

Exploring the Enhancement Pathways for Basic Exhibitions in Small and Medium-Sized Museums Empowered by Digital Technologies

Yue Hu

The Education University of HongKong, HongKong, China

Abstract

At present, the global cultural sector is undergoing a profound digital transformation, with technologies such as 5G, virtual reality, and big data rapidly penetrating the museum industry and driving a comprehensive reform in heritage preservation and exhibition models. As vital carriers of regional cultural transmission, small and medium-sized museums play an essential role in bridging local history and public understanding. However, their basic exhibition modes are under increasing pressure to transform in the face of the digital wave. Constrained by limited funding, technical resources, and talent, these institutions struggle to fully leverage the empowering potential of digital technologies. Based on the resource endowments and development needs of small and medium-sized museums, this paper systematically reviews how digital technologies are reshaping exhibition content delivery, audience experience, and operational models. It also delves into the practical challenges of digital transformation and proposes targeted enhancement strategies from four dimensions: technology selection, content development, talent cultivation, and management optimization. These strategies aim to help museums improve the quality and effectiveness of public cultural services in the digital age.

Keywords

Digital technology; small and medium-sized museums; basic exhibition; exhibition enhancement; pathway analysis.

1. Introduction

Basic exhibitions in museums serve as the core platform for preserving historical memory and transmitting cultural values. The quality of such exhibitions directly influences the realization of public cultural rights and the effectiveness of cultural inheritance. With the rapid development of digital technologies such as 5G, virtual reality (VR), and big data, the digital preservation and display of cultural heritage have become a global trend in the museum sector. Compared to large museums, small and medium-sized museums are often at a disadvantage in this transformation due to constraints in funding, technology, and skilled personnel[1-3]. As a result, they are frequently in a passive, reactive position and fail to fully harness the innovative power of digital tools in their exhibitions. Currently, China is actively promoting a “museum digitalization strategy,” urging museums at all levels to enhance their exhibitions through the application of digital technologies. Against this backdrop, exploring how small and medium-sized museums can elevate their basic exhibitions with digital empowerment is of great significance for promoting their high-quality development and better meeting the public’s cultural needs.

2. The Impact of Digital Technologies on Museum Exhibitions

2.1. Diversifying the Forms of Exhibition Content Presentation

The way museum content is presented directly influences how effectively audiences receive and comprehend cultural information. The introduction of digital technologies has opened new possibilities for exhibition presentation. For instance, 3D modeling allows for high-precision digital replication of artifacts, enabling visitors to examine them in 360 degrees on touchscreens, including internal structures and traces of restoration. Augmented reality (AR) can superimpose virtual scenes onto physical artifacts—for example, generating dynamic images of ancient sacrificial rituals beside bronze artifacts—helping visitors visualize their historical usage. Digital projection technology can overcome spatial limitations by projecting large-scale historical murals onto exhibition walls and integrating dispersed artifact information into coherent narrative chains. A case in point is the digital museum around Egypt's Giza pyramids, which uses 3D modeling to reconstruct the internal passageways of the Khufu Pyramid. Visitors, through AR glasses, can "travel" to the original construction site and witness virtual laborers aligning stone blocks, thus presenting cultural information in a vivid and multidimensional manner.

2.2. Enhancing the Visitor Experience

As public demand for cultural consumption continues to grow, museum visitors now seek more than just knowledge acquisition—they desire deep engagement and emotional resonance. Under traditional exhibition models, fixed artifact displays and unidirectional information delivery often fall short of meeting the increasingly diverse expectations of audiences. This mismatch has led to declining visitor numbers and shorter visit durations in some small and medium-sized museums. The application of digital technology offers effective solutions to these issues by creating interactive and personalized exhibition environments that reconnect audiences with cultural heritage. Intelligent guide systems, for instance, tailor customized visiting routes and interpretive materials based on visitors' age, interests, and real-time behavior. Teenagers may receive mythological stories about the Sanxingdui bronze tree, while researchers are provided with excavation reports on the Sanxingdui sacrificial pits[4-5]. Interactive projection devices convert abstract historical texts into engaging scenes; when visitors assemble fragments of Sanxingdui bronze masks on touchscreens, the system simultaneously explains the casting techniques and symbolic cultural meanings. Virtual reality also breaks physical constraints by immersing visitors in a simulated sacrificial scene at Sanxingdui, allowing them to witness the placement of bronze ritual objects firsthand. These immersive designs strengthen cultural cognition and emotional connection, as illustrated in Figure 1.

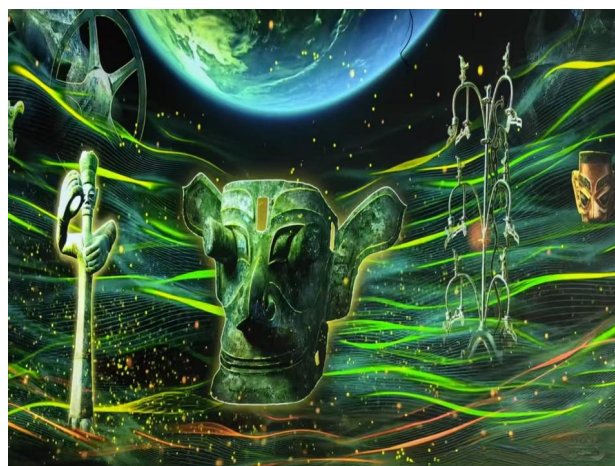


Figure 1. Exploring Sanxingdui through a Digital Encounter

2.3. Innovating Museum Operational Models

Driven by the dual forces of cultural consumption upgrading and the rising public awareness of participation, the traditional museum model that emphasizes "collection over operation" can no longer meet the demands of contemporary development. This challenge is particularly acute for small and medium-sized museums with limited resources, where operational efficiency and public outreach have become pressing issues. Digital technologies, by reshaping the connections among "people, objects, and spaces," are enabling a transformation of operational models from "passive service" to "proactive engagement."

Through tools such as online exhibition halls and virtual tours, museums can transcend physical boundaries and extend their exhibitions to digital platforms, forming a dual-track system that combines "offline physical displays" with "online cloud exhibitions." For example, the Suzhou Zodiac Stamp Museum has utilized VR technology to build a virtual exhibition hall, resulting in a 300% increase in online visits compared to offline attendance.

By leveraging systems that analyze user behavior data, museums can accurately identify visitor interests and develop customized educational programs and cultural-creative products. For instance, the Chengdu Lichao Aviation Museum uses a mini-program to collect interaction data, which is then used to design aviation-themed educational courses. This initiative has led to a 25% increase in return visits.

Such technology-driven operational innovations have significantly reduced operating costs for small and medium-sized museums, enabling them to exponentially expand their service reach and social impact despite resource constraints.

3. Challenges in the Digital Exhibition of Basic Displays in Small and Medium-Sized Museums

3.1. Technological Challenges

There is a significant gap between the rapid advancement of digital technologies and the limited capacity of small and medium-sized museums to adopt them. The adaptability and sustainability of digital applications represent the primary hurdles these institutions must overcome. With limited budgets, many small and medium-sized museums cannot afford the high costs associated with advanced digital equipment commonly used by larger institutions. Some museums have blindly adopted technologies such as VR and holographic projection to appear "digitally advanced," resulting in mismatches between equipment and exhibition space, and heavy maintenance costs[6]. For instance, during renovations, the Hunan Geological Museum introduced eight sets of VR devices, yet due to exhibition spaces of less than 300 square meters, signal interference occurred due to equipment density. Furthermore, monthly maintenance costs of nearly 20,000 yuan exceeded the original budget, and the actual utilization rate of the devices remained below 40%.

3.2. Content Challenges

In an era of increasingly accessible information, visitors demand higher quality and deeper digital content. A lack of originality and depth in digital content constrains the quality of digital exhibitions. Compared to larger institutions, small and medium-sized museums often possess fewer and lower-grade collections. Some institutions over-rely on online resources in their digital displays, borrowing digital models and documentary footage from other museums, which results in content that lacks consistency with their own collections. Even when developing digital content based on their own holdings, the efforts often stop at simple digital rendering of artifacts, with minimal exploration of the historical narratives and cultural values behind them.

3.3. Talent Challenges

A shortage of professional talent directly hinders the advancement of digital exhibitions. The process requires interdisciplinary experts proficient in both museum studies and digital technologies—ranging from digital artifact capture and content creation to system maintenance. However, due to limited compensation and career prospects, small and medium-sized museums struggle to attract such professionals. Most current staff have traditional museum backgrounds with limited digital skills. While some museums temporarily hire technicians for digital projects, these individuals often leave when the project ends. Moreover, the lack of systematic training and development plans makes it difficult to meet long-term talent needs.

4. Pathways to Enhancing Basic Displays in Small and Medium-Sized Museums Through Digital Empowerment

4.1. Selecting Appropriate Digital Technologies

Small and medium-sized museums should choose cost-effective and easily maintainable digital technologies based on their resources and exhibition needs, avoiding blind pursuit of cutting-edge equipment. When selecting technologies, a comprehensive analysis of the museum's collection features, spatial conditions, and target audience should guide decisions on digital applications and expected outcomes. For example, small, locally distinctive artifacts can be digitally archived using 3D modeling technology, satisfying visitors' curiosity about intricate details without requiring expensive equipment[7-8]. For recreating historical scenes, augmented reality (AR) applications via smartphones or tablets can overlay virtual imagery onto physical displays at a lower hardware cost. Open-source technologies and standardized equipment—such as open-source modeling software and generic touchscreen devices—should be prioritized to reduce maintenance expenses caused by proprietary systems. Collaborations with universities or tech companies to establish joint laboratories can also help solve technical challenges and develop customized guide systems with lower costs.

4.2. Establishing a Dynamic Digital Content Update Mechanism

The appeal of digital exhibitions depends heavily on the quality and relevance of their content. To ensure this, museums must develop a systematic mechanism for content updates. Digital content should be rooted in unique collection features and local cultural narratives. This can be achieved by involving local historians in the development of digital scripts to ensure academic rigor and cultural distinctiveness. A tiered update system should be adopted: for basic information such as artifact dating or materials, updates can be scheduled periodically; for narrative content, updates can align with holidays or commemorative events—e.g., adding folklore explanations for traditional festival-related artifacts. Visitor feedback should be collected through online surveys or gallery comment boxes to guide adjustments in content emphasis and presentation style. Moreover, partnerships with local archives and libraries can enhance access to historical documents and visual materials, enriching the content reservoir. These strategies will improve visitor engagement, content accuracy, and academic depth, as reflected in Figure 2.

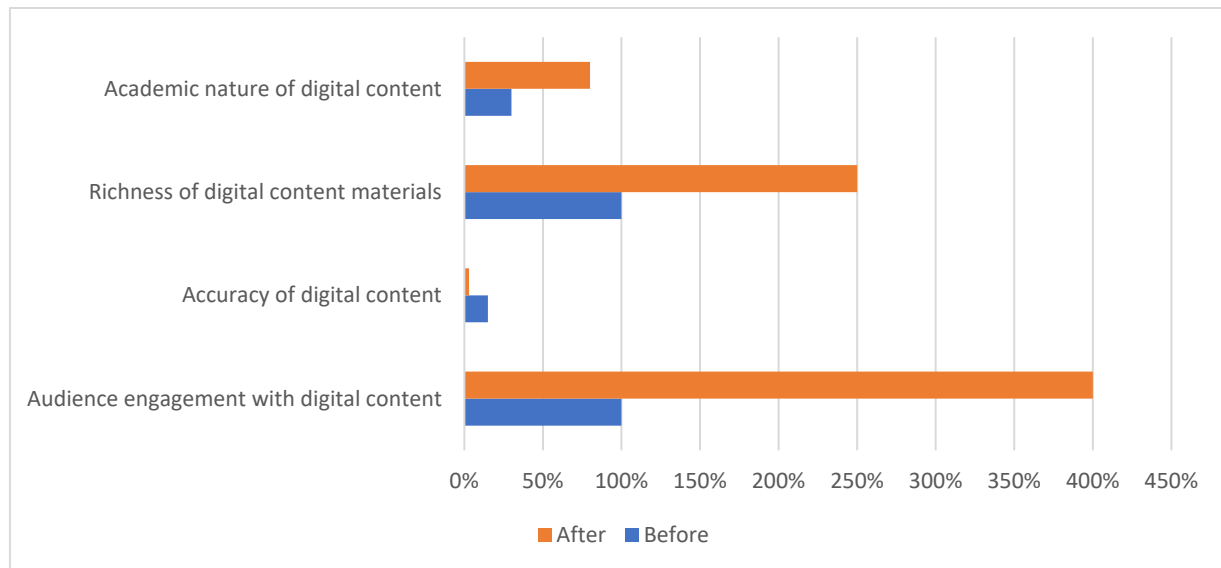


Figure 2. Indicators Before and After Establishing a Digital Content Update Mechanism

4.3. Strengthening Talent Development and Recruitment

The accelerated pace of digital transformation demands new skill sets from museum personnel. However, limited resources place small and medium-sized museums at a disadvantage in talent competition, leading to a severe shortage of interdisciplinary professionals. Recruitment strategies should include creating dedicated digital positions and offering competitive salaries to attract candidates with expertise in digital media production and museology. Emphasis should be placed on hiring core personnel capable of independently managing digital content planning and system implementation. Internally, museums should implement regular training programs. Exhibition curators can be trained in digital storytelling techniques to better transform artifact narratives into digital content, while IT staff can receive system operations training to ensure stable equipment performance. Staff should also be encouraged to attend industry workshops, digital exhibition forums, and case-sharing events to stay informed of emerging trends and technologies. Furthermore, collaborative agreements with universities can provide student interns for project-based support, addressing short-term labor shortages and laying the groundwork for long-term talent pipelines.

4.4. Establishing a Comprehensive Digital Management System

Digital transformation efforts in small and medium-sized museums are often hindered by weak management mechanisms, resulting in project delays and resource waste. A comprehensive digital management system is essential for ensuring structured and effective implementation. A dedicated digital management department should be established with clearly defined roles to oversee project planning, execution, and maintenance—avoiding inefficiencies caused by fragmented responsibilities[9]. In terms of financial management, museums should actively apply for government grants and include digital projects in annual budgets, while also diversifying funding through revenue from cultural products or online donations. Regarding institutional development, standardized procedures must be created to cover digital artifact collection, intellectual property rights, and data security. These should define data formats, acquisition protocols, and copyright usage. For example, the “Jiangnan Cultural Digital Alliance,” a coalition of museums in Jiangsu Province, adopted unified digital standards to enable regional resource sharing. Their jointly developed “Jiangnan Folk Culture Digital Exhibition” successfully reduced individual operating costs and enhanced overall digital exhibition quality.

Table 1. Key Points in Digital Management for Small and Medium-Sized Museums

Key aspects	Specific content	Significance
Funding management	Strive for government special funds, incorporate digital construction into the annual budget, and expand social funding channels (such as cultural and creative sales, online donations).	Ensure the stability of funding sources, avoid waste of resources, and provide financial support for digitalization construction.
System construction	Formulate regulations and rules on digital collection standards, intellectual property protection, and technical security management, standardize the digital cultural relic collection process and data format, and clarify the copyright ownership and usage scope of digital content.	Provide institutional guarantees for the orderly progress of digital exhibitions, and ensure that all work is carried out in accordance with rules.

5. Conclusion

Digital technologies offer vast opportunities for innovating the exhibition design of basic displays in small and medium-sized museums. However, their application is not merely a matter of technological layering, but rather a systematic undertaking involving content reconstruction and experience optimization. In the process of digital transformation, these museums must base their strategies on their unique resource endowments, avoid blindly following trends, and focus on rational technology selection, content development, talent cultivation, and the improvement of management systems. Only in this way can digital technologies truly become empowering tools for enhancing exhibition quality. As digital technologies continue to evolve and industry experience accumulates, small and medium-sized museums should further explore development models tailored to their specific characteristics. This will allow their collections to gain renewed vitality in the digital age, provide higher-quality and more diversified cultural services to the public, and play a greater role in the inheritance and development of regional culture[10].

References

- [1] J. Zhu, Research on the Development of Museums in Singapore, *China Museums*, 1, 107–115 (2016)
- [2] C. Sun, Research on Museum Exhibition Space Experience Design under the Influence of New Media Art, (Beijing Forestry University, 2020)
- [3] D. Liu, Q. Hu, Research on the Construction and Development of Guangzhou Museum Group: A Comparison with Singapore Museums, *Building Materials and Decoration*, 11, 140–141 (2020)
- [4] Q. Qi, New Media Applications Based on Museums: A Pondering on the Current Situation and Trend Analysis of Museums, *Museum*, 2, 11–14 (2021)
- [5] M. Yang, Education as Core, Dual Immersion: An Analysis of the "Story of the Forest" Exhibition at the National Museum of Singapore, *Science Education and Museums*, 1, 20–25 (2021)
- [6] Y. Wang, Research on Contemporary Museum Exhibition Space Design under the Influence of Digital Media Technology, (Harbin Institute of Technology, 2020)
- [7] C. Sun, Y. Zhou, Research on Museum Exhibition Design under the Influence of New Media Art, *Art Education*, 11, 193–194 (2019)

- [8] T. Xue, M. Wang, C. Li, Urban Exploration of Historical and Cultural Spaces in Singapore Museums, *Tourism Planning & Design*, 1, 122–129 (2014)
- [9] D. Xu, A Brief Analysis of Museum Digitalization in the Internet Era: A Case Study of Xiamen Museum, *Relics Appraisal and Appreciation*, 10, 44–47 (2022)
- [10] Y. Liao, Value Expression and Artistic Expression of New Media Technology in Museum Exhibition Space, (Beijing Institute of Fashion Technology, 2018)