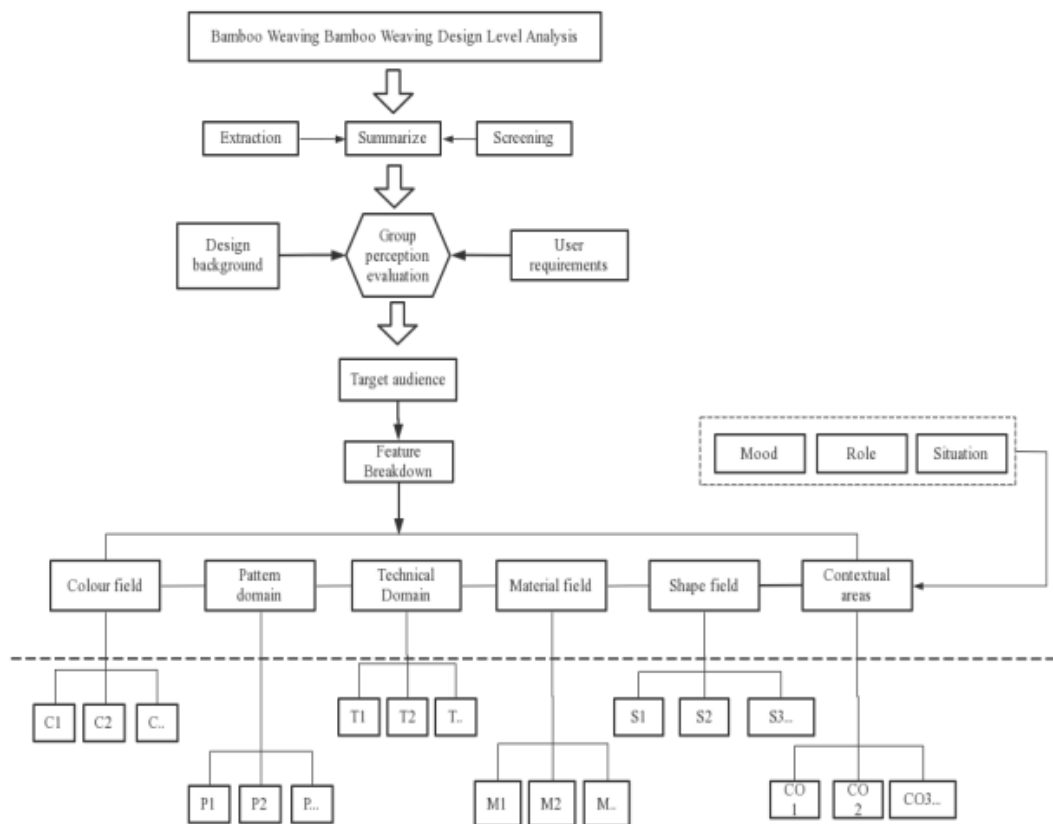


Figure 22 Design factor hierarchy factor analysis model.

KEY: C-Colour ; P- Pattern domain; T-technique domain; M -Meaning field;
C-Colour-field; M-Material field; CO - Contextual areas

Cultural factor analysis mapping is a method of categorising samples with similar attributes according to certain rules. The analysis of the sample mapping helps to find common factors among the diverse samples and can effectively solve the problem of extracting design factors for Chinese cultural characteristics. (See Figure 22 for a partial analysis of the mapping of traditional bamboo weaving).

4.3 Conceptual Transformation - Decomposition and Re-Organisation of Product Function and Form

Based on the old classic product image, combined with the functional attributes of the product under the direction of modern life needs, the form of the product is extended and redesigned to give it a new functional meaning. Through this breaking up and reorganisation of function and form, the traditional form is given new life, while at the same time pieces of traditional life are incorporated into the new product, thus achieving continuity of the traditional bamboo product image and an innovation of the bamboo product function (see Figure 23).

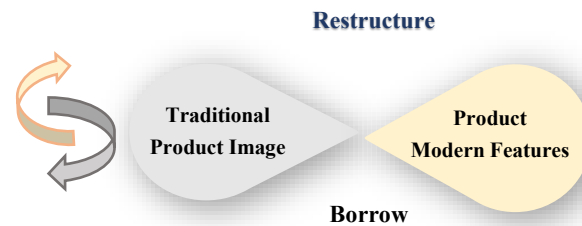


Figure 23 Concept conversion of bamboo weaving products. Integrate bamboo weaving texture into modern technology products

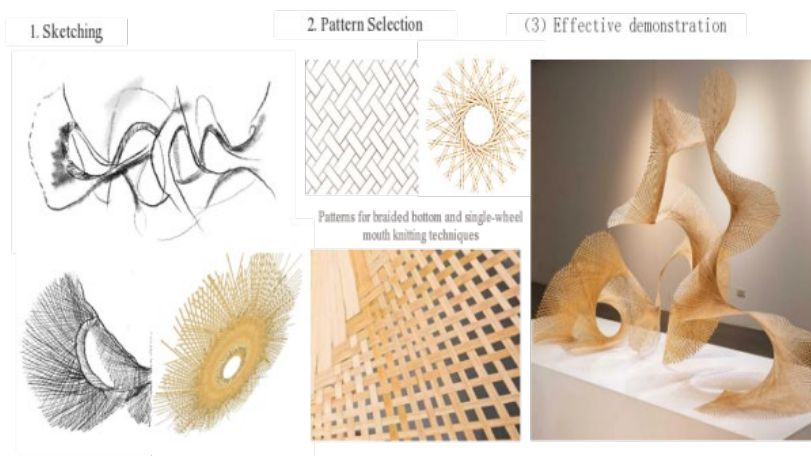


Figure 24 Display of bamboo weaving device products (adapt for Lin,2022).

4.4 Innovation in Bamboo Weaving Processes Incorporating Modern Technology

Through comprehensive analysis and discussion, new ideas and approaches to formal innovation in bamboo weaving products can be provided through the dematerializations of shapes, the reuse of basic bamboo weaving patterns, the effective use of flat bamboo weaving and the application of modern technological aids and abrasives. These innovative methods can not only enrich the formal expression of bamboo woven products, but can also improve the efficiency, quality and standardization of product design, and promote the development and application of bamboo woven craftsmanship in the modern design field.

Forming elements: By dismantling and separating the form elements of bamboo woven products, they become modular elements that can be used and combined independently, thus achieving a more flexible and diverse formal expression.

B. Reuse of basic bamboo weaving patterns: the traditional basic bamboo weaving patterns are redesigned and improved to make them more adaptable to modern aesthetic and functional needs, while using these basic patterns as a design inventory to facilitate the designer's selection and combination in the creative process, thus increasing the innovation and variability of bamboo weaving products.



Figure 25 Bamboo Chandelier Analysis (adapt for Samy Rio,2023)

Design Analysis: Retaining the most natural material of the bamboo tube (see Figure 25), the lamp product design uses a mixture of different bamboo weaving techniques. The bamboo weaving lamp consists of 2 pieces of weaving and 2 pieces of bamboo tubes, the weaving adopts the triangular hole weaving and the quadrangular hole weaving patterns, and using the elasticity and toughness of the bamboo weaving itself, it is spliced together and combines to form a three-dimensional lampshade shape. The lamp can be hung or stood, and the light will form a soft light effect through the bamboo weaving outer cover.

Effective use of graphic bamboo weaving: bamboo weaving is applied to graphic design in innovative ways, such as wall decoration, screens and paintings, combining the unique textures and material properties of bamboo weaving with graphic art to reveal novel visual effects and a sense of space.

Computer-aided bamboo product design: With the help of computer-aided design software, designers can create and modify bamboo woven products in a virtual environment, previewing and adjusting the shape, size and proportion of the product in real time, thus completing the design process more efficiently, while exploring more innovative formal expressions.

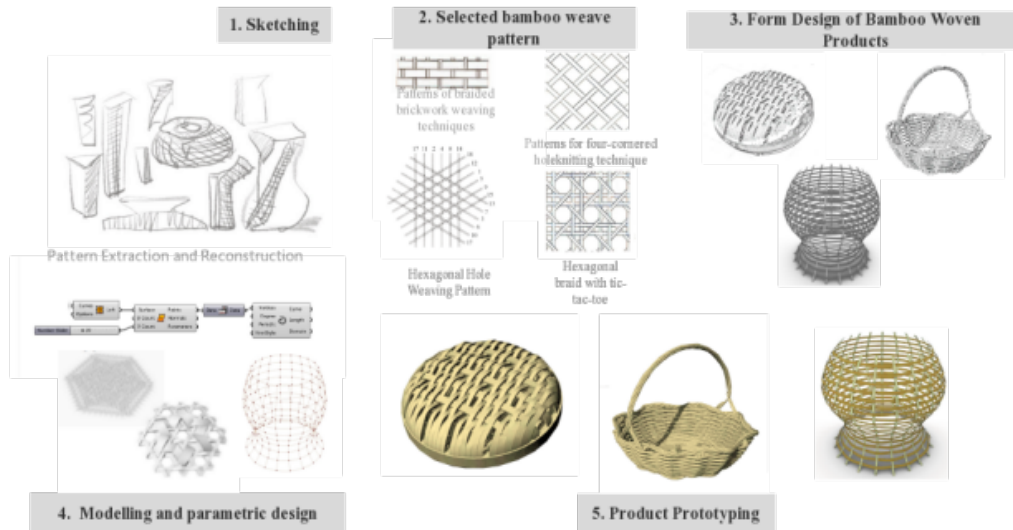


Figure 26 Innovative design of bamboo weaving products by using parametric design

Using abrasives to weave standardised bamboo products (see Figure 26) : By designing and making abrasives, the process of weaving bamboo products can be made more standardised and precise, ensuring consistency and quality stability. The use of abrasives can help weavers to complete their weaving tasks more quickly and accurately, while providing the feasibility of mass production of bamboo woven products.

5 CONCLUSIONS

The construction the innovative design model of Hunan bamboo weaving products seems helping a quadruple helix innovation target group. The model takes the design of bamboo woven cultural derivatives as its theme and constructs a design framework for bamboo woven cultural products by exploring methods such as cultural design symbols, cultural themes, cultural element composition method and construction element fusion construction method. In the model, the method of constructing the carrier of bamboo woven cultural products is mentioned, which includes elements such as the extraction of bamboo woven cultural design factors, the method of transforming design symbols of cultural design factors, the following and refinement of deep colours, the restoration and reshaping of characteristic forms and characters, the reproduction of materials, techniques, skills, structures and functions, and the visualisation of scenarios and moods (see Figure 27).

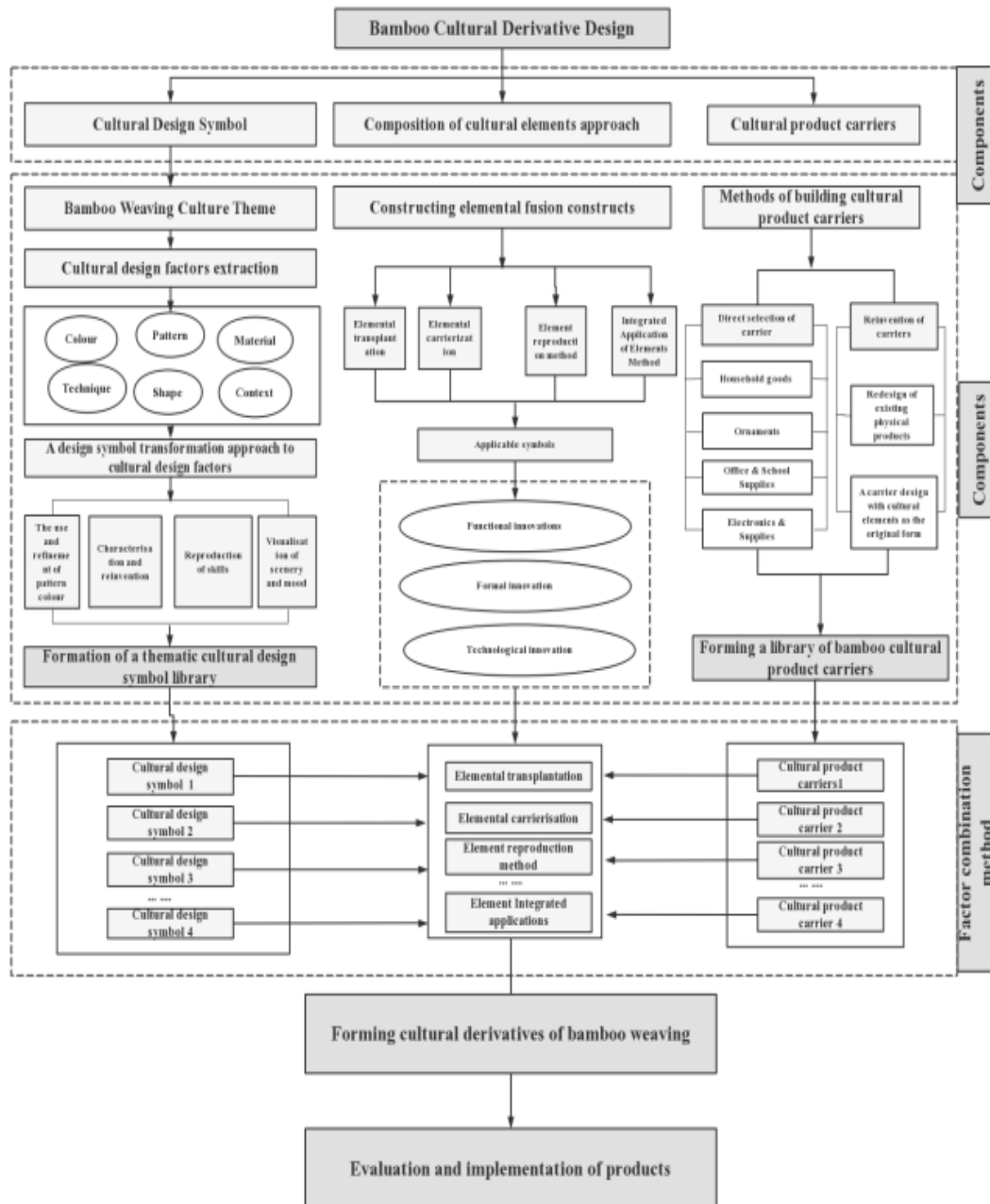


Figure 27 Thinking on the innovative design model of bamboo weaving products

The model also mentions the applicability of methods such as building a thematic cultural design symbol library and element transplantation, element vectorisation, element reproduction, and integrated application of elements. At the same time, the model explores the use of symbols, patterns, colours, forms and other elements in bamboo cultural products, and introduces methods for the design and reproduction of cultural product carriers, including household goods categories, accessories, office and school supplies, electronic products and supplies, etc. Finally, the model also mentions design methods for cultural derivatives, including the method of combining elements, redesigning existing material products, using cultural elements as prototype carriers and forming a bamboo woven cultural product carrier library.

The innovative design of Hunan's bamboo products requires a comprehensive consideration of cultural connotations, craft characteristics and practical application needs. By expanding the range of research subjects, conducting cross-sectional comparative studies, strengthening the integration of

practice and theory, and conducting subsequent research follow-up and validation, the innovation level of Hunan bamboo woven products can be further enhanced and their development and promotion in different application areas can be promoted. Compared to other regions, Hunan's bamboo weaving products are relatively poor in terms of product range and application areas, which is directly related to their geographical environment and craft characteristics, but this does not affect their excellent craft characteristics and cultural connotations.

Taken together, the model provides a systematic approach and ideas to help designers integrate cultural elements into bamboo product design and create unique and culturally rich works by analysing the various elements of innovative bamboo product design.

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CONFLICT OF INTEREST

There are no conflicts of interest.

REFERENCES

- Abidin, S. Z., Bjelland, H. V., & Øritsland, T. A. (2008). The embodied mind in relation to thinking about form development. DS 50: Proceedings of NordDesign 2008 Conference, Tallinn, Estonia, 21.-23.08. 2008, <https://doi.org/10.13140/2.1.3495.3283>
- Abidin, S. Z., Sigurjonsson, J., Liem, A., & Keitsch, M. (2008). On the role of formgiving in design. DS 46: Proceedings of E&PDE 2008, the 10th International Conference on Engineering and Product Design Education, Barcelona, Spain, 04.-05.09. 2008, <https://doi.org/10.13140/2.1.1922.4649>
- Beitz, W., Pahl, G., & Grote, K. (1996). Engineering design: a systematic approach. *Mrs Bulletin*, 71. <https://doi.org/10.1557/S0883769400035776>
- Bellagambi, F. G., Lomonaco, T., Salvo, P., Vivaldi, F., Hangouët, M., Ghimenti, S., Biagini, D., Di Francesco, F., Fuoco, R., & Errachid, A. (2020). Saliva sampling: Methods and devices. An overview. *TrAC Trends in Analytical Chemistry*, 124, 115781. <https://doi.org/10.1016/j.trac.2019.115781>
- Blessing, L. T., & Chakrabarti, A. (2009). *DRM: A design reseach methodology*. Springer. https://doi.org/10.1007/978-1-84882-587-1_2
- Blessing, L. T., Chakrabarti, A., & Wallace, K. (1998). An overview of descriptive studies in relation to a general design research methodology. *Designers: The key to successful product development*, 42-56. https://doi.org/10.1007/978-1-4471-1268-6_4
- Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory into practice*, 39(3), 124-130. https://doi.org/10.1207/s15430421tip3903_2
- Erdos, P. L., & Morgan, A. J. (1970). *Professional mail surveys*. McGraw-Hill New York. <https://doi.org/10.2307/2346638>
- Gergen, K. J., Josselson, R., & Freeman, M. (2015). The promises of qualitative inquiry. *American Psychologist*, 70(1), 1. <https://doi.org/10.1037/a0038597>

- Hall, A. (2007). Vygotsky goes online: Learning design from a socio-cultural perspective. *Learning and socio-cultural Theory: Exploring modern Vygotskian perspectives international workshop 2007*, 1(1), p. 6 Available at: <https://ro.uow.edu.au/llrg/vol1/iss1/6>
- Jacobsen, N. O., & Berg, A. (2021). A Tool for Promoting Intrinsic Motivation in Teams: A Case Study Of Participants' motivation During A Design Project. *DS 110: Proceedings of the 23rd International Conference on Engineering and Product Design Education (E&PDE 2021)*, VIA Design, VIA University in Herning, Denmark. 9th-10th September 2021, <https://doi.org/10.35199/EPDE.2021.69>.
- Leavy, P. (2022). *Research design: Quantitative, qualitative, mixed methods, arts-based, and community-based participatory research approaches*. Guilford Publications. <https://doi.org/10.1111/fcsr.12276>
- Li, W., Zainal Abidin, S., & Mokhtar, S. h. (2023). *Parametric technology is used for the design of weaving products* (Vol. 12599). SPIE. <https://doi.org/10.1117/12.2673477>
- Lias, H., Ismail, A. R., & Hamid, H. A. (2020). Malaysia Textile Craft Industry: Innovation Inspired by Bamboo for Batik Block Contemporary Design. *IOP Conference Series: Earth and Environmental Science*, 549(1). <https://doi.org/10.1088/1755-1315/549/1/012087>
- Liu, Y., Yuan, Y., & Li, S. (2023). Research status and prospect of architecture of bamboo. In *Advances in Civil Engineering: Structural Seismic Resistance, Monitoring and Detection* (pp. 516-522). CRC Press. <https://doi.org/10.3969/j.issn.1000-6567.2013.04.003>.
- Luo, B., Ahmed, S., & Long, C. (2020). Bamboos for weaving and relevant traditional knowledge in Sansui, Southwest China. *Journal of ethnobiology and ethnomedicine*, 16(1), 1-9. <https://doi.org/10.1186/s13002-020-00418-9>
- Mayan, M. J. (2016). *Essentials of qualitative inquiry*. Routledge. <https://doi.org/10.4324/9781315429250>
- Patton, M. Q. (2014). *Qualitative research & evaluation methods: Integrating theory and practice*. Sage publications. [https://doi.org/10.1016/S0260-6917\(03\)00079-0](https://doi.org/10.1016/S0260-6917(03)00079-0)
- Toyong, N. M. P., & Abidin, S. Z. (2021). Data Collection Instrument in Designerly Intuition Study. *Environment-Behaviour Proceedings Journal*, 6(SI5), 33-39. <https://doi.org/10.21834/ebpj.v6iSI5.2925>
- Yao, W., & Zhang, W. (2011). Research on manufacturing technology and application of natural bamboo fibre. 2011 Fourth international conference on intelligent computation technology and automation, <https://doi.org/10.1109/ICICTA.2011.327>.
- Yun, X., Abd Rahman, K. A. A., Mohd Ariffin, N. F. B., & Mohd Ali, N. A. B. (2022). Conceptual framework development of bamboo product designer and craftsman design capability management. *Cogent Engineering*, 9(1). <https://doi.org/10.1080/23311916.2022.2102470>
- Zainal Abidin, S., Anuar Bahari, S., Ibrahim, A., Mohd Ghazali, A. E., Azroll Ahmad, M., Shaleh Mujir, M., Bueno Delgado, M. V., Zbieć, M., Garrido, J., & Ortega, J. J. (2021). Analysing the Malaysian Higher Education training offer for furniture design and woodworking industry 4.0 as an input towards joint curriculum validation protocol. *Asia Pacific Journal of Educators and Education*, 36(1). <https://doi.org/10.21315/apjee2021.36.1.1>
- Zainal Abidin, S., Christoforidou, D., & Liem, A. (2009). Thinking and re-thinking verbal protocol analysis in design research. *DS 58-2: Proceedings of ICED 09, the 17th International Conference on Engineering Design*, Vol. 2, Design Theory and Research Methodology, Palo Alto, CA, USA, 24.-27.08. 2009, <https://doi.org/10.13140/2.1.2971.0404>
- Zhang, W., & Zhou, C. (2022). Research on the design of Chengdu porcelain Tire bamboo knitting products based on user requirements. *Forest products industry*, 59(10), 63-68. <https://doi.org/10.19531/j.issn1001-5299.202210013>
- Zhao, Z., Zhang, Y., He, H., Pan, L., Yu, D., Egun, I., Wan, J., Chen, W., & Fan, H. J. (2022). Bamboo Weaving Inspired Design of a Carbonaceous Electrode with Exceptionally High Volumetric Capacity. *Nano Letters*, 22(3), 954-962. <https://doi.org/10.1021/acs.nanolett.1c03765>
- Zheng, Y., & Zhu, J. (2021). The Application of Bamboo Weaving in Modern Furniture. *BioResources*, 16(3). <https://doi.org/10.15376/BIORES.16.3.5024-5035>