



## **The application of DMA in the basic exhibition of Chinese museums**

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### **Abstract**

This research Article consisted of 3 objectives. They are to 1) assess the impact of digital media on visitor engagement and learning, 2) establish best practices for DMA integration, and 3) explore how digital tools foster cultural accessibility and communication. This study employed a mixed method combining quantitative and qualitative methods to provide a comprehensive understanding of the integration of digital media art in Chinese museums together with the case studies which include detailed case studies of Chinese museums that have successfully integrated DMA into their basic exhibitions. The sample consisted of 171 respondents who were knowledgeable about DMA in the basic exhibition of Chinese museums. The study's findings indicated that digital media art not only enhances the audience's understanding and memory of the exhibition content and improves the immersive interactive experience, but also effectively broadens the boundaries of participation for groups from different cultural and linguistic backgrounds, promoting the widespread dissemination and inheritance of culture. This study not only verifies the ability of digital media art to enhance exhibition quality and audience participation, but also clearly points out that its influence should be realized through the deep integration of policy and practice. In the future, relevant departments and museum managers should further improve the policy environment, deepen cross-border cooperation, and optimize resource allocation to promote the continuous innovation and application of digital media art in museums, and contribute to high-quality development that emphasizes both cultural heritage and innovation.

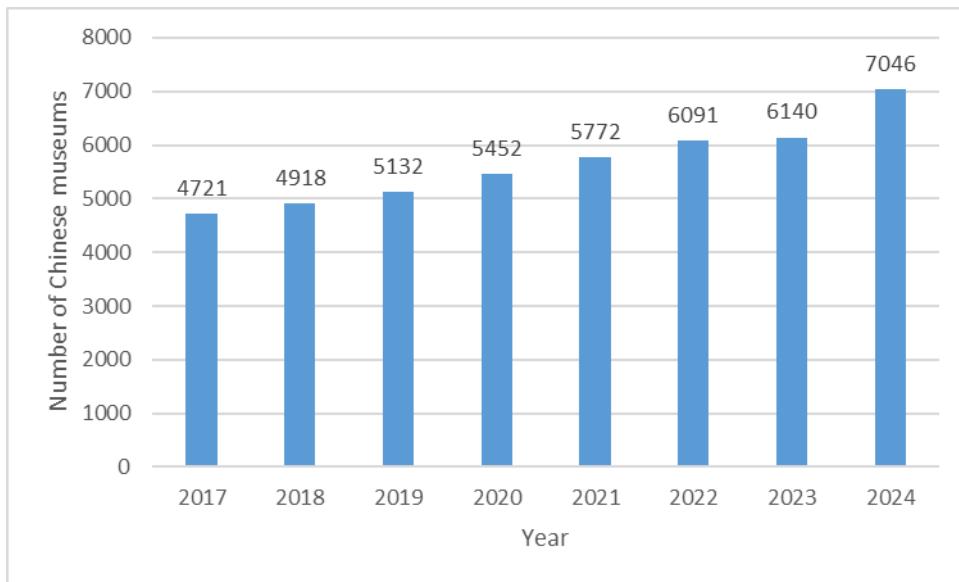
**Keywords:** DMA, Chinese museums, visitor engagement, accessibility and inclusivity, cultural communication



## Introduction

The field of museum exhibitions has undergone significant transformations in recent years, influenced by the rapid integration of digital media art (DMA). Traditional approaches to museum display are evolving to embrace innovative technologies, creating immersive and interactive experiences for visitors. This shift is particularly noteworthy in the context of Chinese museums, which are rich repositories of cultural heritage. As technology continues to shape the way information is presented and consumed, the incorporation of DMA in basic exhibitions becomes a focal point for enhancing the museum experience. The integration of DMA in museum exhibitions is not a new phenomenon. Over the past decade, museums around the world have been experimenting with various forms of digital media, including interactive displays, augmented reality, and immersive installations, to enhance the visitor experience. These technologies have the potential to transform the way visitors perceive and interact with museum collections, offering new perspectives on cultural heritage and art (Bayraktar, D. M., Coşgun, V., & Altan, T. ,2019).

China has an extremely rich cultural heritage that spans thousands of years and, is presented to the public through the existing 7,046 museums (State Administration of Cultural Heritage (SACH), 2025), including 4,927 state-owned museums and 2,119 privately-run museums, making the total number of museums among the world's largest (SACH, 2025).2024 The annual number of visitors to the nation's museums has exceeded 1.49 billion, fully demonstrating the public's broad interest in and enthusiasm for participating in cultural exhibitions. Despite their large numbers, many museums still face problems such as outdated technical facilities, single means of display, and insufficient interactive experiences, especially in attracting "digital natives", i.e., young visitors who have grown up in a digital technology environment. Traditional exhibitions often rely on static panels and artifact displays, which are not interesting and participatory, making it difficult to meet the aesthetic and cognitive needs of contemporary audiences, especially young people.



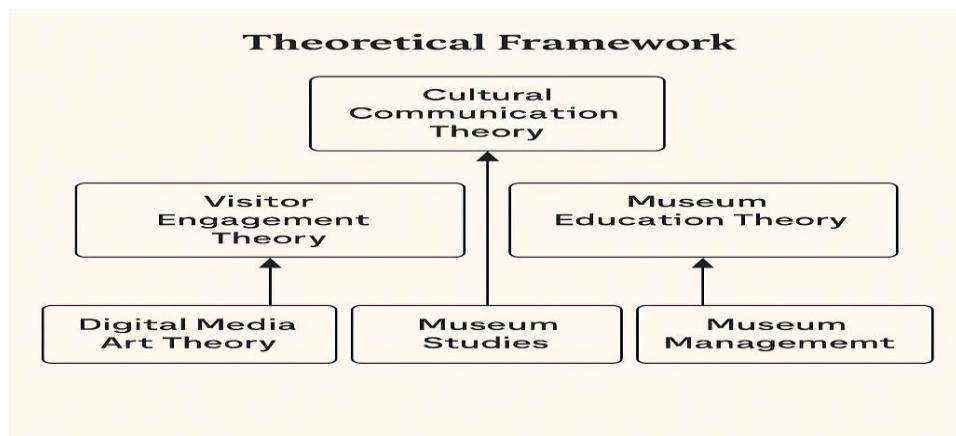
**Figure 1** Number of Chinese museums, 2017-2024

In response to this trend, many leading Chinese museums have begun to experiment with the introduction of DMA and new technologies, and have achieved initial results. For example, the Palace Museum launched the “Digital Forbidden City” project, releasing the “Digital Forbidden City” app, which integrates AR tours, 3D reconstruction, online virtual exhibitions, and other technologies to enhance the digital accessibility and interactive experience of cultural relics. In the exhibition of Mawangdui Han Tomb, Hunan Provincial Museum used immersive projection technology to restore the living environment of “Mrs. Xin Zhui”, and combined it with virtual reality to show the ancient funeral culture, which greatly enhanced the educational significance and interest in visiting. The new hall of Sanxingdui Museum introduced AI explanation system and interactive digital sand table, realizing the “dialogue” between the audience and cultural relics and history, which triggered a strong reaction. The China Science and Technology Museum and the Shanghai Museum of Nature have also made extensive use of multimedia means such as somatosensory interaction, holographic projection and immersive theater, combining science and technology with art and making education fun. Chinese museums have made significant progress in integrating DMA to revitalize their core exhibitions. This trend toward digital interaction reflects broader developments in museum modernization, cultural engagement, and educational accessibility. However, many museums, especially those in rural or underfunded areas, face multiple challenges in deploying DMA, including technical, educational, and logistical issues (Bianchini, S., 2014).



DMA has the potential to enhance visitor engagement, educational outcomes, and intercultural communication, its implementation remains uneven. The lack of institutional frameworks, staff training, and inclusive design hinders long-term success. This research addresses these gaps by identifying effective integration practices and associated challenges in Chinese museum contexts. The integration of DMA into museum exhibitions holds immense promise for enhancing visitor engagement and learning. By leveraging interactive displays, augmented reality, and immersive installations, museums can transform the way visitors perceive and interact with cultural heritage and art. These technologies have the potential to captivate visitors, spark curiosity, and facilitate a deeper understanding of the exhibits. However, the successful implementation of DMA in museum exhibitions is not without challenges. Technological limitations, curatorial and design issues, and questions about visitor engagement and response to these new forms of presentation must be addressed. Understanding and overcoming these challenges are essential for ensuring the effective integration of DMA in the museum setting. One of the main challenges in integrating DMA into museum exhibitions is technological limitations. Museums often face issues related to infrastructure, compatibility, and maintenance when implementing DMA installations. These challenges can lead to technical difficulties, which may negatively impact the visitor experience. Another challenge is related to curatorial and design issues. Incorporating DMA requires a deep understanding of the content, storytelling, and aesthetic integration of digital elements into the physical space of museums. Curators and designers must navigate the complexities of balancing the integrity of the collection with the innovative potential of DMA (Bieszk-Stolorz, B., Dmytrów, K., Eglinskiene, J., Marx, S., Miluniec, A., Muszyńska, K., Niedoszytko G., Podlesińska W., Rostoványi A.V., Swacha J., Vilsholm, R.L., & Vurzer, S. ,2021).

Therefore, this study aims to further fill these theoretical blind spots and provide theoretical basis and practical reference for the integration of digital technology and museums (Jenkins, 2006; Appadurai, 1996).



**Figure** ผิดพลาด! ไม่มีข้อความของสีตัวอักษรที่ระบุไว้ในเอกสาร Theoretical Framework

The research consisted of 3 research objectives. They were 1) assess the impact of digital media on visitor engagement and learning, 2) establish best practices for DMA integration, and 3) explore how digital tools foster cultural accessibility and communication. Moreover, the conceptual framework was shown that the integration of DMA into museum exhibitions is a multifaceted phenomenon that requires a comprehensive conceptual framework to understand its complexities.

This framework serves as a theoretical lens to analyze the interplay between traditional museum practices, the evolution of DMA, and their integration within the context of Chinese museums. By establishing a clear theoretical foundation, this framework guides the research towards a deeper understanding of the dynamics shaping the museum exhibition landscape. The conceptual framework is built upon several key components, each representing a critical aspect of the integration process. Basic Exhibition Principles. Traditional exhibition principles serve as the theoretical foundation and practical guidelines for museum exhibition activities, encompassing aspects such as the logical arrangement of exhibits, narrative methods, cultural relic protection standards, information dissemination methods, and visitor guidance mechanisms.

Traditional exhibitions emphasize authenticity, systemic, and academic rigor, aiming to achieve a rigorous interpretation of history and culture through static displays and textual explanations. This principle emphasizes that artifacts are “visible” but “immovable,” with exhibition forms primarily consisting of glass cases, text-and-image panels, and physical specimens. Audience participation is primarily through “viewing,” passively receiving information. However, in today's era where participatory and immersive experiences are the mainstream demand, this model faces challenges in terms of appeal and educational



dissemination effectiveness. Therefore, against the backdrop of widespread application of digital media technology, traditional exhibition principles are undergoing reconstruction, and their core values need to be continued, integrated, and expanded within the context of new technologies (Fan Xiaoying, & Tang Changming.,2018).

**The Evolution and Forms of Digital Media Art (DMA).** Digital media art is the product of the intersection of technology and art, encompassing a wide range of forms such as augmented reality (AR), virtual reality (VR), mixed reality (MR), interactive projection, holographic imaging, AI interaction, and multi-sensory installations. Its evolution has followed a path from early single-media presentations to multi-modal immersive experiences, gradually forming an experiential ecosystem characterized by interactivity, immersion, and personalization. In museum settings, digital media art is not merely the introduction of technology but a new narrative and expressive form, enabling audiences to “enter history” and “participate in culture,” thereby breaking through the constraints of time and space. It transforms the relationship between exhibits and audiences, shifting from the static distance between “objects and people” to dynamic interaction between “information and people,” thereby enhancing the accessibility, educational value, and communicative power of museums(Bracco, A., Grunwald, F., Navcevich, A., Capdehourat, G., & Larroca, F. ,2020).

## **Literature Review**

The rapid advancement of technology and the ongoing transformation of public cultural consumption patterns are driving a profound transformation in museums. Traditional exhibition formats, which were static and centered on physical objects, are gradually giving way to modern exhibition forms that emphasize interactivity, immersion, and audience participation. DMA encompasses a range of creative forms that blend technology and artistic expression, including augmented reality (AR), virtual reality (VR), holographic projection, interactive installations, multi-sensory imagery, 3D modeling, and digital reconstruction. These tools not only enrich the expressive forms of exhibitions but also provide audiences with multi-dimensional experiences that transcend traditional visual perception. For example, AR technology can bring historical artifacts to life, overlaying hidden background information or stories onto exhibits; VR technology breaks through physical space constraints, allowing audiences to “travel” to a specific historical context or scene, thereby gaining a more immersive understanding of the cultural significance behind the artifacts. This immersive experience responds to a certain extent to the needs of contemporary audiences, especially young people,



for “interactivity,” “experience,” and “personalized” cultural products (Economou, M., & Meintani, E., 2011).

In China, museums are facing a “dual mission”: on the one hand, they must protect a vast cultural heritage system spanning thousands of years of history, and on the other hand, they must adapt to the changes in the way audiences, especially “digital natives,” obtain information and participate in culture in the new era. The introduction of digital media art not only provides a new way of interpreting cultural relics, but also broadens the educational, communication, and social participation functions of museums. However, this change also brings many challenges: for example, how to carry out innovative interpretations while ensuring the authenticity of cultural relics and academic rigor? How can it be effectively implemented under limited budgets and high technical thresholds? How can the accessibility and inclusiveness of digital exhibitions be ensured to truly achieve the goal of “cultural services for all”? These issues are particularly prominent in many small and medium-sized museums in China (Fan Xiaoying, & Tang Changming.,2018).

In order to fully understand the implications of integrating DMA into museum exhibitions, it is essential to examine the theoretical concepts that underpin this research. Several key theories from the fields of DMA, museum studies, visitor engagement, museum education, museum management, and cultural communication are particularly relevant. In the context of increasingly diverse contemporary museum practices, the effective integration of DMA into the exhibition design and educational communication process requires not only the support of the technical operational level, but also the support of a multi-dimensional theoretical framework. This study builds a multi-level theoretical scaffold by integrating DMA theories, museum research theories, visitor engagement theories, museum education theories, museum management theories and cultural communication theories. These theories provide a systematic perspective for understanding the multiple roles of DMA in museum exhibitions from the perspectives of creation methods, organizational management, audience psychology and educational communication, respectively (Falk & Dierking, 2019; Hein, 1998). Besides, DMA theory explores the creation and experience of art through digital technologies. This theoretical framework is concerned with the ways in which digital tools and platforms can be used to create interactive, immersive, and often participatory experiences. The theory also addresses the relationship between DMA and traditional art forms, examining how digital technologies can both complement and challenge established artistic practices. In the context



of museums, DMA theory provides insights into how digital installations can be used to enhance the presentation of cultural heritage.

It also considers the aesthetic and ethical implications of using digital technologies to represent historical artifacts and narratives. For instance, the theory explores how the use of AR and VR in museum exhibitions can create new ways of experiencing art and history, while also raising questions about the authenticity and integrity of digital representations. Further, DMA theory emphasizes the importance of technological innovation in artistic expression, noting that the depth of perception and emotional engagement of the audience can be greatly enhanced through interactive design (Manovich, 2001). With the maturity of virtual reality and augmented reality technologies, digital art offers museums the possibility of creating multi-sensory experiences that not only expand the boundaries of art, but also open up new paths for the preservation and dissemination of cultural heritage (Paul, 2015). In addition, scholars have pointed out that the openness and programmability of digital media enable artists to break through traditional limitations, leading to the dynamic updating of artworks and personalized experiences for viewers (Cameron & Kenderdine, 2007). However, the rapid development of DMA has brought about both authenticity and ethical challenges, especially in the digital reproduction of cultural heritage, which requires more careful handling of the accuracy and cultural sensitivity of the information (Chen, L., 2022).

## **Research Methodology**

This study uses a mixed method combining quantitative and qualitative methods to provide a comprehensive understanding of the integration of digital media art in Chinese museums. The mixed method is particularly suitable for this study because it can collect structured data from a large sample through quantitative surveys to reveal overall trends and correlations, and can also delve deeply into the underlying motivations and details through qualitative interviews or case studies to supplement and explain complex phenomena that are difficult to capture in quantitative results. The quantitative part collects data on the attitudes, behaviors, and effectiveness evaluations of museum staff and visitors through questionnaires, and uses statistical analysis to reveal the key factors and impact paths in the application of digital media art. A large-scale survey of visitors was conducted using a structured questionnaire, with a sample size of 500 people. The questionnaire covered indicators such as visitors' experience, participation, learning



outcomes, and satisfaction with digital media art exhibits, with the aim of identifying the main influencing factors and trends in the exhibition. This phase provides a comprehensive digital evidence base. The qualitative component explores the specific implementation processes, challenges, and strategies of digital technology applications through semi-structured interviews, on-site observations, or case studies. Based on quantitative results, the study selected typical museum staff for semi-structured interviews ( $n = 15$ ) to delve into the mechanisms behind significant trends identified in the questionnaire, such as visitor participation motivations, exhibition optimization suggestions, and challenges in technical implementation. Interview questions were centered around quantitative findings to enrich understanding and validate statistical information.

The two sets of data were cross-validated through triangulation, ensuring the results' broad representativeness while enhancing the depth and interpretive power of the research conclusions. Qualitative analysis provided rich background information and explanations of mechanisms for the quantitative results, helping to understand the cultural and management factors behind the statistical relationships; quantitative analysis provided universal verification for the qualitative findings through extensive data coverage, avoiding the bias of a single perspective. The combination of the two made the research both descriptive and explanatory, forming a multidimensional cognitive framework for the integration of digital media art in museums and enhancing the scientific and practical value of the research (Gao, P., 2021 7& Gong, Zheng. (2025).

**Case Studies:** This phase includes detailed case studies of Chinese museums that have successfully integrated DMA into their basic exhibitions. The selected cases include the National Museum of China, the Shanghai Science and Technology Museum, and the Chengdu Museum, all of which represent museums of different types and geographic regions, and are typical and exemplary in terms of DMA applications. The case selection criteria are mainly based on the following points:

(1) High degree of integration of DMA. Museums that have deeply applied digital media technology in exhibition design and embodied innovative practices are selected to ensure that the study focuses on typical cases of effective application.

(2) Strong representation. Covering national comprehensive museums, science and technology themed museums and regional cultural museums, reflecting



the current situation and differences in the digital development of different types of museums.

(3) Wide geographical distribution. Covering different regions such as Beijing, Shanghai and Chengdu, reflecting the characteristics and challenges of the application of DMA in different regional cultural contexts in China.

(4) Data and information availability. The selected museums provide sufficient research data and access facilities to ensure the depth and authenticity of the case study.

**The combination of these three phases ensures that the study captures the measurable impact of DMA and the subtle experiences of those involved in its implementation, providing practical references and lessons for other museums to promote DMA.**

In this study, a large amount of data on visitor experience brought about by the application of DMA in museum exhibitions was collected by means of a questionnaire survey, aiming to quantitatively assess the impact of DMA on visitor engagement, cultural communication, and educational outcomes. The questionnaire design is based on a multidimensional variable system, covering independent, dependent, mediating, moderating and control variables, with specific operational definitions as follows: The independent variable primarily focuses on digital media art (DMA) and its specific forms of expression, including augmented reality (AR), virtual reality (VR), interactive displays, and multimedia installations, as well as a comparison with traditional exhibition formats(BE). The moderating variable includes accessibility and inclusivity (AAI) of exhibitions, which ensures equal experiences for different groups in terms of physical, sensory, cognitive, and cultural language aspects. The dependent variable, visitor engagement (VE), focuses on visitors' attention, interest, and emotional responses to exhibitions. The dependent variable, educational outcomes (EO), specifically examines visitors' performance in terms of knowledge acquisition, skill development, and understanding and memory. Cultural communication (CC) reflects the museum's ability to convey cultural values and historical information through digital media. Control variables encompass visitors' age, educational level, and technical proficiency to eliminate the interference of demographic and technical factors. Through clear operational definitions of variables and scientific questionnaire



design, the study seeks to reveal the key role of DMA exhibitions in promoting cultural dissemination and realizing educational values, and to provide theoretical support and practical guidance for the digital transformation of museums (Gong, Zheng.,2025).

## Research Discussion

A survey was administered to 500 museum visitors across various provinces in China. The constructs analyzed included: Digital Media Art (DMA), Basic Exhibition Design (BE), Accessibility and Inclusivity (AAI), Cultural Communication (CC), Visitor Engagement (VE), and Educational Outcomes (EO). In order to ensure the reliability and validity of the questionnaire measurement tool, the reliability and validity of the variables were tested in this study. Cronbach's alpha coefficient was used as the reliability index and the results are shown in Table 1

**Table 1** Results of the formal survey reliability analysis

	CRONBACH ALPHA	CRONBACH ALPHA BASED ON NORMALIZED TERMS	NUMBER OF TERMS
<b>DMA(DMA)</b>	.920	.918	8
<b>BASIC EXHIBITION(BE)</b>	.855	.855	4
<b>ACCESSIBILITY AND INCLUSIVITY(AAI)</b>	.795	.798	8
<b>CULTURAL COMMUNICATION(CC)</b>	.789	.801	6
<b>VISITOR ENGAGEMENT(VE)</b>	.891	.899	6
<b>EDUCATIONAL OUTCOMES(EO)</b>	.921	.921	6

The data in Table 1 show that the Cronbach's alpha coefficient of DMA (DMA) reaches 0.920, indicating that the scale has a very high internal consistency; the reliability coefficients of Basic Exhibition (BE) and Visitor engagement (VE) are 0.855 and 0.891, respectively, which are also at a high level. The reliability coefficients of Basic Exhibition (BE) and Visitor Engagement (VE) are 0.855 and 0.891 respectively, which are also at a high level. The reliability coefficients for Accessibility and Inclusivity (AAI) and Cultural Communication (CC) were slightly lower, but both exceeded the minimum acceptance criterion of 0.7,



indicating that the scales have good reliability. The reliability coefficient of Educational Outcomes (EO) is 0.921, which shows that its scale structure is stable and the measurement results are credible.

**Table 2** Results of the formal survey validity analysis -DMA & BE

TERM	FACTOR LOADINGS	COMMON FACTOR	KMO	CUMULATIVE %
<b>DMA1</b>	.912	.928	.886	85.915%
<b>DMA2</b>	.853	.834		
<b>DMA3</b>	.875	.831		
<b>DMA4</b>	.867	.845		
<b>DMA5</b>	.863	.829		
<b>DMA6</b>	.687	.910		
<b>DMA7</b>	.654	.854		
<b>DMA8</b>	.646	.842		
<b>BE1</b>	.547	.299	.790	71.613%
<b>BE2</b>	.942	.888		
<b>BE3</b>	.916	.838		
<b>BE4</b>	.916	.840		

Table 26 shows the results of validity analysis for the variables of accessibility and inclusivity (AAI) and cultural communication (CC). The AAI scale has a total of eight Terms, and their factor loadings are all between 0.696 and 0.921, which are all above the standard of 0.6, showing good Term explanatory power. The KMO value of this scale is 0.763, which is suitable for factor analysis, and the cumulative variance contribution rate is 86.323%, indicating that this single factor explains the overall variance of AAI better.

**Table 3** Results of the formal survey validity analysis - AAI & CC

TERM	FACTOR LOADINGS	COMMON FACTOR	KMO	CUMULATIVE %
<b>AAI1</b>	.708	.891	.763	86.323%
<b>AAI2</b>	.696	.887		
<b>AAI3</b>	.914	.896		
<b>AAI4</b>	.887	.844		
<b>AAI5</b>	.861	.824		
<b>AAI6</b>	.867	.804		
<b>AAI7</b>	.916	.881		



<b>AAI8</b>	.921	.879		
<b>CC1</b>	.901	.826	.804	83.879%
<b>CC2</b>	.884	.822		
<b>CC3</b>	.937	.890		
<b>CC4</b>	.907	.837		
<b>CC5</b>	.907	.825		
<b>CC6</b>	.912	.833		

**Table 3** Results of the formal survey validity analysis - VE

TERM	FACTOR LOADINGS	COMMON FACTOR	KMO	CUMULATIVE %
<b>VE1</b>	.914	.900	.817	88.156%
<b>VE2</b>	.866	.836		
<b>VE3</b>	.886	.839		
<b>VE4</b>	.865	.831		
<b>VE5</b>	.692	.940		
<b>VE6</b>	.707	.942		

According to the analysis results in Table 28, the Visitor Engagement (VE) scale contains six Terms with factor loadings ranging from 0.692 to 0.914, all of which are greater than 0.6, indicating that the correlation between each Term and the latent variables is strong and shows good convergent validity.

Table 4 Results of the formal survey validity analysis - EO

TERM	FACTOR LOADINGS	COMMON FACTOR	KMO	CUMULATIVE %
<b>EO1</b>	.729	.531	.856	72.171%
<b>EO2</b>	.741	.549		
<b>EO3</b>	.922	.850		
<b>EO4</b>	.907	.823		
<b>EO5</b>	.881	.776		
<b>EO6</b>	.895	.802		



Table 4 shows that the educational outcomes (EO) scale has six Terms with factor loadings between 0.729 and 0.922, which are all within a reasonable range, proving that the Terms are closely related to the latent variables and have good convergent validity. The KMO value is 0.856, which indicates that the data are suitable for factor analysis. The cumulative variance contribution rate is 72.171%, indicating that the scale can explain more than 72% of the variance of the latent variables, has strong structural validity, and can reflect the measurement objectives of educational outcomes more accurately.

## Conclusion

The integration of digital media art and basic exhibitions in Chinese museums is a key force in promoting innovation in museum display forms and functions. This study shows that digital media art not only significantly enhances the interactive experience and participation of the audience, but also effectively improves the education and communication effects of cultural heritage. Specifically, the National Museum of China has actively implemented the national policy on cultural digitization, utilizing high-fidelity 3D restoration of artifacts and immersive interactive imaging technologies to optimize exhibition presentation methods, thereby increasing the public's understanding and interest in China's outstanding traditional culture; The Shanghai Science and Technology Museum has aligned with the national "Science and Technology Innovation Leadership" strategy, employing virtual reality (VR) and multimedia interactive technologies to transform abstract and complex scientific principles into intuitive and understandable experiences, thereby significantly enhancing the accessibility and effectiveness of science popularization education; The Chengdu Museum has responded to Sichuan Province's policy on the integrated development of the cultural industry by using "digital museum" construction as a starting point. In exhibitions such as "A Journey to Sanxingdui" and "The Elegance of Shu Culture," it has incorporated holographic projection, naked-eye 3D, and immersive sound effects, achieving the revitalization and innovative dissemination of local cultural resources.

It is worth emphasizing that the conclusions of this study are highly consistent with the policy implementation and practical results in the above cases, and their impact can be more clearly linked to specific museum policies and practices. That is, the effectiveness of digital media art applications stems from both national and local cultural policy support and the specific measures taken by various museums in terms of technology introduction, talent cultivation, and resource coordination. Only through the interaction of policy guidance and



practical innovation can digital media art play its maximum role in museum exhibitions. Although digital media art has achieved remarkable results in terms of exhibition appeal and educational value, practical challenges such as equipment investment, technical maintenance, and professional talent reserves still exist.

The experience and models explored by various museums in practice provide valuable references for the digital transformation of museums across the country. This study not only verifies the ability of digital media art to enhance exhibition quality and audience participation, but also clearly points out that its influence should be realized through the deep integration of policy and practice. In the future, relevant departments and museum managers should further improve the policy environment, deepen cross-border cooperation, and optimize resource allocation to promote the continuous innovation and application of digital media art in museums, and contribute to high-quality development that emphasizes both cultural heritage and innovation.

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