E-B Environment - Behaviour Proceedings Journal

AicQoL2026Jakarta

e-IPH e-International Publishing House Ltd., United Kingdom

https://www.amerabra.org/

14th AMER International Conference on Quality of Life

Sunlake Waterfront Resort & Convention, Jakarta, Indonesia, 02-03 Jan 2026

Knowledge Mapping and Dynamic Frontiers of Zhuang Brocade Research:Through Bibliometric Analysis Based on VOSviewer

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Abstract

Zhuang Brocade, a traditional textile of China's Zhuang ethnic group, embodies cultural identity and intangible heritage but faces preservation challenges amid modernization. This study employs bibliometric methods to map its knowledge structure and evolution, to identify thematic shifts toward interdisciplinary frontiers. VOSviewer reveals "Inheritance" and "Intangible Cultural Heritage" as foundational, with emerging focuses on "Digitalization," "Design Innovation," "Artificial Intelligence," and "Semiotics." Findings indicate a technology-integrated transition, requiring multidisciplinary contributions from computer science, semiotics, and cultural ecology to support dynamic heritage protection and innovation.

Keywords: Digitalization; Design Innovation; Interdisciplinary Research; Cultural Ecology

DOI: https://doi.org/10.21834/e-bpj.v11i35.7542

1.0 Introduction

Zhuang Brocade, a textile tradition, is one of the most characteristic of the Zhuang ethnic group in Southwest China and has great cultural, aesthetic, and historical value. Pattern design, weaving, and symbols are important elements of Zhuang cultural identity and intangible cultural heritage. According to the literature, traditional textile forms, such as Zhuang Brocade, function not only as objects but also as cultural texts that record the community's values, social memory, and cosmological concepts (Nong, 2018). Such an intimate linkage between art and culture has put Zhuang Brocade on the agenda of prominent cultural anthropologists and heritage researchers.

Rapid modernization, industrialization, and changes in visual aesthetics over the last few years, combined with rapid industrial development and shifts in aesthetic consumption, pose difficulties in maintaining and passing down the development of traditional crafts. Researchers observe that intangible cultural heritage needs to be situated in its immediate living space and the culture on which it is based in order to be robust against contemporary changes (Ji, 2004; Ding, 2012). Cultural ecology theory provides a foundation for examining how Zhuang Brocade adapts to changing social, economic, and technological contexts (Steward, 1972).

As interest in Zhuang Brocade research in the field continues to grow, a comprehensive corpus of bibliometric evidence has yet to be published. Previous work has focused on cultural interpretation, symbolic analysis, or design practice (Lu, 2017; Jing, 2022), but few have studied the field's structural evolution and thematic development over time, or even its history. Because of this gap, it was challenging to understand how Zhuang Brocade's knowledge system has expanded and which research avenues remain.

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This study addresses these gaps by employing bibliometric analysis on existing literature to illuminate the knowledge structure, research priorities, temporal changes, and future interdisciplinary strategies for Zhuang Brocade. The purpose of this research is to provide a macro-level overview of the field's evolution toward interdisciplinary integration, complementing qualitative studies with quantitative trends. The aim is to identify thematic shifts and emerging frontiers in Zhuang Brocade research. Specific objectives include: (1) to analyze keyword co-occurrence and temporal trends using VOSviewer; (2) to determine foundational and emerging themes, such as from "Inheritance" to "Digitalization" and "Artificial Intelligence"; (3) to establish interdisciplinary strategies for cultural preservation and innovation that contribute to quality of life in heritage communities.

2.0 Literature Review

This section provides a qualitative overview of key themes in Zhuang Brocade research to complement the quantitative bibliometric analysis, highlighting how prior studies reveal gaps that inform the current work. Research on Zhuang Brocade has advanced along three main academic paths: (1) cultural and anthropological studies; (2) analysis of patterns and design; (3) creative progress through novel technology, cultural creativity, and digital technology.These paths refl ect a stable cultural basis and a broadening interdisciplinary scope.

2.1 Cultural and Anthropological Studies

Research on Zhuang Brocade began with a focus on documenting traditional weaving techniques, community customs, and symbolic meanings in textile motifs. Scholars treat Zhuang Brocade as a cultural text that embodies cosmology, religious beliefs, and ethnic identity (Nong, 2018). Cultural ecology theory interprets culture as an adaptable system influenced by environment, production, and social organization (Steward, 1972). As Ji (2004) noted, cultural practices thrive in their ecological niches, and Steward's multilinear evolution explains adaptive pathways. These studies provide interpretive foundations but highlight issues like the vulnerability of traditional crafts to modernization, deriving the need for adaptive strategies in current research.

2.2 Pattern Analysis and Aesthetic Understanding

Studies systematically analyze geometric motifs, animal and plant visuals, and mythological elements through semiotics and visual culture. Lu (2017) classifies Zhuang Brocade motifs by structure and symbolism, laying academic groundwork for design transformation. Zhang (2016) links motif evolution to social dynamics, emphasizing how cultural motives and environmental contexts drive aesthetic changes. This scholarship guides modern designers but reveals ideas for innovation, such as integrating traditional patterns with contemporary aesthetics, which informs the bibliometric focus on emerging themes.

2.3 Innovation, Cultural-Creative Industries and Digital Technology

Contemporary research emphasizes design transformation and cultural-creative evolution. Jing (2022) explores reworking traditional motifs to balance cultural continuity and modern demands. Wang (2022) argues that heritage requires dynamic transformation for vitality. Digitization trends, including 3D modeling and digital documentation, address preservation while raising authenticity concerns (Ocn, 2021). Bibliometric tools like VOSviewer have been applied to Chinese cultural heritage (Gao, 2015).

From this literature, key issues emerge: while qualitative interpretations dominate, there is limited macro-level structural analysis of thematic evolution and interdisciplinary frontiers. This gap drives the idea for the current bibliometric study, which quantifies trends to identify underexplored areas like AI integration and cultural ecology applications, providing a systematic basis for future innovation.

3.0 Methodology

This study uses a quantitative bibliometric research design to create a systematic knowledge map of the developmental trajectory within the literature on Zhuang brocade. Bibliometric analysis helps identify high-level academic patterns such as thematic clustering, research hotspots, or collaborative networks. It seems well-suited to the field of intangible cultural heritage studies, where knowledge distribution is extensive and impacts various disciplines, including cultural studies, design studies, anthropology, and digital humanities.

3.1 Research Design

This research approach was conducted following these steps: 1) literature selection; 2) data cleaning and standardization of keywords; 3) bibliometric visualization using VOSviewer. Bibliometric methods can also provide a quantitatively objective assessment of knowledge architectures, minimizing subjective interpretation and offering a macro-level, objective analysis of research advancements.

The chosen visualization technology was VOSviewer due to its proven reliability for constructing scientific maps of literature (Van Eck & Waltman, 2010). Similar uses in library and information science indicate its suitability for analyzing co-occurrence networks and temporal patterns (Gao, 2015).

3.2 Rationale for Methods

The procedures were justified based on established bibliometric practices to ensure reliability, objectivity, and relevance to cultural heritage research. VOSviewer was selected over alternatives like CiteSpace because of its user-friendly interface for keyword visualization and its validation in interdisciplinary fields, including Chinese cultural studies (Gao, 2015), which aligns with Zhuang

Brocade's context. This tool minimizes bias in thematic mapping and supports temporal analysis, essential for identifying evolution in quality-of-life-related heritage innovation.

CNKI was chosen as the primary database due to its extensive coverage of Chinese-language literature on ethnic crafts (over 90% of relevant publications), supplemented by English sources for balance and to avoid regional bias. Search terms ('Zhuang Brocade', 'Zhuang textile', 'traditional motifs', 'Zhuang ethnic group') were justified to capture core concepts while maintaining focus, as broader terms could introduce noise.

3.3 Data Collection

Collected data. The relevant data for this research were obtained using CNKI. Search terms were 'Zhuang Brocade', 'Zhuang textile', 'traditional motifs', and 'Zhuang ethnic group'.

After removing duplicate literature, conference abstracts without full document text, non-academic reports, and newspapers, the sample included 618 valid documents. This resulted in metadata that included keywords (1,528) and authors (553). To achieve balanced research perspectives, the retrieved literature included both Chinese and English publications.

3.4 Data cleanup and standardization

To ensure the analytical process is performed accurately, a systematic standardization of data was conducted before data analysis. The main work included two steps: 1) Standardization of author names, especially when there were mixed English spellings; 2) Develop agreement standardization of related synonymous terms (e.g., Zhuangjin; Zhuang Brocade weaving; Zhuang textile) ;3) Removal of unnecessary keywords: study; analysis.

In turn, this step confirmed keywords correctly demonstrated substantial thematic links, preventing semantic confusion and processing repetition.

3.5 Bibliometric Visualization Using VOSviewer

We will use VOSviewer software to produce the following visualizations from the curated and structured data: 1) Keyword co-occurrence networks; 2) Keyword density maps; 3) Temporal evolution overlay diagrams; 4) Author collaboration networks.

In software operation, the following normal bibliometric parameters will be set to ensure effective and valid data analysis: 1. Counting method: Full counting, 2. Minimum key occurrence: 3, 3. Layout algorithm, 4. LinLog/modularity, 5. Visualization mode: [network] density, overlay. The use of VOSviewer aligns with the bibliometric research of international organizations, and its algorithms have been well researched and validated for mapping scientific knowledge structures (Van Eck & Waltman, 2010).

4.0 Findings

Based on the construction guidelines of the VOSviewer developer (Van Eck & Waltman, 2010), four forms of visualizations were developed: a density map based on keywords, a temporal overlay map, the keyword co-occurrence network diagram, and an author collaboration network diagram. Together, these data show the structural evolution, thematic orientations, and emerging research frontiers in cases examining the phenomenon of 'Zhuang brocade'.

4.1 Visualization of Keyword Density

The density map reveals, nevertheless, that Zhuang brocade research still tends to remain largely focused on traditional culture and intangible cultural heritage.

High-density keywords are 'Zhuang brocade,' 'transmission,' 'cultural inheritance,' and 'ethnic culture,' which closely relate to the frameworks of cultural adaptation, ritual significance, and symbolic transmission emphasized over time in the fields of cultural ecology and symbolic anthropology (Ji, 2004; Steward, 1972; Nong, 2018).

Medium-density keywords imply a limited initial range into contemporary design contexts, including but not limited to 'cultural and creative products,' 'innovation,' 'product design,' and 'application.' This can be a natural continuation of the overall trend towards integration of traditional crafts into the creative industries with ICH research, and is consistent with the general development that has been reported in ICH research (Ai & Su, 2024; Zhang, 2016).

Low-density words reveal new technology themes that are gaining interest, such as 'artificial intelligence,' 'integration,' 'modern technology,' and 'creative transformation.' This shows that research is also conforming to the international trend toward the digitalization of intangible cultural heritage (Ocón, 2021) and indicates that computational methods can be a new research frontier.

Taken together, the density of the keywords showed that Zhuang brocade studies tend to remain focused on a cultural base but are gradually moving into an interdisciplinary context.

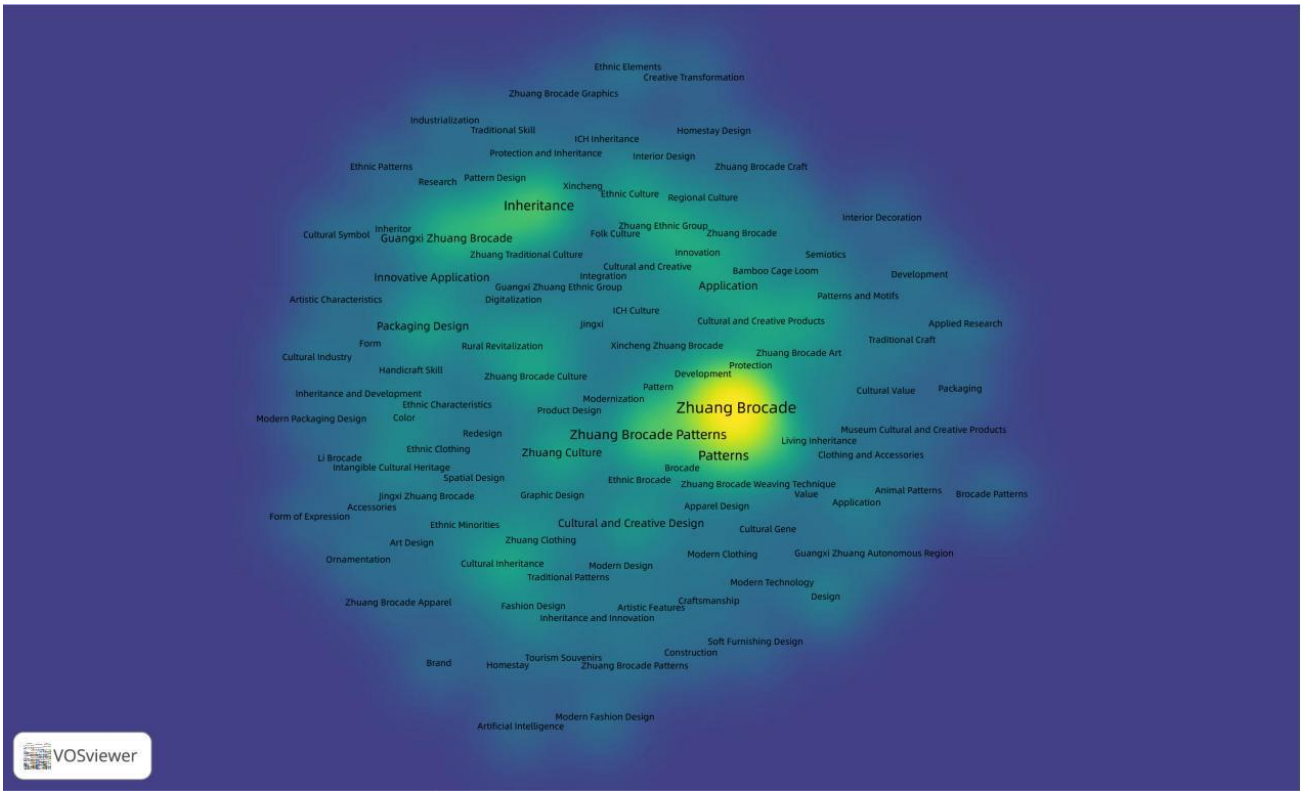

Fig. 1: Keyword Density Visualization

4.2 Temporal Overlay Visualization

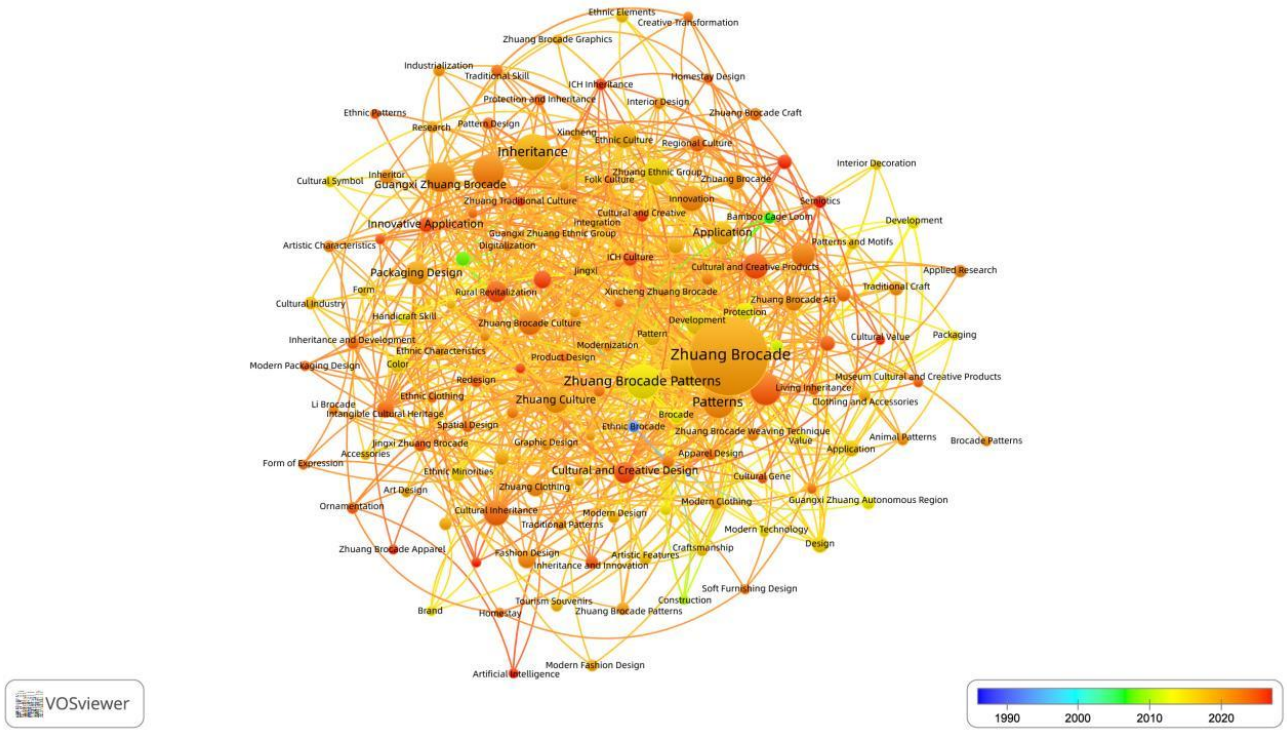

Fig. 2: Temporal Overlay Map

The timeline demonstrates the shift in interest in research on Zhuang brocade:

Phase one (before 2010): In this Phase, research mainly focused on the documentation of the Zhuang brocade culture. Among the terms that dominated these documents were: 'ethnic brocade,' 'bamboo cage loom,' and 'geometric patterns.' Much of the research was

descriptive, seeking to accumulate cultural insight and comprehend patterns according to thematic meanings, consistent with early ethnographic investigations (Nong, 2018; Jing, 2022).

Phase Two (2010 – 2018): An extended research focused on symbolic analysis of Zhuang brocade motifs and aesthetic studies. It shifted focus to symbolic anthropology and aesthetic analysis of cultural significance, ritual symbolism, and ethnic identity. This is consistent with the deepening of the cultural ecology and symbolic interpretation systems (Ji, 2004; Ding, 2012).

Third Phase (2018 – present): This has been characterized by a rapid growth in the Zhuang brocade literature, with new and advanced terms that are mainly terms of innovation, application, and cultural-creative design having dominated the dialogue as new trends. This is in keeping with attempts to digitalise intangible cultural heritage internationally (Ocón, 2021). At the same time, the rise in publications and related keywords aligns with China's 2017 policies on rural revitalisation and protection of the traditional cultural methods of ethnic groups.

Thus, thematic investigations for Zhuang brocade have been transformed from conventional static conservation and preservation studies based on analysis to dynamic analysis and research methods.

4.3 Co-Occurrence Network of Keywords

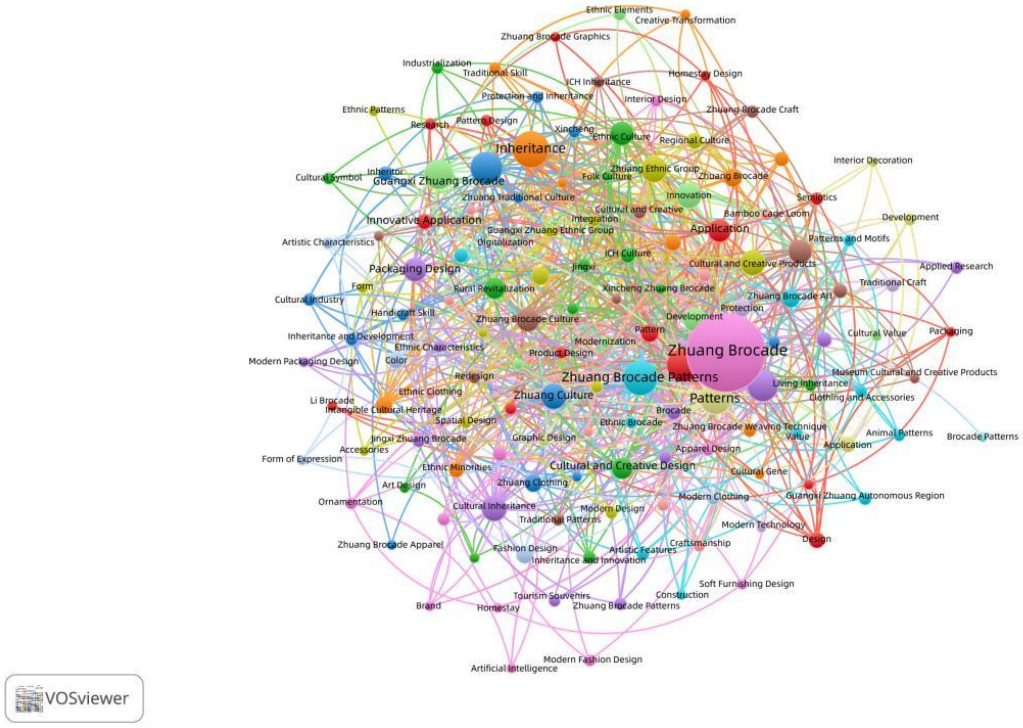

Fig. 3: Keyword Co-Occurrence Network

The network comprises 140 keywords and 670 co-occurrence relationships, with a total link strength of 1036. Additionally, it quickly crystallized into 14 substantial clusters. This diagram is a clear example of a cluster of knowledge modules — a complex, fragmented pattern. These are thematic research concerns that dynamically, interactively contribute to or are interrelated to support the evolutionary model.

The Keyword Co-occurrence Network Map explains that the structure of field knowledge can be broken down into three systemic subsets, i.e., 1) Subsystem I: Cultural Ontology and Fundamental Research. Keywords: Guangxi, Zhuang Brocade, Intangible Cultural Heritage, Inheritance, Zhuang Culture. This is in the traditional categories of cultural preservation and ethnology. 2) Subsystem II: Social Development and Value Transformation. Search terms: Rural Revitalization; Cultural and Creative Design; Design Innovation. This is indicative of the dynamic adjustment and value transformation of the Zhuang Brocade system in the social context. 3) Subsystem III: Technological Empowerment and Modern Design. Keywords: Digitalization, Artificial Intelligence, User Experience. This is the technical environment that the Zhuang Brocade system adapts dynamically, and which is the main driving force behind the development and modernization of the research. And these three subsystems can be interdependent and interactive in the Zhuang Brocade research complex dynamic knowledge system.

4.4 Author Collaboration Network

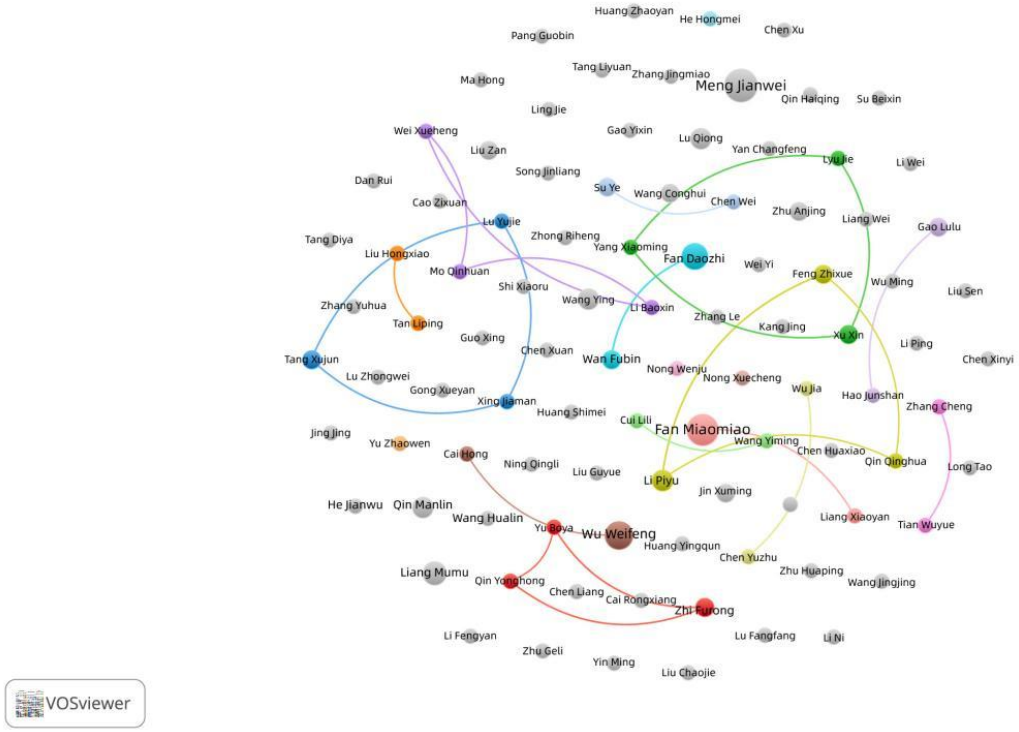

Fig. 4: Author Collaboration Network

The Author Collaboration Network diagram shows that there are two extreme cases of the academic system in this field: collaborative mutual benefit or individual high productivity.

From within the network, a close-knit collaborative cluster has established itself around large and prolific authors like Fan Miaomiao (Documents 9) and Wu Weifeng (Documents 7). These thick connections suggest that team-based collaboration has taken hold as the dominant research paradigm for this domain. Now, yet the map also shows an important problem: there are no connections to scholars with a large publication—Meng Jianwei (10 documents) and Liang Mumu (5 documents)—being grey nodes. It suggests that all these authors have added to the body of work, but were not working cooperatively.

It indicates that interdisciplinary as well as interinstitutional collaboration among these collaborators is still severely limited. Authors generally work within small, isolated studies of isolated groups, which is in line with earlier research that has demonstrated that studies of Zhuang brocade are still conducted independently by humanities scholars (Jing, 2022; Lu, 2017).

4.5 New Frontier Terms to Watch in the Future

Using publication year averages for keywords, we can precisely map the most recent interdisciplinary frontiers. Those are the main areas of frontier that will bring about new knowledge.

Table 1. Latest Interdisciplinary Research Frontier Keywords

Keyword	Year	Interdisciplinary Positioning	Interdisciplinary Integration Need
Artificial Intelligence	2024	Computer Science	Technological foundation driving digital dissemination and pattern generation of Zhuang Brocade
Semiotics	2024	Cultural Theory/Design Studies	Deep cultural meaning decoding and theoretical construction of Zhuang Brocade patterns
Innovative Development	2024	Economics/Sociology	Macroscopic strategy for promoting the industrialization of Zhuang Brocade

The most pressing issue of interdisciplinary fusion in Zhuang Brocade research is the incorporation of Artificial Intelligence and Semiotics, that is, how to use cutting-edge technology to carry and disseminate profound cultural connotations. Such an integration of theory and technology will be key in growing Zhuang Brocade research while boosting its global impact.

5.0 Discussion

The studies show the developmental path of Zhuang brocade research: one is the long-term preservation of the research towards its traditional cultural dimensions, and the two main drivers are social development, changing demands, and policy related to that aspect, and so the new interdisciplinary directions within Zhuang brocade research have been constantly being developed.

The results support that heritage-related cultural analysis is still the intellectual heart of this area. Keywords like 'transmission,' 'patterns,' and 'ethnic culture' in high frequency suggest that scholars focus on themes of symbolic significance, craftsmanship, and cultural identity. The study reflects academic interest in deciphering the allure of Zhuang brocade as a cultural emblem entrenched in community memory and gendered weaving practices. On the other hand, and as Wang (2022) pointed out from an interdisciplinary perspective within the field of intangible cultural heritage studies, there are limits to theoretical innovation if the interpretations of the culture become entrenched in one viewpoint in a more singular way, with no methodological pluralisation taking place.

In 2018 and to come, there was a great shift in the research themes, and research subjects were more centered around design innovation, cultural/creative industries, and digital heritage. Keywords such as 'application,' 'innovation,' and 'cultural and creative industries' also experienced explosive growth, reflecting the global trend of heritage research in which digital technologies are increasingly applied to heritage documentation, visualisation, and reinterpretation (Ocón, 2021).

Keyword co-occurrence networks provide information on the changing patterns, clusters, and domains of interest among the various themes in Zhuang brocade research, to be expressed in clusters relating to cultural studies, design innovation, pattern symbolism, craft methods, digital technology, and the visual arts. This diversity comes from design studies and textile research influences. Even as the scope of research domains continues expanding, real interdisciplinary integration remains a far cry.

Analysis of networks of author collaboration surfaces a concerning situation: research trends are highly segmented, with little institutional cooperation. This type of heritage research often develops separately within institutions in China, limiting methodological innovation and interdisciplinary exchange.

These results indicate that while Zhuang brocade research exhibits positive trends driven by continuous development, technological updates, and policy incentives, it remains constrained by disciplinary fragmentation and methodological duplication. The field is in a transitional phase: traditional cultural analysis continues to form the core of academic identity, while rising interest in digitalisation and innovation signals a shift towards technology-driven cultural development. Future research must strengthen interdisciplinary collaboration, deepen the application of technical methodologies, and explore new theoretical frameworks beyond cultural symbol analysis.

In conclusion, the result shows a growing, yet relatively heterogeneous field in Zhuang brocade research. In order to realise sustainable, creative, and transdisciplinary development in the digital age, the structural limitations outlined here must be acknowledged and solved.

6.0 Conclusion& Recommendations

In this bibliometric paper, academic work on Zhuang brocade is reviewed, outlining thematic developments, methodological perspectives, and newly emerging strands of interdisciplinary inquiry.

6.1 Limitations

This study acknowledges several limitations to provide a retrospective evaluation of its scope and methods. First, reliance on CNKI as the primary database may introduce a bias toward Chinese-language publications, potentially overlooking global English-language contributions and underrepresented perspectives from international scholars. Second, the dataset of 618 documents, while comprehensive for bibliometric purposes, might exclude emerging non-peer-reviewed sources such as social media discussions or gray literature, limiting the capture of real-time trends. Third, VOSviewer's algorithms, though robust, could produce visualization artifacts due to parameter settings, affecting cluster accuracy. Additionally, the analysis focuses on keyword co-occurrence without deep qualitative validation, which may oversimplify complex cultural nuances.

These limitations highlight opportunities for improvement: future research could integrate multiple databases for broader coverage, incorporate mixed-methods approaches for validation, and expand sample sizes to include diverse sources. Addressing these will strengthen the applicability of findings to quality-of-life enhancements in cultural heritage preservation.

6.2 conclusions

Findings provide the following conclusions:

1) Much of Zhuang brocade research still remains focused on a traditional style of interpretation, focusing on traditional craftsmanship, symbolic patterns, and ethnic culture. Such themes follow a long tradition of anthropological and cultural ecology research and indicate that Zhuang brocade, as a cultural symbol system embedded in communal memory and social culture, has important symbolic and identity-conceiving roles (Ji, 2004; Nong, 2018).

2) There is a move from traditional design applications and digital use to innovation, as research on Zhuang brocade is moving towards digital use post-2018. Research topics reveal a dramatically higher focus on cultural and creative sectors and on pattern re-engineering, as well as digital archiving and pattern gene extraction.

3) The network of authors' collaboration on this section highlights continued fragmentation in Zhuang brocade research and a lack of cross-regional, cross-institutional, and interdisciplinary collaborative effort. The prevailing singularity of research based on primary work plus small team working inhibits methodological discovery – especially in areas with multidisciplinary requirements.

6.3 Recommendations

Considering the above analysis, a number of suggestions are presented:

1) Promote collaborative research across disciplinary lines to enable methodological diversity and overcome existing disciplinary barriers.

2) Establish digital heritage facilities for Zhuang brocade, which will comprise digital archives and 2D/3D pattern databases, to conduct novel research and to bring in new design applications. Digitalisation is not only a means of preservation but also a tool for catalyzing cultural renaissance.

3) Systematic directions such as AI-driven pattern synthesis, pattern gene extraction, AI-based pattern generation, algorithm-based gene extraction, and pattern gene extraction and algorithmic visualisation should definitely be investigated. These underserved areas are the most promising areas for revamping Zhuang brocade research and design practice.

4) Strategically bring traditional design into fashion, brand visuals, tourism products, tourism and digital products, and brand imagery, fashion industry, and brand viscerally in new and interesting ways.

Zhuang brocade research now moves into a new stage where interdisciplinary and technological developments are pursued. This field has the potential to develop into one based on innovation, sustainability, and global relevance through addressing structural fragmentation and cross-sector collaboration.

Acknowledgements

I am very grateful to UiTM and Dr. Mumtaz Mokhtar fortheir excellent guidanceand help.

Paper Contribution to Related Field of Study

This article employs a combined methodology of bibliometric analysis and content analysis to systematise developmental trends concerning the three major themes of Zhuang brocade: “heritage preservation”, “innovation”, and “digitalisation”. It thereby establishes a foundation for constructing a clearer knowledge map within this field.

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