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Anthropological Insights into Emotion Semantics in Intangible Cultural Heritage Museums: A Case Study of Eastern Sichuan, China

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Abstract: The preservation of intangible cultural heritage (ICH) has transitioned from “static” and “living” approaches to a “digital ecosystem”, becoming a significant topic of anthropological research. This study, adopting an anthropological perspective, integrates sentiment semantic analysis with user identity classification to propose the Identity and Sentiment-Centered Framework for Intangible Cultural Heritage (ISC-ICH). Drawing on four types of ICH museums in Eastern Sichuan, China—Nanchong Langzhong Wang Shadow Puppetry Museum, Bazhong Pingchang Fanshan Jiaozi Base, Guang’an Eastern Sichuan Folk Museum, and Dazhou ICH Exhibition Hall—as case studies, this research analyzes the core factors contributing to the audience’s sense of local identity, including its composition, emotional needs, and cultural interaction. The findings reveal that: (1) “Explorers” and “Experience Seekers” constitute the primary audience groups, with their emotional evaluations closely tied to cultural depth and interactivity. (2) The digital transformation of ICH museums faces challenges such as resource limitations, festival-centric phenomena, the rise of “internet celebrity” trends, and technological homogenization. This paper introduces a culturally tailored corpus and a comprehensive evaluation framework, highlighting the dynamic interaction between ICH and its audience. Additionally, it proposes effective digital strategies to enhance the social and cultural identity of ICH museums in peripheral regions.

Keywords: anthropology; Eastern Sichuan ICH museums; sentiment semantics analysis; identity classification; intangible cultural heritage



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1. Introduction

Intangible cultural heritage (ICH), a vital component of “human cultural assets”, has long been intertwined with anthropological research. Anthropologists were among the earliest academic groups to document and focus on ICH, and they have been prominent advocates for preserving cultural diversity. Early pioneers, such as American anthropologists Franz Boas and Margaret Mead, undertook salvage ethnography to record endangered cultural practices, while institutions like the Royal Anthropological Institute of Great Britain emphasized the urgency of studying “vanishing customs of native races”, as noted in W. H. R. Rivers’ obituary [1]. These foundational efforts highlighted the irreplaceable role of ICH preservation in safeguarding human heritage, reflecting anthropologists’ profound concern for the fragility of cultural traditions. With the integration of technology,

the perspective on ICH preservation has shifted from “static living” to “digital ecology”, transforming it from merely preserving the “past” into actively shaping the “future”.

Against this backdrop, the emergence of the metaverse and digital twin technologies has profoundly impacted the transformation of intangible cultural heritage (ICH) museums. The metaverse creates virtual spaces that enable cultural heritage to transcend temporal and spatial constraints, while the latter leverages data modeling and dynamic scene reproduction to transform the “static preservation” of ICH into “living regeneration”. UNESCO’s 2021 Dive into Heritage project exemplifies this trend: by employing digital twin technology to construct virtual cultural scenarios, cultural heritage transcends physical boundaries and enters new spatiotemporal dimensions [2]. As Katherine Hayles revealed in her theory of the posthuman, the embedding of technology into human cultural practices has profoundly reshaped the processes of meaning-making [3]. The integration of these technologies represents a cognitive revolution concerning identity, meaning, and heritage.

Although mainstream museums and cultural institutions have greatly benefited from digital transformation, research on the digital transformation of intangible cultural heritage (ICH) museums in peripheral areas is relatively limited, and these museums face more complex challenges. Specifically:

- Capital Dimension: severe constraints in funding and resources coupled with a lack of infrastructure;
- Content Dimension: cultural institutionalization, which results in “deterritorialization” of cultural expressions;
- Experience Dimension: fragmentation and modularization in the allocation of digital resources and the application of technology.

Although Kirshenblatt-Gimblett (2014) highlights the irreplaceable role of peripheral cultural institutions in preserving cultural diversity and local memory [4], existing anthropological literature has not yet deeply explored how to achieve digital transformation in the context of limited resources and geographic dispersion. Therefore, in addressing these challenges, the digital transformation of these museums should focus on preserving cultural authenticity and local distinctiveness, even under constrained conditions. Additionally, it is crucial to improve the efficiency of cultural preservation and enhance public engagement. Selecting the appropriate digital platform is a key factor in this process.

This study identifies two key factors to consider when choosing digital platforms: “technological universality” and “cultural locality”. The former relies on global and standardized data systems to enable efficient data collection and processing, while the latter emphasizes deep adaptation to local culture, leveraging technology to enhance the semantic and emotional uniqueness of the cultural expressions. To this end, three types of digital platforms are the most representative choices: content distribution platforms characterized by real-time updates and broad coverage (e.g., Weibo, WeChat official accounts), recommendation and review platforms embedded in daily life (e.g., Meituan, Dianping), and new social media platforms centered on short videos and multimedia (e.g., Douyin, Xiaohongshu).

The significance of selecting these platforms, however, extends far beyond considerations of technological convenience and cost efficiency. More critically, these platforms unveil the deeper needs underlying public expressions concerning “how to preserve”, “how to understand”, and “how to represent” ICH museums in the digitalization process. This aligns directly with the core issue highlighted by Black (2018)—that the genuine challenge of digitalization resides in the reconstruction of cultural meanings rather than in the mere adoption of technological tools [5].

This study examines the ICH museums of Eastern Sichuan, China—namely, the Nanchong Langzhong Wang Shadow Puppetry Museum, Bazhong Pingchang Jiaozi Base,

Guang'an Eastern Sichuan Folk Museum, and Dazhou Digital Culture Museum—through an anthropological perspective. It combines sentiment semantic analysis with user identity recognition to explore the core factors influencing the audience's sense of local identity, proposing effective digital strategies to enhance the social and cultural identity of ICH museums in peripheral regions. The study introduces several key innovations and contributions. Firstly, it combines sentiment semantic analysis with user identity recognition for the first time, constructing a localized, exclusive corpus to reveal audience emotional needs and identity characteristics, thereby addressing a significant gap in ICH digital research. Secondly, by employing culturally sensitive corpora and advanced machine learning models (e.g., BERT-SVM), the study establishes a tailored pathway for sentiment analysis within the Chinese cultural context, deepening the understanding and expression of local cultural symbols. Lastly, through anthropological intervention, it proposes an emotion-driven participation model and develops a theoretical framework for digital transformation, offering precise and actionable guidance for the sustainable development of marginalized ICH museums.

2. Literature Review

2.1. *The Evolution of ICH Preservation and Anthropological Engagement*

The development trajectory of intangible cultural heritage (ICH) preservation has been profoundly influenced by the growing recognition of the international community and the advancement of “other-culture” studies in academia. Historically, early notions of ICH were shaped by various cultural frameworks, such as the American concept of “physical heritage”, UNESCO's “non-physical heritage”, and Japan's classification of “tangible/intangible heritage” [6]. In 1992, UNESCO officially replaced the categories of “physical/non-physical” heritage with “tangible/intangible” heritage [7]. The adoption of the Convention for the Safeguarding of the Intangible Cultural Heritage in 2003 cemented “intangible cultural heritage” as an operational term and framework [8]. Anthropologists played a pivotal role in shaping these concepts and drafting relevant treaties.

Anthropology has consistently contributed to the theory and practice of intangible cultural heritage (ICH) preservation throughout its development [9]. Early anthropologists, such as Franz Boas, laid the foundation for classification systems in ICH [10]. However, critics have noted that such “salvage ethnography” often overlooked the dynamic development of cultures [11]. As global modernization intensified, anthropology research shifted its focus toward the preservation of “living cultures”, emphasizing the values of cultural practitioners and their environments [12].

This perspective reframes ICH preservation from focusing on “artifacts” to a dynamic exploration of cultural practices and social relationships. ICH practitioners are not only bearers of culture but also active producers of cultural meaning. Their lifestyles and social contexts are integral to the preservation process, fostering an integrated approach to “object-person-place” that has advanced the convergence of ICH and museums.

Under the influence of anthropology, museums have evolved from “cultural fortresses” to “educational spaces” and ultimately to “cultural stages” [13]. This progression has laid the groundwork for innovative concepts such as ecomuseums, which have significantly advanced cultural preservation practices. Ecomuseums emphasize the organic relationships between people, environments, and cultural landscapes, advocating for in situ and dynamic conservation approaches that foster a symbiotic relationship between culture and nature [14]. UNESCO has further affirmed the central role of museums in safeguarding intangible cultural heritage (ICH), highlighting their dual function as material repositories for cultural continuity and as platforms for public engagement and enhanced social functionality [15].

This recognition underscores the transformative potential of museums in integrating culture, community, and environment, thereby solidifying their role as both cultural guardians and enablers of dynamic heritage preservation.

2.2. Digital Transformation in ICH Preservation: Opportunities and Challenges

As cultural heritage preservation increasingly integrates with technologies such as the metaverse and digital twins, it propels ICH protection into a digital and intelligent era, offering efficient solutions for tourism guidance, on-site maintenance, and the safeguarding of heritage objects [16]. These technologies not only provide innovative tools for the preservation and dissemination of fragile and ephemeral cultures but also create new pathways for the reproduction of cultural meanings and intergenerational transmission.

The application of metaverse and digital twin technologies focuses on core areas such as digital collection and storage, as well as digital display and dissemination. While these advancements promote the dynamic regeneration of ICH, they also underscore the disparities in resources, technology, and capabilities between mainstream museums and marginal ICH venues.

The foundation of metaverse and digital twin technologies—digital collection and storage—relies on tools like 3D scanning, 3D modeling, and GIS mapping, which form the basis for the dynamic preservation of ICH practices [17]. However, marginal regions often face significant challenges in conducting comprehensive collection and storage efforts due to insufficient funding, resource shortages, and inadequate infrastructure [18]. Metaverse and digital twin technologies offer the possibility of immersive experiences and cross-temporal cultural exchanges in the realms of display and dissemination. VR, AR, and multimedia interactions enhance the breadth and depth of ICH exhibitions [19]. For example, China's Qiang Culture Digital Museum employs 3D modeling to recreate traditional embroidery techniques [20], Italy's Murano Glass Museum digitizes traditional glassmaking crafts [21], and the Sergio Iovino Virtual Museum presents rich ethnocultural traditions across time and space [22].

Nonetheless, scholars caution that overreliance on technology may weaken cultural transmission and diminish educational richness [23]. Additionally, digitization has sparked ethical and cultural controversies across various fields. Challenges related to privacy protection, data ownership, and technological transparency have emerged in digital applications [24]; issues such as digital image manipulation and copyright disputes have raised concerns about cultural authenticity, privacy risks, copyright conflicts, and shifts in societal values [25].

2.3. Application of Sentiment Analysis in Anthropology and Public Engagement in ICH Museums

1. Anthropological Foundations of Sentiment Analysis

Sentiment semantics has emerged as a promising interdisciplinary approach to understanding cultural interactions. In his concept of “thick description”, Clifford Geertz (1973) emphasized that emotions are transmitted through cultural symbol systems, serving as a key to interpreting cultural displays and their intrinsic meanings [26]. The works of scholars such as Claude Lévi-Strauss's ‘Tristes Tropiques’, Marjorie Shostak's ‘Nisa: The Life and Words of a !Kung Woman’, and Pierre Bourdieu's ‘The Weight of the World’ integrate ethnography with emotional theory, providing an anthropological lens for sentiment semantics analysis [27–29].

2. Importance of Public Engagement

The core of digital preservation for intangible cultural heritage (ICH) lies in user interaction and engagement. By leveraging social media and other digital platforms,

ICH has gradually become embedded in everyday life, enhancing its accessibility and interactivity [30]. However, due to insufficient digital capabilities, many traditional ICH museums struggle to meet contemporary audiences' expectations for digital experiences. This disconnect highlights a persistent gap between cultural transmission and audience needs [31–33]. This misalignment underscores the critical importance of deeply exploring user needs and optimizing interactive experiences for the preservation of intangible cultural heritage.

3. Current Research on Sentiment Analysis

In recent years, sentiment analysis has gradually expanded from the fields of computer science and linguistics into cultural studies, emerging as a novel quantitative tool for interpreting emotional interactions within cultural contexts [34]. Research in this domain has focused on algorithm refinement [35] and applications in online product reviews [36] and social media texts [37]. However, there remains a significant gap in exploring the emotional experiences of the audience within the context of ICH museums. Although Wabiser and Singgalen (2024) employed machine learning algorithms to analyze Wamena's cultural heritage narratives [38], further progress is needed in understanding cultural contexts, capturing the dynamic nature of intangible heritage, and refining audience profiling.

2.4. Research Gaps and Contributions

In summary, while significant progress has been made in the preservation of intangible cultural heritage (ICH) across cultural transmission, digital development, and social meaning construction, the study of audience experiences in peripheral ICH museums remains underexplored. These museums face compounded challenges in cultural preservation, technological adaptation, and resource allocation, and the lack of user-experience-based data support may exacerbate the risk of heritage loss.

3. Methods

This study develops the Identity and Sentiment-Centered Framework for Intangible Cultural Heritage (IEC-ICH) to guide the analysis and enhancement of user engagement in ICH museums. The framework, drawing from Lauren Vargas's *Smart Media Museums in the New Data Terroir*, integrates interdisciplinary methodologies that merge anthropological insights with advanced digital techniques [39]. As shown in Figure 1, the framework comprises five key steps:

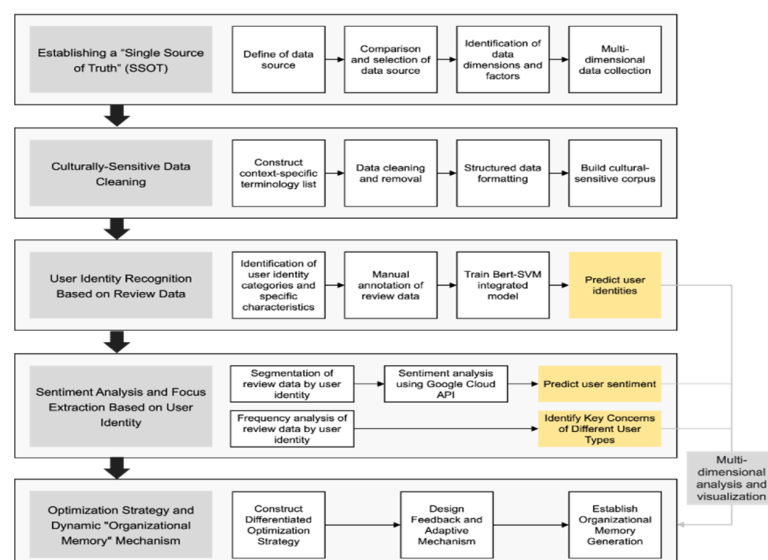


Figure 1. IEC-ICH (created by the authors).

Step 1: Establishing a Single Source of Truth (SSOT). Based on the anthropological method of “digital ethnography”, this step integrates multi-dimensional data sources to support identity recognition and sentiment analysis. The Single Source of Truth (SSOT) is a data management concept designed to create a unified and reliable data source within an organization, ensuring that all shared and utilized information originates from a consistent system [39].

Social media serves as one of the most critical platforms for promoting public participation in heritage preservation [40]. In this study, data sources are systematically compared and selected based on the research field. Data dimensions and indicators are established, with relevant information extracted from platforms such as text-based platforms (Weibo, Xiaohongshu, and WeChat official accounts), short-video platforms (Douyin (TikTok) and Kuaishou), and service review platforms (Ctrip, Dianping, and Mafengwo). The collected data encompass multi-dimensional metrics, including comments, likes, and views. These metrics form the foundation of a robust dataset for subsequent analysis, ensuring consistency and reliability across all information sources.

Step 2: Data Cleaning with Localized Knowledge. To preserve cultural authenticity, this step constructs a region-specific and culturally sensitive corpus by systematically cleaning the collected data. The process includes:

- Localized glossary developments: Based on field research and literature, a glossary specific to the region’s ICH symbols, dialect expressions, and metaphorical terms is created to avoid cultural dilution during data cleaning.
- Data cleaning and structuring: Redundant and irrelevant data are removed, and the remaining data are structured according to standardized formats across dimensions.
- Corpus creation: The result is a diverse corpus that supports big data analysis while maintaining cultural authenticity, enabling the “digital representation of cultural symbols”.

This step minimizes the risk of cultural dilution and ensures the dataset reflects the region’s specific characteristics.

Step 3: User Identity Recognition from Review Data. From an anthropological perspective, exploring the motivations and purposes behind user comments on intangible cultural heritage (ICH) museums is an important means of analyzing cultural interactions between museums and users, as well as optimizing exhibition strategies [41]. As one of the leading figures in the field of museum audience research, John H. Falk’s *Identity-Related Visitor Motivation Model* provides an innovative framework for user identity studies. This model focuses on individual identity needs, analyzing visitor motivations, behaviors, and meaning—making processes, thus transcending the traditional demographic—based paradigm [42]. Although some scholars argue that this model downplays the diversity of visitors’ life contexts [43], Falk, through long-term research and interdisciplinary integration, has constructed a dynamic predictive model supported by “Pragmatism”, providing a systematic perspective for understanding visitor behavior [44].

This study adopts Falk’s classification system to categorize audience identities into five types: Explorer, Experience Seeker, Professional/Hobbyist, Recharger, and Facilitator. Multiple rounds of manual annotation are then conducted on the selected text data using keyword examples as references (see Table 1). Subsequently, a BERT-SVM integrated model is utilized for the intelligent identification of user identities: first, fine-tuning BERT to achieve vectorization of text comments; second, constructing a classification model using SVM combined with SMOTE to address the class imbalance in label data; and third, applying the model to identify user roles across all comment data and analyze the composition of user groups in intangible cultural heritage (ICH) museums.

Table 1. Introduction and challenges of four types of ICH museums in Eastern Sichuan (created by the authors).

Name	Established (Time and Location)	Scale and Character	Cultural Features and Significance	Pain Points and Technical Bottlenecks	Current Applications of Metaverse and Digital Twin
Wang Shadow Puppetry Museum	2003, Langzhong Ancient City, Nanchong, Sichuan	Non-state museum; collection of over 2000 shadow puppets	Preservation and inheritance: Shadow puppetry has been passed down since the Kangxi period. Recognized as UNESCO World intangible cultural heritage and a National ICH.	Aging audience: Low participation from younger visitors. Limited resources: Lacks an independent digital promotion platform.	Initial digital archives established; some works included in the Shadow Art app by Chinese Zhihui Toying.
Fanshan Jiaozi Base	2017, Royal Mountain, Pingchang, Bazhong, Sichuan	State-owned ICH heritage base; 300 sqm area with over 300 photos and 100 artifacts on display	Ritual performances: A male dance tradition integrated into rural wedding and social ceremonies. Recognized as a National ICH.	Low social recognition: Limited dissemination range. Space constraints: Limited conditions for physical exhibitions.	Primarily 2D recordings, with metaverse platforms undeveloped.
Daotai Courtyard	2019, Xiexing, Guang'an, Sichuan	Privately operated museum; collection of over 10,000 items	Historical significance: Restored former residence of Daotai Zheng Renqing, Shanxi Hedong Military Inspector during the Qianlong period. Preservation and transmission of Eastern Sichuan folk culture through the venue.	Unclear market positioning: Insufficient accuracy in branding as a "popular photo spot". Funding shortages: Development relies on local support.	Digital displays remain confined to physical exhibit modes.
Digital Hall	2019, Dazhou, Sichuan	State-operated public cultural venue; 750 sqm exhibition space	Comprehensive: Covers 10 categories of ICH, including folk literature, traditional dance, and music. Innovative: Uses VR and other digital technologies for ICH display.	High maintenance costs: Digital platform stability is inadequate. Limited reach: Local focus restricts broader impact.	Digital display platform established with some interactive features, though digital applications require improvement.

Step 4: Sentiment Analysis and Focus Extraction. Reviews are categorized according to the user identities identified in previous steps. Each review is then analyzed using the Google Cloud Sentiment Analysis API to determine its emotional orientation and intensity. These data are used to evaluate how well the museum's services align with the needs of different user roles based on their emotional feedback. Additionally, leveraging the localized glossary developed in Step 2 and the Jieba Chinese word segmentation database, a frequency analysis of terms in user reviews is conducted. This process identifies user concerns and links them to specific features of the museum, providing insights into the alignment between user needs and museum offerings.

Step 5: Optimization Strategies and Establishing Dynamic "Organizational Memory". By synthesizing the findings from user identity analysis, sentiment analysis, and focus extraction, this step develops strategies for enhancing ICH museums in three key areas: differentiated user targeting, improvement of service experiences, and refinement of service content. These strategies aim to build a dynamic relationship between localized knowledge and the diverse characteristics of visitor groups. Furthermore, a cyclical feedback mechanism integrates the results from the current analysis phase into subsequent data collection and evaluation processes. This iterative approach establishes a reflexive and evolving "organizational memory", bridging local cultural heritage with the needs of modern audiences.

4. Case Analysis of Four Types of ICH Museums in Eastern Sichuan

Eastern Sichuan, a region rich in China's intangible cultural heritage (ICH), embodies a dynamic interplay of regional cultural landscapes, social structures, and historical memories. In recent years, the Sichuan Provincial Government has intensified efforts to integrate cultural resources, digitize ICH exhibitions, and promote living heritage transmission. For instance, the 2022 Sichuan Provincial *14th Five-Year Plan for Culture and Tourism* designated ICH projects in Eastern Sichuan as key targets for digital preservation support [45]. Additionally, the *8th China Chengdu International Festival of Intangible Cultural Heritage* actively promoted the Eastern Sichuan ICH Tour [46]. However, in the broader context of metaverse and digital twin technologies, ICH museums in Eastern Sichuan face multiple challenges in their digital transformation, highlighting the urgent need for deeper technological integration and enhanced resource support.

To explore the diversity of ICH types (folk crafts, traditional dance, and regional folk customs) and their varying levels of engagement with metaverse and digital twin technologies (ranging from traditional displays to digital transformation), this study focuses on four representative museums: the Wang Shadow Puppetry Museum in Langzhong Ancient City, Nanchong (Shadow Puppetry); the Fanshan Jiaozi Base in Pingchang, Bazhong (Jiaozi); the Eastern Sichuan Folk Museum in Guang'an (Daotai); and the Digital Exhibition Hall of the Dazhou Cultural Center (Digital Hall) (see Figure 2).

As shown in Table 2, Shadow Puppetry, established in 2017, aims to preserve and transmit the 350-year-old art of shadow puppetry. Its four themed halls—"Origins", "World Renown", "Local Masterpiece", and "Training Base"—showcase the cultural and technical aspects of shadow puppetry [47]. Despite establishing a digital archive, its digital efforts remain basic and relatively simplistic. Jiaozi, a project of the Pingchang Cultural Center in Bazhong, was recognized as a national-level ICH item in 2008. Originating in the seventh year of the Xianfeng era in the Qing Dynasty, Jiaozi is a lively folk dance featuring drum performances, named for its resemblance to traversing mountains. Over generations, it has evolved into a celebratory dance used in weddings and birthdays. However, its digitization is limited to 2D visual recordings and lacks multidimensional dynamic presentations. Daotai in Guang'an, rebuilt in 2016, integrates historical architecture with

local culture, focusing primarily on static exhibitions. Originally constructed during the Kangxi reign of the Qing Dynasty, the Daotai residence was restored as Guang’an’s first cultural venue combining collection, exhibition, experience, and education [48]. Yet, its digital transformation is almost nonexistent, with no application of metaverse or digital twin technologies. In contrast, Digital Hall (formerly Daxian District Cultural Center), established in 1978, has adapted over time to changing administrative boundaries and cultural needs. Its ICH Digital Exhibition Hall offers basic VR interactive experiences, but integration with advanced metaverse and digital twin technologies remains at a nascent stage [49].

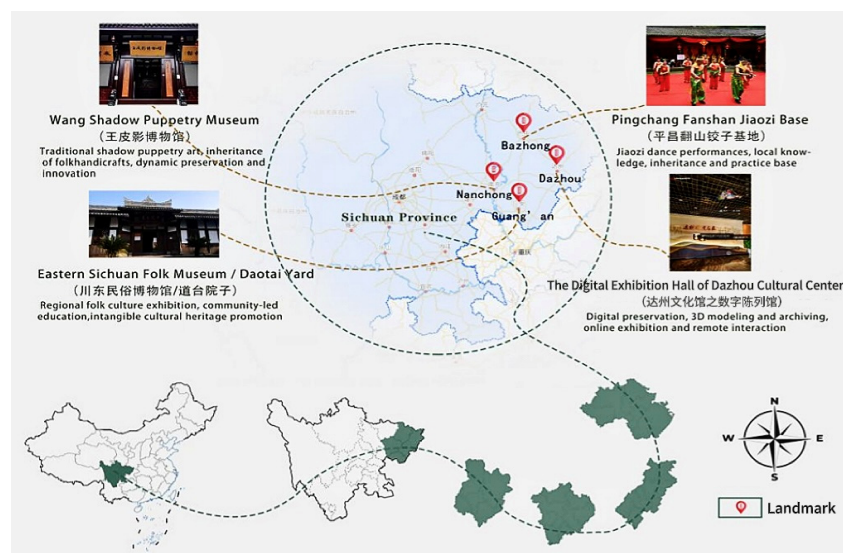


Figure 2. Location map of ICH museums in Eastern Sichuan, China (created by the authors).

Table 2. Key terms in the ICH museum corpus (created by the authors).

No.	Term (English and Chinese)
1	Daotai Courtyard (道台院子)
2	Guang’an Eastern Sichuan Folk Museum (广安川东民俗博物馆)
3	Wang Shadow Puppetry Museum (王皮影博物馆)
4	Langzhong Ancient City (阆中古城)
5	Jiaozi (翻山饺子)
6	Wang Shadow Puppetry (王皮影)
7	Wang Biao (王彪)
8	Jiaozi (饺子)
9	Guang’an (广安)
10	Eastern Sichuan (川东)
11	Pingchang (平昌)
12	Bazhong (巴中)
13	Nanchong (南充)
14	Shadow Puppetry Museum (皮影博物馆)
15	National Intangible Cultural Heritage (国家非物质文化遗产)
16	Chengdu International ICH Festival (成都国际非遗节)
17	Intangible Cultural Heritage (非物质文化遗产)

In summary, while these museums actively explore localized practices and foster community collaboration, their digital applications are largely focused on static collection and display, with limited progress in dynamic modeling and immersive experiences. Technological limitations, combined with resource constraints and geographic remoteness, further exacerbate digital inequalities.

4.1. Data Collection and Cleaning

This study aims to construct a comprehensive visitor experience dataset through multi-platform data collection and cleaning, with a particular focus on feedback from groups such as young audiences, cultural enthusiasts, and tourists. Due to the niche nature of the research subjects and the absence of relevant data on certain service evaluation platforms, multiple platforms were utilized as a Single Source of Truth (SSOT). Data were gathered from text-based, short-video, and service evaluation platforms.

1. Data Sources and Collection

In existing studies analyzing text data from public platforms related to public cultural service facilities, common data sources typically fall into the following categories:

Content publishing platforms characterized by real-time updates and broad information coverage, such as Weibo, Toutiao, and WeChat Public Accounts.

Recommendation and review platforms closely tied to daily life, such as Meituan, Dianping, Ctrip, Qunar, Tuniu, and Mafengwo.

Emerging social media platforms that primarily host short videos and multimedia content, such as Douyin (TikTok), Kuaishou, and Xiaohongshu.

Using the names of the four museums as search terms, a preliminary review revealed that the second category of platforms had relatively limited information, with most data concentrated on Xiaohongshu and Douyin. This indirectly indicates that the promotion and reviews of local folk museums are more prevalent on emerging social media platforms.

By analyzing the page structure and interface characteristics of Xiaohongshu and Douyin, packet capture tools were used to intercept network requests related to searches and comments, identifying API parameters and data formats. For dynamically loaded content, browser automation tools simulated user behavior, including logging in, searching, and scrolling, to retrieve complete comment data. To address anti-scraping mechanisms, methods such as disguising request headers, rotating proxy IPs, and controlling request frequency were implemented. The extracted HTML data were parsed to obtain key fields, including user information, note content, comment content, and publication time, which were stored in a structured CSV file format. The dataset includes 155 articles and 670 comments from Xiaohongshu, as well as 665 articles and 14,523 comments from Douyin, totaling 16,013 entries. The temporal range for the publication of these articles and comments spans from 11 September 2018 to 12 August 2024.

2. Data Cleaning and Corpus Construction

In accordance with the principles of “cultural sensitivity” and “de-redundancy”, and with the inclusion of manual review, irrelevant and unclear data, such as entries containing only ambiguous emoticons or lacking meaningful content, were removed during the data cleaning process. As a result, the dataset was refined to include 15,212 valid entries, distributed as follows: 558 entries for the Shadow Puppetry Project, 10,682 for the Jiaozi Project, 2099 for the Daotai Project, and 1873 for the Digital Hall Project. These data encompass user feedback from four intangible cultural heritage (ICH) museums in Eastern Sichuan, providing a foundation for analyzing user experiences, needs, and cultural heritage transmission.

The cleaned corpus focuses primarily on user comment content and supplements the results of dictionary-based segmentation with keywords not covered in existing dictionaries. The keyword supplementation was conducted across the following four dimensions, as detailed in Table 2.

Names of folk museums directly related to this study, such as “Daotai Courtyard (道台院子)”; place names associated with the locations of the museums, such as “Guang’an (广安)”; names of representative figures related to the museums, such as “Wang Biao (王彪)”; and relevant titles associated with the museums, such as “National Intangible Cultural Heritage (国家级非物质文化遗产)”.

4.2. User Identity Recognition for ICH Museums

4.2.1. Identity Types and Annotation Principles

In this study, the construction of identity labels is approached not as a mere classification problem but as an in-depth interpretation of keywords and emotional responses within the textual content of participants at Eastern Sichuan ICH museums, reflecting a “human-centered” systematic analytical framework. Based on Falk’s audience identity classification model, the identity labels of ICH audiences are categorized into the following five types:

- **Explorer:** Visitors seeking knowledge and novel personal experiences. They prefer delving into the historical background and cultural context of museums, showing a high level of interest in traditional ICH content.
- **Experience Seeker:** Focused on the interactivity and entertainment value of museums, these visitors enjoy immersive cultural activities, such as live performances and interactive displays. For them, museums serve as platforms for socializing and self-expression, often shared as “photo-worthy spots”.
- **Professional/Hobbyist:** Visitors with strong professional backgrounds or hobbies related to ICH. They typically engage deeply with project details, craftsmanship, and collections.
- **Recharger:** These visitors view museums as places for relaxation and leisure, seeking mental and emotional reprieve. Their experiences are often characterized by a lighthearted and pleasant emotional experience, emphasizing tranquility and aesthetic enjoyment.
- **Facilitator:** This group consists of emotionally indirect participants who primarily accompany others during visits rather than having an intrinsic interest in the museum’s content.

The definitions of the five categories, as outlined above, served as the foundation for data annotation. To ensure that annotators comprehended the categories clearly and to maintain consistency in the labeling process, detailed characteristics for each category—such as the motivations and objectives of visitors, visit frequency, and behaviors—were explicitly delineated. Corresponding keywords from the comments that relate to these characteristics were also provided, as shown in Table 3.

To ensure the reliability and validity of the annotations, a three-round annotation process was implemented. In the initial round, junior researchers performed the annotations individually, flagging instances where the classification of comments was ambiguous or unclear. In the second and third rounds, the annotations were carefully reviewed and validated by experts in anthropology and intangible cultural heritage studies, who assessed and confirmed the initial annotations.

Table 3. Falk (2016) museum visitor identity classification model (created by the authors).

No.	Participant Role Classification	Characteristics	Keywords
0	Explorer (Falk, 2016, pp. 198–200)	<p>Visit Motivations and Objectives: Strong Curiosity; expand the horizons; non-professional; self-directed learning</p> <hr/> <p>Frequency: Repeat Visits</p> <hr/> <p>Visitor Types and Behaviors: Selective attention; independence</p>	Learning, fun, revisit, knowledge, reading, educational forget, steep learning curve, brain vacation more literate, expand their horizons.
1	Experience Seeker (Falk, 2016, pp. 205–208)	<p>Visit Motivations and Objectives: Experience collection; socially and recreationally driven; non-professional interest; the whole package—exhibits, food, gifts, and a good time; pursuit of uniqueness; “must-see” destinations within a community</p> <hr/> <p>Frequency: Non-regular visitor</p> <hr/> <p>Visitor Types and Behaviors: Hybrid visitor type; price sensitivity</p>	Tourist, new, once a year, concert, restaurant, food, once in a while, participating, once-in-a-lifetime, experience
2	Professional/Hobbyist (Falk, 2016, pp. 209–213)	<p>Visit Motivations and Objectives: Professional/Hobbyists motivation; desire for specific knowledge; critical evaluation</p> <hr/> <p>Frequency: Not necessarily frequent visitors</p> <hr/> <p>Visitor Types and Behaviors: Targeted mission less socially motivated; conscious and specific purpose</p>	History, teacher, ideas, convey, tough concepts, professional, close-up images, books
3	Recharger (Falk, 2016, pp. 213–215)	<p>Visit Motivations and Objectives: Mental rejuvenation; spiritual tranquility; aesthetic beauty; inspiration</p> <hr/> <p>Frequency: Intentional visits; purposeful</p> <hr/> <p>Visitor Types and Behaviors: personal aesthetics; pleasure seeking; non-educational</p>	Reflect, rejuvenate, beautiful building, look at the space, quiet, introspection, mental relaxation, soul, God’s creation, restorative experiences
4	Facilitating Parents	<p>Visit Motivations and Objectives: Meeting the needs and interests of children or grandchildren; personal intellectual interests secondary to children’s needs; other-oriented experiences</p> <hr/> <p>Frequency: Visit frequency depends on child-appropriate offerings</p> <hr/> <p>Visitor Types and Behaviors: Prone to share children’s educational experiences</p>	Children/ kids, fun place for kids, run around, interact, native habitat, nature learning, sneak it in there
	Facilitating Socializers (Falk, 2016, pp. 201–205)	<p>Visit Motivations and Objectives: Meeting the needs and interests of another adult; personal intellectual interests secondary to another’s needs social venue; other-oriented experiences</p> <hr/> <p>Frequency: Visit frequency depends on social needs</p> <hr/> <p>Visitor Types and Behaviors: Attracted by marketing and promotion; price sensitivity</p>	Opportunity, art, lukewarm, friend, together, meet people, social place

4.2.2. User Identity Recognition Based on BERT and SVM

1. BERT Embedding Generation

To obtain deep semantic representations from text, the BERT-based Chinese pre-trained model was used. BERT utilizes a stacked Transformer architecture to generate contextually rich word embeddings for the input text sequences. For a given input sequence $\{t_1, t_2, \dots, t_n\}$, the model generates the following outputs:

$$H = [h_0, h_1, \dots, h_n] \in \mathbb{R}^{n \times d}$$

Here, h_0 represents the embedding of the [CLS] token, which is used for sentence-level global semantic representation. The embedding h_0 is extracted as the text feature for subsequent classification tasks. To enhance model performance, the BERT model is fine-tuned by adding a fully connected layer to the output layer:

$$Z = Wh_0 + b$$

where $W \in \mathbb{R}^{|\mathcal{C}| \times d}$, $b \in \mathbb{R}^{|\mathcal{C}|}$.

The category probability distribution is calculated using the Softmax function:

$$p(c|h_0) = \frac{\exp(z_c)}{\sum_{c' \in \mathcal{C}} \exp(z_{c'})}$$

During fine-tuning, the cross-entropy loss function is adopted as the optimization objective:

$$\mathcal{L} = -\frac{1}{N} \sum_{i=1}^N \sum_{c=1}^{|\mathcal{C}|} y_{i,c} \log p(c|h_0^{(i)})$$

where $y_{i,c}$ represents the one-hot encoding of the true class label for the i -th sample.

2. Data Dimensionality Reduction

To address the issue of imbalanced class distribution, which may negatively affect the performance of the classification model, SMOTE (Synthetic Minority Oversampling Technique) is applied. SMOTE generates synthetic samples for the minority class using the following formula:

$$x_{new} = x_i + \lambda(x_j - x_i) \quad \lambda \sim Uniform(0,1)$$

where x_i and x_j are instances from the minority class and λ is a random value between 0 and 1.

3. SVM Classifier and Hyperparameter Optimization

After feature generation, the SVM is used as the classifier. Given the features and class labels, the objective of the SVM is to find the optimal separating hyperplane. The decision function is defined as:

$$f(x) = \text{sign}(w^T x + b)$$

The optimization objective is to maximize the classification margin by solving the following:

$$\min_{w,b} \frac{1}{2} \|w\|^2 + C \sum_{i=1}^N \max(0, 1 - y_i (w^T x_i + b))$$

To enhance model performance, grid search is employed to select the optimal hyper-parameters. Five-fold cross-validation is used to evaluate the model:

$$Score = \frac{1}{K} \sum_{k=1}^K Accuracy(D_k^{test})$$

The final selected optimal parameters, as shown in Table 4, are used to train the classifier. Table 5 presents the validation metrics (precision, recall, F1-score, accuracy, and average score) for the five classes of the model.

Table 4. Details of model training data and parameter settings (created by the authors).

Title 1	Description
Training dataset	Explorer(0): 73 Experience Seeker(1): 108 Professional/Hobbyist(2): 42 Recharger(3): 38 Facilitator(4): 59
Parameter setting	C: 0.1 Class weight: balanced Kernel: linear
Accuracy	0.875
Score	0.9375

Table 5. Model validation metrics (created by the authors).

Class	Precision	Recall	F1-Score	Support	
0	1.00	1.00	1.00	5	
1	0.90	0.75	0.82	12	
2	0.86	0.86	0.86	7	
3	0.67	1.00	0.80	2	
4	0.86	1.00	0.92	6	
Accuracy	0.875				
Cross-validation Scores	0.885	0.917	0.958	0.969	0.958
Average Score	0.9375				

4. Evaluation and Model Saving

The model performance is evaluated using metrics, such as accuracy, defined as follows:

$$Accuracy = \frac{Number\ of\ Correst\ Predictions}{Total\ Number\ of\ Predictions}$$

$$Precision = \frac{TP}{TP+FP}, Recall = \frac{TP}{TP+FN}, F1 = 2 \cdot \frac{Precision \cdot Recall}{Precision+Recall}$$

Based on the analysis of identity label data from the four museums, the “Explorer” group dominates across all museums. Audience distribution for the Shadow Puppetry Museum and the Daotai Museum, with the ‘Explorer’ category excluded, as shown in Figure 3. Specifically, the audience composition for these two museums, ranked by proportion from highest to lowest, are as follows: Experience Seekers at 53% and 59%, Rechargers at 19% and 23%, Professionals/Hobbyists at 17% and 13%, and Facilitators at 11% and 5%, respectively.

In contrast, the identity distributions for the Jiaozi Base and the Digital Hall display significant differences. For these two museums, audience proportions rank as follows: Experience Seekers at 54% and 55%, Professionals/Hobbyists at 18% and 29%, Rechargers at 16% and 12%, and Facilitators at 12% and 4%, respectively. Among these, the Jiaozi Base demonstrates a relatively balanced distribution across all categories, while the Digital Hall

shows a pronounced imbalance, particularly with Rechargers and Facilitators, whose combined proportion accounts for less than 20%.

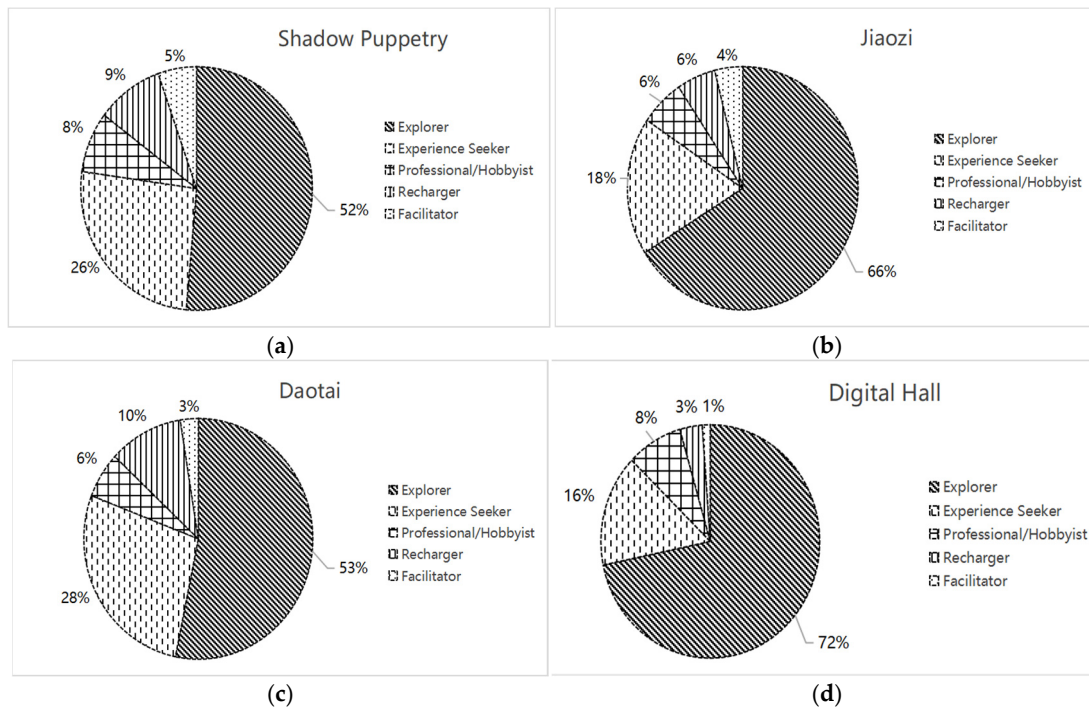


Figure 3. Composition of the five user identity types across four ICH museums (created by the authors). (a) Distribution chart of the five identity labels for Shadow Puppetry; (b) distribution chart of the five identity labels for Jiaozi; (c) distribution chart of the five identity labels for Daotai; (d) distribution chart of the five identity labels for Digital Museum.

Among the four venues, the Jiaozi Base demonstrates a relatively balanced distribution across all categories, reflecting a diverse audience base. In contrast, the Digital Hall shows a pronounced imbalance, particularly in the Rechargers and Facilitators, whose combined proportion accounts for less than 20% of its total audience.

Notably, Facilitators account for only 5% of the audience for the Daotai Museum, ranking second-to-last, and a mere 4% of the Digital Hall, marking the lowest proportion observed among all museums.

4.3. Sentiment Analysis and Focus Extraction Based on User Identity

4.3.1. Sentiment Analysis Based on User Identity

Sentiment analysis of user comments was conducted using the Google Cloud Sentiment Analysis module, focusing on two key metrics: Sentiment Polarity and Sentiment Intensity. The sentiment analysis method is integrated into Google's Natural Language API. Although the specific models and parameters of the API are not publicly disclosed, this method has been widely applied in various text analysis tasks. The sentiment analysis method, as part of Google's Natural Language API, has been employed in numerous applications despite the underlying models and parameters not being open-sourced. For instance, Hotchkiss et al. utilized Google NLP API's sentiment analysis method to analyze themes and sentiments in caregiver reviews related to hospice care in the United States [50]. Similarly, Nugroho et al. applied Google NLP API for sentiment analysis on feedback datasets provided by higher education students [51]. Additionally, Pandey et al. leveraged Google NLP to analyze sentiment in 100,000 tweets containing topics such as "COVID-19" and "Coronavirus", providing insights into public emotions during the COVID-19 outbreak [52].

Sentiment polarity ranges from -1 to 1 , where -1 to 0 indicates negative sentiment, and 0 to 1 indicates positive sentiment. Sentiment intensity measures the strength of the sentiment, with values ranging from 0 to positive infinity, where higher values indicate stronger emotional intensity.

For each user role within the four museums, the mean sentiment polarity and intensity were calculated. The results, presented in Figure 4, provide a comparative analysis of sentiment metrics both within each museum and across museums.

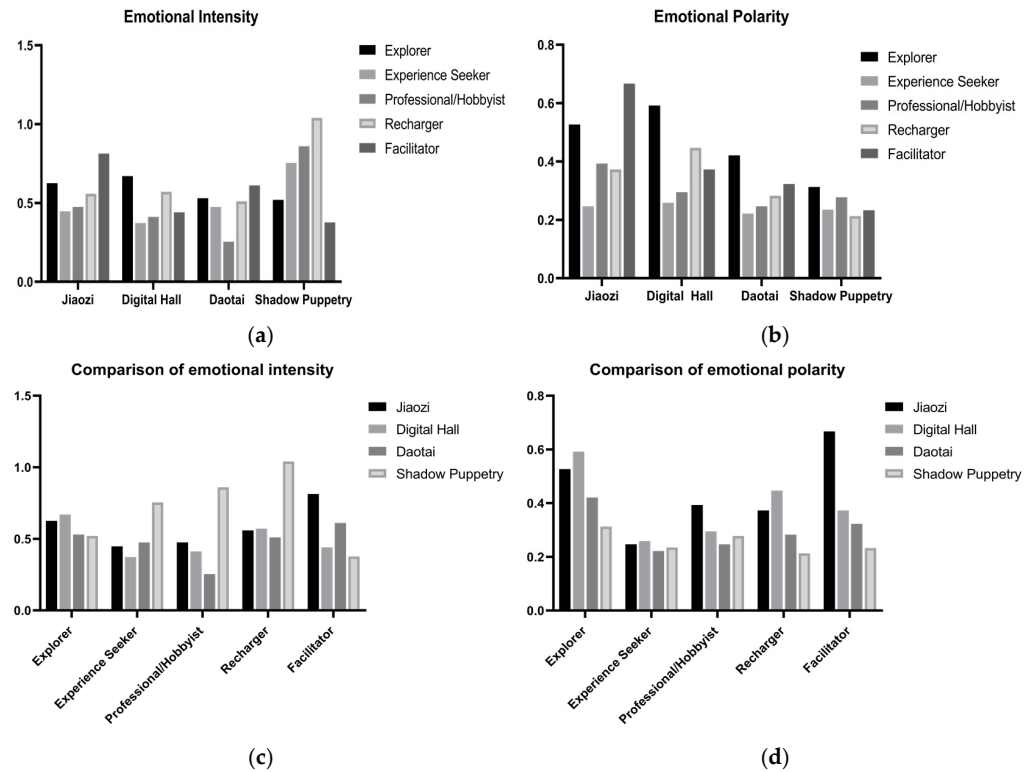


Figure 4. Comparison of sentiment polarity and intensity across user identity types in four museums (created by the author). (a) Figure showing the comparison of emotional intensity by identity labels; (b) figure showing the comparison of emotional polarity by identity labels; (c) figure showing the comparison of emotional intensity among four museums; (d) figure showing the comparison of emotional intensity among four museums.

In terms of sentiment polarity, the Jiaozi Base exhibited significant variability, with “Explorers” (0.527) and “Facilitators” (0.667) standing out as the most positively engaged groups. The Digital Hall displayed overall stability, with “Explorers” scoring 0.592 and “Rechargers” 0.447, while other roles, including “Experience Seekers (0.259)” and “Professionals/Hobbyists” (0.295), showed relatively balanced polarity. The Daotai Museum showed a consistent profile, with “Explorers” achieving the highest polarity at 0.421, while other roles ranged between 0.2 and 0.3. In contrast, the Shadow Puppetry Museum exhibited weaker sentiment across all categories, particularly for “Explorers” (0.313) and “Experience Seekers” (0.235).

When comparing museums, the Digital Hall performed best in sentiment polarity for “Explorers” (0.592), “Experience Seekers” (0.259), and “Rechargers” (0.447). The Jiaozi Base excelled in “Professionals/Hobbyists” (0.393) and “Facilitators” (0.667). Notably, sentiment polarity for “Experience Seekers” showed minimal variation across museums, with scores ranging from 0.222 (Daotai) to 0.259 (Digital Hall).

For sentiment intensity, the Jiaozi Base maintained stability across most categories, with “Facilitators” standing out at 0.813. Similarly, the Digital Hall exhibited consis-

tency, with “Explorers” achieving the highest intensity at 0.67. The Daotai Museum displayed moderate sentiment intensity, with slight increases for “Experience Seekers” (0.475) and “Facilitators” (0.611), while other categories were comparatively lower. The Shadow Puppetry Museum demonstrated the highest sentiment intensity overall, particularly for “Rechargers” scoring an impressive 1.04—the only value exceeding 1 among all museums.

When comparing museums, intensity values for “Explorers” was closely aligned, differing by less than 0.1 across the four museums. For “Experience Seekers”, “Professionals/Hobbyists”, and “Rechargers”, the Shadow Puppetry Museum displayed significantly higher intensity, with scores steadily increasing to 0.754, 0.86, and 1.04, respectively. However, in the “Facilitators” category, the Shadow Puppetry Museum had the lowest intensity at 0.377, while the Jiaozi Base recorded the highest at 0.813.

These findings underscore the emotional engagement dynamics among user roles and museums. They provide valuable insights for developing strategies to enhance visitor experiences and foster deeper cultural connections.

4.3.2. Focus Extraction for Each Museum Based on User Identity

To analyze the key areas of focus for different user identities, comment data were categorized based on the user identity labels associated with each comment. The Jieba segmentation tool was applied to tokenize the comment texts for each identity group, with a customized dictionary incorporated to enhance the model’s ability to recognize localized terms (as shown in Table 2).

In the current field, word frequency statistics are often treated as a prerequisite for textual semantic analysis, such as for identifying textual label dimensions. For example, Liu et al. used word frequency statistics to identify key category labels in restaurant reviews from Meituan and Weibo for Shanghai’s urban districts [53], while Wang and Zhuang employed this method to identify high-frequency words in reviews of historical districts on TripAdvisor and Ctrip, clarifying evaluation dimensions [54]. Although word frequency statistics may seem limited for deep semantic analysis, the texts in this study have already been categorized by audience type using deep learning methods. This makes word frequency analysis a straightforward and effective tool for identifying features of comments from different visitor groups, highlighting a methodological distinction from traditional studies by integrating sentiment analysis and word frequency within an audience-focused framework.

Specifically, for a given museum, a sequence of comment texts $D = \{T_1, T_2, \dots, T_n\}$ corresponding to a certain user identity is provided. Each T_i represents an individual comment record, which is tokenized into a sequence of words $W_i = \{w_{i1}, w_{i2}, \dots, w_{im}\}$ through segmentation. This process can be expressed as:

$$W_i = jieba.lcut(T_i)$$

The segmentation results for all comments under a given identity were then combined to form a complete word list $W = \cup_{i=1}^n W_i$, serving as input for frequency analysis. For each word w in the list, its frequency $f(w)$ was calculated as:

$$f(w) = \sum_{i=1}^n \sum_{j=1}^{m_i} \mathbb{I}(w = w_{ij})$$

where \mathbb{I} is an indicator function, taking the value 1 when $w = w_{ij}$, and 0 otherwise. The statistical results produced a set of words and their corresponding frequencies, which were then sorted in descending order for subsequent analysis.

To refine the results, word frequency lists for each user identity were manually screened to remove punctuation marks and generic terms unrelated to the museum’s characteristics, such as “really”(真), “you”(你), and “is”(是). After screening, the cleaned word list was visualized, and we incorporated the corresponding on-site images of the museum, as shown in Figures 5–11. This process highlights the key areas of focus for different user identities, providing valuable insights into user perceptions and preferences for each museum.

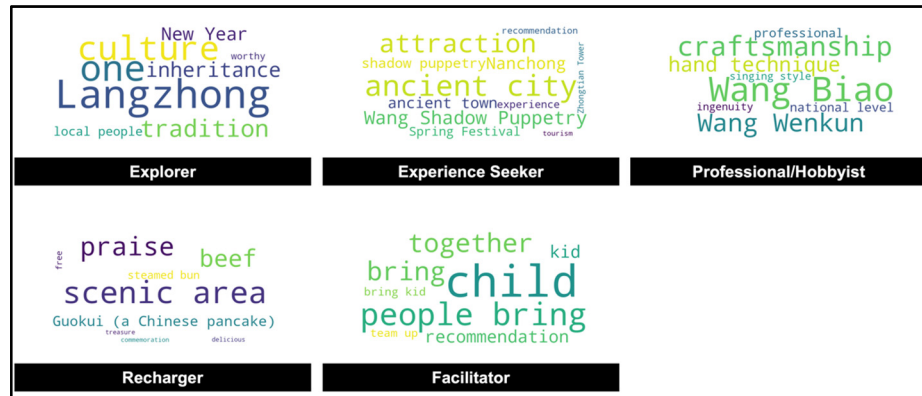


Figure 5. Keyword word cloud for different user identities in the Wang Shadow Puppetry Museum (created by the authors).



Figure 6. Exhibition and traditional performance areas of the Wang Shadow Puppetry Museum. (a) Exhibition and traditional performance areas of the Wang Shadow Puppetry Museum; (b) traditional performance areas of the Wang Shadow Puppetry Museum.

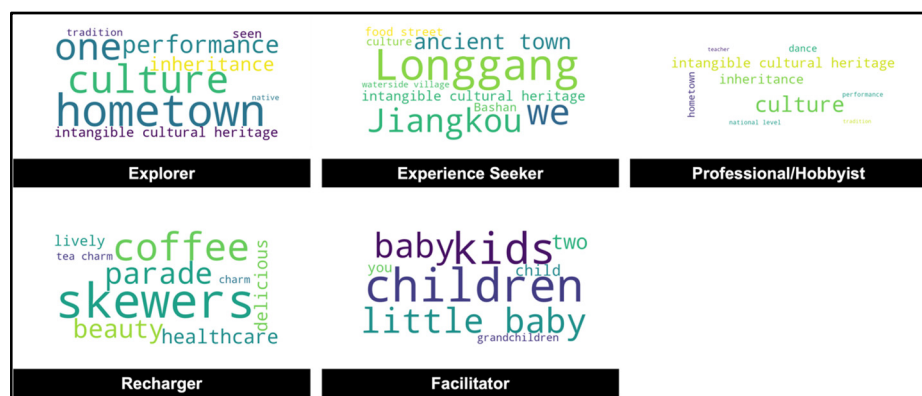


Figure 7. Keyword word cloud for different user identities in the Fanshan Jiaozi Base (created by the authors).



Figure 8. Interpretation activities and dance performance scenes at the Fanshan Jiaozi Base. (a) Interpretation activities at the Fanshan Jiaozi Base; (b) dance performance scenes at the Fanshan Jiaozi Base.

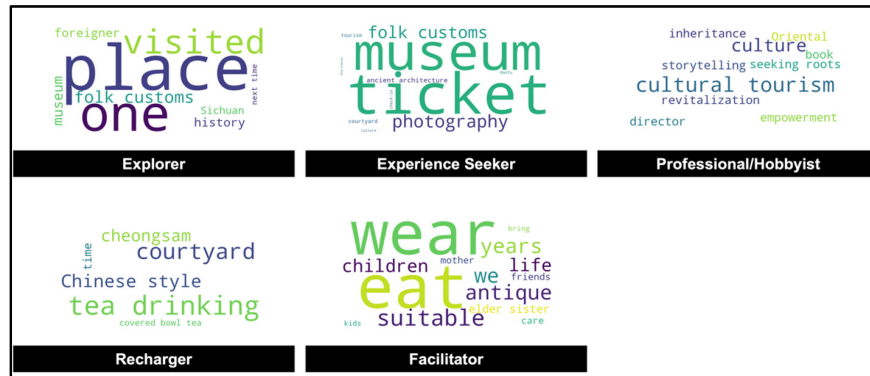


Figure 9. Keyword word cloud for different user identities in the Eastern Sichuan Folk Museum/Daotai Courtyard (created by the authors).



Figure 10. Filming scene of the promotional video and exhibition environment of the Eastern Sichuan Folk Museum in Guang'an. (a) Filming scene of the promotional video of Daotai; (b) exhibition environment of Daotai.

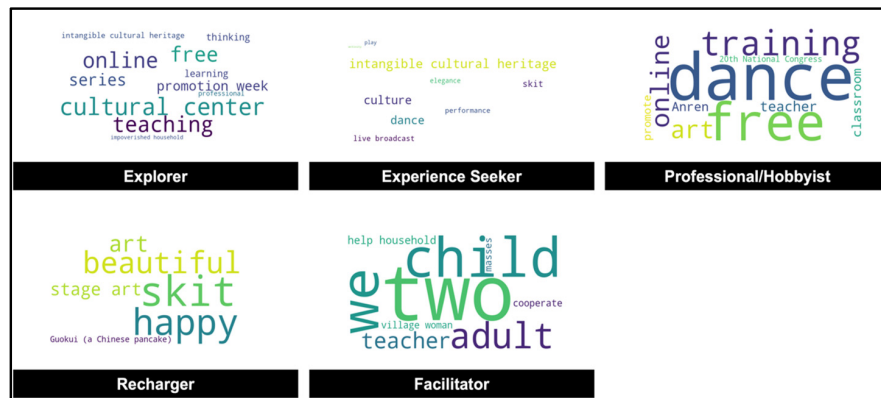


Figure 11. Keyword word cloud for different user identities in the Digital Exhibition Hall of the Cultural Pavilion (created by the authors).

The keyword analysis for the Shadow Puppetry Museum highlights distinct audience interests (Figure 5). Explorers focus on cultural sightseeing, with keywords like “langzhong” (40 mentions) and “culture” (33 mentions). Experience Seekers prefer immersive activities such as “wang shadow puppetry” (21 mentions) and emphasize cultural symbols like “spring festival” (19 mentions). Professionals/Hobbyists prioritize craftsmanship and heritage, with terms like “wang biao” (11 mentions) and “craftsmanship” (7 mentions). Rechargers seek relaxing experiences, favoring keywords like “free” (5 mentions) and “scenic area” (3 mentions). Facilitators concentrate on family-friendly activities, with terms such as “child” (10 mentions) and “together” (6 mentions). Overall, the museum integrates historical heritage and craftsmanship with diverse audience experiences to enhance cultural engagement and emotional connection, as illustrated in Figure 6.

The keyword analysis for the Jiaozi Base (Figure 7) highlights distinct audience interests: Explorers focus on hometown culture (“hometown” 119 mentions, “culture” 93 mentions); Experience Seekers prefer regional scenes and food (“longgang” 83 mentions, “jiangkou” 57 mentions); Professionals/Hobbyists emphasize ICH heritage and dance techniques (“intangible cultural heritage” 39 mentions, “inheritance” 36 mentions); Rechargers enjoy parades and food (“skewers” 14 mentions, “coffee” 10 mentions); and Facilitators prioritize family activities (“kids” 90 mentions, “children” 82 mentions). These findings reflect Jiaozi culture’s emotional resonance, cultural value, and family-friendly appeal. In Figure 8, the vibrant and lively atmosphere of the Jiaozi Base is vividly depicted.

The keyword analysis for the Daotai Museum (Figures 9 and 10) highlights varied audience interests. Explorers focus on local history, such as “place” (25 mentions), “folk customs” (14 mentions), and “sichuan history” (12 mentions). Experience Seekers show strong interest in “photography” (43 mentions), “folk customs” (41 mentions), and “hanfu”. Professionals/Hobbyists emphasize “cultural tourism” (5 mentions) and “inheritance” (2 mentions). Rechargers favor “tea drinking” (23 mentions) in traditional courtyards. Facilitators prioritize interactive experiences shared with “children” (5 mentions). Overall, the analysis reflects a comprehensive audience demand for local culture, folk experiences, and social engagement.

The keyword analysis for the Digital Hall, as shown in Figures 11 and 12, reveals diverse audience interests. Explorers show strong interest in “cultural center” (116 mentions), “online” (41 mentions), and “series of events” (23 mentions). Experience Seekers focus on “ICH projects” (362 mentions), “dance” (86 mentions), and “skit” (54 mentions). Professionals/Hobbyists prefer “dance” (32 mentions) and “training” (16 mentions). Rechargers value the “happy” atmosphere of performances (5 mentions) and “art” (3 mentions). Facilitators emphasize the need for cultural activities that involve both “children” and “adults” (2 mentions separately). Overall, the analysis highlights the audience’s multifaceted demand for ICH education, cultural events, and artistic dissemination.

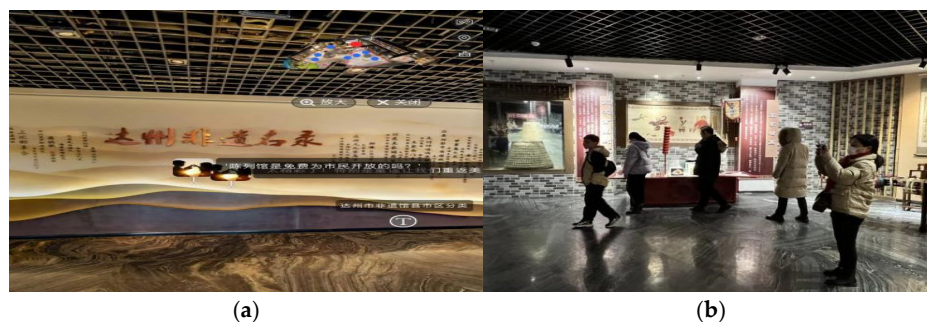


Figure 12. VR exhibition scenes and on-site interaction photos from the intangible cultural heritage Digital Exhibition Hall. (a) VR exhibition scenes from the Digital Hall; (b) on-site interaction photos from the Digital Hall.

5. Discussion

Based on an analysis of the historical context of these four types of museums, as well as their audience composition, emotional polarity and intensity, and keyword frequency statistics, this study comprehensively examines their cultural practices and social significance from an anthropological perspective. Additionally, it offers a critical reflection on and outlook on the challenges faced by these museums.

The decision to discuss the Wang Shadow Puppet Art Museum alongside the Fanshan Jiaozi Base, and the Daotai Courtyard with the Digital Museum, stems from the distinction between two types of settings. The former represents spaces characterized by “local embedding”, where cultural transmission heavily relies on local social networks and ritualistic configurations. In contrast, the latter emphasizes artistic expression and technological display, reflecting more modern and digital trends.

Shifting from “static” to “digital ecology”, and drawing on an interview with Master Wu, who has over 30 years of heritage practice, the study explores local embeddedness and digital transformation. It highlights Master Wu’s strong endorsement of this framework and underscores the social significance of his practice.

5.1. The Duality of Festivalization: Social Integration and Alienation in Eastern Sichuan’s Intangible Cultural Heritage Museums

“The festival is, in fact, a paradoxical thing; festival events function as a form of social integration and cohesion, while simultaneously they are sites of subversion, protest or exclusion and alienation. It is precisely this paradoxical nature that creates the festival’s socio-spatial and political significance for notions of community and belonging [55].”

This duality reflects the inherent complexity of festivalization in intangible cultural heritage (ICH) museums: it provides a platform for cultural identity while also risking cultural alienation.

The Nanchong Langzhong Wang Shadow Puppet Museum, as a national hub for shadow puppet art with over a century of history, illustrates these contradictions. On the one hand, festivalization elevates shadow puppet art as a symbol of cultural identity during specific moments, strengthening emotional connections between the museum and its audience. Keywords like “Spring Festival” and “tradition” highlight its central role in festive celebrations. The “Rechargers” group exhibits high emotional intensity (1.04), indicating that they find relaxation and escapism in festival-related activities. On the other hand, festivalization brings challenges of cultural alienation and rigidification. The museum’s limited online data collection (only 558 entries) reveals its shortcomings in daily communication and community engagement. Shadow puppetry risks becoming a cultural artifact reserved for “special occasions”, losing its connection to the everyday life of Langzhong Old Town and transitioning into a symbolic rather than active cultural element. This alienation is further reflected in the lower emotional intensity of the “Companions” group (0.377), showing the museum’s inability to facilitate meaningful interactions among families and friends. Festival activities often have a transient appeal, failing to extend the vitality of traditional art into sustained community interactions, thus exacerbating the marginalization of ICH in modern society. To address this dilemma, the ISC-ICH framework suggests that digitalization strategies should focus not only on broadening and deepening cultural dissemination but also on avoiding cultural alienation and community disconnection. This requires balancing the “consumptive” and “practical” aspects of culture in the digital era.

Currently, the festivalization of the Fanshan Jiaozi Base, particularly its activities during holidays or special occasions (e.g., weddings), highlights its dynamic balance between social integration and alienation. Fanshan Jiaozi serves as both a carrier of “auspicious meanings” and a social tool in the local community, fostering collective partici-

pation and identity, especially among families, parent–child groups, and friends. Emotional data reveal that the “Companions” group shows a high emotional intensity of 0.813, significantly higher than other museums. Traditional performances like “The Clanging Sound” and “The Bold Dance” attract diverse groups, generating strong emotional resonance, as reflected in the emotional fluctuations of the “Explorers” (0.527) and “Companions” (0.667). However, festivalization has led to the increasing standardization of Fanshan Jiaozi’s dances and performances. Its participant base has expanded, especially through campus outreach and popularization programs. The original dance forms, based on four fundamental techniques—striking, wiping, flipping, and spinning—have evolved into simplified versions represented by four major schools: Guo, Yue, Tan, and Wu. To meet broader public demands, Fanshan Jiaozi has been adapted into stage, fitness, and square dance versions by removing complex movements [56]. While these versions are easier to learn, they diminish the unique technical skills and cultural symbolism of the traditional form. Additionally, the cultural connotation of “exorcising evil spirits” has been largely overlooked. This evolution has eroded the 400-year-old cultural uniqueness and regional characteristics, weakening its social function and historical significance. Under the ISC-ICH framework, the core challenge for the digital development of Fanshan Jiaozi is avoiding “historical dissolution”. Digitalization must not only enhance the cultural meaning of “dancing for joy” but also delve into and highlight its regional characteristics and historical context to preserve its cultural depth and multidimensionality.

5.2. The Possibilities of Digitalization: Social Dissemination and Cultural Reproduction in Eastern Sichuan’s ICH Museums

From an anthropological perspective, digital transformation signifies profound shifts in the production, dissemination, and consumption of social and cultural practices. In the museum and cultural heritage sectors, the interaction between digital technologies and traditional culture has become a crucial academic topic, with the phenomenon of “internet celebrity (or ‘viral’) culture” serving as a prominent example of this transformation. As Black (2018) argues, digitalization is not merely a technological innovation but a redefinition of the relationship between museums and their audiences [15]. Museums have shifted from being guardians of heritage and conveyors of knowledge to providers of cultural consumption. Likewise, audiences have transitioned from cultural participants to “consumers” of culture.

The Daotai Courtyard Museum exemplifies the commodification of local culture in digital transformation. Audience data show a predominance of “Explorers” and “Experience Seekers”, while “Professionals/Enthusiasts” exhibit lower emotional engagement. This indicates that while the museum successfully attracts tourists, it lacks depth and academic rigor. The museum’s cultural symbols are heavily visualized and entertainment-oriented, promoting interaction centered on “Tea (茶)”, “Photography (拍照)” and “check-in (打卡)”. However, this approach neglects the Daotai Courtyard’s deeper social and historical roles, such as its significance as an 18th-century administrative residence during the Qianlong period.

Although this “internet celebrity” phenomenon can generate short-term traffic and economic benefits, it also introduces several issues:

- Dilution of Local Cultural Context: Failing to represent the deep historical and social relationships embedded in local administration, cultural exchange, and social structures.
- Simplified Audience Roles: Encouraging passive consumption behaviors such as “Hanfu photoshoots” and “tea drinking”, limiting audience interaction and co-creation with cultural content.

- **Decoupling of Cultural Symbols from Local Identity:** Cultural symbols are generalized for mass appeal, which weakens local uniqueness and leads to the erosion of cultural capital.

To address these tensions, the Daotai Courtyard Museum must move beyond immediate consumption toward cultural immersion by incorporating emotional dimensions, local identity, and cultural reproduction into its digital strategy. This “re-contextualization” process could restore its social and historical significance.

Similar to the “internet celebrity” tendencies of the Daotai Courtyard Museum, the Dazhou Cultural Center serves as one of the more digitally advanced examples among the four museums, utilizing popular technologies such as VR to achieve initial digitization of ICH displays. However, its content and format reveal tendencies toward standardization and homogenization. As Appadurai (1996) notes, under the influence of globalized media and technology, local cultures are often “compressed” and “reproduced”, gradually losing their unique regional characteristics [57]. The VR exhibits at the Dazhou Cultural Center rely heavily on standardized interactions and visual designs, failing to deeply explore and present Dazhou’s social memory and historical context [58]. Audience data indicate that the center’s displays primarily attract “Explorers” and “Experience Seekers”, but are less appealing to “Rechargers” and “Companions”, who value emotional connection, with both emotional intensity and engagement percentages significantly lower for these groups.

Core Issues Identified Through the ISC-ICH Framework:

- **Flattening of Local Culture:** The VR exhibits fail to reflect Dazhou’s complex history and social memory, relying on homogenized designs that lack distinct visual or narrative elements.
- **Lack of Deep Narratives:** The content focuses on surface-level spatial and scenic displays without delving into the deeper stories and meanings of local artifacts and heritage.
- **Limited Interactivity:** Interaction is restricted to basic functions like rotation and zooming, lacking advanced features such as audio narration, text pop-ups, or virtual tours, which could enhance user engagement.
- **Monotonous User Experience:** Content does not cater to diverse audience groups with layered designs, limiting its ability to meet the needs of various users.

These issues highlight the critical importance of showcasing deep social significance and fostering emotional resonance in the process of digital cultural dissemination.

5.3. From “Static” to “Digital Ecology”: Exploring the “Digital Vitality” of ICH Museums

Viewing the center from the periphery, traditional intangible cultural heritage (ICH) museums in Eastern Sichuan, China, are striving to overcome regional and resource limitations through digitalization. However, as they transition from “static presentation” to a more comprehensive “digital ecosystem”, they face significant challenges, including festivalization, trends driven by internet celebrity culture, and technological homogenization. To tackle these issues and ensure the living continuation of ICH, the adoption of dynamic and adaptive digital strategies is imperative. From an anthropological perspective, digitalization is intertwined with complex dynamics of locality, globalization, and modernity. Drawing on insights from an interview with Master Wu, a national-level ICH inheritor, along with case analyses of the Fanshan Jiaozi Base, Daotai Courtyard Museum, Wang Shadow Puppet Art Museum, and Dazhou Cultural Center, this study proposes four key recommendations for examining ICH digitalization through an anthropological lens.

1. Extending the Everyday Vitality of Culture

Festivals, through their connections with agricultural cycles, identity expression, public rituals, cultural symbolism, and economic activities, can effectively extend the everyday vitality of culture [59]. Taking the Fanshan Jiaozi Base as an example, Master Wu noted that performances are primarily concentrated during major holidays such as Spring Festival and National Day, while visitor numbers remain sparse on regular days. These short-lived celebrations need to be transformed into sustained cultural practices embedded in daily life to ensure traditions can evolve with society. To achieve this, the Fanshan Jiaozi Base and other ICH museums must explore ways to integrate their practices into local production rhythms and everyday social life. For example, the Fanshan Jiaozi Base could develop visual content, such as animated short films or interactive games, showcasing elements of traditional performance tied to local production, such as rice-field dances and farming culture. Additionally, live-streaming daily rehearsals, skill training, and community interactions could further enhance the visibility and relevance of these practices.

2. Highlighting the Uniqueness of Local Culture

The uniqueness of local culture does not exist in isolation. It is deeply embedded in its historical context, community interactions, and localized practices. The 400-year legacy of Fanshan Jiaozi, the evolution of shadow puppetry since the early Kangxi era, and the historical significance of Daotai Courtyard as an 18th-century residence all reflect the locality and cultural depth of these heritage assets. These characteristics form the core competitive advantage of ICH and should be the primary focus of digital presentations. Looking ahead, the ISC-ICH framework suggests employing virtual reality (VR) and augmented reality (AR) technologies to recreate historical scenarios associated with ICH. For instance, holographic projections could be used to reconstruct the ceremonial performances of Fanshan Jiaozi, conveying its profound cultural meaning to audiences. As Master Wu explained:

“Fanshan Jiaozi was originally used to exorcise spirits before evolving into rituals for weddings and ceremonies. The performance includes 48 distinct movements with diverse forms, such as high-platform, ground-level, and traditional versions. Performers wear long robes and masks, enhancing the mystique. The movements, paired with music, are grand and lively, creating a spectacular atmosphere.”

By integrating historical narratives with modern audience experiences, digital presentations can avoid the pitfalls of formalization and homogenization, ensuring that the unique essence of local culture is preserved and effectively conveyed.

3. Reshaping Audience Interaction

As Master Wu emphasized during the interview, “ICH should not only be watched but also experienced and interacted with”. This perspective advocates a shift from passive observation to active participation. Drawing on Geertz’s “thick description”, Bourdieu’s “logic of practice”, Appadurai’s “cultural flows”, and Turner’s “liminality”, ICH museums can enhance interaction by connecting local communities with global networks and transforming ritual transmission into emotional connections.

This involves two key strategies: inwardly, creating a “middle ground” where immersive design enables audiences to shift from “viewers” to “participatory co-creators”, and outwardly, using digital technologies, such as live streaming, social media campaigns and AR, to engage diverse audiences in the practices of Eastern Sichuan culture.

4. Constructing Intergenerational Cultural Memory

Intergenerational transmission is essential for sustaining ICH. Master Wu shared his grandson’s participation in Fanshan Jiaozi performances, highlighting how familial cultural learning not only preserves skills but also strengthens bonds across generations. To

support this, museums can develop family-oriented workshops and intergenerational performance opportunities tailored to the needs of “Companions” and “Rechargers”. They can also strengthen emotional connections across family and community by enabling interactive experiences that foster cultural continuity and resonance. These efforts ensure ICH remains a living tradition rooted in both emotional and cultural connections across generations.

From the Fanshan Jiaozi Base to the Daotai Courtyard Museum, the Shadow Puppet Art Museum, and the Dazhou Cultural Center, these institutions’ digitalization efforts reveal the interplay between locality and universality, as well as individual and collective experiences. These practices emphasize the importance of “digital vitality” in preserving and transmitting ICH, where technology integrates with cultural understanding and social interaction. Achieving digital vitality requires grounding initiatives in the uniqueness of local culture while applying dynamic technologies that strengthen emotional connections and sustain cultural practices in daily life. Short videos and holographic projections can help ICH transcend the limitations of festivalization and become part of everyday experiences. Locality forms the core of ICH, with intergenerational transmission adding emotional resonance. Crucially, a balance must exist between technology and culture. Respecting the locality and historical context of ICH while harnessing digital tools can overcome dissemination barriers, revitalizing ICH in contemporary society.

6. Conclusions

Despite numerous challenges—such as technological limitations, manpower, and data resources—intangible cultural heritage (ICH) museums in Eastern Sichuan hold unique cultural advantages that present significant potential for future development. From an anthropological perspective, this study examines peripheral ICH museums’ meta-verse and digital twin transformation, focusing on the tension between local cultural preservation and globalized technologies. It highlights the critical role of “digital vitality” in bridging cultural transmission and technological integration.

Utilizing the Identity and Sentiment-Centered Framework for Intangible Cultural Heritage (IEC-ICH), this study identifies “Experience Seekers” and “Explorers” as the primary audience groups, reflecting a strong demand for immersive experiences and cultural exploration. Case studies from the Fanshan Jiaozi Base, Daotai Courtyard, Wang Shadow Puppetry Museum, and the digital hall of Dazhou Cultural Center reveal the complexities of integrating local culture with digitization practices. These cases illustrate tensions between individual and collective, as well as local and universal dimensions while showcasing the potential of ICH museums in emotional engagement, cultural dissemination, and technological innovation. For instance, the Fanshan Jiaozi Base demonstrates community cohesion and parent–child appeal through ritual embedding. Similarly, the Wang Shadow Puppetry Museum excels in its dual roles of cultural tourism and interactive experiences, receiving strong emotional evaluations. The Dazhou Cultural Center exhibits significant potential in education and cultural promotion. At the same time, the Daotai Courtyard attracts visitors as a social and trendy destination, highlighting the importance of re-contextualizing local cultural symbols.

To revitalize “digital vitality”, this study proposes four key strategies. First, enriching daily expressions of ICH culture can break free from the limitations of festivalization. Second, deeply exploring local cultural symbols enhances their uniqueness and authenticity. Third, diversifying immersive interactive experiences better responds to varied audience needs. Finally, fostering intergenerational interactions achieves dynamic cultural regeneration. Dynamic regeneration lies at the heart of “digital vitality”. ICH culture can transition from static displays to active integration into everyday practices by employing

technologies such as short videos and holographic projections. Local characteristics serve as the foundation, while intergenerational transmission enriches emotional depth. Cross-generational connections within families and communities transform ICH into a bridge for emotional resonance and cultural memory.

This study acknowledges several limitations. The data primarily rely on online user feedback, which may introduce selection bias and overlook the experiences of less digitally active users. The classification of user identity labels could benefit from further refinement to align more closely with Falk's updated categorization. Although existing studies have utilized Google APIs for sentiment analysis across various contexts, the application of such methods in a culturally specific context remains debatable. Given that comments regarding intangible cultural heritage museums involve region-specific and culturally unique terms and references, training a dedicated model or fine-tuning a large pre-trained model based on comment data appears to be a more effective approach. Future work will focus on developing more suitable sentiment analysis and feature word identification models, grounded in the recognition of user identity, to further enhance the overall method proposed. Additionally, the proposed optimization strategies and feedback mechanisms have not yet undergone long-term validation in practical applications.

Future efforts should delve deeper into audience needs, refine sentiment analysis, integrate online and offline communities, and foster cross-platform interactions. Developing dynamic feedback mechanisms will advance ICH museums from "static" preservation to a transformative "digital ecology". This shift can provide "central" opportunities for peripheral ICH museums, ensuring sustainable development in a digital era.

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