

DIGITALIZATION'S ROLE IN PRESERVING HAKKA CULTURE THROUGH THEMATIC ANALYSIS

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Abstract

In an increasingly digitalized society, younger generations face growing challenges in sustaining cultural identity, making the preservation of intangible cultural heritage a pressing issue. This study investigates Hakka cultural heritage in southern Jiangxi, focusing on traditions, festivals, and cultural practices central to community identity. Employing a mixed-methods design that integrates expert interviews, questionnaire surveys and applies thematic analysis to identify key cultural elements critical for heritage transmission among Generation Z. The findings indicate that rapid technological change and the inherent complexity of intangible heritage create significant challenges, including high costs, limited resources, and risks of digital obsolescence. The thematic analysis of festivities and cultural artistry highlights recurring patterns that are essential to the cultural identity of the Hakka community. These qualitative findings are reinforced by quantitative results, which show strong demand among Generation Z for cultural education, participation, and digitally mediated approaches to heritage preservation. Expert insights further highlight the potential of immersive technologies in enhancing cultural transmission. The implication of this research extend beyond southern Jiangxi, offering insights into how digitalization can be harnessed to preserve culture heritage globally.

Keywords: Hakka culture, preservation of cultural heritage, Digitalization, Intangible Culture, thematic analysis

Introduction

Hakka is a distinct cultural group and is known for its rich traditions, language, and unique architecture (Christiansen, 1998). The preservation of cultural heritage, particularly in the wake of rapid globalization and urbanization, makes safeguarding both its tangible and intangible elements and passing them down to future generations of high importance. However, as China undergoes rapid globalization, industrialization, urbanization, and economic growth, younger generations are gradually having lesser chances of engaging with their cultural roots (Islam et al., 2019). This distancing is further compounded by an identity crisis, particularly evident in metropolitan cities, which makes it increasingly difficult to preserve intangible aspect cultural heritage. Previous research has identified several challenges in this context, particularly related to the misalignment of digital technologies with cultural practices and the difficulties in sustaining traditional cultural expressions amidst global economic challenges (Hou et al., 2022; Rizzo, 2016).

Literature Review

literature review synthesizes current research on cultural transmission, the evolving role of digital technologies in heritage preservation, and practical challenges that arise when applying these technologies to context-specific cultural systems such as Hakka heritage.

Challenges in Cultural Transmission and Technology

Previous studies indicate that, despite significant technological advancements in cultural heritage preservation, challenges persist in ensuring effective cultural transmission, particularly when addressing the identity crisis among younger generations (Zeng et al., 2023). This issue is especially critical in the context of utilizing digital technologies to preserve Hakka culture. This study seeks to fill this gap by exploring how modern technological tools can be adapted to support cultural transmission in a rapidly changing socio-economic environment.

Furthermore, upon deeper evaluation of the specific technological challenges affecting cultural heritage preservation, it becomes evident that the application of current technologies, such as 3D modeling, virtual reality (VR), augmented reality (AR), XR, artificial intelligence (AI)-driven big data and the Internet of Things (IoT), often face issues of compatibility with specific cultural contexts, affecting the acceptability and sustainability of cultural heritage preservation projects (Hou et al., 2022; TK, 2022). Given these challenges, it is crucial to improve the effectiveness and efficiency of technological tools in preserving specific constituents of cultural heritage, specifically preserving the essential elements of cultural heritage.

Digitization and digital preservation, while central to technology-driven heritage work, also illustrate these limitations. According to Liao et al. (2020), digitization involves converting physical objects into digital resources, However, this process alone does not guarantee cultural

transmission across generations. Despite its role in facilitating access and a larger scope of dissemination, digitization alone does not ensure the long-term preservation of cultural knowhow and artistry. Zhou (2017) emphasize that despite advancements in digitization, preserving and transmitting intangible cultural heritage remains a challenge(Zhou,2007). Thus, strategies beyond mere digitization are required to achieve sustainable cultural transmission.

Cultural Constituents and Heritage Interdependence

In the context of cultural transmission from one generation to the next, identifying the most crucial aspects of the culture is necessary. Understanding these cultural components is fundamental to determining which technological approaches can meaningfully enhance, protect, and disseminate Hakka cultural heritage.

Cultural heritage consists of both tangible and intangible aspects. Following the convention for protection of world cultural and natural heritage in 1972, UNESCO defines intangible cultural heritage as referring to "the practices, representations, expressions, knowledge, skills—as well as the instruments, objects, artefacts and cultural spaces associated therewith—that communities, groups and, in some cases, individuals recognize as part of their cultural heritage." Tangible objects often serve as carriers or manifestations of intangible cultural elements, facilitating their transmission. For instance, artifacts may represent cultural practices or beliefs, acting as tangible embodiments of intangible heritage. Therefore, the distinction between tangible and intangible culture isn't always clear. While the exact term "tangible cultural heritage" is not explicitly defined in the UNESCO Convention, it is generally understood as being in contrast to intangible cultural heritage. Tangible cultural heritage often includes physical objects, artifacts, or places associated with intangible elements, but it is distinct as it includes "properties forming part of the cultural and natural heritage" that are listed on the World Heritage List(Bouchenaki,2003). Unlike intangible heritage, which is constantly recreated, tangible heritage is usually associated with the notion of "authenticity" and requires different safeguarding approaches and methods.

Intangible culture is inherently intertwined with tangible cultural forms, as the transmission of intangible practices frequently relies on material symbols, tools, and objects that embody deeper norms and values. Thus, the definitions of tangible and intangible culture cannot be completely separated, they have a symbiotic relationship. In this light, the 2003 UNESCO meeting emphasized this overlap by recognizing intangible heritage as a separate entity consisting of practices, knowledge, and expressions integral to cultural identity and advocating for its safeguarding alongside tangible heritage. Furthermore, the meeting also called for more innovative methods for safeguarding intangible cultural heritage. Today, technologies such as AI artificial intelligence provide new tools for protecting intangible culture. However, to achieve effective cultural preservation, it is necessary to identify and protect tangible and intangible cultural heritage, understand their interconnections, and adapt protection measures to changing and evolving contexts (Hariri, 2021) .

Contextualizing Cultural Heritage Through Expert Interviews

Expert interviews have been widely employed as an effective method for gaining insights into local cultural traditions and heritage. This approach enables researchers to access the knowledge and expertise of individuals deeply embedded within specific cultural and technological contexts, thereby offering nuanced and context-sensitive perspectives. Compared with many other research procedures, expert interviews allow for broader and deeper exploration of complex cultural phenomena. As a qualitative research method, they provide valuable tools for examining the potential role of digitization in the preservation and dissemination of cultural heritage (Chilisa, 2019; Libakova & Sertakova, 2015; Ling, 2023; Smith et al., 2016; Stern & Humphries, 2022; Thomas & Settler, 2024). Collectively, these studies demonstrate the diverse applications of expert interviews in cultural heritage research. In this study, engagement with Hakka cultural experts facilitates a culturally grounded understanding of Hakka worldviews, practices, and heritage systems.

Within this broader scholarly context, research on Hakka culture emphasizes its geographically dispersed historical development and transregional cultural networks, particularly across mainland China, Taiwan, and Southeast Asia. Scholars argue that preserving Hakka cultural heritage contributes to maintaining cultural diversity amid increasing cultural homogenization. Recent studies also point to the growing role of intelligent and digital technologies in enabling dynamic forms of cultural documentation, management, and revitalization (Zhang, 2024).

However, the preservation of cultural heritage through technological advancements add layers of complexity and the dynamic nature of digital technologies introduces additional cost and resource limitations alongside advantages. Consequently, a pressing concern arises that which technological advancements or technological tools are most suited for being effectively leveraged for the enhancement, preservation, and transmission of crucial constituents of cultural heritage. This question underscores the difficulty in identifying optimal technological solutions tailored to specific cultural contexts.

Methodology

This study employed a mixed-methods research design, grounded in Cultural Transmission Theory and the Technology Acceptance Model (TAM), to investigate how digital technologies can support the preservation and transmission of Hakka cultural heritage in the contemporary socio-cultural context. These theoretical frameworks conceptualize cultural heritage transmission as a dynamic process shaped by both internal cognitive factors and external technological and social environments, highlighting the role of digital media in mediating cultural learning and identity formation, particularly among younger Generation .

By integrating qualitative and quantitative methods, this study examines how culturally significant elements of Hakka heritage can be identified, represented, and transmitted through digital technologies. Expert knowledge, audience perceptions, and digital cultural representations are jointly analyzed to uncover dimensions of cultural meaning that may be overlooked by single-method approaches. This integrated methodological strategy enables a comprehensive understanding of how digital tools facilitate cultural engagement, participation, and intergenerational transmission in the context of intangible cultural heritage.

In light of these challenges and the imperative for preservation, this paper aims to better understand how to apply digital technology to cultural heritage preservation by adopting the method of expert interviews in order to identify the most crucial constituents of Hakka cultural heritage and matching them with the effective tools of new technological advancements.

Participant recruitment and selection

Semi-structured expert interviews were conducted with three purposively selected participants representing key domains relevant to the study: Hakka cultural heritage, digital exhibition technology, and AI-based cultural creation. Participants were selected based on their professional expertise, practical experience, and contributions to cultural preservation or digital innovation. This purposive sampling strategy ensured the inclusion of diverse yet complementary perspectives on cultural transmission and technological application.

The interviewees included: a senior Hakka cultural heritage expert and museum curator; a digital technology specialist with extensive experience in VR-based exhibition design; and a young AI artist specializing in AI-generated cultural installations. Together, these participants represent different generational, professional, and disciplinary standpoints, enabling an in-depth exploration of how cultural heritage preservation can be approached through both traditional expertise and emerging digital practices. This expert-based qualitative approach allowed for nuanced analysis of how cultural and technological contexts jointly shape strategies for cultural preservation and engagement with younger generations.

Data collection process

Data collection was conducted in three interconnected stages: expert interviews, questionnaire surveys, and digital exhibition analysis. This section focuses on the qualitative data collection process through expert interviews. All expert interviews were conducted in a semi-structured format, allowing flexibility while maintaining alignment with the research objectives. Interviews were carried out online via video conferencing platforms due to geographical and scheduling constraints. Each interview lasted approximately 60–90 minutes and was audio-recorded with participants' consent. Interview questions were designed around core themes, including: identification of essential elements of Hakka cultural heritage, the role of digital technologies in cultural preservation, challenges and opportunities in digital heritage practices, and strategies for engaging Generation Z in cultural learning. The semi-structured format encouraged participants to share professional experiences, examples, and reflections, enabling

the collection of rich, context-sensitive narratives that reveal how digital technologies are perceived and applied in cultural heritage contexts.

Data analysis

The qualitative data were analyzed using Thematic Analysis (TA), following the framework proposed by Boyatzis (1998). All interview recordings were transcribed verbatim to ensure accuracy. Initial coding was conducted to identify meaningful data segments related to cultural elements, technological affordances, generational engagement, and transmission strategies.

These codes were subsequently reviewed, refined, and grouped into higher-order themes to capture recurring patterns and conceptual relationships across the interviews. The analysis focused on how experts conceptualize the preservation of Hakka culture in the digital era and how digital technologies mediate cultural meaning, accessibility, and participation. Through iterative comparison and refinement, several core themes were identified, which are discussed in detail in the Results section. This systematic analytical process enhanced the credibility and reliability of the findings.

Ethical considerations, informed consent, and risks and benefits

This study adhered to established ethical standards for social and cultural research. All participants were fully informed of the study's objectives, procedures, data usage, and confidentiality measures, and provided written informed consent. Participation was voluntary, with the right to withdraw at any stage. Interview data were anonymized during transcription, and all recordings and transcripts were securely stored and accessed only by the research team. Although no financial compensation was provided, the study offered participants a professional platform to share expert perspectives on cultural preservation and digital innovation, contributing to academic and practice-oriented discussions on the sustainable transmission of intangible cultural heritage.

Results

The study offers a comprehensive evaluation of how digital technology intersects with the preservation of Hakka cultural heritage. Structured systematically to follow the methodology, it ensures that each research objective is addressed with clarity and detail.

In the first section, insights gained from expert interviews are analysed, where key themes regarding the integration of technology in cultural preservation are identified and discussed. Building on these qualitative insights, the findings are further validated and corroborated by quantitative data from a survey designed for Generation Z, creating a robust cross-validation of the earlier results. The combination of qualitative and quantitative data provides a deeper examination of the effectiveness of VR exhibitions in preserving and conveying cultural

heritage. Through thematic analysis of the exhibitions, the study identifies the strengths and limitations of current digital preservation strategies, aiming to provide a multifaceted perspective on the role of digital technology in cultural preservation.

Results from Expert Semi-Structured Interviews

Through this process, the critical roles of cultural experts, technological innovators, and AIGC artists in the digitization and preservation of Hakka heritage are explained. The findings revealed the importance of technology in broadening the understanding of intangible cultural components, the narrative power of virtual and digital environments in cultural storytelling, and the necessity of creativity and visual appeal in engaging the next generation with cultural heritage.

By using Boyatzis's thematic analysis framework, themes were defined and coded in summarizing the core findings four primary themes emerged (Table 1): intangible cultural preservation, technology as a cultural bridge, cultural identity in digital spaces, and engagement of Generation Z in cultural heritage. These themes are elaborated upon in the following subsections.

Table 1: Key Themes and Codes for the Preservation of Hakka Culture through Technology

Theme	Code	Description	Key Findings
Theme 1: Intangible Cultural Preservation	Code 1.1: Intangible Culture Immersion	The experts emphasized that technology, especially immersive experiences like VR, plays a critical role in preserving intangible elements of Hakka culture, such as handcrafts, ceremonies, and other traditional activities. These are forms of cultural expression that cannot be fully understood or appreciated through mere observation; instead, they require a deep, immersive engagement.	Digital Technology can help bridge this gap by recreating these cultural practices in a digital environment, allowing individuals to experience them as if they were part of the Hakka community. It offering deep engagement, crucial for preserving cultural expression.
	Code 1.2: Technology in Intangible Cultural Preservation	Another significant point discussed was the use of technology to overcome the time constraints faced by modern individuals,	Engaging with technology-driven experiences can simulate the living and cultural experiences of Hakka people, effectively

		especially younger generations, who may not have the opportunity to live within the Hakka community for extended periods of time.	providing a solution for the problem of cultural transmission from one generation to the other in the fast-paced modern society of today. This technological tools ensure that the rich intangible heritage of the Hakka community is preserved and made accessible to future generations.
Theme 2: Technology as a Cultural Bridge	Code 2.1: Storytelling and Spatial Narrative Methods	Experts highlighted the importance of storytelling and spatial narrative methods in the design of immersive experiential spaces. These methods can be utilised for effectively engaging audiences, particularly younger generations, in cultural heritage through digital means.	By leveraging technology to create immersive narratives, cultural content can be presented in a way that resonates with Generation Z, making the preservation of Hakka culture more impactful and accessible.
	Code 2.2: Budgetary Considerations for Small Venues and Emphasis on Uniqueness	Due to budgetary constraints, it is essential that these small venues differentiate themselves by emphasizing specific cultural aspects rather than attempting to replicate grand narratives.	This approach allows for a more targeted and cost-effective preservation strategy, ensuring that the essence of Hakka culture is maintained and effectively communicated even in smaller, resource-limited settings.
	Code 2.3: Focus on Folk Festivals and Handicrafts	Experts recommended that small venues typically concentrate on highlighting folk festivals, handicrafts, and specific cultural details. This focused approach enables a more meaningful and detailed preservation of Hakka culture, which is particularly important for	By emphasizing these aspects, the preservation efforts can be more authentic and relatable to Generation Z, fostering a deeper connection to their cultural roots.

		maintaining the cultural identity and heritage of the Hakka people.	
Theme 3: Cultural Identity in Digital Spaces	Code 3.1: Cultural Identity and Global Significance	The experts emphasized that digital exhibitions should not only represent Hakka cultural identity but also connect it with its spiritual essence and global cultural significance. This interconnected approach ensures that while the exhibitions preserve the unique aspects of Hakka culture, they also position it within a broader, global context.	Digital technologies serve as platforms for showcasing the global relevance of Hakka culture, making it more relatable to global audiences while preserving its unique aspects. This approach not only strengthens the cultural identity of the Hakka community but also promotes a deeper understanding and appreciation of its cultural heritage on a global scale.
Theme 4: Engagement of Generation Z in Cultural Heritage	Code 4.1: AI Art in the Digital Age	The role of AI in art creation is recognized as an important tool in contemporary art, particularly within the context of preserving cultural heritage. While AI tools are valuable, creativity and artistic aesthetics remain central to the process.	This code underscores the importance of integrating AI technology into cultural projects while ensuring that the human creativity and aesthetics remain central to the process.
	Code 4.2: Consideration for Young Audiences	Engaging young people in cultural preservation projects requires careful consideration of their interests. Experts advise that the digital reproduction of Hakka culture should be tailored to appeal to younger audiences, ensuring that the content is relevant and engaging for Generation Z.	This approach is critical for ensuring that cultural heritage is not only digitized and preserved in its physical form but also is preserved through the active engagement and participation of the true inheritors of that culture, which are the next generation.
	Code 4.3: Innovation in	Digital reproduction projects aimed to preserve	This involves reimagining and revitalizing traditional

Cultural Expression	cultural heritage should strive to innovate the expression of traditional culture, aiming to create what can be described as " a cultural-level 'phenomenon "	cultural elements in a way that resonates with contemporary audiences, particularly the youth. Innovation in cultural expression is essential for making cultural heritage dynamic and relevant in the modern age.
Code 4.4: Youth-Centric Innovation in Cultural Expression	Further emphasizing the need for innovation, this code focuses on the role of AI in creating youth-centric cultural expressions. The goal is to attract younger audiences by innovating in digital reproduction, while preserving the core cultural values of Hakka heritage.	This approach ensures that cultural preservation is not static but evolves in a way that is both appealing and meaningful to the younger generation.
Code 4.5: Sharing the Youth-Centric Innovation Theme with Participants for Validation	To ensure that the innovations resonate with the intended audience, it is important to share these youth-centric innovations with participants for feedback and validation.	This collaborative approach ensures that the cultural preservation efforts are aligned with the preferences and attitudes of Generation Z, making them more effective.

The key themes explored the role of technology in preserving and transmitting Hakka culture, particularly for Generation Z. Theme 1 highlighted how immersive technologies like VR are essential for preserving intangible cultural elements, ensuring deeper engagement and continuity of Hakka practices. Theme 2 demonstrated how technology serves as a bridge for cultural preservation, particularly through storytelling, unique presentations, and focusing on specific cultural aspects, making preservation efforts more impactful for younger audiences. Theme 3 emphasized digital exhibitions' role in connecting Hakka cultural identity with global heritage, engaging Generation Z and enhancing Hakka culture's visibility worldwide. Finally, Theme 4 underscored the importance of using innovative approaches, such as AI tools, to engage younger generations in cultural preservation, ensuring that Hakka heritage evolves dynamically while maintaining its core values in the digital age.

Results from Generation Z Surveys

The survey included 58 Generation Z respondents born between 1995 and 2010. The gender distribution was relatively balanced, with 44.83% male and 55.17% female participants, ensuring representation of diverse perspectives. All respondents were from China, with the majority residing in the Gannan region, which provides a geographically relevant context for examining local Generation Z's attitudes toward Hakka cultural heritage.

The survey evaluated respondents' exposure to and awareness of Hakka culture. A total of 67.24% of respondents indicated that they occasionally engage with content related to cultural heritage or traditional culture. The majority (77.59%) access this content through digital platforms, with social media being the most popular, as 94.83% of respondents reported primarily using platforms like WeChat, Weibo, and Douyin to obtain traditional cultural information. These figures highlight the strong tendencies of Generation Z gaining knowledge about their cultural heritage through modern technologies and platforms, underscoring the importance of digital channels in cultural transmission and preservation. The findings suggest that while traditional cultural practices are less prevalent in daily life, the younger generation predominantly accesses cultural information through modern technological means.

Generation Z exhibits a very positive attitude toward the preservation of Hakka culture. An overwhelming majority (96.55%) of respondents strongly believe in the importance of safeguarding Hakka cultural heritage. Additionally, 70.69% of respondents expressed interest in knowing more about Hakka culture. There is also a notable willingness to engage in cultural preservation efforts, particularly through digital means, indicating a readiness to adopt and support digital strategies for cultural transmission.

Generation Z respondents generally perceive digital technology, including VR and AR, as powerful tools for preserving and promoting Hakka culture. Specifically, 77.59% of respondents claimed that digital technology can assist in better preserving Hakka culture and making it more accessible to younger generations. Furthermore, a significant proportion (98.27%) expressed a willingness to experience Hakka culture through VR, indicating strong alignment between their preference to digital technology and their tendencies in integrating digital solutions into cultural heritage initiatives.

The survey revealed a clear preference among respondents for interactive elements in digital cultural exhibitions. A significant 96.55% of respondents believe that incorporating interactive elements can enhance the appeal of digital displays representing Hakka culture. Features such as VR tours, interactive storytelling, and immersive experiences were particularly favored, with 91.38% expressing interest in VR/AR experiences, and 74.14% appreciating the integration of digital art and entertainment. These preferences emphasize the necessity of digital displays that not only provide information but also actively engage their audience, making the cultural experience more participatory and dynamic.

Results from Thematic Analysis of VR Exhibitions

To evaluate the effectiveness of digital technologies in the preservation and transmission of cultural heritage to younger generations, this study selected a VR-based digital exhibition as the analytical case, given VR's capacity for immersive, interactive, and experiential cultural representation. Adopting Klaus Krippendorff's Content Analysis Method to conduct a thematic analysis of the 2023 "Looking into the Mirror of Dunhuang" digital exhibition. Unlike quantitative methods, thematic analysis allows for an in-depth exploration of the underlying themes within digital content, making it particularly valuable for understanding the subtle contributions of VR technology to cultural heritage preservation. This approach captures both explicit and implicit messages conveyed through the medium. The study's findings are based on an analysis of 17 news reports published between 2023 and 2024 by highly credible and official mainstream media outlets, including Xinhua News Agency, Beijing News, Guangming Online, China Youth Net, Lanzhou Daily. Through this comprehensive analysis, using the "Looking into the Mirror of Dunhuang" VR digital exhibition as a case study (Figure 1), the paper provides a thorough analysis of the application of technology in cultural preservation and the emerging trends in this domain.

Figure 1

Dunhuang-Themed VR Digital Exhibitions (2020 - 2023)



Dunhuang VR Exhibition in Search of Mirrors, China·Duhuang (2023)



Dunhuang Metaverse, Duhuang· China (2022)



Meet Dunhuang, Perking· China (2021)



'Thousand-Year Dream' of Mogao Caves, ShangHai· China (2020)

The thematic analysis results reveal the key applications and trends of VR technology in cultural preservation. The analysis shows that cutting-edge technologies widely used in digital heritage preservation include high-definition immersive environments, 3D modeling, game engine physical rendering, and global dynamic lighting. These technologies not only provide rich interactive experiences but also enable visitors to deeply explore and experience cultural heritage details in a virtual environment through augmented reality and immersive cultural displays.

Particularly in the "Looking into the Mirror of Dunhuang" exhibition, VR technology has demonstrated its ability to recreate authentic cultural experiences, allowing users to virtually explore the caves with a 360-degree perspective and closely appreciate the details of the murals. The thematic analysis indicates that these technologies are not merely tools for replication, but crucial platforms for promoting cultural understanding and intergenerational dialogue. This innovative application significantly enhances the appeal of cultural tourism while also facilitating the global dissemination and preservation of Dunhuang culture.

The study results (as shown in Table 2) indicate that, through content analysis of news reports on the "Looking into the Mirror of Dunhuang" digital exhibition, the main themes identified were cultural value, heritage and preservation, technological application, visitor experience and project impact, and project background and collaboration.

Table 2

Content analysis results of the "Dunhuang VR Exhibition in Search of Mirrors, China·Dunhuang (2023-2024)" VR exhibition from online news.

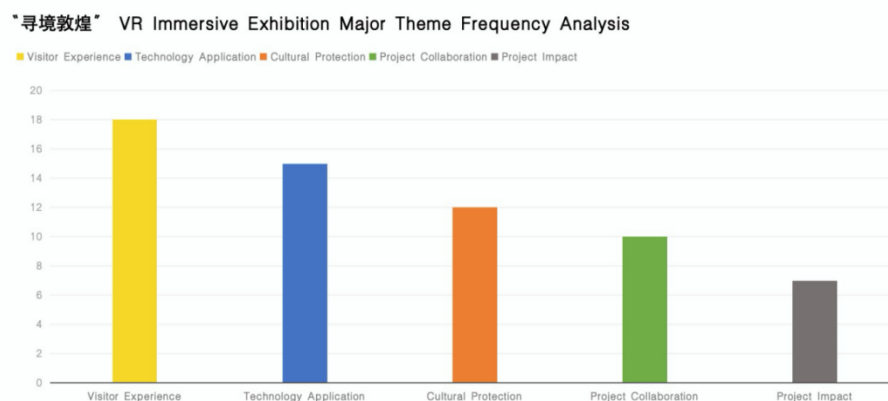
NO.	Coding Content
Technology Application, Visitor Experience and Project Impact	● Includes: Technology Description (Tech), Technology Innovation (Innovation), Visitor Experience (Experience), Immersive Cultural Experience (Immersive Cultural Experience), Project Impact (Project Impact), Cultural Tourism Boom (Cultural Tourism Boom) ● Description: This category covers all descriptions of technology applications and innovations, showing the application and innovation of technologies such as VR, 3D modeling, and game engines in cultural displays. At the same time, it emphasizes the immersive tour and interactive experience through VR technology, making tourists not only spectators, but also part of the experience, and showing the promotion and overall influence of the project on cultural tourism. ● Frequency: 18 times

Cultural Value, Heritage and Protection	● Includes: Cultural Value (Culture), Cultural Heritage (Cultural Heritage), Cultural Preservation (Cultural Preservation) ● Description: This category emphasizes the historical and artistic value of Dunhuang culture, showcases the project's efforts and achievements in inheriting and promoting Dunhuang culture, and places special emphasis on the protection of cultural heritage. ● Frequency: 12 times
Project Background and Cooperation	● Includes: Project Background (Background), Cross-Sector Collaboration (Cross-Sector Collaboration), Policy Support (Policy Support) ● Description: Covers the background information of the project and the multi-party cooperation between cultural institutions and technology companies, and demonstrates the successful implementation of the project in the context of cooperation between multiple institutions. ● Frequency: 10 times

On the other hand, the results of the theme frequency analysis of the Exploring Dunhuang VR exhibition, compiled by the authors based on mainstream media reports from 2023 to 2024, are presented in Figure 2.

Figure 2

“Dunhuang VR Exhibition in Search of Mirrors ” VR immersive exhibition major theme frequency analysis (Researcher resource, 2023-2024)



These themes demonstrate the significant effects of VR technology on cultural presentation and preservation, visitor experience and engagement, and the promotion of cultural tourism. In the frequency analysis, visitor experience and engagement had the highest frequency, indicating that news reports particularly emphasize the immersive and interactive experiences brought by VR technology. The application of VR technology in the "Mirror of Dunhuang" project not only achieved cultural heritage preservation through high-precision cultural presentations, but also enhanced the visitors' understanding and appreciation of Dunhuang culture by enhancing their experience and interaction. Merging technology application with visitor experience is logical because one of the core objectives of technology application (e.g., VR technology) is to enhance visitor experience. The innovative application of VR technology directly increases visitor interactivity and engagement, making the combined analysis of both aspects more reasonable. Supported by multi-party cooperation and policy support, the project successfully enhanced Dunhuang's cultural influence and tourism development.

Through detailed analysis of VR digital exhibition content, this study corroborates the qualitative research results from expert interviews. The analysis provides for the understanding of the specific role VR technology plays in cultural education and preservation, allowing for significant theoretical and practical implications. It offers recommendations for policymakers and practitioners to develop more effective cultural protection strategies. Additionally, by analysing the design and user experience of VR exhibitions, researchers can identify best practices for using digital technology in cultural preservation, thus showing the application of these technologies in actual protection work. Ultimately, by analysing and evaluating the cultural performance of VR exhibitions, more engaging digital preservation strategies for the younger generation can be developed, ensuring the continuous transmission and development of cultural heritage in modern society. These findings provide important insights for the design and implementation of similar cultural preservation projects using digital technologies in the future.

The thematic analysis of the digital exhibitions showed the critical role of VR technology in cultural preservation and presentation, particularly in enhancing visitor experience and promoting cultural tourism. The results indicate that VR technology not only can be used for the protection of cultural heritage through high-precision cultural displays but also deepens visitors' understanding and appreciation of Dunhuang culture by enhancing interactivity and immersion.

Firstly, the analysis highlighted that "visitor experience and engagement" is through VR exhibitions, as it was the most frequently mentioned aspect in news reports. This emphasis reflects the significant impact of VR technology in creating immersive and interactive experiences for visitors. This enhancement allows visitors to become not just spectators of cultural content, but active participants in the cultural experience, thereby strengthening their emotional connection to cultural heritage and ultimately contributing to the preservation of intangible cultural identity and heritage.

Secondly, the integration of VR technology with visitor experience is important for cultural expression, as one of the primary objectives of technology application is to enhance visitor engagement with the cultural content. Through the innovative use of VR technology, exhibitions have effectively increased visitor interactivity and engagement, making this combined analysis be able to present a triangulation of evidence. Specifically, in the "Looking into the Mirror of Dunhuang" project, the successful implementation supported by multi-party collaboration and policy initiatives not only amplified Dunhuang's cultural influence but also contributed to the development of local tourism.

Moreover, the thematic analysis validated and supplemented the qualitative research findings from expert interviews, ensuring the comprehensiveness and reliability of the study's conclusions. This analysis helps us to understand the specific role of VR technology in cultural education and preservation, providing valuable recommendations for policymakers and practitioners to develop more effective cultural protection strategies.

Finally, by conducting an in-depth analysis of VR exhibition design and user experience, researchers can identify best practices for the application of digital technology in cultural preservation, thus promoting its implementation in actual preservation work. Through the analysis and evaluation of the cultural content shown in VR exhibitions, we can develop digital preservation strategies that are in line with eh attitudes, preferences, and modes of learning and acquiring knowledge for younger generations, ensuring the continued dissemination and development of cultural heritage in modern society. These findings can inform the design and implementation of similar cultural preservation projects and policies in the future.

To summarise, firstly, through semi-structured interviews with experts in the fields of Hakka culture, digital technology, and AI-art design, and through rigorous thematic analysis of the content of the interviews and VR exhibitions alongside quantitative measure of Generation Z's attitudes and preferences towards technology and cultural preservation, the important role of technology in protecting and spreading Hakka culture and the urgency of protecting intangible cultural heritage for Generation Z was investigated. Mr. Younan Wan emphasized the key role of technology in protecting intangible culture as a key theme for cultural preservation of Hakka cultural heritage, Liu Yang highlighted that digital exhibitions of Hakka culture should combine cultural identity and spiritual essence and focus on folk festivals and handicrafts, and Mr. Qinzhen Chen suggested considering young people's interests, innovating traditional cultural expressions and emphasizing visual effects to engage Generation Z. These insights provide important guidance for determining the key elements and inheritance mechanisms of Hakka culture, and help to prioritize the protection of important cultural content and match appropriate technologies under the limitations that these technological tools have.

Secondly, the results of the questionnaire survey and quantitative analysis show that Generation Z has a positive attitude towards the application of digital technology in cultural preservation. Most respondents believe that digital technology can better preserve Hakka culture, they are willing to experience Hakka culture through VR, and believe that digital technology enhances

the interactivity and overall attractiveness of the exhibition for them. This shows that Generation Z has a high interest and willingness to use Hakka culture and digital technology, and can identify which digital technologies are most easily accepted by the younger generation, providing a basis for designing effective digital preservation solutions and strategies.

Thirdly, the content of VR digital exhibitions was analysed in detail using Klaus Krippendorff's content analysis framework to evaluate its design principles, user experience, and cultural performance. The results show that VR exhibitions have the potential to tell the story, history, and significance of the Dunhuang Grottoes and play an important role in preserving Dunhuang's national culture. This helps to gain a deeper understanding of how VR digital exhibitions can convey cultural content through design and interactive experience, as well as the effectiveness of these exhibitions in cultural protection, and provides a comprehensive and systematic reference for the application of digital technology in the protection of Hakka cultural heritage.

Discussion

The results of this study indicate that youth have tendencies and preferences towards the application of digital technology in cultural preservation. This finding aligns with previous literature emphasizing the importance of technology in cultural preservation (Horne et al., 2023), (Li, 2022), (Adewumi, 2022). Moreover, Mr. Younan Wan highlighted the critical role of technology in preserving intangible culture. Mr. Liu Yang suggested virtual reality as an effective cultural preservation tool, and Mr. Qinzhen Chen emphasized the role of innovative cultural expressions for the engagement and learning of Generation Z.

By integrating the findings from thematic analysis of expert interviews and digital exhibitions, alongside quantitative analysis of the attitudes and preferences of Generation Z, this study systematically explored the application of digital technology in preserving Hakka cultural heritage. Through a mixed-method approach, including expert interviews, surveys, and content analysis, the study provided in-depth insights into the views of experts from various fields on Hakka cultural preservation and the role of digital technology. The findings align with the views of Professor Zhang Zheng from Tsinghua University, who noted that the deep integration of technology has propelled the intelligent and dynamic management of digital resources in intangible cultural heritage (ICH), transforming its dissemination into a more popular, immersive, and scenario-based experience (Zhang Zheng, 2024).

In addition, the study also examined the attitudes of Generation Z towards Hakka culture and their acceptance and preference towards digital technology. Additionally, it systematically analyzed the application of digital technology in Hakka cultural heritage preservation, offering new perspectives and specific case studies through the examination of VR digital exhibitions. While clarifying the significance of technology in protecting and disseminating Hakka culture, the study emphasized the need to prioritize and align appropriate technologies with key cultural components under technical constraints, thereby providing targeted strategies for effective

cultural preservation. The study also highlighted Generation Z's attitudes and preferences to use digital technology for cultural preservation, providing new avenues and strategies for effectively and efficiently using digital technology for the preservation of intangible cultural identity and heritage.

However, the study's sample size was relatively small, primarily concentrated on the youth in the Ganzhou region, potentially limiting the generalizability of the findings. Future research can expand the sample range to include more age groups and regions to enhance the representativeness of the results. Additionally, despite efforts to avoid leading questions, there may still be subjective biases in the survey responses influenced by personal views and experiences. Future studies should further optimize questionnaire design and survey methods to minimize subjective bias. This study mainly focused on the application of digital technology in Hakka cultural heritage preservation, without in-depth exploration of other cultural preservation factors such as policy support and social participation. Future research could broaden the scope to consider more factors influencing cultural preservation.

In summary, this study conducted a comprehensive analysis of the role digital technology and can play in Hakka cultural heritage preservation, addressing experts' concerns such as "the current limitations in research in choosing appropriate digital technologies" (Caine, 2024) and "Documenting intangible cultural heritage as an act of development, not simply of preservation only (Scovazzi, 2024)", emphasizing the need for matching appropriate technologies in cultural preservation. Future research can further analyse the cultural content of Hakka heritage and apply technology according to different themes for effective transmission from one generation to the next and the preservation of intangible cultural identity and heritage. While technology offers a promising method for preserving Hakka cultural heritage, limitations in devising plans and policies that are feasible in terms of time-restrictions and funding necessitate a collaborative approach that integrates expert opinions from the different disciplines and areas, including views from experts in preservation of cultural heritage, digital technology, AI-art design, and potentially other areas such as educational psychology . By acknowledging these challenges and utilizing expert insights, we can ensure the priority preservation of intangible Hakka cultural heritage, particularly the significance of folklore and traditional artistry. Furthermore, influenced by global cultural preservation strategies, fostering strategies for the protection of intangible cultural heritage will provide sustainable solutions for the preservation for Hakka culture for future generations.

Conclusion

The results of this study indicate that the rapid development of digital technology, along with constraints on time and resources which should be taken into consideration when devising a plan or policy for preservation of Hakka cultural heritage. Therefore, combining technological innovation with expert insights and traditional preservation methods proves to be a more effective approach. This comprehensive method not only leverages the advantages of advanced

technology but also draws extensively on the expertise and traditional practices of professionals, thereby achieving effective preservation and transmission of Hakka cultural heritage from one generation to the next.

Through surveys and quantitative analysis, the study found that Hakka youth have preferences towards the application of digital technology in cultural preservation and generally recognize its crucial role in preserving and transmitting traditional culture to the next generation. Expert interviews provided deep insights into the key elements of cultural preservation, emphasizing the critical role of technology in preserving intangible culture, the design principles of digital exhibitions, and the application of AI art in cultural expression. By integrating approaches by the different experts from cultural preservation, digital technology, and Ai- art design, this study systematically provided insights for the implemented digital cultural preservation plans and policies, enhancing the effectiveness and efficiency of cultural preservation solutions.

Despite some limitations, such as a small sample size and potential subjective bias in participant responses, the study offers valuable recommendations for policymakers and practitioners, contributing to the advancement of cultural preservation. Future research can expand the sample size to include more age groups and regions and further explore the specific applications of different digital technologies in cultural preservation.

In navigating the complexities of cultural transmission and preservation, a balanced and prioritized approach that embraces both conservation and innovation is imperative. Research can explore new avenues by utilizing advanced technological tools with the enduring achievements of human civilization. This includes the strategic combination of traditional cultural practices with contemporary technological trends, thereby recontextualizing cultural narratives to resonate with the present era, while maintaining a preserving the historical continuity. For example, AI-generated content (AICG) offers a transformative potential for intangible cultural heritage preservation, autonomously generating culturally-informed content and recreating traditional practices through immersive virtual experiences. By findings effective and efficient ways to use digital technology to preserve intangible cultural identity and heritage, world heritage cultures such as Hakka cultural heritage can continue to contribute to the cultural expressions of diverse nations and foster a robust framework for mutual learning on a global scale.

Acknowledgement

This research was supported by the 2022 Jiangxi Province Higher Education Humanities and Social Sciences Research Project (Project No. YS22215). The authors acknowledge the institutional support that made this study possible.

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