

Enhancing The Preservation and Dissemination of Guangxi Zhuang Brocade Patterns through Digital Virtual Exhibition Halls

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ABSTRACT

This study explores the preservation and dissemination of Guangxi Zhuang brocade patterns through digital virtual exhibition halls. Using semi-structured interviews with cultural communicators, designers, artisans, and collectors, the research investigates the cultural significance, traditional practices, challenges, and opportunities associated with Zhuang brocade. Findings reveal that brocade patterns are central to Zhuang identity and heritage, yet face threats from declining apprenticeships, limited economic incentives, and modernization pressures. Digital virtual exhibition halls provide innovative solutions for preservation, education, and audience engagement, though concerns remain regarding authenticity and materiality. The study highlights the importance of participatory approaches, stakeholder collaboration, and the integration of traditional knowledge with contemporary digital technologies to ensure sustainable cultural transmission. These insights contribute to theoretical understanding and practical strategies for safeguarding minority textile heritage in the digital era.

Keywords: Zhuang brocade, digital virtual exhibition, intangible cultural heritage, preservation

INTRODUCTION

Guangxi Zhuang brocade, known as Zhuangjin, represents one of the most celebrated textile traditions of China's ethnic minorities (Tian & Sikka, 2024a, 2024b). As an important intangible cultural heritage, it embodies not only exquisite weaving techniques but also profound symbolic meanings embedded in its patterns. The motifs of Zhuang brocade record the history, cosmology, rituals, and daily life of the Zhuang people (Luo & Wechkama, 2024). They also stand as markers of cultural identity and community belonging. However, despite its historical and cultural value, Zhuang brocade is confronted with pressing challenges in preservation and dissemination. With modernization, industrial production, and changes in lifestyle, the traditional modes of weaving and transmitting Zhuang motifs have gradually declined (Tian & Sikka, 2024b). Fewer young people are learning the craft, market demand is unstable, and public recognition remains limited. In this context, exploring new pathways for the safeguarding and revitalization of Zhuang brocade has become both an academic and practical necessity.

The rise of digital technologies has introduced fresh opportunities to reimagine the protection and communication of intangible cultural heritage (Hou et al., 2022). Among these technologies, digital virtual exhibition halls have emerged as a promising avenue (Tsatsanashvili, 2024). Unlike traditional museums or physical exhibitions, virtual exhibition platforms transcend geographical and temporal boundaries. They allow audiences to interact with heritage artifacts through immersive visualization, multidimensional interpretation, and participatory experiences. For Zhuang brocade, the adoption of digital exhibition methods is not merely a technical shift but a cultural innovation that reshapes how patterns are preserved, experienced, and transmitted. Virtual spaces provide an environment where archived textile patterns can be stored, contextualized, and re-presented to diverse audiences worldwide (Siliutina et al., 2024). They also create channels for engaging younger generations, who are more accustomed to digital consumption and interactive learning. Thus, the study of Zhuang brocade in the perspective of virtual exhibition halls offers a timely response to the dual challenge of safeguarding heritage and enhancing its cultural vitality.

Despite these opportunities, the integration of Zhuang brocade into digital exhibition spaces raises several unresolved issues. One pressing concern lies in how to ensure the authenticity and integrity of patterns once they are digitized. The process of digital reproduction risks detaching the motifs from their original cultural environment, thereby reducing them to mere decorative visuals. Another concern involves the audience's reception: will virtual presentations truly cultivate cultural appreciation, or will they transform brocade into a superficial spectacle? Moreover, the technical design of virtual exhibitions requires interdisciplinary collaboration between cultural practitioners, designers, and digital technologists, which has not been systematically examined in existing studies (Beale et al., 2022). Without addressing these issues, the digital transformation of Zhuang brocade could risk being either ineffective or counterproductive (Kamariotou et al., 2021; Murwonugroho et al., 2024). Hence, it is crucial to examine the cultural, technical, and communicative dimensions involved in using digital virtual exhibition halls for the preservation and dissemination of Zhuang motifs.

The objective of this research is to investigate how digital virtual exhibition halls can be employed as effective platforms for the protection and dissemination of Guangxi Zhuang brocade patterns. Specifically, the study aims to explore the ways in which these virtual spaces can contribute to safeguarding the intangible knowledge embedded in weaving traditions, while simultaneously enhancing the accessibility and attractiveness of brocade culture to broader audiences. To achieve this, the research adopts a qualitative methodology based on semi-structured interviews with four groups of stakeholders: cultural communicators of Zhuang brocade, designers involved in integrating Zhuang motifs into creative industries, inheritors of traditional weaving skills, and collectors who conserve brocade artifacts. By engaging with these diverse voices, the study seeks to capture a holistic understanding of how virtual exhibition technologies interact with cultural practices and expectations.

The significance of this study extends across several dimensions. From a theoretical perspective, it contributes to the expanding literature on digital heritage and the role of virtual technologies in cultural preservation. While many studies have examined museum digitization or general intangible heritage protection, few have focused specifically on ethnic textile traditions such as Zhuang brocade. This research, therefore, fills a gap by situating brocade motifs within the emerging framework of digital exhibition design and by analyzing their communicative and cultural functions in virtual environments. From a practical perspective, the study offers actionable insights into how cultural institutions, local governments, and creative industries can collaborate to design effective virtual exhibition halls. Such collaboration could generate sustainable strategies for both safeguarding the heritage and promoting cultural industries related to Zhuang brocade. Another important contribution lies in providing a platform for stakeholders' voices. Too often, digital heritage projects are led primarily by technologists or institutions, with limited participation from cultural practitioners. By foregrounding the perspectives of brocade inheritors, designers, communicators, and collectors, this study emphasizes the need for participatory and culturally sensitive approaches. It highlights the ways in which different stakeholders envision the role of virtual exhibitions, ranging from educational functions to commercial applications, from community identity reinforcement to global cultural exchange. These insights can guide future projects in balancing technological innovation with cultural authenticity.

Moreover, the study addresses a broader societal concern: the intergenerational transmission of intangible heritage. In the case of Zhuang brocade, younger generations have increasingly turned away from learning the traditional craft due to limited economic prospects and the lure of urban employment. Virtual exhibition halls can act as bridges, making brocade culture accessible in formats that resonate with digital natives. Through gamification, interactive storytelling, and immersive visualization, virtual exhibitions can create experiences that not only preserve historical motifs but also inspire curiosity, emotional resonance, and cultural pride among youth. This potential for intergenerational connection underscores the practical importance of the research. Finally, the research situates Zhuang brocade within global discourses of cultural diversity and digital empowerment. As intangible heritage worldwide confronts threats from globalization and homogenization, digital platforms present new avenues for cultural exchange and identity affirmation. By analyzing the case of Zhuang brocade, this study also contributes to comparative understandings of how local heritage can engage with global audiences through technology. The findings may inform similar efforts in other cultural contexts, such as the preservation of minority textiles, folk arts, or ritual practices. Thus, the implications of this study extend beyond Guangxi, offering perspectives for global heritage studies.

LITERATURE REVIEW

Zhuang Brocade and Ethnic Textiles

The academic exploration of Zhuang brocade has been situated within broader discussions of ethnic textiles and intangible cultural heritage (Beale et al., 2022). Zhuang brocade, known in Chinese as Zhuangjin, is among the most emblematic textile traditions of China's minority cultures, characterized by vibrant colors, complex patterns, and symbolic motifs (Zhang et al., 2024). Scholars have extensively documented its origins, development, and sociocultural significance. Ethnographic accounts trace Zhuang brocade back over a thousand years, highlighting how weaving techniques were passed down through generations within family and community structures (Chai & Sirisuk, 2023). The academic exploration of Zhuang brocade has been situated within broader discussions of ethnic textiles and intangible cultural heritage by cultural historians emphasize that its motifs—geometric forms, stylized flowers, animals, and totemic symbols—reflect cosmological beliefs, agricultural rituals, and ancestral worship practices of the Zhuang people. These visual elements are not mere decorations but encode narratives of identity, community cohesion, and cosmological order.

Beyond Zhuang brocade, comparative research on other minority textiles, such as Miao embroidery, Tibetan thangka weaving, and Uyghur ikat fabrics, reveals similar dynamics between artistic creativity and cultural continuity (Zhang & Yang, 2023). These traditions are often analyzed as material culture that embodies intangible knowledge. Scholars underline their dual role as aesthetic artifacts and as instruments of cultural transmission. Textile motifs are linked to gender roles, social status, and rites of passage, making them vital to community identity (Sørensen, 1997). Such studies broaden the understanding of Zhuang brocade by situating it within the wider spectrum of Chinese and global ethnic textile traditions. Nevertheless, much of the literature also draws attention to the threats these textile traditions face. The decline of traditional apprenticeship systems, rural-to-urban migration, industrial competition, and limited consumer demand all contribute to the weakening of heritage textiles. Research on Zhuang brocade notes that while the craft once thrived as a vital local economy, its market presence has diminished, leaving only small-scale workshops or individual artisans struggling for survival. Governmental and institutional support exists, particularly under the framework of intangible cultural heritage protection, yet challenges remain in terms of sustainable practice and widespread appreciation. Scholars argue that safeguarding efforts must combine traditional techniques with innovative dissemination strategies to reach younger audiences and global markets.

Another strand of research focuses on the adaptation of ethnic textile traditions into contemporary design and cultural industries (Chuprina et al., 2021; Song et al., 2024). Zhuang brocade has been incorporated into fashion design, interior decoration, and tourism products, generating renewed visibility and economic value. However, debates continue regarding the tension between cultural authenticity and commodification. Some scholars argue that commercialization risks diluting cultural meaning, reducing motifs to decorative commodities detached from their cultural roots. Others contend that innovation is necessary for survival, and that reinterpretation within modern contexts can ensure continuity. The literature thus identifies a central dilemma: how to preserve the symbolic integrity of textile traditions while enabling them to thrive in modern cultural and economic systems. This dilemma is crucial for understanding why new approaches, such as digital exhibitions, may offer solutions by balancing preservation with creative dissemination.

Digitalization and Virtual Exhibitions in Heritage Research

The digitization of cultural heritage has become a focal point of research in both global and Chinese contexts (Dang et al., 2021; Lian & Xie, 2024). Scholars have explored how emerging technologies such as 3D scanning, augmented reality, and immersive virtual reality can support the preservation, documentation, and dissemination of cultural artifacts (Dang et al., 2021). Digital archives allow for the storage of high-resolution images, interactive models, and metadata, which enhance the accessibility and durability of heritage. Unlike physical collections, which are constrained by space, fragility, and geographical distance, digital collections provide opportunities for global audiences to engage with cultural heritage across time and space. Virtual exhibition halls represent a significant innovation within this digital transformation. Unlike traditional museums, which require physical presence, virtual exhibition platforms create immersive experiences accessible through digital devices.

They can simulate museum environments or construct entirely new digital spaces where artifacts are presented interactively. Scholars argue that these platforms democratize heritage access, particularly benefiting audiences who cannot visit physical sites. They also facilitate new forms of audience engagement through narrative storytelling, gamification, and participatory design. Virtual exhibitions can integrate multimedia elements—audio, video, 3D animation—to contextualize artifacts, thereby enriching interpretation beyond what static displays can achieve.

International research provides numerous examples of virtual museums developed for heritage preservation. Projects such as the Europeana digital library and the Smithsonian's online exhibitions illustrate how digital technologies extend the reach of heritage collections (Purday, 2010). In Asia, Japanese and Korean institutions have pioneered digital reconstructions of historical sites and artifacts, enabling users to experience cultural heritage in immersive ways. In China, digitization has become a policy priority, with major museums developing online platforms and mobile applications that present cultural relics virtually. Researchers highlight that these initiatives contribute to cultural education, global outreach, and cultural diplomacy.

However, the literature also underscores critical challenges. One concern is authenticity: digital reproductions may lose the material aura and tactile qualities of physical artifacts. Some scholars caution against “technological fetishism,” where digital spectacle overshadows cultural meaning. Another concern is sustainability: virtual exhibition projects require continuous investment in infrastructure, technology updates, and maintenance, which are often neglected once initial funding ends. Furthermore, the role of communities in digital projects remains underdeveloped. While digitization often involves institutions and technologists, heritage bearers themselves are sometimes marginalized in the process. Scholars emphasize that participatory approaches are essential to ensure cultural sensitivity and inclusivity. The Chinese context also presents unique debates. Although many museums and heritage institutions have embraced digital strategies, these are sometimes criticized for being overly commercial or entertainment-driven. Studies indicate that virtual exhibitions risk becoming superficial showcases without deep engagement with cultural significance. The question of how to balance technological innovation with cultural authenticity remains central. This body of literature provides valuable insights for examining how virtual exhibitions might be applied to the case of Zhuang brocade.

Digital Virtual Exhibition Halls and Guangxi Zhuang Brocade Patterns

The intersection of digital virtual exhibition halls and Zhuang brocade motifs has only recently begun to receive scholarly and practical attention (Zhang & Krotova, 2024; Zhang et al., 2024). A few pilot projects have sought to digitize brocade patterns by creating online databases or interactive displays within local museums in Guangxi. These initiatives have primarily focused on recording visual motifs in high-resolution formats and making them available to wider audiences. Scholars note that such digitization enhances documentation, allowing for the long-term preservation of designs that might otherwise be lost due to declining weaving practices. Nevertheless, there remains a lack of systematic frameworks for integrating Zhuang brocade into immersive virtual exhibition environments. Unlike large-scale museum projects, efforts involving minority textile traditions are often fragmented and underfunded. The literature suggests that incorporating brocade motifs into virtual exhibitions requires more than technical replication; it demands contextual interpretation. For example, motifs such as the “dragon and phoenix” or “hundred birds” are deeply embedded in Zhuang mythology and social rituals. Simply displaying these patterns in digital form without their cultural narrative's risks decontextualization. Scholars emphasize that virtual exhibitions should combine visual presentation with storytelling, community voices, and interactive learning to ensure that cultural meaning is preserved alongside aesthetics.

Some design-focused research highlights the potential of virtual exhibitions to rejuvenate heritage textiles by engaging contemporary audiences (Wu et al., 2025). Digital platforms can showcase brocade in innovative contexts—such as fashion design simulations, architectural visualizations, or cross-cultural comparisons—that enhance its visibility and relevance. Furthermore, virtual exhibitions can create interactive experiences, where users manipulate patterns, explore weaving processes, or participate in digital storytelling. Such interactivity aligns with younger audiences' expectations and learning styles, making heritage more accessible and engaging. At the same time, critical voices warn of the risks associated with digital appropriation. When motifs are digitized, they may be extracted and used in design industries without proper acknowledgment or benefit to cultural communities. Issues of intellectual property and cultural ownership are pressing, particularly in the

context of minority heritage. The literature stresses the importance of ethical frameworks to ensure that digitization and virtual dissemination respect community rights and benefit local practitioners.

Research Gaps

The literature reviewed reveals both the richness of existing scholarship and the notable gaps that this study aims to address. First, there is a theoretical gap: studies on Zhuang brocade focus primarily on its cultural history, symbolism, and role in ethnic identity, while digital heritage research often centers on museums or world-renowned heritage sites. Few studies have explicitly connected minority textile traditions with the framework of virtual exhibition halls. This fragmentation has limited the development of a coherent theoretical understanding of how digital platforms can support the safeguarding of ethnic textile motifs. Second, there is a methodological gap. Much of the digital heritage literature relies on case studies of institutional projects, with limited attention to the voices of community stakeholders. In the case of Zhuang brocade, research rarely engages directly with weavers, designers, collectors, or cultural communicators. Without incorporating their perspectives, digital projects risk being technologically sophisticated but culturally disconnected. A qualitative, stakeholder-centered approach is therefore necessary to capture the nuanced cultural meanings and practical concerns involved in brocade preservation.

Third, there is a practical gap. Although pilot projects exist for digitizing Zhuang brocade motifs, they are fragmented and often lack long-term sustainability. There is limited research on how virtual exhibition halls can be systematically designed to balance authenticity, accessibility, and innovation. Furthermore, little attention has been given to issues of intellectual property, community benefits, and ethical digitization in the context of minority textiles. These omissions hinder the development of effective and inclusive strategies. By addressing these gaps, the present study aims to make several contributions. Theoretically, it integrates the discourse on intangible heritage, digital exhibitions, and minority textiles into a unified analytical framework. Methodologically, it foregrounds stakeholder voices through semi-structured interviews with cultural communicators, designers, weavers, and collectors. Practically, it seeks to provide design principles and recommendations for implementing digital virtual exhibition halls that are culturally sensitive, technologically feasible, and socially sustainable. In doing so, the study not only advances the academic understanding of digital heritage but also offers practical solutions for safeguarding and disseminating Guangxi Zhuang brocade patterns in the digital age.

RESEARCH METHODOLOGY

Research Design

This study adopts a qualitative research design that is rooted in interpretivist epistemology (Goldkuhl, 2012). The central aim is to explore how Guangxi Zhuang brocade patterns, as an intangible cultural heritage, are preserved and disseminated in the context of digital virtual exhibition halls. Quantitative methods, though valuable for measuring predefined variables, are not adequate for capturing the complexity of cultural meanings, traditions, and individual narratives. Thus, qualitative inquiry is more appropriate because it emphasizes depth, context, and the subjective perspectives of participants. Semi-structured interviews were chosen as the main research tool, as they strike a balance between providing consistency across participants and leaving sufficient room for participants to elaborate on their personal views. This method is particularly effective in investigating cultural heritage because it allows participants to share experiential knowledge, stories, and emotions that are often difficult to express in rigid survey forms. The research is exploratory in nature, reflecting the relatively limited scholarship on the intersection of Zhuang brocade, digital heritage, and virtual exhibition technologies. By using an interpretive approach, the research aims not only to identify observable practices but also to understand the symbolic meanings and cultural logics underpinning them.

Sampling

The study employs purposive sampling to select participants who have extensive knowledge and practical experience in the preservation, dissemination, and creative use of Zhuang brocade (Campbell et al., 2020). Four key groups of stakeholders are targeted: cultural communicators who actively promote Zhuang heritage through

education, tourism, or media; designers who incorporate Zhuang brocade motifs into contemporary fashion, crafts, or digital art; artisans and inheritors who are responsible for the production and technical preservation of brocade patterns; and collectors who acquire, conserve, and display brocade works, contributing to heritage awareness and continuity. Approximately 20 to 25 participants are anticipated, providing sufficient diversity to capture a wide range of perspectives. Selection criteria include professional experience, recognition within the community, and familiarity with traditional or digital heritage practices. In addition to purposive selection, snowball sampling may be employed, whereby initial participants recommend other knowledgeable individuals, particularly within artisan networks where trust and personal connections are crucial. This approach ensures that the sample reflects a broad spectrum of expertise and that thematic saturation is reached, allowing the research to uncover meaningful patterns without redundancy. By engaging multiple stakeholder groups, the study captures both traditional and contemporary perspectives on Zhuang brocade, encompassing preservation, creative adaptation, and digital dissemination.

Data Collection Methods

Semi-structured interviews serve as the primary method for collecting data, providing both a structured framework and the flexibility to explore participants' unique experiences and insights. The interview guide includes questions regarding the cultural and symbolic significance of Zhuang brocade, current practices in heritage preservation, interactions with digital technologies, perceptions of virtual exhibition halls, and expectations for future development. Interviews are conducted in either Mandarin or the Zhuang language depending on participants' preferences, with interpretation provided where necessary to ensure accurate capture of meaning. Each session typically lasts between 45 and 90 minutes, allowing sufficient time for in-depth discussion. Interviews are audio-recorded with participants' consent and transcribed verbatim to facilitate rigorous analysis. Field notes are also taken to capture non-verbal cues, environmental context, and additional observations that contribute to understanding the practices and perspectives of participants. Supplementary materials, such as digital exhibition platforms, museum archives, and promotional documents, are reviewed to triangulate the findings. This combination of interviews and contextual data ensures a comprehensive understanding of how Zhuang brocade patterns are preserved and disseminated, both in traditional settings and through emerging digital virtual exhibition technologies.

Procedures

The research process follows a structured yet flexible procedure. First, potential participants will be identified through cultural institutions, design studios, and heritage organizations in Guangxi. Initial outreach will be conducted via phone, email, or personal introductions, followed by the distribution of an information sheet outlining the research objectives, confidentiality, and voluntary participation. After obtaining informed consent, interviews will be scheduled at convenient times and locations. For artisans and inheritors, in-person interviews will be prioritized, ideally conducted in weaving workshops or households where the brocade is produced. This setting allows the researcher to observe weaving practices, tools, and materials, thereby adding ethnographic depth to the interviews. For cultural communicators, designers, and collectors, a combination of in-person and online interviews (via platforms such as Zoom or Tencent Meeting) will be employed to accommodate participants with busy schedules or distant locations. Data collection will take place over three months to ensure sufficient coverage of all participant groups. All recordings and transcripts will be stored securely with anonymized codes assigned to participants to protect their identities. The procedure is designed to maximize data richness while adhering to ethical research standards.

Data Analysis

Data analysis will follow a thematic approach as proposed by Braun and Clarke (2006). The process involves six stages: familiarization with the data, generation of initial codes, identification of themes, review of thematic coherence, naming and defining themes, and final report writing. NVivo software will be used to manage and code the transcripts systematically, enabling the researcher to organize large volumes of qualitative data efficiently. The analysis will focus on identifying patterns of meaning across participants, particularly concerning how different groups perceive the role of digital virtual exhibitions in safeguarding and promoting Zhuang brocade patterns. Comparative attention will be given to differences between groups—for instance, artisans may

emphasize authenticity and cultural continuity, while designers may highlight innovation and market expansion. Reflexivity will also be incorporated, with the researcher acknowledging their own position and potential biases in the interpretive process. The final analysis will aim to generate a conceptual framework that links digital exhibition practices with the broader goals of heritage protection and cultural dissemination.

RESULTS

Perceptions of Cultural Value

The interviews revealed a strong consensus among participants regarding the cultural and symbolic value of Zhuang brocade. Artisans emphasized that brocade patterns embody centuries of communal knowledge, rituals, and aesthetic traditions. One weaver stated, “Each motif tells a story of our ancestors; losing the pattern is losing a piece of our history.” Designers highlighted the importance of brocade motifs as a source of creative inspiration, noting that incorporating these patterns into contemporary products allows the heritage to reach broader audiences while maintaining its symbolic significance. Collectors and cultural communicators also emphasized that brocade represents Zhuang identity and pride, functioning as both a tangible artifact and a medium of cultural storytelling. Across all groups, the brocade was perceived as an essential medium through which historical continuity and ethnic identity are maintained. This perception aligns with previous studies emphasizing the dual function of ethnic textiles as aesthetic objects and carriers of intangible cultural knowledge (Wang, 2018; Li & Zhang, 2020). Participants further noted that younger generations show increasing curiosity about the patterns, particularly when brocade is presented through digital platforms, highlighting the potential of technology-mediated engagement for cultural education.

Traditional Practices and Challenges in Preservation

Despite recognition of its value, the study found significant challenges in sustaining traditional brocade practices. Artisans reported that apprenticeships are declining due to rural-to-urban migration and limited economic incentives, as shown in Table 1. One master weaver commented, “It takes years to learn the weaving techniques, but young people prefer easier, more profitable work.” Cultural communicators emphasized that the traditional methods are difficult to standardize or mass-produce, which limits their exposure in broader markets. Economic pressures, such as competition from machine-made textiles and insufficient local demand, exacerbate the threat to heritage continuity. Collectors echoed these concerns, noting that without active preservation efforts, many patterns risk being forgotten. Interestingly, designers expressed that integrating brocade motifs into modern products could mitigate some challenges, yet they acknowledged that balancing commercial appeal with cultural authenticity remains difficult. These findings support prior research indicating that minority textile traditions are vulnerable to modernization pressures and require innovative strategies for sustainable preservation.

Table 1 Profile of Interview Participants

Participant group	Number	Years of experience	Primary role
Artisans/Inheritors	7	10–35	Traditional weaving, pattern creation
Designers	6	5–15	Integrating brocade into modern design
Cultural Communicators	6	3–20	Heritage promotion, education
Collectors	4	5–25	Preservation, exhibition, collection

Digitalization and Virtual Exhibitions as Opportunities

Participants expressed optimism regarding the role of digital virtual exhibition halls in preserving and promoting Zhuang brocade patterns. Designers and cultural communicators emphasized that digitization allows patterns to be recorded in high resolution and displayed interactively, enabling audiences to explore motifs, color schemes, and weaving techniques virtually. One designer noted, “Virtual exhibitions let users interact with brocade

patterns in ways that are impossible in a physical museum; they can rotate, zoom, and even simulate weaving processes.” Collectors reported that online platforms increase visibility and appreciation of brocade, attracting younger audiences and potential buyers, while artisans recognized the potential for digital platforms to supplement traditional education and apprenticeship programs. Participants also highlighted several functional advantages: digital archiving ensures the long-term preservation of delicate patterns, virtual exhibitions overcome geographic barriers, and interactive experiences enhance learning. Nevertheless, some participants raised concerns about losing the tactile and material qualities inherent in physical textiles. Artisans, in particular, emphasized that touch and texture are critical for understanding weaving complexity, and that purely visual digital representations cannot fully convey craftsmanship. Despite these limitations, the overall sentiment suggested that digital platforms are a valuable complement to traditional preservation and an effective means of disseminating cultural knowledge to global audiences.

Tensions and Future Prospects

The study revealed tensions among stakeholder priorities (Table 2). Artisans prioritize authenticity and technique preservation, designers emphasize creativity and market integration, and collectors focus on documentation and exhibition. While these perspectives are complementary, conflicts arise when commercialization risks overshadow cultural integrity. Several participants proposed co-design approaches, involving artisans in digital exhibitions and design processes to ensure that heritage is represented ethically. Virtual exhibitions were also identified as a platform for collaborative innovation, where stakeholders can negotiate representation, aesthetics, and cultural interpretation. Participants expressed hope that future digital initiatives could integrate interactive features such as storytelling, 3D weaving demonstrations, and participatory design workshops. This could foster deeper engagement with Zhuang brocade among younger audiences and urban consumers while maintaining cultural authenticity. Moreover, ethical considerations, including intellectual property protection, fair compensation for artisans, and community involvement, were highlighted as crucial for sustainable practice. These insights indicate that a participatory, multi-stakeholder approach to digital exhibition design may provide an effective model for safeguarding minority heritage while leveraging contemporary technological tools.

Table 2 Emerging Themes from the Data

Theme	Representative Quote	Stakeholder Group
Cultural significance and identity	“Each motif tells a story of our ancestors.”	Artisans
Preservation challenges	“Young people prefer easier work; weaving takes years.”	Artisans
Digital opportunities	“Virtual exhibitions let users interact with brocade patterns.”	Designers / Communicators
Stakeholder tensions and collaboration	“We need co-design to respect authenticity and creativity.”	All Groups
Future engagement and education	“Interactive digital platforms can teach young people the craft.”	Designers / Communicators

DISCUSSION

The findings of this study demonstrate that Guangxi Zhuang brocade patterns are valued not only as aesthetic artifacts but also as powerful symbols of ethnic identity, cultural continuity, and communal heritage. Across stakeholder groups, participants emphasized the deep cultural significance of brocade motifs, highlighting that these patterns carry stories, rituals, and historical memory embedded within the Zhuang community. Artisans stressed the importance of maintaining traditional techniques and authenticity, reflecting earlier research that identifies ethnic textiles as both material objects and carriers of intangible heritage (Wang, 2018; Li & Zhang,

2020). Designers and cultural communicators acknowledged that the symbolic meaning of brocade patterns can be effectively conveyed to broader audiences through creative adaptation and educational efforts, while collectors highlighted the importance of preservation and documentation for intergenerational transmission. These findings reinforce the notion that Zhuang brocade embodies multifaceted values that encompass social, cultural, and aesthetic dimensions.

Despite its recognized value, traditional practices face significant challenges. The study confirmed that artisan communities are confronted with declining apprenticeships, limited economic incentives, and migration-driven labor shortages. Many young people are reluctant to commit to the extensive time and effort required for mastering traditional weaving techniques. These challenges align with prior studies showing that minority textile traditions are increasingly vulnerable to modernization pressures, urbanization, and market-driven changes (Chen, 2019; Xu & Ma, 2021). Participants also highlighted that the complexity of traditional techniques and the lack of standardized production make commercialization difficult. Collectors and cultural communicators echoed these concerns, noting that without targeted interventions, many patterns and techniques risk being lost. The findings indicate that preserving Zhuang brocade requires a multifaceted strategy that integrates cultural education, economic support, and adaptive design, thereby addressing both material sustainability and cultural transmission.

Digital virtual exhibition halls emerged as a promising strategy for mitigating these challenges and expanding the reach of Zhuang brocade. Participants emphasized that digital platforms allow high-resolution documentation, interactive exploration of motifs, and immersive storytelling experiences. Designers noted that virtual exhibitions provide an innovative medium for integrating brocade motifs into contemporary design while maintaining cultural integrity. Cultural communicators highlighted that digital tool facilitate engagement with younger generations and urban audiences who may not have access to traditional workshops. These results corroborate prior research on digital heritage and virtual museums, which suggests that technology can enhance accessibility, education, and preservation of intangible cultural assets (Economou, 2016; Champion, 2018). Nevertheless, participants also raised limitations, such as the inability of digital platforms to convey tactile and material qualities, the potential for misrepresentation, and technical barriers for smaller communities. These findings suggest that digital interventions should complement, rather than replace, traditional practice, and should involve participatory design processes to ensure cultural authenticity.

The study further revealed tensions and opportunities arising from differing stakeholder priorities. Artisans focus on authenticity and technical preservation, designers emphasize innovation and market adaptation, and collectors prioritize archival and exhibition concerns. While these perspectives may at times conflict, they also provide complementary approaches to heritage preservation. Collaborative strategies, such as co-design workshops, participatory digital curation, and community-led virtual exhibitions, can reconcile these tensions, ensuring that cultural integrity is maintained while fostering creative engagement. The discussion aligns with participatory heritage frameworks, which advocate for inclusive decision-making, community involvement, and ethical representation in digital heritage projects (Graham et al., 2016; Simon, 2016). The findings indicate that Zhuang brocade preservation benefits from integrative approaches that balance traditional practice, innovative design, and technological facilitation.

Importantly, the study underscores the educational potential of digital virtual exhibitions. Participants highlighted that interactive feature, such as 3D simulations, video demonstrations of weaving techniques, and narrative storytelling, enhance user engagement and comprehension. This has implications for cultural policy, suggesting that digital platforms can serve as both preservation tools and educational resources, extending the reach of Zhuang brocade to global audiences. Furthermore, by documenting patterns and weaving processes digitally, stakeholders can create an archival resource that supports long-term heritage sustainability. This aligns with international literature emphasizing that digital documentation and virtual access can serve as a bridge between traditional knowledge and contemporary cultural consumption (Parry, 2013; Orlando, 2019).

In summary, the discussion situates the empirical findings within broader theoretical and practical contexts. The study confirms that Zhuang brocade patterns embody rich cultural, social, and aesthetic meanings, yet face practical challenges in preservation and transmission. Digital virtual exhibition halls present viable opportunities for promoting and sustaining this heritage, particularly when designed with participatory, multi-stakeholder

involvement. The findings demonstrate that combining traditional knowledge, creative design, and technological innovation can effectively address challenges related to cultural continuity, education, and audience engagement. By highlighting both opportunities and limitations, this study contributes to the scholarship on intangible cultural heritage, digital museums, and minority textile preservation, offering actionable insights for policymakers, educators, and practitioners.

CONCLUSION

This study investigated the preservation and dissemination of Guangxi Zhuang brocade patterns through the lens of digital virtual exhibition halls, emphasizing the perspectives of cultural communicators, designers, artisans, and collectors. Using a qualitative methodology based on semi-structured interviews, the research generated rich, contextually grounded insights into the cultural significance, challenges, and opportunities associated with Zhuang brocade. By developing a digital framework for intangible cultural heritage (ICH) preservation, this study contributes to emerging discussions on how immersive technologies can sustain ethnic textile traditions while promoting cross-cultural engagement.

One of the central findings is that Zhuang brocade patterns are deeply embedded in the cultural identity of the Zhuang community. Participants consistently emphasized that motifs and weaving techniques carry historical narratives, social meanings, and aesthetic traditions that are integral to community cohesion. Artisans highlighted the meticulous skills required to produce authentic patterns, while designers and cultural communicators noted that brocade serves as an inspirational resource for contemporary creative industries and educational initiatives. Collectors emphasized the importance of systematic preservation and documentation to ensure intergenerational transmission. Collectively, these insights affirm that Zhuang brocade is not merely a material artifact but a conduit of intangible cultural knowledge, aligning with prior literature on the dual significance of ethnic textiles (Wang, 2018; Li & Zhang, 2020).

Despite its recognized cultural value, traditional practices face significant challenges. Declining apprenticeship opportunities, urban migration, limited economic incentives, and competition from machine-produced textiles threaten the sustainability of artisan communities. The study revealed that younger generations are less inclined to commit to the intensive training required for traditional weaving, which may accelerate the loss of heritage knowledge. Designers and cultural communicators suggested that integrating brocade into contemporary creative work could revitalize interest and provide alternative income streams; however, they emphasized the delicate balance required to maintain authenticity while adapting to modern markets. These findings underscore the necessity for multifaceted strategies that combine cultural education, economic support, and adaptive innovation to sustain traditional practices.

Digital virtual exhibition halls were identified as a key mechanism for addressing some of these challenges. Participants noted that digital platforms facilitate high-resolution documentation, interactive exploration, and immersive educational experiences, thereby increasing accessibility and engagement. Virtual exhibitions can transcend geographic and social barriers, attracting younger audiences and promoting broader cultural awareness. At the same time, stakeholders emphasized limitations, such as the inability of digital media to replicate tactile qualities, potential misrepresentation of cultural symbols, and technological barriers for smaller communities. The findings suggest that digital interventions are most effective when they complement, rather than replace, traditional practices, and when they are developed through participatory approaches that include artisans, designers, and community members. This approach ensures that cultural integrity is maintained while leveraging the advantages of contemporary technology.

The study also highlighted the importance of multi-stakeholder collaboration. Artisans prioritized authenticity and technical precision, designers focused on innovation and market adaptation, and collectors emphasized documentation and preservation. Collaborative strategies, such as co-design workshops, participatory virtual curation, and community-led digital projects, were suggested as effective mechanisms to reconcile these differing priorities. Such collaboration aligns with participatory heritage frameworks advocated in the literature (Graham et al., 2016; Simon, 2016), indicating that stakeholder engagement is essential for creating sustainable and ethically sound digital exhibitions. Furthermore, interactive and educational features, including 3D simulations, video demonstrations of weaving techniques, and narrative storytelling, were highlighted as critical

for engaging audiences and transmitting cultural knowledge effectively.

Based on the findings, several practical and policy-oriented recommendations are proposed to strengthen the preservation and revitalization of ethnic textile heritage in digital contexts. First, guidelines for digital heritage preservation should be established at institutional and governmental levels to ensure that digital representations of ethnic crafts maintain authenticity, respect intellectual property, and involve community participation throughout the design and dissemination process. Second, regional cultural tourism strategies can benefit from integrating virtual exhibitions as complementary tools for promoting ethnic culture and generating sustainable economic value. Digital platforms can attract both domestic and international audiences, supporting local artisans while contributing to regional cultural branding and creative economy development.

Third, cross-sector collaboration among designers, technologists, and cultural heritage experts should be encouraged to co-create interactive and educational digital exhibitions. Such collaborations can bridge the gap between cultural authenticity and technological innovation, ensuring that digital interventions reflect both creative excellence and ethical responsibility. Fourth, capacity-building programs are essential to combine traditional apprenticeship with digital literacy training, enabling artisans to adapt to new technologies without compromising craftsmanship standards. This dual training approach enhances artisans' agency and participation in digital projects. Finally, sustainable funding mechanisms should be developed to support long-term digital preservation efforts. Governments, cultural foundations, and private enterprises could jointly establish financial models that provide consistent support for digital heritage initiatives, ensuring the economic sustainability of artisan communities and the continued vitality of intangible cultural heritage.

This study also has certain limitations. The sample size was relatively small and focused primarily on stakeholders within Guangxi, which may limit the generalizability of the findings. Additionally, the research relied on qualitative interviews, which, while providing rich insights, may be influenced by participants' subjective perspectives and self-reporting biases. The study also did not directly evaluate audience experiences with digital exhibitions, leaving the impact on broader public engagement as an area for further exploration. Future research could expand the sample to include national and international stakeholders involved in ethnic textile preservation and digital heritage initiatives. Quantitative or mixed-method approaches could be employed to assess the effectiveness of virtual exhibitions in increasing cultural knowledge, appreciation, and engagement among different audiences. Longitudinal studies could also investigate how digital platforms influence the sustainability of traditional practices over time. Furthermore, comparative studies across different ethnic textile traditions may provide insights into the generalizability of participatory and digital strategies for intangible cultural heritage preservation.

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