

SUSTAINABLE EVOLUTION OF NON-HERITAGE CRAFTS: CROSS-BORDER INTEGRATION OF LEIZHOU CATTAIL AND GREEN MATERIALS IN DESIGN PRACTICE

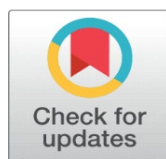
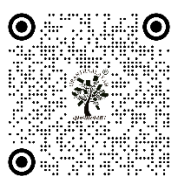
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Received 28 March 2026

Accepted 29 April 2026

Published 07 May 2026

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DOI

[10.29121/shodhkosh.v7.i1.2026.7860](https://doi.org/10.29121/shodhkosh.v7.i1.2026.7860)

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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ABSTRACT

This study focuses on the Leizhou cattail weaving technique under the perspective of green design and explores its sustainable transformation path and cultural and creative product practice in the contemporary context. Through the integration of traditional craftsmanship and environmentally friendly materials, the study responds to the needs of Generation Z users for products with functional, aesthetic and cultural values, and promotes the green transformation and living inheritance of intangible cultural heritage skills. Using a combination of literature review, questionnaire survey, field observation, material experimentation and design practice, the study systematically analyses the historical basis and ecological characteristics of cattail weaving and evaluates its potential for integration with a variety of green materials in terms of structure and visual expression. The design experiments were carried out using a creative notebook as a vehicle to construct a product proposal that integrates the aesthetics of craftsmanship and the concept of environmental protection. The results show that the composite application of cattail with reused materials such as bamboo fibre, recycled webbing and waste packaging materials performs well and has high application value. The study verifies the non-heritage design path based on user-orientation and material experimentation, and proposes a replicable green innovation model to provide theoretical support and practical reference for the contemporary expression and market transformation of non-heritage crafts.

Keywords: Leizhou Cattail Weaving, Intangible Cultural Heritage, Green Materials, Sustainable Design, Cultural and Creative Industries

1. INTRODUCTION

In the context of the deepening of the global sustainable development strategy, the concept of green design has been increasingly integrated into the cultural and creative industries and the preservation of intangible cultural heritage

[Ghazali et al. \(2023\)](#). As a traditional handicraft that combines ecological wisdom and craft aesthetics, Leizhou cattail weaving skill not only carries a deep regional cultural memory, but also has natural material characteristics such as renewable and non-polluting, which lays a good foundation for its green transformation [Thyavihalli et al. \(2019\)](#). However, in the face of the multiple demands of Generation Z consumers for functionality, aesthetics, and cultural values, the technique still faces multiple challenges in terms of material adaptation, design language, and market communication [Dragolea et al. \(2023\)](#).

In recent years, the extensive use of green materials in product design has provided a new path for the contemporary expression of traditional crafts. Researchers have been trying to combine green materials such as bamboo fibre, bio-based materials and recyclable materials with traditional handicrafts, exploring design methods that give equal weight to eco-friendliness and cultural expression [Li and Gao \(2024\)](#). Meanwhile, Generation Z, as the core group of current cultural consumption, has a strong sense of green consumption and cultural identity, and puts forward higher demands on the environmental attributes and cultural connotations of non-heritage products [Zheng et al. \(2023\)](#). In this context, there is an urgent need to construct a new paradigm for sustainable innovation of NRHs from the perspective of multi-dimensional linkage of 'craft-material-design-user' [Van Kesteren et al. \(2007\)](#).

This study takes Leizhou cattail weaving technique as an entry point, systematically investigates its historical origin, ecological characteristics and craft structure, and evaluates the suitability of various green materials (e.g., bamboo fibre, recycled webbing, discarded packaging materials, etc.) for weaving and carries out fusion design practice on the basis of literature analysis, user research and material experiments. The research aims to build a non-heritage design path that is centred on the application of green materials and guided by users' needs, to respond to the contemporary market demand for green cultural products, to promote the contemporary expression and industrial transformation of non-heritage crafts in the sustainable design system, and to provide theoretical support and practical basis for the green development and youthful dissemination of traditional handicrafts.

2. RESEARCH OBJECTIVES

This research aims to analyse the current situation and problems of the sustainable inheritance of Leizhou cattail weaving wisdom, to clarify the guiding ideology, and to design and develop innovative cattail weaving products by integrating the wisdom of traditional craftsmanship with green materials.

3. LITERATURE REVIEW

3.1. RESEARCH ON THE CULTURAL VALUE OF LEIZHOU CATTAIL WEAVING CRAFT

As an important intangible cultural heritage of Guangdong Province, Leizhou Cattail Weaving carries profound historical and regional cultural values. Through the combing of historical documents, local records, ethnographic data and research papers related to intangible heritage, it can be seen that cattail weaving embodies the unique ecological environment utilisation wisdom of the Leizhou region.

Literature shows that cattail weaving products in cattail mats, cattail clothing items, cattail furniture, cattail food packaging, cattail cultural creative products, etc., are mostly used in the design and development of rural life scenes, with their simple shapes and diverse patterns, and have a strong local style. In recent years, researchers have begun to systematically elaborate the craft from multiple perspectives, such as cultural identity, social value, and educational heritage. [Figure 1](#) shows the keyword co-occurrence network analysis diagram in China Knowledge Network (CNKI).

Figure 1

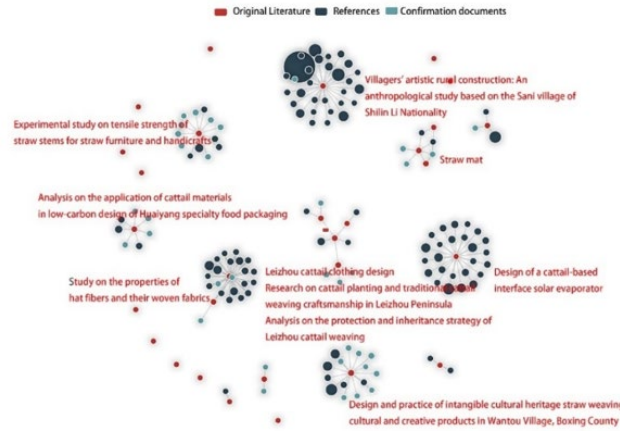


Figure 1 Keyword Co-Occurrence Network Analysis Diagram

Source: Author

3.2. CURRENT STATUS OF RESEARCH ON THE SUSTAINABLE AND INNOVATIVE DEVELOPMENT OF LEIZHOU CATTAIL WEAVING

With the continuous advancement of ecological civilisation and the concept of non-heritage living heritage, Leizhou cattail weaving is gradually transforming from traditional household utensils to cultural and creative products, tourism souvenirs, and eco-packaging. In the literature, researchers generally point out that cattail itself has ecological properties such as renewable, natural and non-polluting, which provides a natural material basis for its sustainable transformation [Tung \(2012\)](#). In recent years, some scholars have introduced the concepts of ‘green design’ and ‘circular economy’ into the development of NRL products [Geissdoerfer et al. \(2017\)](#), proposing the integration of cattail grass with modern green materials (e.g., PLA, recycled plastics, and natural dyes) to enhance the functionality of the products [Geissdoerfer et al. \(2017\)](#). to enhance product functionality and market competitiveness. In addition, some local universities and design organisations have also carried out the joint project of ‘Creative Design + Sustainable Design’ based on bushy grass, trying to integrate the traditional craft with modern visual language, functional structure, and environmental protection concepts, and to expand the application scenarios of bushy grass in modern life.

Existing research results mainly focus on the following aspects: (1) redesign of product function and aesthetic value; (2) introduction of ecological materials and processing improvement; (3) environmentally friendly packaging in the industrial chain; (4) construction of sustainable brand story and non-heritage culture dissemination path.

Generally speaking, the research on sustainable innovation of Leizhou cattail weaving is still in the exploratory stage, and lacks a systematic evaluation model and a mature green material integration path, so in the future, it is still necessary to study from multiple dimensions, such as ‘material science’, ‘design practice’, and ‘market feedback’. In the future, it is still necessary to carry out integrated research from ‘material science’, ‘design practice’, ‘market feedback’ and other dimensions.

In order to present a clearer picture of the development path of Leizhou cattail weaving under the framework of sustainable design, this paper constructs a logic model of cattail product innovation based on the existing research results, combining the core elements of traditional craftsmanship, application of green materials, product redesign, and market adaptation [Figure 2](#). Starting from traditional craftsmanship, the model promotes the reconstruction of product structure and aesthetics through the introduction of green materials, and ultimately faces the diversified application scenarios in the modern consumer market, providing a theoretical framework and path reference for future convergent innovation.

Figure 2



Figure 2 Model Diagram of Product Innovation of Bushels Under Perspective of Sustainable Design

Source: Author

3.3. OVERVIEW OF RESEARCH HOT SPOTS OF GREEN MATERIALS IN SUSTAINABLE PROCESS AND PRODUCT DESIGN

In recent years, the research of green materials in sustainable process and product design has gradually formed a diversified and integrated development trend. From the results of the keyword co-occurrence analysis of the literature in the Web of Science database in the past five years, it can be seen that the research mainly focuses on three hot directions, as shown in [Figure 3](#).

First of all, material type and ecological performance research is one of the core contents of the current research. Keywords such as 'green materials', "biodegradable", 'bio-based materials', 'natural fibers', 'bamboo fiber', etc. appear frequently, reflecting the fact that researchers pay special attention to the types of materials that are eco-adaptive, biodegradable and resource renewable [El-Sayed and Youssef \(2023\)](#) [El-Sayed and Youssef \(2023\)](#). For example, polylactic acid (PLA), biocomposites, and nanocellulose are widely used in biopackaging, construction, and textiles, which not only meet the requirements of degradability, but also have good mechanical properties and interfacial adaptability [Sayed et al. \(2024\)](#). Secondly, the design and reuse of sustainable materials has become an important direction of research. Keywords such as 'sustainable materials', 'recycled materials', "circular economy", 'recycled materials', 'circular economy', and 'renewable resources' appear frequently, indicating that research is no longer limited to the materials themselves, but focuses on their full life cycle management and systematic redesign [Jain et al. \(2024\)](#). Academics generally emphasise the regenerative capacity of green materials and their role in "closed-loop ecosystems", promoting a shift from a linear to a circular economy model for traditional processes [Guan et al. \(2021\)](#). Thirdly, the fusion of materials and traditional processes is also gaining attention. The words 'material innovation', 'eco-friendly', 'low carbon', 'green packaging', 'green packaging', and 'low carbon' appear in the word cloud, 'green packaging', 'sustainable design' and other keywords appear in the word cloud, showing that academics are trying to integrate green materials into the innovative design of traditional handicrafts, such as weaving, packaging, cultural and creative products and other fields ([Lavania et al. fields Lavania et al. \(2023\)](#)). This kind of research not only continues the cultural connotation of traditional crafts, but also meets the dual demands of modern consumers for environmental protection and aesthetics [Zhang et al. \(2022\)](#).

Figure 3**Figure 3** Hot Word Cloud of Green Materials Research

Source: Author

4. RESEARCH METHODOLOGY

Step 1: Traditional craft value excavation and literature analysis. Focusing on the historical origins, pattern characteristics and technical forms of Leizhou's cattail weaving, a systematic analysis was carried out by means of literature research, field observation, field visits and semi-structured interviews. The research covered four towns, namely Shentang, Taiping, Yangjia and Longmen, and summarised the feasible paths for the integration of craftsmanship differences and materials through regional product comparisons and expert interviews. The interview outlines were

tested for content validity (CVI=1.00), and the information obtained was coded thematically to provide a theoretical basis for subsequent research.

Step 2: Quantitative research on green consumption behaviour of Generation Z. A structured questionnaire was designed for the Generation Z group aged 18-30 in Guangzhou, covering five modules: demographic characteristics, environmental attitudes, product preferences, price sensitivity and consumption intentions. The questionnaire was reviewed by experts and pre-tested, and 527 valid questionnaires were collected with good reliability and validity (Cronbach's $\alpha=0.978$; KMO=0.972; Bartlett $p<0.001$). A combination of online random sampling and offline supplementation was used to analyse the driving mechanisms and constraints of Generation Z's green consumption behaviour.

Step 3: Green material screening and knitting suitability experiment. Based on the theory of green design, material experience and life cycle assessment (LCA), an assessment system covering environmental protection, processing suitability, aesthetic performance and structural stability was constructed, and after screening more than ten types of materials, five types of representative green materials were selected to carry out standardised knitting experiments. The experiments used both straight and twill techniques, unified material specifications and operating procedures, and comprehensively evaluated aesthetics, functionality and suitability through the Likert scale and subjective feedback to systematically analyse the feasibility of each material combination.

Step 4: Product design conception and preliminary verification. Combined with user feedback and experimental results, we carry out the exploration of cultural and creative product design, selecting the notebook as the design carrier, and integrating the cattail weaving and green materials for the structure and pattern design. The design process is based on the material performance test, combining the traditional craft language and modern aesthetic needs, through the effect diagram to show the application of different material combinations, preliminary verification of its visual performance, functionality and cultural suitability of the integration potential, to provide a basis for the subsequent development of product design.

5. RESEARCH RESULTS

5.1. MINING THE VALUE OF TRADITIONAL LEIZHOU CATTAIL CRAFT AND LITERATURE ANALYSIS

5.1.1. LITERATURE RESEARCH: CULTURAL VALUE OF CATTAIL WEAVING AND RESEARCH STATUS OF GREEN MATERIALS





As a provincial intangible cultural heritage of Guangdong, Leizhou cattail weaving contains deep historical and regional cultural values, and is widely used in the fields of mats, clothing, furniture and packaging, with distinctive local styles and practicality in life. In recent years, academics have systematically explored its cultural identity, educational heritage and social functions. Meanwhile, the research on green materials in sustainable design continues to increase, mainly focusing on the ecological performance of materials, biodegradable and recycling mechanisms, as well as the integration and innovation of green materials and traditional craftsmanshi. The research constructs an innovation model based on the synergistic development of traditional weaving techniques and green materials, proposes to promote the reconstruction of product structure and aesthetics with ecological materials, and provides a theoretical basis and practical path for the transformation of traditional crafts into modern cultural and creative products.

5.1.2. SAMPLE OBSERVATION: PRODUCT EVOLUTION AND MARKET ADAPTATION ANALYSIS

Four representative areas, namely Shentang Town, Taiping Town, Yangjia Town and Longmen Town, are selected to analyse the evolution characteristics and adaptation paths of bushel grass weaving products in terms of design styles, material combinations, functional positioning and consumer groups under different market orientations through on-site observation and field visits. According to the observation results, the products in different regions show multiple trends in style expression, such as geometric simplicity, totem anthropomorphism, modern splicing and exquisite portability; the material has expanded from single bushel to composite materials such as metal, leather, colourful thread and cloth; and the consumer group has extended from local tourists to urban white-collar workers and overseas buyers, which has demonstrated a stronger ability to stratify the market. However, there are still problems such as the convergence of

design languages and the shallow expression of cultural connotations, and the overall innovativeness and recognition of the products in many places need to be improved [Table 1](#).

Table 1

Table 1 Summary and Analysis of Observational Data				
Dimension	Shentang Town: Huapu Lighting	Yangjia Town: Zurong Handcraft Workshop	Taiping Town: Craft Stalls/Workshops	Longmen Town: Gucheng Scenic Area Handcraft Spot
Product Style				
Design Style	Geometric layering, minimalist style	Patchwork and diverse, modern eclectic	Totemic imitation, cultural symbolism	Delicate and portable, practical
Materials	Cattail + metal	Cattail + leather + tassels/fabric	Pure cattail	Cattail + colored threads + beads
Consumer Group	Overseas design buyers, high-end consumers	Urban youth with unique style, white-collar workers	Local residents and tourists	Cultural enthusiasts, tourism consumers
Innovation Value	Strong design sense, integration of modern decorative aesthetics	Fusion of traditional and trendy elements, novel cultural tone	Prominent regional culture, strong symbolism	Combination of local cultural symbols and delicate craftsmanship

Source: Author

At the same time, through the process observation of the production sites of traditional workshops and new studios, we systematically compare the technical path and efficiency performance of each link of ‘raw material - design - weaving - shaping - packaging’. The results show that the traditional units are purely handmade. The results show that the traditional workshops continue their empirical skills by hand, which is flexible but less standardised, while the emerging workshops have introduced dehumidifying equipment, fixed frames and composite materials to improve operational efficiency and consistency of the finished product. In terms of design mechanism and market response, some of the new teams have established a modular and serialised product system, and combined with e-commerce, customisation and cultural tourism channels to form a positive feedback, reflecting the initial trend of transition from ‘experience-driven’ to ‘structural optimisation’ [Table 2](#). On the whole, the Leizhou bushy grass weaving products have taken shape in terms of material expansion, style extension and market expansion, and are moving from traditional skills to a new stage of modern design and technology integration.

Table 2

Table 2 Summary and Analysis of Observational Data		
Stage	Traditional Workshops	Emerging Design Studios
Weaving Method	Fully handcrafted	Handcrafted + semi-automated
Material Use	Single cattail	Cattail + diverse materials
Design Style	Traditional patterns	Modular + trendy symbols
Production Efficiency	Long cycle, low standard	Optimized process, improved efficiency

Source: Author

5.1.3. SEMI-STRUCTURED INTERVIEWS: EXPERT INSIGHTS ON THE INTEGRATION OF CRAFTSMANSHIP AND GREEN MATERIALS

In order to explore in depth the practical basis and development path of the integration of Leizhou cattail weaving and green materials, this study conducted semi-structured interviews with six experts (designers, non-genetic

inheritors, researchers and governmental stakeholders), focusing on the topics of material application, design innovation, market status and policy support. The interview outlines were evaluated by CVI, and the scores of each dimension were 1.00, with good content validity. The results show that green materials have not yet been systematically applied to the practice of bushy weaving, which is mainly limited by material suitability, appearance coordination and difficulty of access. Although some designers try to introduce foreign materials to enrich product performance, the application of green materials is still in the preliminary exploration stage. In terms of design innovation, it is difficult to balance aesthetics and functionality, and product forms tend to be the same. At the policy level, the existing support focuses on the protection of non-heritage and lacks specific guidance on green integration. At the same time, experts generally believe that the integration mechanism of 'green materials - traditional crafts - modern design' should be constructed, and school-enterprise co-operation, platform construction and practical projects such as 'non-heritage in school' should be promoted to form a sustainable development path. In the meantime, experts generally agreed that a mechanism for the integration of 'green materials, traditional crafts and modern design' should be established, and school-enterprise co-operation, platform construction and practical projects such as 'non-heritage in school' should be promoted.

Table 3

Table 3 Thematic Summary of Expert Interviews		
Primary Theme	Secondary Theme (Code Label)	Summary Viewpoints
Craft Status	Craft inheritance	Weaving mainly practiced by older generations; youth lack motivation to inherit.
	Market situation	Market leans toward cultural and tourism products; serious product homogenization.
Design Innovation	Design integration	Attempts to combine traditional craft with new materials; green material use still limited.
	Eco design barriers	Challenges in applying eco-materials in terms of adaptability and aesthetics.
Material Selection	Material selection criteria	Selection focuses on touch and elasticity; based on traditional experience.
	Material practice	Eco-materials mostly in trial phase, limited by cost and access.
Government Support	Gov policy awareness	Current policy emphasizes heritage protection; lacks clear support for green integration.
	Gov policy demand	Suggestions include promoting 'heritage in schools' and 'green workshops'.
Future Development	Future innovation path	New products should integrate aesthetics and functionality to attract younger markets.
	Eco material potential	Biodegradable fibers and other green materials show potential for cattail integration.

Source: Author

5.2. CONSUMER RESEARCH AND EMPIRICAL STUDY IMPLEMENTATION OF GRASS WEAVING PRODUCTS FOR GENERATION Z IN GUANGZHOU CITY

5.2.1. QUESTIONNAIRE DESIGN AND DATA RELIABILITY

In order to gain an in-depth understanding of the knowledge, attitude and purchasing behaviour of Guangzhou's Generation Z consumers towards woven grass products, so as to provide an empirical basis for the design and marketing of green woven grass products, this questionnaire survey, with young people between the ages of 18 and 30 years old in Guangzhou as the main target, covers four major parts: (1) demographic characteristics; (2) attitudes towards environmentally friendly consumption; (3) knowledge and satisfaction of woven grass products; (4) Price acceptance and consumption willingness. The questionnaire adopts a 5-point Likert scale and matrix multiple choice questions to ensure quantitative expression and multi-dimensional coverage of the data. A total of 527 valid samples were obtained through random sampling of online questionnaires, covering various universities in Guangzhou and the social youth population. In terms of sample structure, the proportion of respondents aged 18-22 reached 72.87%, women accounted for 54.27%, the student group was dominant, accounting for 74.38%, and 66.03% of the respondents had a monthly income of less than 2,000 yuan, which made the samples highly compatible with the portrait of Generation Z's green consumption and research on the needy population. In order to verify the measurement quality of the questionnaire, this study carried out reliability and validity tests on the data. the Cronbach's alpha coefficient was 0.978, indicating that the

questionnaire has a very high internal consistency; the KMO value was 0.972, and the result of the Bartlett's spherical test was significant ($p < 0.001$), so the structural validity was good, and the data were suitable for factor analysis, which met the reliability standard of academic research. The data is suitable for factor analysis and meets the reliability standard of academic research.

Table 4

Table 4 Reliability and Validity Analysis		
Indicator	Value	Judgment Standard
Sample Size	528	>200 considered good
Number of Items	51	>30 is favorable for factor analysis
Cronbach's α	0.978	>0.9 Excellent, >0.8 Good
KMO Value	0.972	>0.9 Excellent
Bartlett's Test p-value	0.000 (Significant)	<0.05 Significant

Source: Author

5.2.2. RESEARCH RESULTS AND ANALYSIS

The research shows that Generation Z consumers generally have strong environmental awareness, 73.24% agree that environmentally friendly products have a positive effect on the environment, and 59.58% believe that environmental consumption is a personal responsibility. 40.04% pay attention to the environmental attributes of the products on their own initiative, and 41.94% are willing to adjust their consumption methods, but only 38.33% are willing to pay a higher price, which reflects a contradiction between environmental protection concepts and price sensitivity. This reflects the contradiction between the recognition of environmental protection concept and price sensitivity.

In terms of product awareness, consumers are concerned about 'material durability' (77.22%), 'multi-functionality' (75.52%) and 'fashionable design' (69.64%), and 72% are concerned about 'environmental protection'. 69.64%), and 72.1% recognised the product's 'expression of cultural innovation', while 41.37% were concerned about the 'traceability of carbon footprint'. In the scale, 'material durability' (4.05 points) and "multifunctionality" (4.03 points) are the top scores, and 'cultural innovation' is 3.93 points. In terms of satisfaction, 'aesthetics' (3.82) and "practicality" (3.83) were rated highly, while 'cost-effectiveness' was slightly lower, suggesting that pricing needs to be optimised.

Consumers have high expectations for 'modern aesthetic design' (70.02%) and 'material durability' (70.58%), while "functionality" (68.88%) and 'functionality' (68.88%) have high expectations. 68.88%) and 'integration of non-heritage culture' (67.93%). In the actual experience, the scores of 'colour richness' (3.67), 'functional diversity' (3.74) and 'environmental certification mark' (3.79) are low, indicating that the design details and green transparency still need to be improved. This indicates that design details and green transparency need to be improved.

In terms of price perception, 45.83% think the price and value 'generally match', 21.02% think 'do not match', 50.38% can accept 5-10% green premium, 33.71% clearly do not accept. 81.63% preferred 'green premium', 81.63% preferred 'green premium', 81.63% preferred 'green premium', 81.63% preferred 'green premium'. 81.63% prefer products under 100 RMB, showing that they are price sensitive and value for money. Information channels are mainly social media (53.41%), e-commerce platforms (45.26%) and brick-and-mortar shops (39.4%), but online trust is on the low side, with only 41.1% believing that the content of the social media is credible, and that brick-and-mortar experiences and recommendations from friends and family are more trusted.

In terms of behavioural willingness, 47.16% have a neutral attitude towards future purchases, 39.02% have a clear willingness to buy, and 47.15% are willing to recommend the product, which is higher than the willingness to buy, reflecting the potential of word-of-mouth communication. 51.51% accept the green premium, and nearly half of them approve of the existing purchasing channels, which lays the foundation of the green transformation of straw products.

Table 5

Table 5 Gen Z Consumers' Attention, Satisfaction, and Improvement Needs on Eco-Friendly Cattail Products		
Category	Indicator	Average Score

Product Attention	Material durability	4.05
	Multifunctional usability	4.03
	Fashionable design	3.87
	Cultural innovation	3.93
	Carbon footprint traceability	3.80
Satisfaction	Aesthetic appeal	3.82
	Practicality	3.83
	Cost performance	3.77
	Material texture	3.80
	Creative expression	3.82
Improvement Needs	Modern aesthetic design	3.89
	Material durability	3.91
	Functional diversity	3.87
	Integration of intangible heritage	3.89
Actual Performance	Color richness	3.67
	Functional diversity	3.74
	Eco-label certification	3.79

Source: Author

Generation Z has a high recognition of the green value and cultural connotation of grass weaving products, possesses strong information sensitivity and aesthetic appeal, and is the potential main force to promote the modernisation of non-heritage crafts. Its consumption attitude is rational and attaches importance to the balance of function, design and cost-effectiveness. Currently, there is still room for improvement in the functional performance, design creativity, green transparency and communication strategy of grass weaving products. In the future, green disclosure and cultural innovation should be strengthened, and online and offline channels should be integrated to promote the sustainable development of traditional crafts in the consumption context of Generation Z.

5.3. EXPERIMENTAL STUDY ON INTEGRATION OF ECO-FRIENDLY MATERIALS AND DANDELION WEAVING





5.3.1. SCREENING OF DANDELION AND GREEN MATERIALS

This study introduces the theories of green design, material experience and life cycle assessment (LCA) at the sample selection stage as the theoretical basis for the screening and assessment of environmentally friendly materials. Among them, the green design theory focuses on the environmental friendliness and cultural continuity of the whole life cycle of the product; the material experience theory emphasises the comprehensive perception of the material at the level of tactile sensation, aesthetics and cultural significance; and the LCA method evaluates the environmental impact of the material from the perspective of ecological load. Under this framework, we initially screened out the types of materials that are compatible with cattail weaving, including plant fibres, natural materials, recycled materials, synthetic biomaterials and recycled waste materials. After combining green attributes, processing suitability and visual harmony, five types of materials were selected for the experiment: bamboo fibre, waste webbing, straws, waste plastic woven bags and packaging nets. Bamboo fibre is delicate and strong, and matches the colour tone and weaving performance of cattail; waste webbing is colourful and flexible, which is conducive to enhancing the visual performance; straws are lightweight and waterproof, which is suitable for three-dimensional composition design; and used woven bags and packaging nets are tear-resistant and structurally stable, which helps to enhance the durability of the products. Other alternative materials such as straw fibre, corn husk, recycled paper fibre and biodegradable plastics were not included in the experiment due to their lack of strength or poor processing suitability.

5.3.2. FABRICATION PROCESS OF THE WEAVING EXPERIMENT

The experiment was divided into four stages: stage 1, material and tool preparation. Dry treated bushes were selected as the base, combined with bamboo fibres, discarded webbing, straws, used plastic woven bags and discarded packaging nets, and all materials were processed according to uniform standards for size and hardness. Auxiliary tools include scissors, white paper and textured paper for material positioning and fixing. The second stage, warp arrangement and fixing. The bushes were arranged on the white paper according to the preset pattern, and the two ends were fixed with textured paper to form a stable warp thread structure. The number and spacing of warp threads are set according to specifications to ensure sample consistency. In the third stage, weft weaving operation. Adopting the interlaced weaving method of straight and twill, all kinds of environmental protection materials were interspersed between the warp threads of the bushes, and their suitability for weaving was tested one by one. During the process, the focus is to observe the coordination of tension, smoothness of operation, and material breakage or entanglement. Stage 4: Weaving completion and surface adjustment. The structure of the sample is trimmed to ensure a smooth and tight surface, optimising the visual and tactile effects. The specific process and corresponding steps are detailed in [Table 6](#).

Table 6

Table 6 Weaving Experiment: Process and Illustration Mapping			
Stage No.	Stage Name	Operation Description	Illustration No.
1	Material Preparation	Prepare cattail, eco-friendly materials, scissors, masking tape, paper, etc.; standardize material size	
2	Warp Setup	Arrange cattail according to the pattern and fix with masking tape into warp structure	
3	Weft Weaving	Insert eco-materials into the warp using traditional techniques to test adaptability	
4	Product Adjustment	Trim and adjust the structure to enhance flatness and tactile quality	

Source: Author

5.3.3. SAMPLES OF WEAVING EXPERIMENT RESULTS

In order to systematically evaluate the integration effect of the five types of green materials and the cattail weaving process, the experiment was carried out under uniform conditions to produce samples (20cm × 20cm), using both straight and twill techniques, with all combinations based on natural cattail, and at least two samples were produced for

each group of materials. The various materials show different characteristics in terms of structural stability, visual performance and process suitability. The bamboo fibre has a firm structure and good texture; the waste webbing is colourful and decorative; the straws show a strong sense of line and creativity; the plastic woven bag is stable and durable with industrial aesthetics; and the packaging mesh shows a transparent and decorative effect, which is suitable for light structural applications, and the samples of the weaving results are shown in [Table 7](#).

Table 7

Table 7 Weaving Outcomes: Material Samples				
No.	Eco-friendly Material Used	Weaving Method	Fabric Effect	Visual Outcome
1	Bamboo fiber + cattail	Plain + twill	Tight structure, natural sheen, enhanced texture	
2	Discarded ribbon + cattail	Plain	Colorful, flexible, decorative	
3	Straws + bamboo fiber + cattail	Plain	Innovative form, strong lines, showcases reuse potential	
4	Recycled plastic woven bag + cattail	Twill	Sturdy, lightweight, presents an eco-industrial aesthetic	
5	Discarded mesh wrap + cattail	Plain	Light and translucent, suitable for lighting and storage structures	

Source: Author

5.3.4. COMPREHENSIVE EVALUATION OF SAMPLE WEAVING EXPERIMENT RESULTS

The evaluation system covers the dimensions of aesthetics, function, durability, cost and fit, and combines the Likert five-point scale with subjective feedback for quantitative and qualitative analysis. The evaluation indicators include visual aesthetics, colour integration, texture performance, functional support, physical durability and cost. To ensure that the results are objective and reliable, 5 to 10 design students and teachers were invited to participate in the scoring. The results show that bamboo fibre is outstanding in terms of aesthetics and structural stability, with high overall

suitability; waste plastic woven bags have excellent stability and high overall scores; and waste packaging nets have relatively low scores in terms of structure and aesthetics. The evaluation results of each material are detailed in [Table 8](#).

Table 8

Table 8 Designer/Student Evaluation Results (5-Point Likert Scale)					
Material No.	Eco-friendly Material	Avg. Aesthetic Score	Avg. Structural Stability	Avg. Adaptability	Overall Evaluation (Mean)
1	Bamboo fiber	4.8	4.6	4.4	4.6
2	Discarded ribbon	4.3	3.2	3.5	3.7
3	Straw	3.5	3	3.4	3.3
4	Recycled plastic woven bag	4.4	4.2	4.3	4.3
5	Discarded mesh wrap	3.2	3	3.3	3.2

Source: Author

Based on the scoring results and user feedback, there is a clear difference in the weaving performance of the five categories of green materials. Bamboo fibre is excellent in aesthetics and functionality, with natural luster and delicate texture, strong structural stability, good dyeing performance, and is suitable for high-strength product design, but it is costly and hard. Waste webbing is colourful, decorative and comfortable to hold, suitable for visual expressive design; however, the splicing stability is insufficient and it is not suitable for load-bearing structures. Straws have unique forms and creative potential, but their fit and ease of processing are weak, so they should be used in conjunction with structural materials. Waste plastic woven bags are lightweight, strong and colourful, with good structural stability, suitable for large-area applications, and have good practicality and visual performance, although their environmental attributes are slightly lower. Waste packaging nets have strong permeability and light texture, with certain decorative effects, but limited support and durability, suitable for use as auxiliary materials. Overall, bamboo fibre and plastic woven bags are suitable for structural products, webbing and straws are suitable for creative design direction, and packaging nets can be used as visual supplementary materials. The experimental results provide empirical support for the material selection and process optimisation of green woven straw products.

5.4. PRODUCTISATION ATTEMPTS FOR INTEGRATION OF NON-HERITAGE CRAFTS AND GREEN MATERIALS

Based on the previous comprehensive research results of questionnaire survey, field observation and material experiments, the design practice focuses on the functionality, aesthetics and cultural expression needs of Generation Z for environmentally friendly grass weaving products. According to the results of the research, the target group is generally concerned about the sustainability of the material and aesthetic expression, and attaches importance to the integration of traditional craftsmanship and modern design, which provides a clear direction for product development.

The design of the notebook is based on an environmentally friendly composite material made of coffee grounds and a plant-based binder, which has a good texture and natural properties. The hollowed out area is embedded with a composite weaving material of bamboo fibre and cattail, a combination that shows good structural and visual adaptability in the experiment, reflecting the organic fusion of traditional techniques and modern materials. The binding adopts a replaceable core and wire binding process, enhancing the cycle of use and the possibility of personalisation. The overall design is synergistic in structure, material and cultural expression, which initially verifies the feasible path of integrating non-heritage crafts and green materials, and provides a practical basis for the contemporary expression and market transformation of related products, as shown in [Figure 4](#).

Figure 4

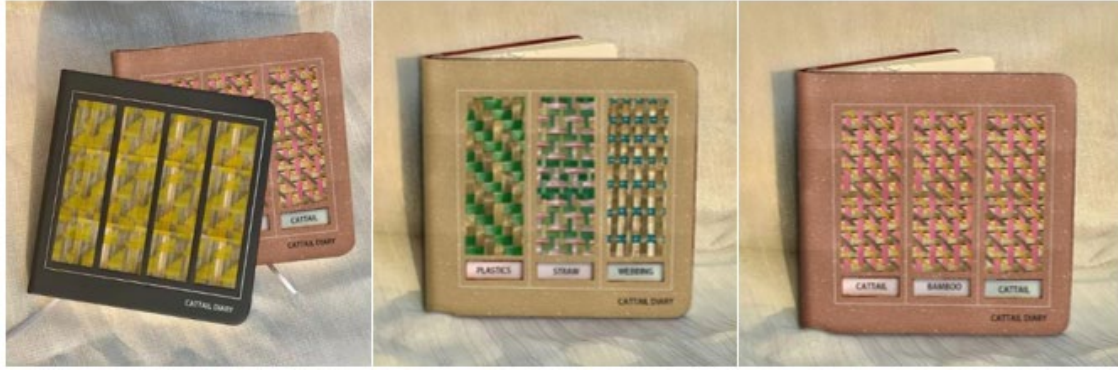


Figure 4 Eco-Friendly Notebook Design

Source: Author

On this basis, a matching bookmark is further designed. The outer layer is made of environmentally friendly coffee grounds recycled paper, which has a natural texture and good environmental attributes; the inner layer is embedded with a pattern woven by combining cattail and recycled materials, which continues the design logic of 'non-heritage crafts + green materials' in the laptop products. The bookmark realises the lightweight transformation of traditional craftsmanship in form and function, and enhances the overall consistency and cultural recognition of the product series, as shown in [Figure 5](#).

Figure 5

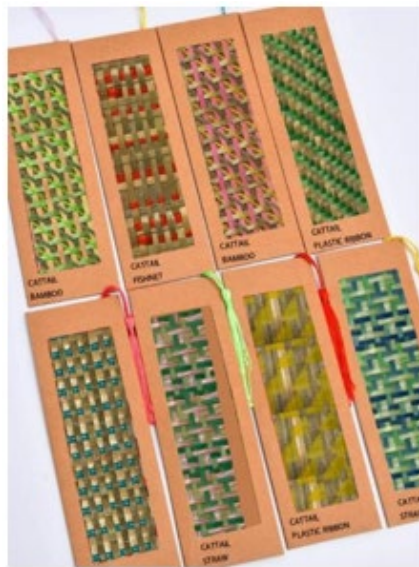


Figure 5 Eco-Friendly Bookmark Design

Source: Author

In addition, exclusive environmental labels are designed for the series of products, labelling the ecological characteristics of the cattail material and the background of Leizhou's non-heritage, emphasising the value of the products in green transformation and cultural heritage, and aiming to direct consumers' attention to the contemporary expression of the concept of sustainable design and traditional craftsmanship, as shown in [Figure 6](#).

Figure 6**Figure 6** Eco-Label Design

Source: Author

6. CONCLUSIONS AND DISCUSSION

This study focuses on the green transformation and innovative application of Leizhou bushy grass weaving, and systematically explores the integration path between non-heritage crafts and sustainable materials. Through literature analysis, questionnaire research, material experiments and product design practice, the study responds to the design demands of contemporary consumers, especially Generation Z, for greenness, functionality, aesthetics and cultural values, and explores the contemporary expression of traditional crafts in a green context. The study draws the following main conclusions:

- 1) This study identifies the multi-dimensional demands of Generation Z consumers for material environmental friendliness, aesthetic expression and cultural identity in the consumption of cultural and creative products, and emphasises that non-heritage products should achieve green transformation and cultural regeneration in the context of the new era.
- 2) The experimental results show that, as a traditional natural material, cattail has good ecological performance and visual characteristics, especially when used in combination with green materials such as bamboo fibre, it can improve the structural stability and aesthetic value, showing good potential for application.
- 3) The design practice takes the notebook as a carrier, and constructs a product programme integrating traditional craftsmanship, green materials and modern design language, effectively balancing practicality and cultural expression, and verifying the feasibility of the design path based on user research and material experimentation guidance.
- 4) This research constructs a replicable green innovation design paradigm for non-heritage crafts, emphasising user demand as the guide, material experiment as the support, and cultural inheritance as the kernel, which provides the practical basis and theoretical support for the contemporary expression and market transformation of the non-heritage craft of straw weaving.

ACKNOWLEDGMENT

Researcher would like to express her sincere to the thesis advisor, Asst. Prof. Dr. Chanoknart Mayusoh for her invaluable help and constant encouragement throughout the course of this research. In addition, the researcher has to give thanks to all lecturers for their assistance: Asst. Prof. Dr. Akapong Inkuer and Asst. Prof. Dr. Pisit Puntien. At the same time, the researcher gratefully thanks to Miss Sasanant Rattanapornpisit, Mr. Chat Sukarin, Miss Vistha Chintaladdha, Miss Kanyanee Phangsua, etc. for their strong support.

Finally, the researcher would like to express her gratitude to Suan Sunandha Rajabhat University School of Fine and Applied Arts for their support in all aspects.

CONFLICT OF INTERESTS

None.

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