



ENHANCE UNDERSTANDING OF TANG DYNASTY TOMB MURAL PAINTING THROUGH
DIGITAL ART MEDIA



A Thesis Submitted in Partial Fulfillment of the Requirements
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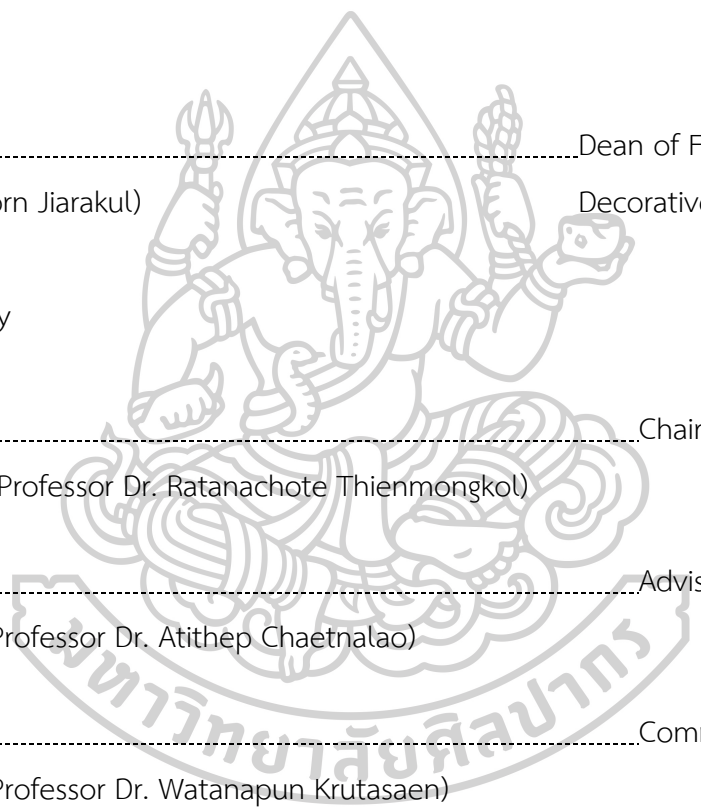


By
Mr. Jie GUO

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This thesis presents a case study that explores a digital interactive installation's design and development process. The research aims to enhance the situational design of the Tang Dynasty Tomb Mural Museum through digital media and to delve into the cognitive factors that sway the audience's museum visits. The study starts with a review of the literature on media interaction in traditional museums, highlighting the research background and related issues. Researchers employed a multi-method approach, which included fieldwork, surveys, and consultations with experts and practitioners. They have systematically documented and analyzed the evolution of the research. The resultant design combines immersive digital media, NFC data interaction technology, and dynamic digital image display technology. It encapsulates the traditional Chinese philosophical principle of "harmony between man and nature," aiming to redefine the digital environment in museums. Findings suggest that situational design driven by digital media enhances audience engagement with cultural relics and alters their visitation and interaction behavior, as evidenced by specific examples and data. The study emphasizes the critical role of digital media in raising audience awareness in museum situational design. Expert reviews and exhibition trials validated this novel approach. The thesis concludes by acknowledging its limitations, detailed in the main body of the thesis, and proposing future research directions. It predicts that technological advancements will lead to more innovative digital interactive experiences, with a heightened focus on personalized visitor experiences. The study could provide valuable insights for improving the digital preservation and display of cultural relics in Chinese museums.

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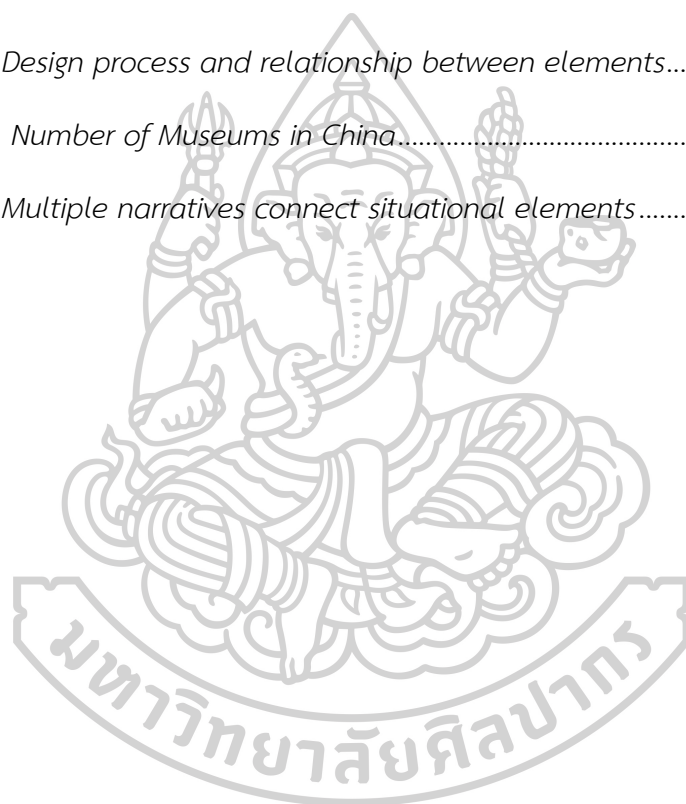
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Chapter 1 Research Background

1.1 Background and significance of the problem

In today's digital age, digital media technology plays a vital role in museum exhibition displays. The introduction of new media and interactive forms based on digital technology has enriched the design concepts of museum situations, providing a novel way to enhance audience attraction and improve their visiting experience. Consequently, the focus of museum work has shifted from traditional collections and exhibitions of cultural relics to the visitor experience. While digital situational design presents significant challenges to traditional museum exhibitions, it also provides new opportunities to reconcile the contradiction between museum exhibitions and audience cognition. The essential elements of museum situational design are space, media, audience, and exhibition, which shape the digital museum visiting experience with the audience experience at the core (Jingbo & Baoxia, 2019) (Figure 1).

However, in China, the involvement of existing digital technology in designing museum exhibitions has resulted in a common problem where the technicality of digital media takes precedence over other aspects. Digital technology only enhances the visual effects of exhibitions and fails to integrate cultural relics, media, and audiences effectively (Hampton, 2017). Consequently, traditional museums introducing digital media still serve traditional exhibitions. Research should focus on the audience experience and explore the possibility of improving audience cognition through digital situational design from a design perspective. Therefore, the digital situational design of museums aims to integrate museum exhibitions, digital media technology, and audience experience in China's current stage. The design process aims to elevate the museum exhibition's situational design concept, information interaction mode, and story narrative logic through digital media technology, providing a new dimension to the audience's visiting experience (Fang, 2020).



Figure 1 Tang Dynasty tomb murals - pictures of warriors
Source: Cultural relics collected by Shaanxi History Museum, 2021.

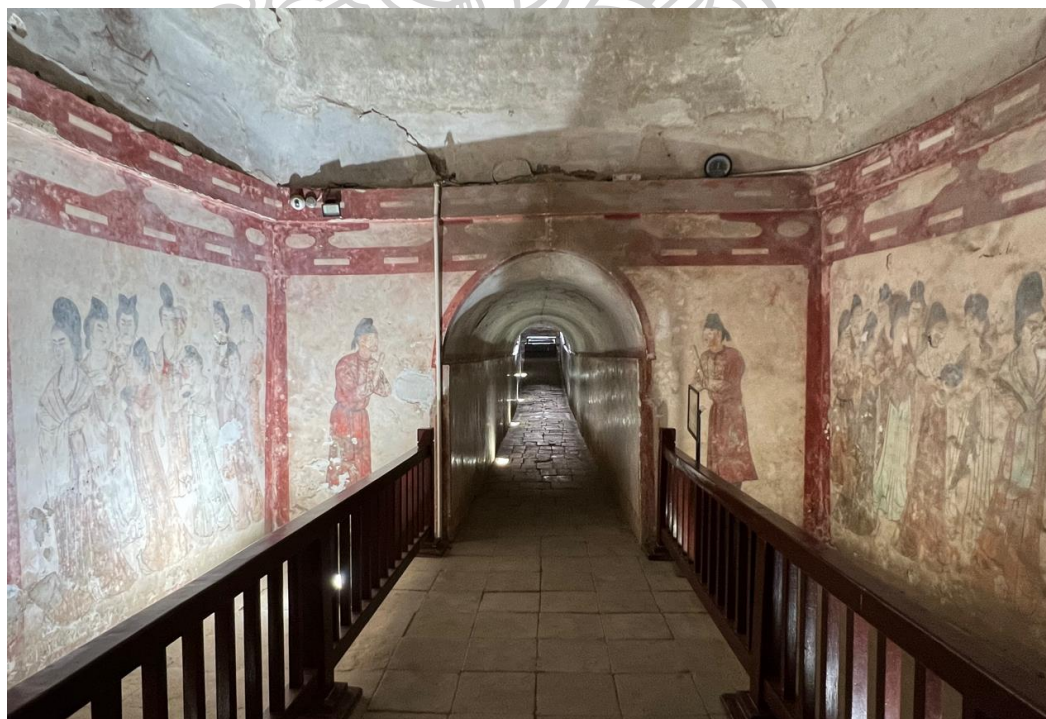


Figure 2 The chamber of the tomb of Princess Yongtai in the Tang Dynasty
Source: Photographed by the Author, 2021.

1.1.1 Background of the problem

Tang Dynasty tomb murals belong to the ancient Chinese aristocratic culture, which is an aspect of the mainstream culture of the Tang Dynasty. On the one hand, it is the image interpretation of the relevant records in the existing literature (Xingming, 2005). On the other hand, it is the verification and supplement of some unknown information in the literature and has the functions of verification, correction, and supplement. The understanding of paintings should not stop at the techniques and expressions of paintings. However, more importantly, we should pay attention to the cultural phenomena and philosophical meanings in the social relations reflected in the paintings, such as politics, economy, culture, etiquette, diplomacy, and life. Searching for the value that can spread the murals of the Tang Dynasty tombs and improving the audience's understanding of the murals' content has become the background and significance of the article research.

The long-term isolation from the external environment has made the tomb murals fragile (Anding et al., 2018). Museum exhibitions must provide strict protection for tomb murals, which leads to challenges for the audience experience. Affected by natural and artificial destruction for thousands of years, most of the existing Tang Dynasty tomb murals are mutilated and damaged, losing the color and texture of the past. It is difficult for ordinary audiences to see the contents of the murals clearly during the visit, which is a challenge to the audience's visiting experience (Figure 2). Since the content represented in the murals is the cultural landscape of the Tang Dynasty society's regulations, social customs, religious beliefs, and ideological concepts, it is difficult for ordinary audiences to understand the cultural phenomena reflected in the tomb murals. Even the living conditions of people thousands of years ago reflected in the tomb murals are different from the living conditions of modern people. The audience's misunderstanding also directly affects understanding information about the Tang Dynasty tomb murals (Hooper-Greenhill, 2006). The above problems have caused difficulties for the audience to visit the museum, which is not conducive to disseminating information on the tomb murals and is not conducive to improving the audience's experience and cognition during the museum visit.



Figure 3 The murals of Wat Phumin Temple in Nan Province, Thailand
 Source: Photographed by the Author, 2021.

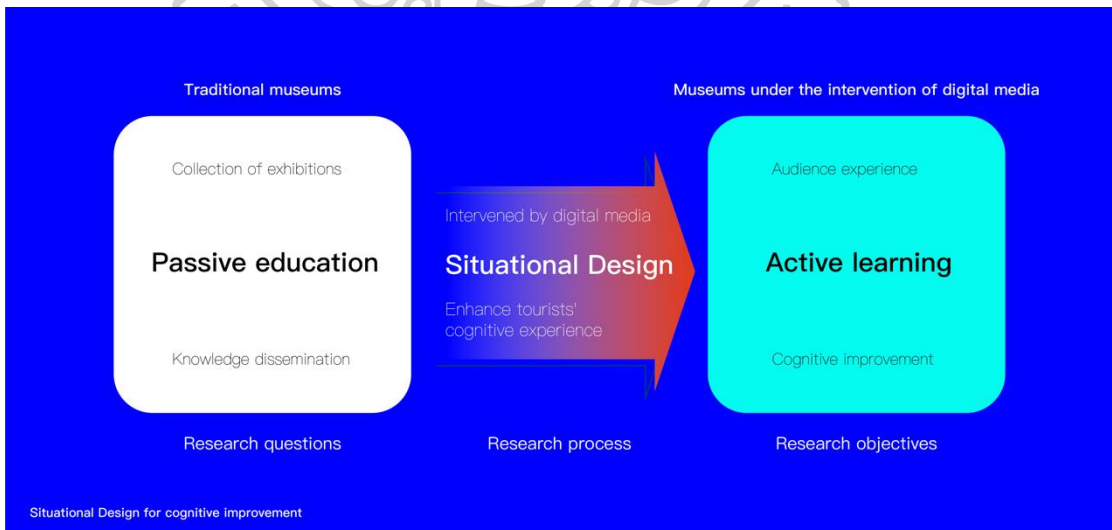


Diagram 1 Situational Design for Cognitive Improvement

Source: Produced by Author, 2021.

The preservation of murals poses a significant challenge to the conservation of cultural relics in China and the broader research agenda in Thailand and other countries worldwide (Figure 3). This field confronts various obstacles, including the natural ageing of mural materials, the impact of changing weather patterns, and the threat of human damage. Consequently, finding effective preservation methods for murals has become an urgent priority. To address this issue, a comprehensive research effort is necessary to develop advanced preservation technologies, devise protective measures tailored to different murals, and strengthen the maintenance and restoration of these cultural relics. Additionally, raising public awareness of the importance of mural preservation is essential to ensure that cultural heritage is valued and protected for future generations.

Audiences are losing their enthusiasm for visiting traditional museums, and meeting audiences' needs for visiting experience has become an essential prerequisite for attracting audiences in the digital age to enter museums and give full play to the value of museums (Falk, 2009). Since the core concept of traditional museum exhibition design is the collection and exhibition of cultural relics, traditional museums cannot cut into exhibition and situation design from the perspective of audience needs. It leads to the fact that the audience can only passively receive information while visiting the museum and cannot actively explore and acquire knowledge according to their needs. The audience in the digital age has become the core of the museum's situation design. The museum exhibition takes the audience's experience, effect, satisfaction, and the audience's visit harvest as essential evaluation criteria (Yujing, 2015). As the museum's main body, the audience is no longer a passive viewer but an active participant and builder, becoming a part of the museum's situational design. The way audiences obtain information in the digital age is changing from passive education to active exploration (Diagram 1). The interaction between the audience and the exhibits, media, and space constitutes the four essential elements of the museum situation design. With the help of digital media technology, the museum situation design helps the audience absorb and understand the generation, content, traditional Chinese culture, and philosophical information in the murals (Jie, 2021).

In recent years, digital media technology has become an essential tool for museum exhibition design. By incorporating sound, video, animation, and interactive media design, digital media technology enhances visitors' understanding of exhibit information and significantly improves cognition (Congqi, 2016). While traditional museums have incorporated digital media into their exhibition design, the nature of dissemination means that digital media technology is still an extension of the exhibition latitude of the basic information of cultural relics. From the perspective of the effect of digital media technology-assisted exhibitions in existing museums, the traditional museum exhibition concept can no longer meet audiences' needs in the digital age (Giannini & Bowen, 2019). Thus, museums must prioritize audience experience and use digital media to drive design innovation and promote audience cognition, enabling "experience in a situation and learning in experience."

In traditional museum exhibitions, the popularization of intelligent voice and video exhibitions of interactive digital systems still follows the concept of "things" as the core of design services (Ferguson et al., 2005). This approach represents a functional extension of the limitations of traditional furnishings and does not change the passive situation of visitors when acquiring knowledge. Consequently, it could be more effective in improving visitors' knowledge acquisition. The digital media art exhibition form of the Shanghai TeamLab Art Museum (Figure 4) provides a new direction for museums to explore (Hong & Yilin, 2018). The immersive digital media art display provides visitors with a new situational experience that stimulates exploration and learning. This new experience form breaks through the binary opposition between visitors and the objects they visit in traditional museum exhibitions. By relying on digital media technology, visitors walk into the objects they visit, enabling "experience in the scene, learning in the experience." However, museums must also address challenges brought by digital media art, such as the transformation of traditional exhibition spaces and new issues in program design, budgeting, post-maintenance, and management of digital media art (Li et al., 2012).

Overall, digital media technology-assisted exhibitions have the potential to enhance visitors' experiences and cognition in museums significantly (Li et al., 2012). By prioritizing audience experience and using digital media to drive design innovation,

museums can provide immersive and engaging experiences that facilitate learning and exploration.



Figure 4 Universe of Water Particles on a Rock, TeamLab, 2018

Source: Teamlab website, <https://www.pacegallery.com/artists/teamlab/>, 2021.

1.1.2 Significance of the Problem

From two perspectives, enhancing the audience's cognition of the murals in the tombs of the Tang Dynasty using digital media art is significant.

Firstly, it provides a guiding ideology for transforming abstract cultural concepts into concrete mural forms and summarizes the visual turning theory of the first culture of murals (Xian, 2004). Utilizing the visual turn theory of murals can assist designers in guiding art design from a theoretical standpoint and understanding the Chinese people's concept of life and death. This paper analyzes the shape and configuration of the mural tombs in the Tang Dynasty, summarizes the structural characteristics and symbolic meaning, and presents an interactive digital situational experience to the audience through the expression of digital media art.

Secondly, the situational design of the murals in the tombs of the Tang Dynasty, under the intervention of digital media, enhances the audience's cognition. Utilizing the visual turning theory of culture as the guiding ideology, the original materials of the Tang Dynasty tomb murals collected by the Shaanxi History Museum, and the interactive characteristics of digital media technology, create a museum situation design with interactive attributes for the audience (Stevens & Martell, 2003). The design aims to enhance the audience's awareness of the museum visit. The digital media situation design places the audience at the core, the exhibits as the foundation, the medium as the means, the space as the container, and the goal of enhancing the audience's cognition. The research will make academic contributions to the digital protection and exhibition of cultural relics in Chinese museums.

1.2 Research objectives

The main objective of this research is to investigate how digital media situational design can enhance audience cognition and improve the visiting experience of museum exhibitions. Specifically, the research aims to:

- 1.2.1 To analyze the challenges and opportunities of digital media technology in the museum situation design.
- 1.2.2 To explore digital media situational design strategies and methods in the Tang Dynasty Murals exhibition context.
- 1.2.3 To evaluate the effectiveness of the digital media situational design in improving audience awareness and enhancing their visiting experience.
- 1.2.4 To provide theoretical and practical references for designing and promoting digital media situational design in Chinese museums.

1.3 Research questions

To achieve the research objectives, the following research questions are proposed:

1.3.1 What are the challenges and opportunities of digital media technology in the museum situation design?

1.3.2 How can digital media situational design strategies and methods be applied to the Tang Dynasty Murals exhibition?

1.3.3 How effective is digital media situational design in improving audience awareness and enhancing their visiting experience?

1.3.4 What can theoretical, and practical references be provided for designing and promoting digital media situational design in Chinese museums?

1.4 Importance of the research

This research is significant as it focuses on the audience experience and explores the possibility of enhancing audience cognition through digital situational design from a design perspective. It aims to use digital situational design in museums to address the challenge of integrating museum exhibitions, digital media technology, and audience experience in China's current context. The design process attempts to elevate the situational design concept, information interaction mode, and story narrative logic of museum exhibitions through digital media technology to enhance the audience's visiting experience (Diagram 2). Through knowledge summarization, this paper examines the exemplary effect of design practice under the intervention of digital media on the digital protection and exhibition of cultural relics in Chinese museums.

1.5 Scope of research

The Research aims to investigate how digital situational design can improve audience cognition and visiting experience in museum exhibitions, focusing on Tang Dynasty tomb murals in China. To achieve the research objectives, the scope of the Research is divided into three areas: information, group, and creative design.

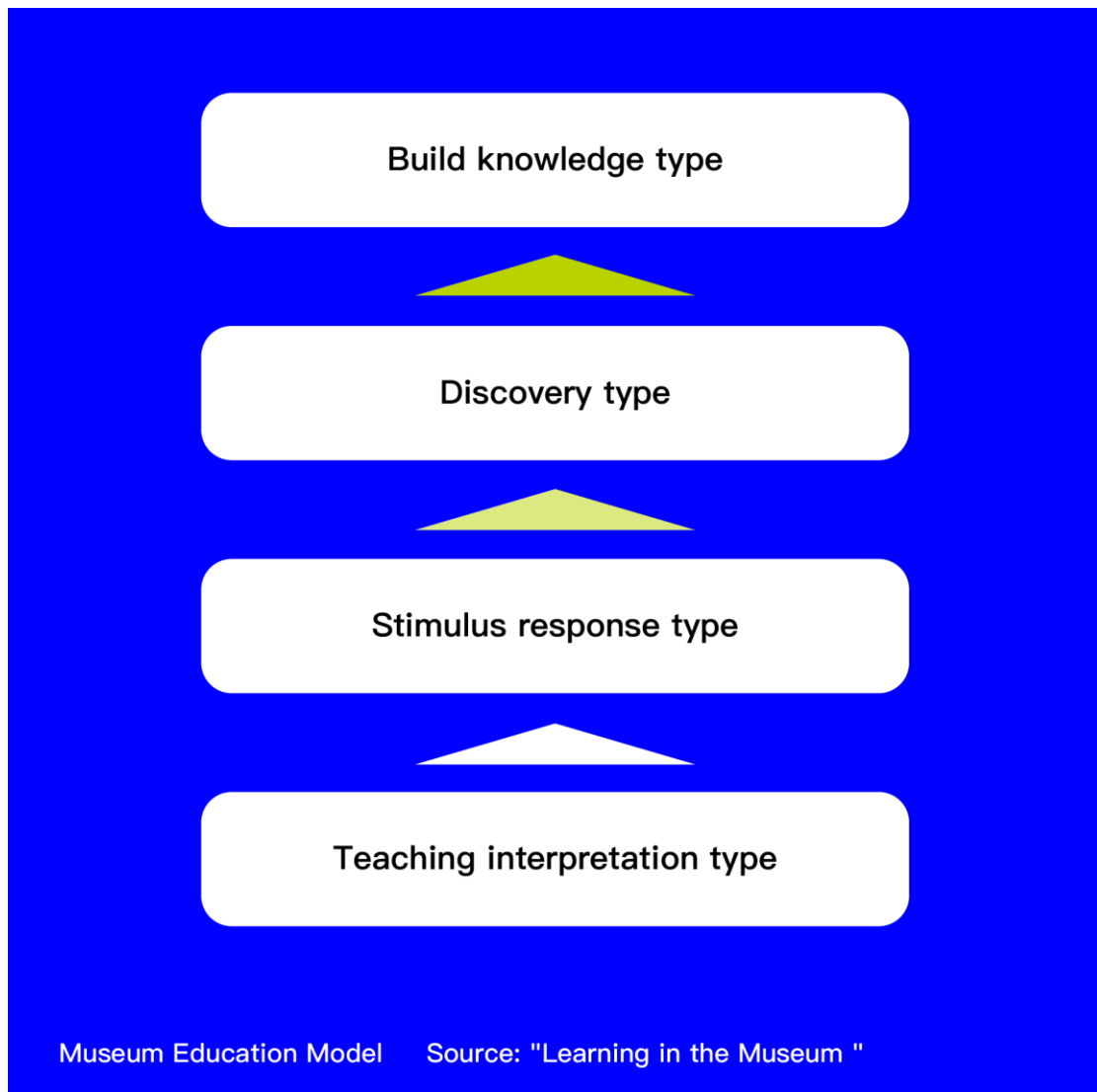


Diagram 2 Museum Education Model
Source: Learning in the Museum, 2021.

1.5.1 Scope of information

The first area of Research is focused on gathering and analyzing relevant information:

1.5.1.1 Review academic literature and the current state of Tang Dynasty tomb murals in tombs.

1.5.1.2 Investigate the application and development of digital media technologies in museum exhibitions.

1.5.1.3 Explore digital situational design methods, and examples applied to museum exhibitions.

1.5.1.4 Conduct case studies on the Treasures Hall of Tang Dynasty Tomb Murals in Shaanxi History Museum to examine the impact of digital media intervention on the situational design of tomb murals.

1.5.1.5 Develop a digital situational design prototype of the Tang Dynasty tomb mural exhibition, relying on the Treasures Hall of Tang Dynasty Tomb Murals in Shaanxi History Museum, and research audience behavior, perception, and experience during the prototype exhibition.

1.5.2 Population range

The second area of Research focuses on the population range:

1.5.2.1 The study will include visitors to the exhibition hall of murals in the tomb of the Tang Dynasty in the Shaanxi History Museum.

1.5.2.2 During the demonstration of the digital situational design prototype of the Tang Dynasty Tomb Mural Treasures Museum, visitors and experts will be invited to provide feedback, and data collection and analysis will be conducted.

1.5.3 Design scope

The third area of Research is focused on the design scope:

1.5.3.1 Conduct experiments on the digital visual design of tomb murals in the Tang Dynasty to explore the impact on audience cognition.

1.5.3.2 Conduct experiments on digital situational design to improve the audience's experience in the museum exhibition.

1.5.3.3 Develop a prototype display to showcase the impact of digital situational design on the Tang Dynasty tomb mural exhibition.

1.6 Research framework

This study examines the role of digital situational design in enhancing audience cognition, using the Tang Tomb Mural Treasure Hall in Shaanxi History Museum as a case study. Drawing on an analysis of the development and evolution of Chinese tomb murals, the researchers investigate the impact of various social and cultural factors, such as ethnicity, religion, and painting techniques, on the visual representation of tomb murals. Specifically, the researchers propose a visual Cultural turn theory, which

posits that tomb murals evolved from abstract cultural concepts to more figurative depictions.

Given the current state of mural exhibitions and the opportunities afforded by digital media technology, the researchers explore the methods, techniques, and processes of digital situational design in museums. To test the effectiveness of these techniques, the researchers use design prototypes, expert interviews, and audience surveys as research tools. By analyzing the rationality of design concepts and models through a comprehensive research protocol, the researchers summarize the creative principles, methods, and means of digital media art involved in the situational design of Tang Dynasty tomb murals.

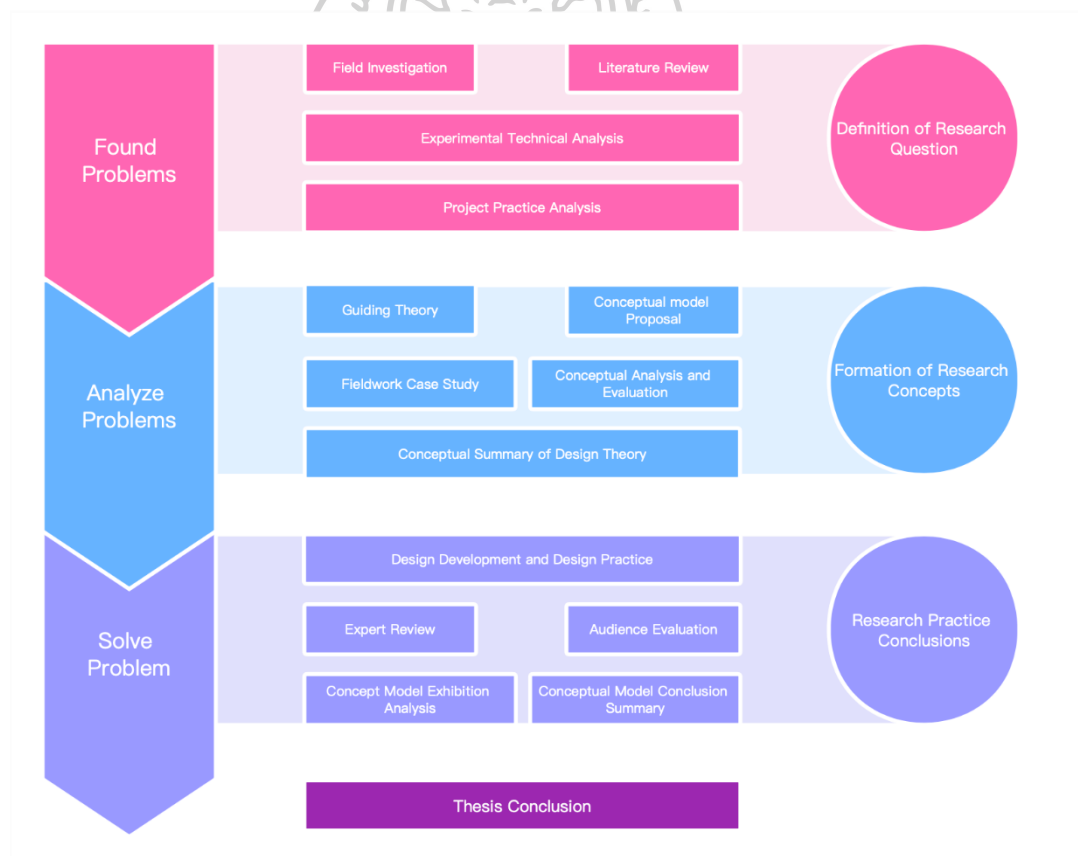


Diagram 3 Research Methodology

Source: Produced by Author, 2021.

1.7 Preliminary agreement

In this study, the researchers investigated several museums, including the Shaanxi History Museum, the Yongtai Princess Tomb Museum, the Zhanghuai Prince Tomb Museum, and the Yide Prince Tomb Museum. The case study of the Shaanxi History Museum's Tang Dynasty Mural Treasures Museum provided the basis for establishing a prototype model study of the exhibition, which aimed to explore digital situational design methods to enhance audience cognition.

To evaluate the effectiveness of these methods, the researchers compiled questionnaires to collect information from visitors who visited the digital exhibition of tomb murals in the Tang Dynasty. Through the analysis and evaluation of the questionnaires, the researchers aimed to study the audience's satisfaction with the exhibition of prototype models.

The ultimate goal of this research is to explore the theory of the situational design of Tang Dynasty tomb murals under the intervention of digital media and to enhance the audience's experience, perception, and learning when visiting the Tang Dynasty tomb murals.

1.8 Research methods and research process

This study employs a mixed-methods approach, utilizing qualitative, investigative, and experimental development research. The collection of physical and documentary materials will serve as the foundation for the design practice creation. Furthermore, a literature review, data collection, and digital media art creation analysis will be conducted to enhance audience awareness of information acceptance (Diagram 3).

1.8.1 Definition problem

The primary objective of traditional museums is to collect cultural relics and disseminate knowledge. However, the design of exhibitions, guided by the concept of objects, offers information to the audience through passive information dissemination. As a result, a dichotomy exists between the cultural relics and the audience, making it challenging for traditional museum exhibitions to capture the audience's attention (Burton & Scott, 2007). In the digital age, audiences require multi-dimensional means

of information dissemination to fulfill their cognitive needs. During visits, the audience is Drawn to the experience, atmosphere, and emotional satisfaction offered by the exhibition situation (Hampton, 2017). Audiences anticipate the museum situation design to focus on "people" and foster active exploration to meet their individualized learning requirements. Traditional museum exhibition models are at odds with the personalized exhibition preferences of the audience, and the exhibition design cannot meet the cognitive needs of the audience in the digital age. Therefore, researchers have proposed using digital interactive media technology to improve audience cognition.

1.8.2 Literature review and fieldwork

1.8.2.1 Learn the content, theory, and exhibition of Tang Dynasty tomb murals through the following methods:

1. Conduct a literature review of the theory of Tang Dynasty tomb murals.
2. The researchers conducted a field trip to the Tang Dynasty tomb murals site.
3. Researchers conduct data collection, expert interviews, and audience surveys.
4. The researchers conduct on-site observation and collect visiting information.

1.8.2.2 The information, content, theory, and design of the research project realize the situational design of the Tang Dynasty tomb murals under the intervention of digital media through the following methods:

1. Conduct a literature review of digital media arts.
2. Examine existing successful cases of digital media serving the exhibition.
3. Researchers conduct data collection, expert interviews, and audience surveys.
4. Observe the current state of the museum to gather necessary information.

1.8.3 Summarize research methods and theories through theoretical research and field research.

1.8.4 Study the audience's needs and propose necessary design solutions according to the differences between different groups.

1.8.5 Obtain analytical data through experiments. With the help of the audience and expert feedback, test the experiment's validity, generalize the experimental model, and summarize the digital media situational design theory.

1.8.6 The conceptual model proposal aims to create a new experience of visiting for the audience through the combination of technology and cultural relics in the situational design under the intervention of digital media.

1.8.7 Field investigation and Research in Shaanxi History Museum, Yongtai Princess Tomb Museum, Zhanghuai Prince Tomb Museum, and Prince Yide Tomb Museum.

1.8.7.1 Analyze the current situation of the collection of cultural relics and the exhibition situation in the Tang Dynasty tomb mural exhibition hall.

1.8.7.2 Compile questionnaires to collect visiting information about museum visitors.

1.8.8 Conduct questionnaire survey and analysis, summarize the conclusions of the questionnaire survey.

1.8.9 Conduct a conceptual analysis to construct a framework for models and exhibition patterns.

1.8.10 Conduct field investigations and hold experimental seminars on the digital situational design of the murals in the tombs of the Tang Dynasty.

1.8.10.1 Carry out the design of the digital content of the Tang Dynasty tomb murals.

1.8.10.2 Verify the validity of the digital media creation theory through the exhibition of prototype models.

1.8.11 Creation of prototype models of digital media situational design under the guidance of creation theory.

1.8.11.1 Researchers prepare teams, content, equipment, and tools.

1.8.11.2 Guide the creation of digital media art prototype models through theory.

1.8.11.3 Arrange the related preparations for the exhibition and data collection.

1.8.11.4 Plan for unexpected events

1.8.12 Information collection for prototype model exhibition:

1.8.12.1 Receive feedback from the audience through questionnaires, and study the following information:

1. Audience Classification

2. The researchers on-site visit the audience's opinion on the prototype exhibition.

3. Audience surveys and informal feedback collected.

1.8.12.2 Collect exhibition information through interviews and study the following information:

1. Provide general interviews that serve the audience.

2. To study the extent to which the audience's perception and emotion are affected by the digital media situational design during the visit.

3. The researchers study how digital media situational design enhances audience perceptions.

4. The rationality of digital media situational design intervening in museum exhibitions.

5. The technical support and reference of the digital media situational design and creation theory to related exhibitions.

1.8.13 Through the questionnaire survey, interview, observation, and analysis of the exhibition prototype model, summarize and extract the information, and summarize the knowledge and suggestions.

1.8.14 Conceptual model conclusions are Drawn through experiments during the exhibition. Through analysis, summarize the digital media art creation framework under the guidance of digital media art creation theory.

1.8.15 Draw the structure of the thesis by summarizing the design process, research results, and new knowledge of the thesis.

1.9 Research results

This study proposes a research framework that explores the potential of digital media in the situational design of Tang Dynasty tomb murals. Traditional museum exhibition design has focused on displaying physical objects. However, this research seeks to transform it through digital media interventions, creating a more engaging and interactive experience for the audience. The proposed digital situation design prioritizes the audience's experience and incorporates exhibition effect, customer satisfaction, and audience gains as essential evaluation criteria.

This research contributes to the situational design and digital media by proposing an innovative approach to museum exhibition design that prioritizes the audience's experience and emotional connection to cultural artifacts. Furthermore, this research provides a foundation for future studies and can serve as a guide for museum professionals seeking to enhance their exhibition design through digital media interventions.

In summary, this study's proposed framework and theoretical model provide a valuable contribution to the field of museum studies, specifically in the design and use of digital media to enhance the audience's experience and emotional connection to cultural artifacts.

1.10 Definition of terms

1.10.1 Tang Dynasty Tomb Mural

Tomb murals from the Tang Dynasty are representative of ancient Chinese aristocratic culture, encapsulating an integral part of mainstream culture during that era. These murals vividly document various aspects of the cultural landscape of the Tang Dynasty, including the codified system, social customs, religious beliefs, and philosophical ideologies. On the one hand, they serve as an illustrative interpretation of related accounts in the existing literature. On the other hand, they play a role in verifying and supplementing specific details not sufficiently elaborated upon in historical records, thus validating, rectifying, and complementing these records. A comprehensive understanding of these artworks should be broader than their painting techniques and modes of expression. Instead, focusing on the cultural phenomena and philosophical significance inherent in the political, economic, cultural, ceremonial, diplomatic, and everyday social relations reflected in the paintings is crucial.

Due to being buried underground for centuries, tomb murals require strict measures for preservation. After enduring a millennium of natural and anthropogenic destruction, many extant murals from the Tang Dynasty are now fragmented and damaged, having lost their original colors and textures. It challenges the audience's experience, as viewers often need help to discern the murals' content.

Tang Dynasty tombs, particularly those with significant and high-ranking murals, are predominantly in the Xi'an region. Consequently, the study of murals from the tombs in this region is particularly representative. Over 120 mural tombs from the Tang Dynasty have been excavated and cleaned, with approximately 80% located in the Xi'an area of Shaanxi Province. These tombs are typically high-ranking burial sites. An analysis of the chronology of these excavated mural tombs reveals that they span the early, middle, and late periods of the Tang Dynasty, thereby providing a comprehensive representation of the overall landscape of mural tombs from this era.

1.10.2 Museum Situation Design

Museum Situation Design refers to a specialized approach in spatial design, which aims to create a context or "situation" for the artifacts or information displayed within a museum, thereby enhancing visitor comprehension, engagement, and

retention. It often involves consideration of how the displayed items interact with their environment, how to guide visitors' lines of sight and movement pathways, and how to construct a space conducive to education, communication, and exploration through design.

The central principle of situation design is to make the exhibition content more appealing and interactive, providing visitors with an experiential way of exploring rather than just passively viewing exhibits. Designers utilize a variety of elements, such as color, lighting, sound, layout, multimedia, and interactive installations, to create an immersive environment. This design approach allows visitors to feel part of the exhibits' historical, cultural, or scientific backdrop.

Museum Situation Design can significantly influence visitors' perceptions and understanding, giving them a deeper comprehension of the exhibited content. It stimulates their curiosity, enhances participation and memory retention, and enables a richer, more immersive experience during their museum visit.

1.10.3 Cognitive Factors

Cognitive Factors, encompassing psychological and mental processes, drive a museum visitor's engagement with and comprehension of the exhibits and presented information. These factors critically mold the visitor's holistic museum experience, dictate their learning outcomes, and determine their interaction level with the exhibits.

1. Perception: Visitors' interpretation of sensory information hinges on this element. Factors such as layout, lighting, color, interactive elements of exhibits, and the visitors' pre-existing knowledge or expectations shape perception.

2. Attention: Given the copious information in a museum, attention governs the information a visitor prioritizes. The design of the exhibition, the visitor's interests, and the relevance of the information to the visitor inform this element.

3. Memory: As a pillar of a museum's learning process, memory dictates a visitor's retention capacity for the information provided during the visit. Strategies like repetition, storytelling, and interactive exhibits enhance this retention capacity.

4. Problem-solving: Encouraging visitors to think critically, form connections, and engage in activities or games related to the exhibits activate problem-solving abilities, especially in museums that seek to foster an interactive learning environment.

5. Decision-making: This refers to deciding which exhibits to visit, the duration to allocate to each exhibit, and the mode of interaction with the exhibits, governed by the visitor's interests, the perceived relevance of the exhibits, and the museum's layout.

In understanding the role of cognitive factors in a museum context, one can strive to design more efficacious and engaging exhibits, elevate the visitor experience, and amplify the museum's educational value.

1.10.4 Digital Media Arts

Digital Media Art is an artistic discipline that extensively uses digital technologies as an essential component of the creative and presentation process. This term can encompass a wide array of practices where art and technology converge.

From a technical perspective, Digital Media Art represents the utilization of digital tools and platforms in creating, manipulating, and presenting artistic content. These tools can range from digital image and video editing software, computer-aided design and modeling tools, and digital audio workstations, to coding languages designed for creative expression. These technologies provide artists with new methods for creating and exhibiting their work, allowing for creative expression and interaction.

Artistically, Digital Media Art introduces new possibilities and challenges. This field enables artists to manipulate aesthetic experiences in unprecedented ways, develop immersive and interactive environments, and even blur the boundaries between art and the audience. Simultaneously, it also challenges traditional conceptions of art, introducing questions regarding authorship, permanence, and the role of the medium.

From the audience's perspective, Digital Media Art offers an often interactive experience that can reshape the audience's role from a passive viewer to an active participant. The interaction can be physical, cognitive, or emotional, encouraging audiences to engage with the artwork in various ways. The inherent reproducibility of digital media also allows art to be more accessible, extending beyond the traditional spaces of galleries and museums to online platforms and virtual environments.

In summary, Digital Media Art stands at the intersection of technology and art. It utilizes digital tools to create innovative art forms, challenges traditional art practices,

and redefines the audience's role, providing a critical perspective on our increasingly digitized world.

1.10.5 Digital Interaction

Digital Interaction is a multi-disciplinary concept revolving around designing, developing, and applying technologies that facilitate interactive digital experiences. It is integral to the user experience within various digital systems, encompassing websites, mobile applications, virtual reality, augmented reality, and more.

Technically, Digital Interaction refers to the principles, techniques, and tools that enable the design and implementation of interactive digital systems. It includes using programming languages, algorithms, data structures, and design patterns, allowing developers to create interfaces that respond to user inputs in real-time. It also involves a deep understanding of hardware and software platforms, networks, databases, and security protocols to ensure seamless and secure interaction experiences.

From a user perspective, Digital Interaction creates intuitive, efficient, and engaging interaction between users and digital systems. It involves understanding user behaviors, needs, and motivations and using this information to inform the design of the user interface (UI) and user experience (UX). The aim is to make the interaction as short, satisfying, and effective as possible, improving user engagement and satisfaction.

From a developmental standpoint, Digital Interaction constantly evolves, driven by technological advancements and changing user expectations. Emerging technologies like artificial intelligence (AI), virtual reality (VR), augmented reality (AR), and the Internet of Things (IoT) are redefining how users can interact with digital systems. These technologies enable more immersive, personalized, and context-aware interaction experiences, shaping the future of Digital Interaction.

In summary, Digital Interaction sits at the intersection of technology, design, and user experience. It involves designing and implementing technologies that support effective interaction between users and digital systems, creating meaningful and engaging user experiences, and evolving with technological advancements and changes in user expectations.

1.10.6 Interaction with Performance

Interaction with performance describes a dynamic relationship between the participants and the ongoing performance, often seen in interactive art, live performances, and digital media.

1. Technological Aspect: With the advent of digital technology, interaction with performance has undergone a significant transformation. Virtual reality (VR), augmented reality (AR), and various sensor technologies enable real-time interactions with performances. This technology-mediated interaction ranges from manipulating digital objects or elements of a virtual environment to provoking different responses from performers.

2. Interaction Aspect: The core of interaction with performance lies in its bidirectional communication. Instead of a one-way delivery from performers to the audience, the interaction encourages mutual feedback and responses, creating a dynamic, ongoing dialogue. This interaction might be physical, emotional, or digital, depending on the nature of the performance.

3. Participant's Perspective: For participants, interaction with performance is a shift from passive observation to active engagement. They could influence, change, or become a part of the performance, creating a more dynamic, participatory, and immersive experience. This active involvement can lead to deeper connections with the performance and other participants, contributing to a sense of community or shared experience.

4. Performance Exhibition Perspective: From the performance exhibition's viewpoint, enabling interaction opens new possibilities for creative expression and audience engagement. It invites spontaneity and improvisation, making each performance unique and personalized based on the interactions it fosters. Moreover, it offers novel storytelling and narrative development, shaping the performance in response to the participant's input.

In summary, understanding the concept of "interaction with performance" requires consideration of various aspects, including the role of technology, the nature and process of interaction, the experiences and perspectives of the participants, and the implications for performance exhibition. This concept transforms from traditional,

unidirectional performance towards more dynamic, interactive, and participatory modes of cultural expression.

1.11 Chapter summary

This study aims to investigate the potential of digital technology to enhance the relationship between Tang Dynasty tomb murals and their audience, focusing on improving information transfer. Specifically, the research seeks to enhance museum exhibition situational design by integrating digital media technology. The experiment serves as a prototype to analyze and test the effectiveness of digital media intervention on the audience's cognition of the Tang Dynasty tomb mural situational design.

The experiment emphasizes the application theory of digital media technology with a selection principle that promotes the collaboration of four museum situational design elements: space, media, audience, and exhibition. Models provide the necessary conditions for data collection.

The prototype experiment tests the relevance of digital media art creation principles, serving as a theoretical basis to guide the creation of digital media art displays in relevant exhibitions. The goal is to enhance the audience's experience, perception, learning, emotion, and memory (Meng et al., 2022).

This paper proposes a research framework for digital media intervention in the situational design of Tang Dynasty tomb murals. The digital situation design seeks to change the traditional object-centered museum exhibition design concept to prioritize the audience's experience. The proposed design incorporates exhibition effect, customer satisfaction, and audience gains as essential evaluation criteria, with the ultimate goal of raising the audience's awareness of the cultural artifacts on display.

In summary, this study's proposed research framework and prototype experiment provides valuable insights into enhancing museum exhibition design through digital media interventions, improving the audience's emotional connection to cultural artifacts. Furthermore, the findings of this research can guide museum professionals seeking to improve their exhibition design through digital media interventions.

Chapter 2 Literature Review And Related Research

2.1 Introduction to the murals in the tombs of the Tang Dynasty

2.1.1 The significance of tang dynasty tomb murals

Tang Dynasty tomb murals reflect Tang Dynasty culture (Figure 5) and embody the Chinese belief in rebirth. The development of tomb murals dates back to the Sui and Tang Dynasties. It symbolized a shift in the Chinese people's belief in rebirth from preserving the body's integrity to the rebirth and transformation of the soul within the tomb space. Tomb buildings, as the carrier of life and death transformation, carry symbolic significance, and the imaging system no longer serves as the guide to ascend to immortality. Instead, it is transformed into a realistic depiction of life, reflecting Chinese Confucianism's philosophical concept of "death likes life" (Yong & Bo, 2015).

Murals became the main form of artistic expression in Chinese society during the Tang Dynasty, and they played a crucial role in aristocratic culture, especially aristocratic funeral culture. The images depicted in tomb murals recorded the cultural landscape of the Tang Dynasty's regulations, social customs, religious beliefs, and ideas (Xingming, 2005). The murals' content recorded the Tang Dynasty's etiquette system, making them valuable cultural relics for future generations to study the social development of the Tang Dynasty. The arrangement of archaeological excavation reports shows that the evolution of tomb murals presents the development of painting during the Tang Dynasty, with a gradual formation of a complete system and a mature style (Wei, 2001).

On the one hand, the specific painting images confirm the relevant images recorded in existing documents. On the other hand, they supplement and verify the documents from the perspective of archaeological and cultural relics. Thus, the Tang Dynasty tomb murals serve as historical evidence and verify, supplement, correct, and reshape history (Xingming, 2007) (Figure 6).



Figure 5 "Maids of Honor" on the south side of the east wall of the front chamber
 Source: Tomb of Princess Yongtai, Shaanxi History Museum, 2021.



Figure 6 Tang Dynasty tomb murals toured in Taiwan
 Source: Xinhua News Agency, 2021.

Tang Dynasty tombs are primarily found in the Xi'an area, with large-scale and high-level mural tombs concentrated in this region. Therefore, studying the mural tombs of the Tang Dynasty in Xi'an is of typical significance. Formal, scientific archaeological excavations and clean-ups of Tang Dynasty tomb murals began in the 1950s (Figure 7). More than 120 Tang Dynasty mural tombs have been cleared and excavated, of which about 80% are concentrated in Xi'an, Shaanxi Province, and are all high-grade tombs (Zicheng, 1959). The excavated Tang Dynasty mural tombs spanned the early, middle, and late Tang Dynasty, forming a physical system that reflects the overall appearance of Tang Dynasty tomb murals. The discovery of many Tang Dynasty mural tombs provided many archaeological excavation briefs and professional reports for research. The availability of relevant documents and pictures has provided graphic and textual conditions for later research. Thus, the Tang Dynasty tomb murals meet the conditions for systematic research (Bai, 1982).



Figure 7 Excavation of the mural tomb

Source: Popular Archaeology, 2021.

2.1.2 Morphology and configuration of mural tombs in the Tang Dynasty

The form and configuration of the mural tombs in the Tang Dynasty continued the form of the tombs in the late Northern Dynasty (AD 386- 581) and the Sui Dynasty

(AD 581-618). In the inheritance of Chinese culture, the ancients' cognition of death developed the definition of life and death into the belief in the rebirth that "death is like life." Ancient Chinese tombs, especially the tombs of high-level nobles and royal families, paid attention to the presentation of the ritual system of tombs and showed strong characteristics of the times in terms of normative, class, and epochal. Especially in the late Han Dynasty (around AD 200), the prevalence of horizontal tombs provided the ideological basis and environmental conditions for the belief in rebirth (Xiaoyang, 2014). The tomb murals of the Tang Dynasty have gradually developed their characteristics of the times in the historical evolution and development. The form of the mural tombs and the configuration of the murals represent the class ideal and social identity of the Tang Dynasty society. They are essential materials for the study of the cultural landscape of the Tang Dynasty (Lijun, 2008). Understanding the relationship between the structure of the tomb and the configuration of the murals will help to correctly understand the characteristics of the tomb culture of the past dynasties, accurately grasp the cultural connotation carried by the murals, and clarify the development time of the culture.

2.1.2.1 Inheritance and evolution of tomb structures

Tomb structures play a crucial role in carrying the murals of tombs, particularly in the case of horizontal tombs, which resolved the need for architectural space to rebirth spiritual beliefs (Huacheng, 2021). Unlike the closed and isolated vertical tombs, horizontal tombs focus on the connection between the two worlds and the continuity of spiritual beliefs. This appearance of the horizontal tomb was revolutionary and fundamentally transformed the nature of tomb structures. Subsequently, the change in space conditions provided a foundation for the theme of subsequent murals. Scholars Li Dexi and Guo Dewei argue that underground tomb architecture mimics above-ground buildings and reflects people's imagination of the world after death (Dexi & Dewei, 2004). With the advent of horizontal tombs, murals found a spatial basis for their depiction (Figure 8). During the Han Dynasty, portrait stones dominated tomb murals. These stones were carved with portraits and placed in underground tombs, ancestral cemetery halls, tombs, and temples. Since most of these structures were funeral buildings, Han portrait stones are considered sacrificial funeral art (Li, 2017).

The themes portrayed are mainly centered around mystery and creating an ambiance for mysterious stories. It can be inferred that people's perception of death in the Han Dynasty was still limited to the blessings of mysterious powers. This perception helped integrate other religious powers to enrich tomb culture (James, 1995).

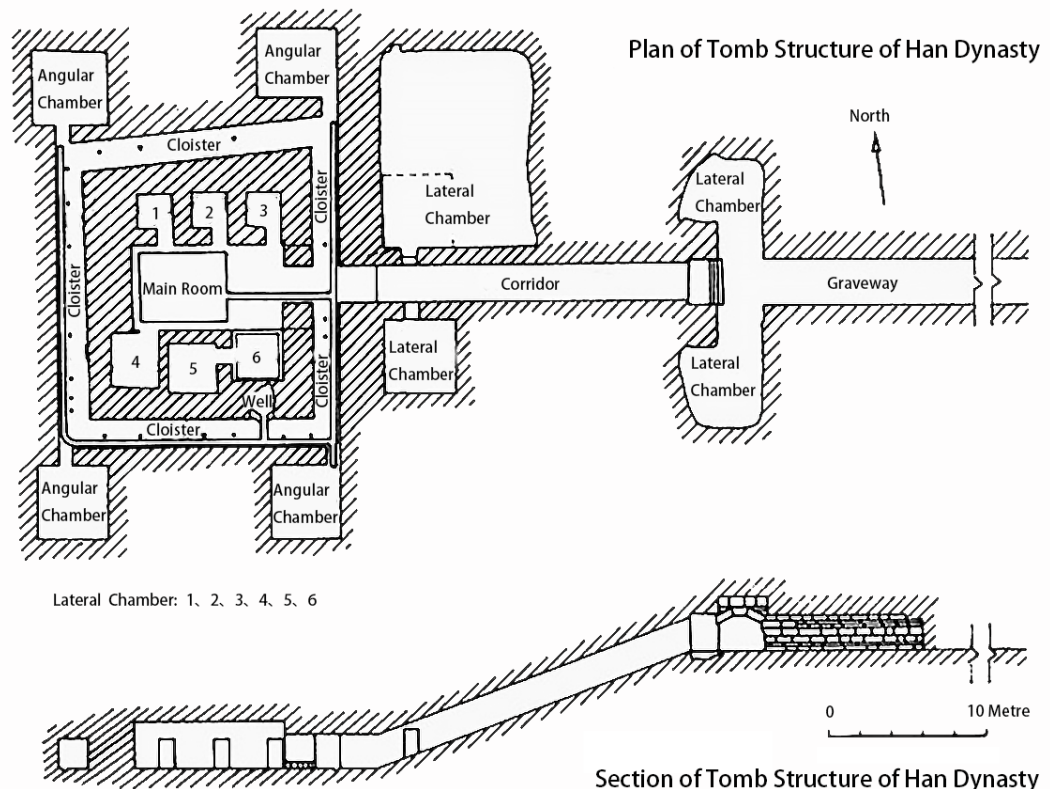


Figure 8 Han Dynasty tomb structure map

Source: Produced by Author, 2021.

The tomb structures continued to evolve during the Northern and Southern Dynasties (AD 386-581). The shape of the tombs in southern China changed gradually under the influence of Han Dynasty culture while maintaining the same style (Dien & Dien, 2007). In northern China, the minority regimes enriched the original Chinese cultural foundation. The formation and evolution of northern minority cultures were influenced by the cultures of the Kushan Empire in Afghanistan, the Sassanid Dynasty in Persia, and the Han Dynasty in China (Zhang & Zhang, 2020) (Figure 9). The influence

of these cultures prompted the northern minority regimes to present a thriving scene in tomb murals and enriched the original Chinese traditional forms in the structure of the tomb and the style of the murals. The aristocratic burial structures of the regimes in northern China were mainly composed of slope tomb passages, passage holes, patios, niches, corridors, and tomb chambers (Baofu, 1997). The aristocratic tombs of the Tang Dynasty inherited the structure of the Northern Dynasties' tombs.

The earliest traces of the atrium in tombs can be traced back to the late Western Han Dynasty (around the first century AD). The form evolved from the "Shaft pit" found in earlier slope tombs. The "Shaft pit" opens a horizontal square burial between the burial chamber and the tomb passage leading to the ground, directly connected to the burial tunnel and the burial chamber (Campbell, 2010). The structure was initially designed to facilitate the construction of slope tombs during tomb construction and gradually evolved into a ceremonial structure that symbolized identity (Xiaoyang, 2018b). Around the fourth century AD, a stable normative burial structure consisting of slope tomb passages, patios, corridors, and vaulted tombs was established in China (Figure 10). During the Northern Zhou Dynasty (AD 557-581), the slope tomb passage and patio cavern became the primary form of the royal family's tombs. These tombs were significant in scale, and the number of patios increased. The tombs of the Sui Dynasty's aristocrats continued the tombs in the slopes and courtyards of the Northern Zhou Dynasty and influenced the form of the nobles' tombs in the early Tang Dynasty (Meitian, 2004).

The basic configuration of mural tombs in the early Tang Dynasty can be summarized as follows:

A. The size of inclined tomb passages increased to reflect the nobility's class status and value pursuit.

B. The number of patios increased, and a fixed pattern was formed. By the early Tang Dynasty, the tomb patios had matured and become a stable form of tombs for the aristocracy, especially the royal family. They also became a symbol of representative tomb culture during the Tang Dynasty.



Figure 9 The foreign cultural elements in the reliefs of the murals in the tomb of Yuhong in the Northern Dynasty

Source: Shanxi Museum, 2021.

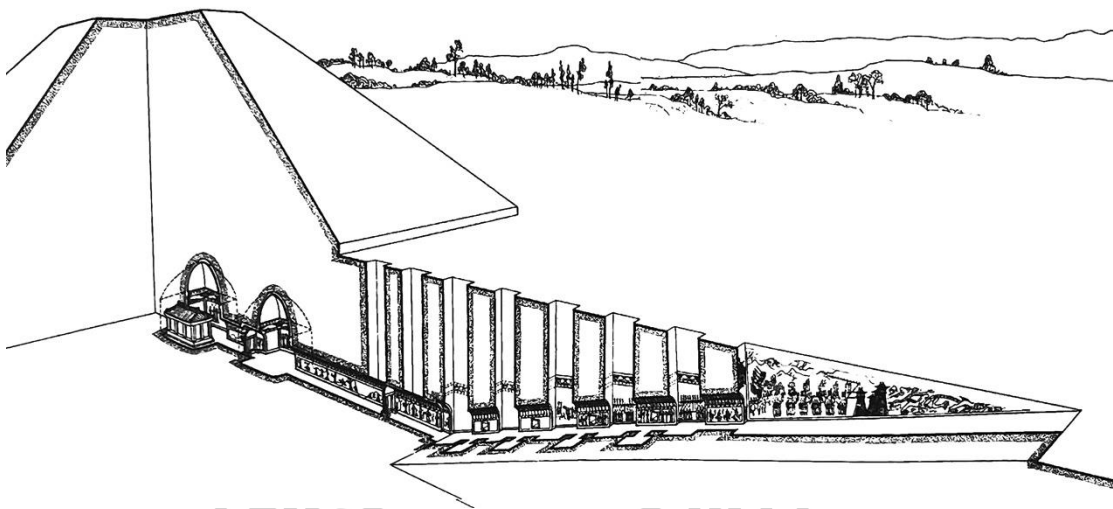


Figure 10 Structural diagram of the tomb of Prince Yide

Source: Murals of the tomb of Li Chongrun in Tang Dynasty, 2021.

C. The passing-through hole became a fixed form of opening niches in pairs on the east and west walls of the patio.

D. A corridor was opened on the south side of the tomb, and the corridor and tomb were made of bricks.

E. The tomb's plan was square, and the top was mainly a dome structure.

These basic configurations reflect the unique characteristics of the mural tombs during the early Tang Dynasty, which were heavily influenced by previous dynasties' cultural and artistic achievements. The evolution and development of tomb structures

and mural art during this period reflected the era's complex historical and cultural background (Eckfeld, 2005).

2.1.2.2 Inheritance and change in tomb mural layout

The evolution of tomb murals is closely tied to the development of tomb shapes, particularly the emergence of horizontal tombs, which provided realistic conditions for the production of tomb murals (Shi & Wang, 2023). Horizontal tombs gained popularity in China during the third century AD. During the late Han Dynasty, tomb art was influenced by social culture and religious beliefs, resulting in two different image systems with different requirements for mainstream and non-mainstream societies (Krupa et al., 2020).

The mainstream image system emphasized gods with the ancestors' breath and traditional gods that were in lines with mainstream social thought, such as the worship of the native primitive religion, heaven and earth, and auspicious gods. The non-mainstream image system focused on the spirits of immortals, the new type of deities in the immortal system, and the newly constructed deity world represented by the Queen Mother of the West (Qin, 2005). The worship of the Queen Mother of the West is believed to have originated from the religious beliefs of the ancient Persian Empire, reflecting the fusion of Eastern and Western cultures (Carter, 2006) (Figure 11).



Figure 11 Worship and mysterious atmosphere of the Queen Mother of the West in the Han Dynasty tomb mural image system

Source: History of Chinese Tomb Murals, 2021.

The development of tomb murals during the Han Dynasty did not yet have an overall normative form. From a content perspective, the top of the tomb was the fixed part, depicting cosmic and celestial phenomena, while other parts were expressed in a framed manner (Suhadolnik, 2011). The continuity of the picture narrative was relatively independent and needed more unity and coherence. The subject matter and form of expression were relatively random. The picture layout was divided into frames, with the upper, middle, and lower arrangements presented on the wall surface, resulting in a cluttered story space (Wu, 2021). Overall, it differed from the tomb murals in the Tang Dynasty, which presented scenes of the tomb owner's home life before death through a unified space that cooperated with the tomb structure (Figure 12).



Figure 12 Themes and compositional characteristics of murals in the Han Dynasty

Source: History of Chinese Tomb Murals, 2021.

Han Dynasty tomb murals exhibited various forms, such as silk paintings, lacquer paintings, murals, portrait stones, and bricks. He Xilin defined the theme of Han Dynasty tomb murals (Xilin, 2002) as "covering the world and all-encompassing themes," which can be divided into four categories:

1. A heavenly scene depicting cosmic celestial phenomena and various gods and auspiciousness.
2. All kinds of ghosts and characters in the tomb ward off evil spirits.
3. The personal experience of the tomb owner and related home life scenes.
4. Historical stories and figures flaunt Confucian moral ideals.

During the Southern Dynasty, tomb murals inherited the Han dynasty system, focusing on expressing the life of the tomb owner and the concept of the fairyland.

However, new elements gradually emerged in the tomb murals, including images of Gao Shi, a prominent Confucian figure, portrayed in works such as "Seven Sages in Bamboo Forest" and "Rong Qiqi" (Xu, 2021). As a result, the atmosphere of ascending immortals diminished, giving way to a more mundane tone. It is reasonable to infer that the tomb owners had a strong nostalgia for life, which overshadowed their expectations for the afterlife (Figure 13).

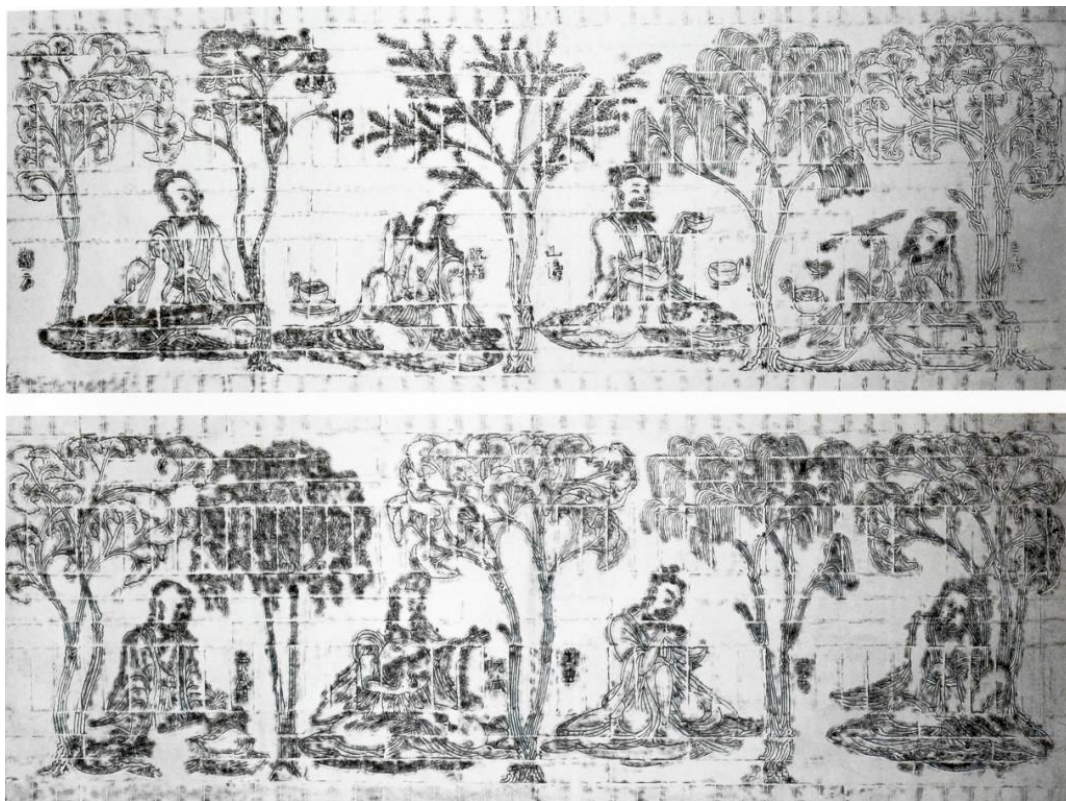


Figure 13 Brick rubbings of the Seven Sages in the Bamboo Forest and Rong Qiqi

Source: Nanjing Museum, 2021.

The Northern Dynasties, established by ethnic minorities, showcased a thriving scene in tomb mural art. The Northern Dynasties' rulers integrated the Han nationality's national and primary culture during their rule. The tomb murals followed the image structure of previous dynasties but with a greater emphasis on reinforcing imperial power in the mural images. It reflected the normative nature of the etiquette system (Dawei, 2004). Later generations referred to the form of tombs from the Northern

Dynasties as the "Yecheng Model." The Yecheng Model prioritized the overall layout and interconnectedness of the tomb murals (Huiying & Xiaohong, 2022). The realistic images formed a unified space that strengthened the narrative and coherence of the tomb space, resembling a unified ceremony site that blended scenes inside and outside the noble mansion's courtyard (Figure 14).

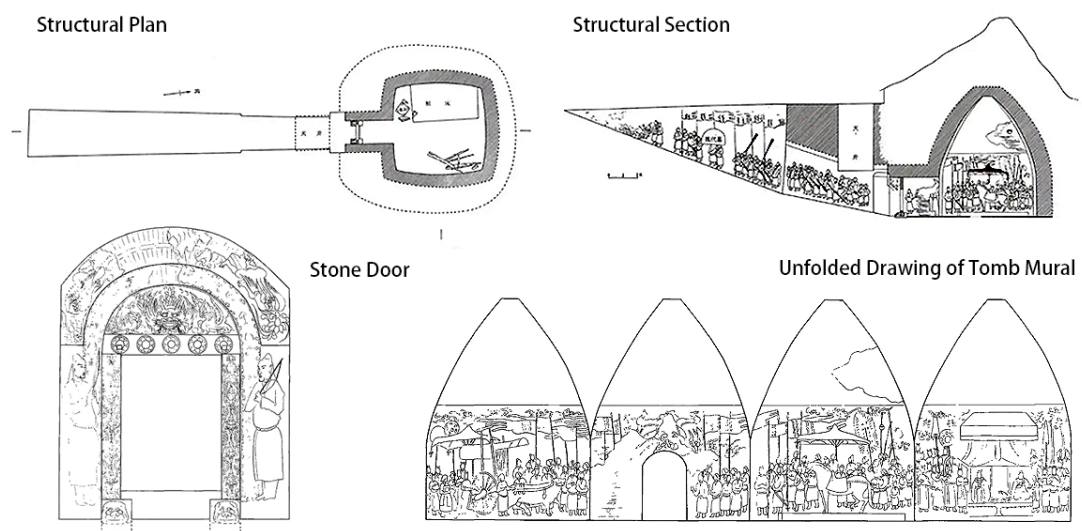


Figure 14 The structural plan, section, and murals of the tomb of Xu Xianxiu in the Northern Dynasties

Source: *Report of the Tomb of Xu Xianxiu in the Northern Qi Dynasty*, 2021.

The tomb murals of the Northern Dynasties are distinguished by the integration and interweaving of two sets of image systems, each guided by ritual and etiquette norms to demonstrate the overall unity of the tomb murals (Zhongming, 2000). The realistic image system portrays a unified space scene inside and outside the noble mansion in the real world, while the cosmic and mysterious image system depicts the virtual world. The narrative is developed around a portrait of the tomb owner at the center of the north wall, with the two systems complementing each other to convey a sense of situational continuity (Meitian, 2005).

The realistic image system includes images of guards of honor, attendants, palace maids, carriages and horses, songs and dances, banquets, and buildings

arranged in an orderly manner in a continuous and unified space from the entrance of the tomb to the back tomb, exhibiting obvious etiquette norms (Figure 14). In contrast, the mysterious image system is presented by the blue dragon and white tiger at the entrance of the tomb, the images of feathered people, mythical beasts, luan birds, flowing clouds, and lotus flowers in the upper part of the tomb structure, as well as the images of mythical beasts inside the tomb (Zhongming, 2000) (Figure 15) (Figure 16).

The normativeness of the tomb murals in the Northern Dynasties profoundly impacted the development of the tomb murals in the Sui and Tang Dynasties (Chao, 2014).

During the Tang Dynasty (AD 618-907), the mural tombs of the aristocratic class continued the form of the Northern Dynasties, particularly the Northern Zhou Dynasty (AD 557-581) and Sui Dynasty (AD 581-618), in terms of their form and mural configuration (Xiaoyang, 2016). However, they tended to become more standardized. The mural tombs of this period were generally large in form and scale, and most had slopes and patios. Holes and niches became a fixed pattern. The tomb adopted a dome-top structure, and the royal family and the powerful class adopted a double tomb structure. The coffin bed or coffin was placed west of the northern burial chamber, becoming the norm. The tomb structure of the sloping tomb road and patio caverns fully matured in the early Tang Dynasty, and it became a stable tomb structure for the nobles of the Tang Dynasty (Jie & Chaetnao, 2022).

The graphics of the tomb murals in the early Tang Dynasty inherited the layout and content of the Northern Dynasties but gradually developed their unique characteristics (Yi, 2007). In the tomb chamber, the portrait of the tomb owner was no longer the core of the mural's narrative. Instead, the sarcophagus in which the tomb owner's bones were displayed became the focus. This change skillfully unified the actual and virtual situations organically, strengthening the unified spatial layout of the mural and the tomb structure. Through gates, gate towers, and shadow-made wooden structures, the tombs' murals built the noble mansions' interior and exterior scenes in a unified space, showcasing a solid order and etiquette (Xingming, 2005).



Figure 15 The realistic image system in the tombs of the Northern Dynasties
Source: Shanxi Museum, 2021.

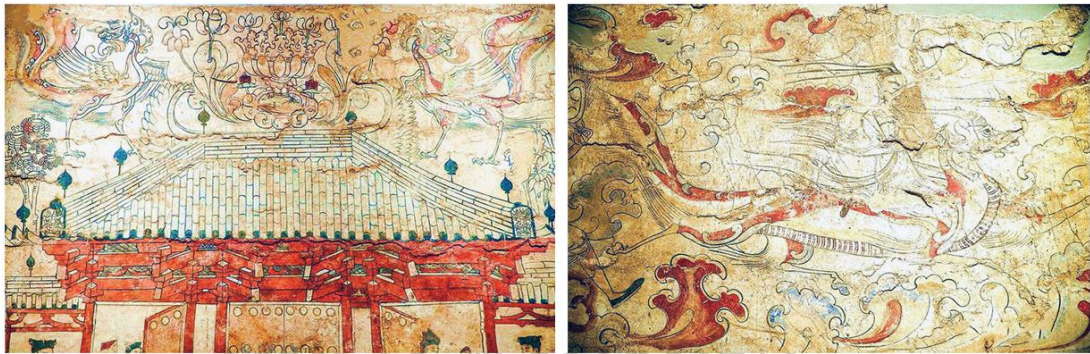


Figure 16 The mysterious image system in the tombs of the Northern Dynasties
Source: Shanxi Museum, 2021.

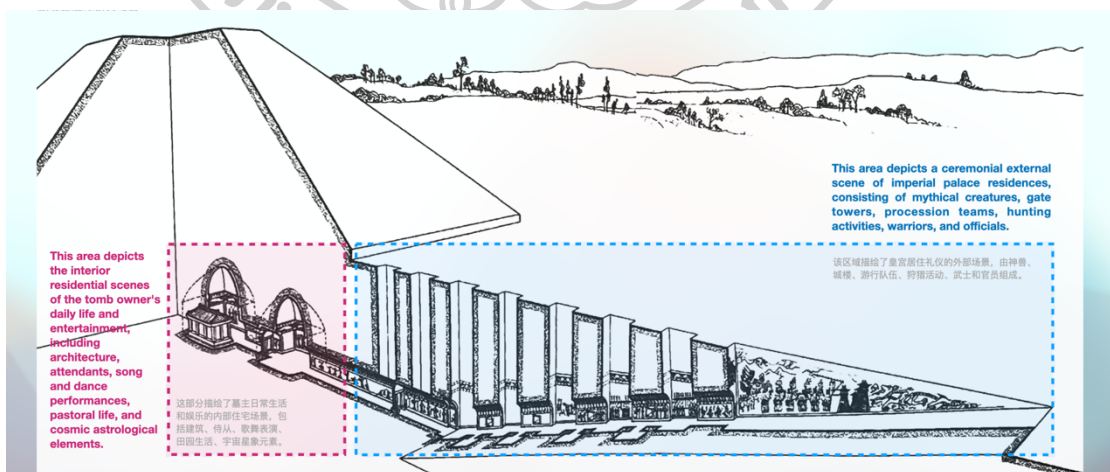


Diagram 4 Schematic diagram of the structure of the noble tombs of the Tang Dynasty

Source: Drawn by Author, 2021.

2.1.2.3 Form and mural configuration of tang dynasty mural tombs (Diagram 4)

A. The form and arrangement of murals in the early Tang Dynasty (AD 618-713)

The form of the mural tombs in the early Tang Dynasty showed that the tombs were facing south, and the overall structure was located on a central axis. The order of the structure of the tombs is the slope tomb, the passage, the patio, the niche, the corridor, and the vaulted tomb. The burial chamber structure presents quantitative differences due to different identities and classes (Eckfeld, 2005) (Figure 17).

The murals' content is in line with the interior and exterior scenes of the noble mansion in the unified space (Figure 18). At the entrance of tomb passages, blue dragons, white tigers, gate towers, ceremonial guards or hunting trips, ceremonial guest envoys, chariots and horses, halberds, gatekeepers, and warriors are generally drawn at the entrance of the tomb. The interior of the courtyard of the aristocratic mansion is represented within the first passage hole, the passage hole symbolizes the corridor, and the patio symbolizes the courtyard. For the passage through the hole and the patio, the diagrams of ceremonial guards, animal taming, halberds, and servants were drawn. The corridor represents the scene of the inner house, and the mural images revolve around the life and entertainment of the tomb's owner. The part of murals was images of servants, palace maids, and maids, singing and dancing, and Cosmic images drawn on the vaulted ceiling at the top of the burial chamber. The entire tomb connects the unified space inside and outside the aristocratic mansion through the image structure of shadow wood (Yi, 2008) (Diagram 5).

The realistic image system and the universe's mysterious image system are integrated into the unified image space. The mysterious images were gradually reduced in the murals of the Tang Dynasty tombs. Only the four mythical beasts and the lark, the auspicious bird, the cirrus cloud, the golden blackbird, the toad, and the laurel tree inside the image of the sun and the moon remained (Jie & Weimin, 2011) (Figure 19) (Figure 20). It shows that people in the Tang Dynasty paid more attention to the nostalgia for the present world, and secular life and social etiquette became the main body of the tomb mural painting (Diagram 6).

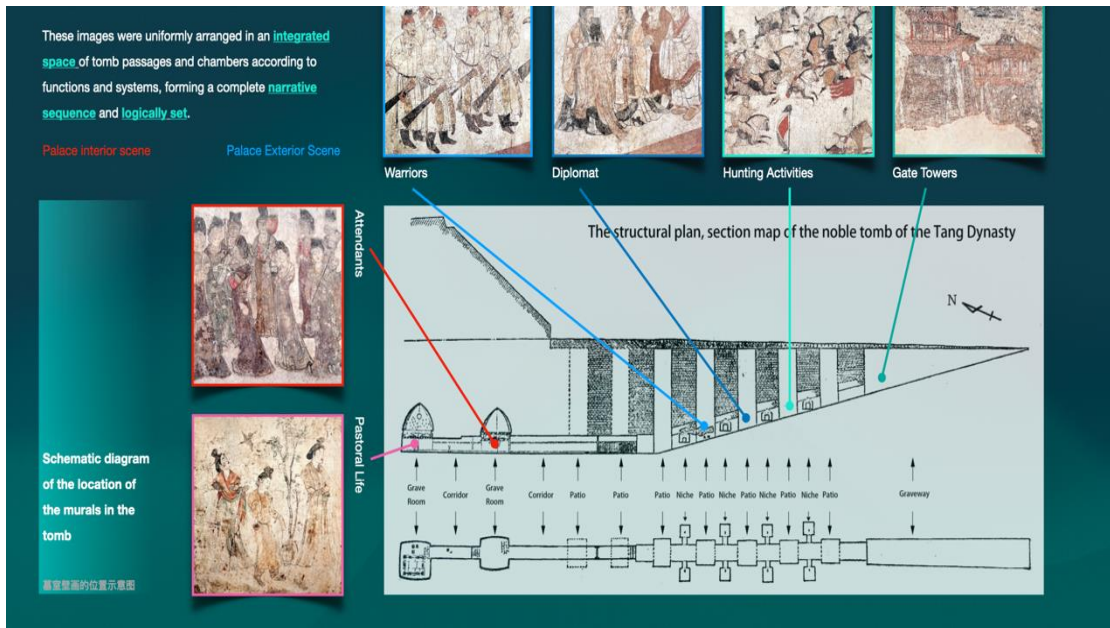


Diagram 5 Image system representing the real world in Tang Dynasty murals

Source: Drawn by Author, 2023.

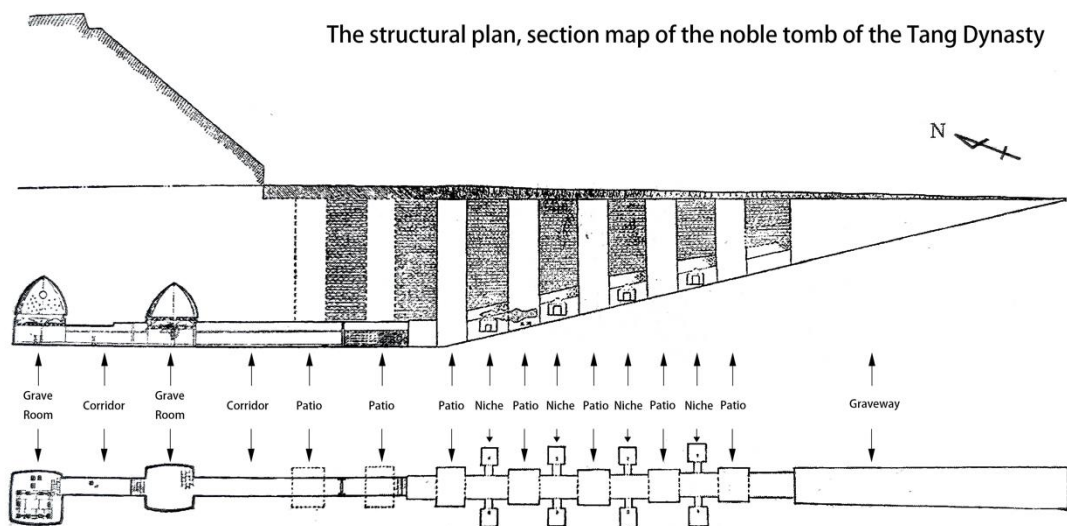


Figure 17 The structural plan, section map of the noble tomb of the Tang Dynasty

Sources: Cultural Relics, 2021.



Figure 18 The unified spatial expression in the murals of the tomb in the Tang Dynasty

Source: The Author took pictures in the tomb of Princess Yongtai, 2021.



Figure 19 The mysterious patterns in the murals of the tomb - the cloud pattern and patterns

Source: The Author Photographed the tomb of Prince Yide, 2022.



Figure 20 The dome and the celestial image in the murals of the tomb in the Tang Dynasty

Source: The Author took the tomb of Prince Yide, 2022.

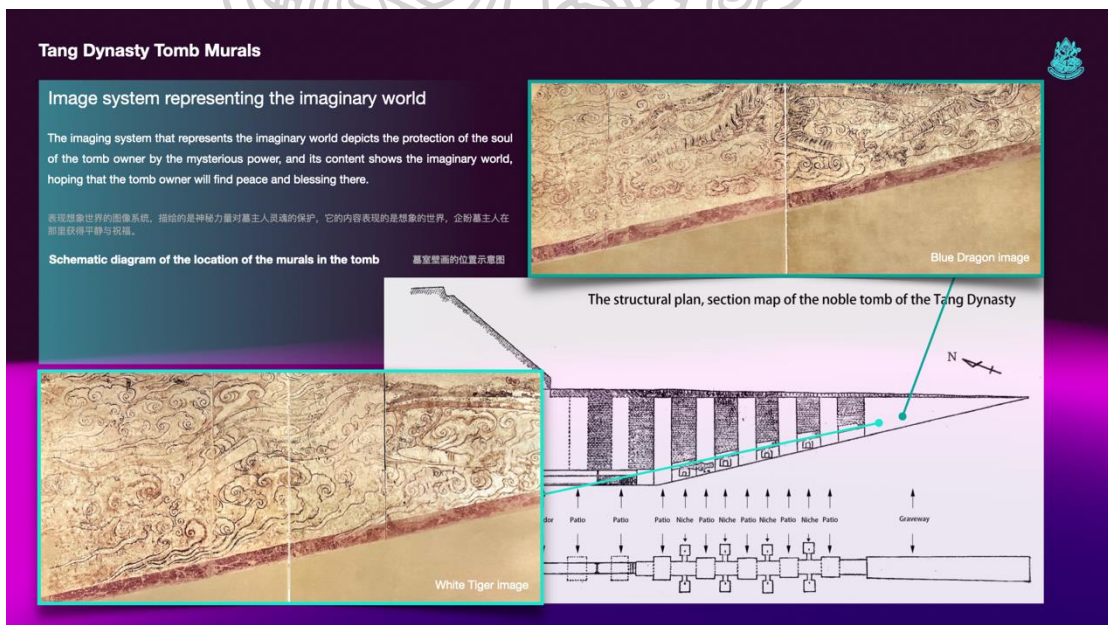


Diagram 6 Image system representing the imaginary world in Tang Dynasty murals

Source: Drawn by Author, 2023.

The design concept of the mural tomb in the Tang Dynasty is to simulate real social life scenarios, focusing on the courtyard's hierarchy and the social class's particularity. The themes expressed in the murals of the tombs of the Tang Dynasty are images of ceremonial guards, doormen, servants, palace maids, music, and dances in real life, reflecting the splendid, warm, and comfortable life of the nobles. From this, we can infer that the spiritual world of the Tang Dynasty people is full of self-confidence and vitality (Xu & Rong, 2004).

B. Form and Arrangement of Murals in Muraled Tombs during the Tang Dynasty (AD 713-766)

During its period of prosperity, the Tang Empire experienced the An-Shi Rebellion in AD 755, marking a turning point in the dynasty's history (Houbin, 1999). As the national strength was gradually weakened, the scale and structure of the mural tombs in the Tang Dynasty underwent significant simplification while retaining strict hierarchical differences, as compared to the tombs of the same level in the early Tang Dynasty.

Although courtyards still existed in the tombs of high-ranking nobles, they were reduced or even omitted. The shadow wooden structure was simplified and gradually omitted. The double-chambered mural tomb in the Tang Dynasty disappeared, and only the single-chamber structure remained. This simplification of the tomb structure resulted in a reduction in the area of the tomb murals. Ceremonial travel and honor guard scenes were simplified, and screen murals became the mainstream painting style in the tombs (Xingming, 2007) (Figure 21).

C. The Shape and Arrangement of Murals in Middle and Late Tang Dynasty Muraled Tombs (AD 766-907)

The tombs of the Tang Dynasty during the middle and late periods experienced a decline in all aspects, including the shape and configuration of the murals. Despite the Tang Dynasty's prosperity, the tombs did not reflect this. The patio structure continued to shrink and nearly disappeared from the muraled tombs of the mid-late Tang Dynasty. Additionally, the shadow wooden structure was wholly degraded from the mural tombs of the Middle and Late Tang Dynasties (Feng & Xiaosong, 2021).

The screen murals in these tombs primarily depicted flowers, birds, and ladies, showcasing the changes in social customs during the late Tang Dynasty. The images of the guard of honor and the halberds, which represented social order and the rank of the tomb owner, disappeared, reflecting the social collapse during the middle and late Tang Dynasties. An essential change in the Tang Dynasty mural tombs during the middle and late periods was the appearance of Suzaku and Xuanwu pictures on the north and south walls of the west side of the tomb. This change in form disrupted the design pattern of unifying spaces (Yuanliang et al., 2021).



Figure 21 Simplification of the murals in the tomb of the Tang Dynasty -- Music and Dance pictures and Screen pictures

Source: Han Xiu's tomb of the Tang Dynasty, 2021.

2.1.2.4 Research on the contents of mural tombs in the Tang dynasty

Scholars have Produced various academic concepts regarding the contents of Tang Dynasty tomb murals. Wang Rinpo, He Xiuling, and Shan Wei (Rinpo et al., 1984) divided the murals into eight categories: Four Gods, Hunting, Guard of Honor, Court Life, Protocol, Religion, Architecture, and Astrology. However, their emphasis on generalizing court life, protocol, and religious content has weakened the elaboration of social life and production images. Yin Shengping (Shengping, 1991) defined the contents of the Tang Dynasty tomb murals as four gods, astrology, religion, architecture, rituals and guards, hunting, life, and friendly exchanges between ethnic groups (Figure 22).



Figure 22 The scene of aristocratic travel reflected in the murals in the tomb of the Tang Dynasty

Source: The murals in the tomb of Prince Zhang Huai, 2021.

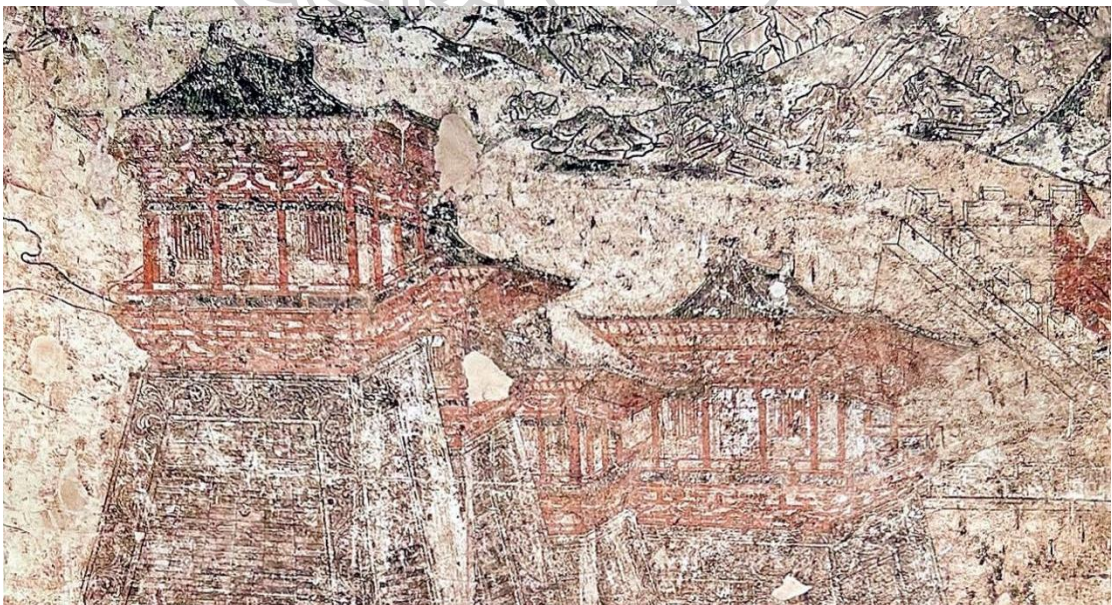


Figure 23 Architecture of the Tang Dynasty

Source: Murals in the tomb of Prince Yide, 2021.



Figure 24 Foreign Envoys

Source: Murals in the tomb of Prince Zhanghuai, 2021.

Li Qiushi (Qiushi, 1972) compared the passage through the tomb of Prince Yide to the gates of a city. According to his interpretation, the first passage was the palace gate, the second was the palace gate, and the third was the palace gate (Figure 23).

Regarding the image of foreigners in the murals, scholars have given their suggestions (Figure 24). Yunxiang (Yunxiang, 1984) believes that the foreign envoys wearing feather crowns in the guest envoy picture are not Japanese but ancient Koreans. Wang Weikun (Weikun, 1996) analyzed the background of the events in the picture and identified the characters' identities from their clothes based on documents and archaeological excavations. Yang Jin (Jin, 2018) suggested that the "Protocol Map" on the west wall of the tomb hall shows the scene of foreign envoys participating in the funeral. Patricia Eichenbaum Karetzky (Karetzky, 1984) systematically organized and analyzed the image characteristics of foreign people and objects in Tang Dynasty

paintings, expounding that foreign cultures profoundly influenced the life of the Tang Dynasty nobles.

Fan Shuying (Shuying, 2001) systematically sorted out the hierarchy and scale of honor guards in the murals of the tombs of the Tang Dynasty (Figure 25). Respectively, the first-level princes and princesses travel with the honor guard; the second-rank princesses with lower status than princes and princesses travel; the third-rank senior officials travel with honor guards. Furthermore, she expounded on the differences in the tomb murals in the Tang Dynasty.

Qi Dongfang (Dongfang, 1998) studied the images of various utensils in the murals of the tomb of Princess Fangling in the Tang Dynasty. He found that they showed the modeling characteristics and usage methods of gold and silver utensils in the Tang Dynasty, consistent with the archaeological objects and related literature records. It reflects the living conditions of the nobles at that time and the grand occasion of cultural exchanges between the East and the West during the Tang Dynasty (Figure 26).

Gu Tiefu (Tiefu, 1956) restored the Doucun painted in the joint tomb of Xue Mo and his wife Shi in the eastern suburbs of Xi'an City, suggesting that the wooden structure depicted in the painting could serve as a model for the construction of aristocratic mansions. Pei Jianping (Jianping, 2011) further elaborated on the architectural images in Tang tomb murals, categorizing them into individual and group buildings with specific layouts and functional divisions. The Que Building is among the examples used as a reference blueprint for single buildings (Figure 27).

Yu Jingfang (Jingfang, 2014) conducted a study on the "Ruiyun Chariots and Horses Farewell Picture" unearthed from the tomb of the Changle Princess. Jingfang found that the composition of the picture resembled the "Luo Shen Fu Tu" by the Eastern Jin painter Gu Kaizhi, and suggested that the towed vehicle in the picture expressed a yearning for a blissful world.



Figure 25 The Hierarchy and scale of honor guards

Source: The tomb of Zhanghuai, 2021.



Figure 26 Gold and silver wares in the murals in the tombs of the Tang Dynasty

Source: Shaanxi History Museum, 2021.



Figure 27 The shadow wood structure in the tomb mural and the architecture of the Tang Dynasty

Source: Shaanxi History Museum, 2021.

Some notable academic seminars on Tang Dynasty tomb murals include the "International Academic Lecture on Tang Tomb Murals and Sino-Japanese Cultural Exchange in the Tang Dynasty" in April 2000, jointly organized by the Shaanxi History Museum, the Japan-China Sui and Tang Culture Symposium, the Asahi Travel Agency, and the Asahi Overseas Planning Association. The "China-Japan Tang Tomb Mural Protection and Restoration Seminar" was hosted by the museum and Japan's Nara Institute of Cultural Properties. At the same time, the "International Academic Seminar on Tang Tomb Murals" was held at the Shaanxi History Museum in October 2001 (Lan, 2002). These seminars provided a platform for scholars to discuss Tang Dynasty tomb murals from various perspectives, including history, culture, art, and protection. They resulted in the publication of numerous research documents on the subject.

2.1.3 Tomb murals of the Tang Dynasty collected by Shaanxi History Museum

The Tang Dynasty Mural Treasures Museum of Shaanxi History Museum is the first museum in China with the theme of Tang Dynasty tomb murals. The venue was jointly constructed by China and Italy and was officially opened to the public in June 2011 (Figure 28). The main functions of the Tang Dynasty Mural Treasures Hall of the Shaanxi History Museum are to carry the exhibition and display of the Tang Dynasty tomb murals, restorative and protection of the Tang Dynasty tomb murals, and related academic exchanges and cooperation. The exhibition hall covers an area of more than 1,000 square meters and nearly 600 tomb murals from more than 20 Tang tombs and

97 murals. Eighty-two were designated national first-class cultural relics (Museum., 2020).



Figure 28 Night View of Shaanxi History Museum

Source: Shaanxi History Museum, 2021.



Figure 29 Entrance to Princess Yongtai's Tomb

Source: Photographed by the Author, 2022.

The murals on the tomb of Princess Yongtai, the tomb of Prince Yide, and the tomb of Prince Zhang Huai are the most refined cultural relics in the collection of the Tang Dynasty Mural Treasures Museum of Shaanxi History Museum. They are relatively well preserved, and the murals are fully configured. As the tombs of princesses and princes buried in the size of imperial mausoleums, these three tombs of the Tang Dynasty maintained the highest tomb form among the excavated tombs of the Tang Dynasty (Xiaojing, 2017). The murals' painting skills, configuration, and etiquette specifications all present the highest standard of royal life in the Tang Dynasty around AD 706 (Dongfang, 2006). Descendants can learn about the social regulation norms of the Tang Dynasty from the murals in the tombs of the Tang Dynasty and feel the cultural self-confidence and spiritual pattern of the prosperous dynasty.

2.1.3.1 Murals of princess yongtai's tomb (committee, 1964)

Princess Yongtai's tomb murals in the Tang Dynasty Mural Treasures Museum of Shaanxi History Museum are a collection of well-preserved and fully-configured artwork demonstrating the highest royal life standard in the Tang Dynasty (Sung, 2019). The murals start at the tomb's entrance in the south and run through the entire tomb structure to the rear tomb in the north (Figure 29). The tomb passages, passage holes, patios, corridors, and chambers are adorned with murals depicting a wide range of subjects.

The east wall of the tomb passage features murals of honour guards and warriors, followed by Blue Dragon, Tower, and shadow wooden buildings connected to the first passage as the palace wall. Natural landscapes, including hills, trees, and streams, are depicted outside the wall, but many have fallen off due to poor preservation. Near the tower, a guard of honour composed of 5 groups of samurai is shown, showcasing the majesty of the royal family and social etiquette. A 6-pole halberd stand is situated near the first entrance of the hole, and in front of it, barbarian grooms lead horses.

The content of the west wall of the tomb passage is symmetrical with the content of the east wall of the tomb passage. A group of ceremonial warriors, white tigers, and single towers are depicted. The top of the cave is painted with flower

patterns and cloud cranes. The front and rear corridors' walls are adorned with figures, flowers and plants, rocks, and red corals, with similar content on both sides.

The east wall of the front room is divided into two rooms, each with a group of palace maids. The west wall is symmetrical, with a group of palace ladies. One male attendant is painted on both sides of the arch on the south wall of the front room, and two palace ladies are painted on each side of the arch on the north wall. The top of the front room is in the shape of a dome, with the sun, moon, and Milky Way painted inside. The layout of the back room is similar to that of the front room. One male servant is painted on the east side of the south wall, and five palace ladies and male servants are painted on the west side. Two groups of palace maids are depicted in the east murals. The north wall is divided into two rooms, the east side of which is painted with a group of bands, and the west side is painted with a group of figures. The dome at the top of the back room is painted with a celestial map, similar to the front room's layout.

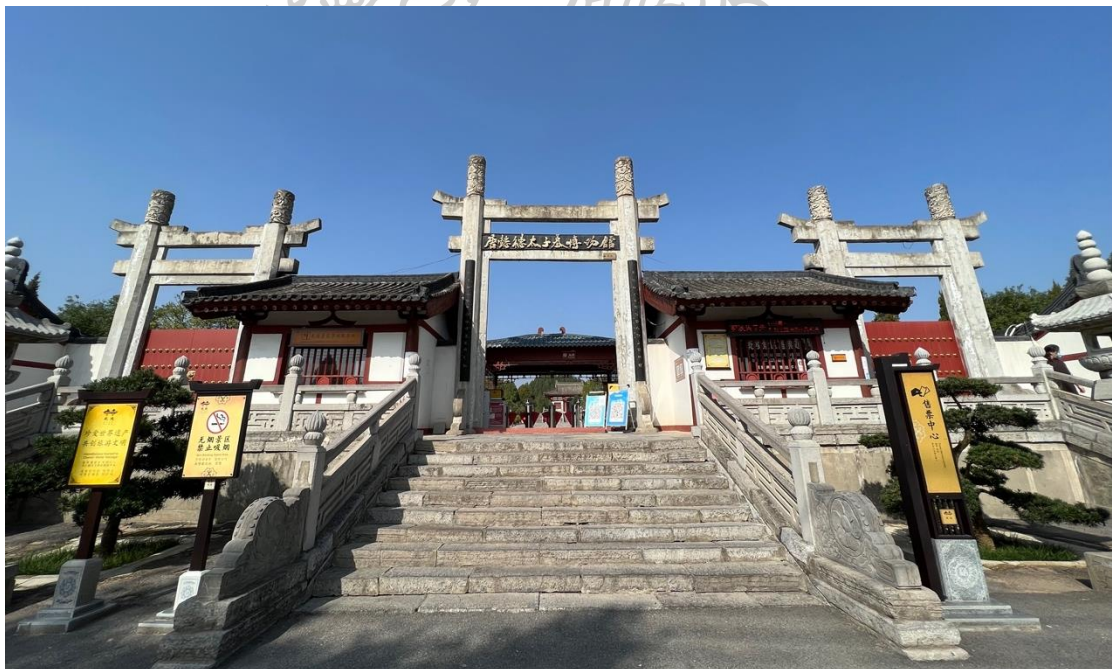


Figure 30 Entrance to the Tomb of Prince Yide

Source: Photographed by the Author, 2022.

2.1.3.2 Murals of prince yide's tomb (G. C. a. E. B. E. T. o. T. T. Shaanxi Provincial Museum, 1972)

The murals of Prince Yide's tomb span the entire structure, starting from the south entrance to the rear tomb in the north (Figure 30). They are painted on the walls of the tomb passages, passage holes, patios, corridors, and tomb chambers. The East wall at the front of the tomb is adorned with blue dragons and immortals, followed by the tower and the city wall. The background depicts a landscape behind the tower and city wall. The grand travel honour guard is depicted on the northern part of the lower section of the tower, consisting of a horse-riding honour guard, a walking honour guard, and a motorcade.

The painting content of the west wall of the tomb path is symmetrical with that of the east wall, with a white tiger at the front end. A five-bay gate is painted above the first passage, along with towers and city walls on the east and west walls of the tomb passage, forming a formal architectural structure symbolizing the palace gate. The first and second passages on the east and west walls of the cave depict scenes of domesticating beasts, with bow-and-arrow servants, cheetahs, falcons, hounds, and harriers. The two walls of the first and second patios are adorned with halberds, with 12 rods on each side, reflecting the emperor's etiquette specifications. The east and west walls of the cave were painted with servants and maids, while the east and west walls of the third patio were painted with carriages. From the fourth passage to the front corridor, the two walls are painted with palace maids, rocks, flowers, and birds, with the top adorned with precious flowers. The connection between the dome roof of the front room and the four walls is depicted as a wooden structure to express the building structure. The east and west walls of the front room are divided into two rooms, with group portraits of palace ladies painted in each. The two walls of the north and south arches are also painted with pictures of palace maids. The astronomical map of the sun, the moon, the stars, and the Milky Way is Drawn in the dome, consistent with the dome in the murals of Princess Yongtai's tomb. The content and form in the rear corridor are similar to the front corridor, and the murals in the back and front rooms are also consistent.

The tomb of Prince Yide boasts the complete and highest level of murals among the Tang Dynasty mural tombs excavated in China (Wang & Shao, 2017). The ceremonial travel map vividly depicts the grand scene of the prince's journey. The picture of taming a leopard, a picture of a harrier playing with a dog, and a picture of a palace maid are all exceptional works in the tomb murals of the Tang Dynasty.

2.1.3.3 Murals on the tomb of Prince Zhang Huai (G. C. a. E. B. Shaanxi Provincial Museum, Tang Tomb Excavation Group, 1972)



Figure 31 Entrance to the Tomb of Prince Zhanghuai

Source: Photographed by the Author, 2022.

The murals of Prince Zhanghuai's tomb extend from the southern entrance to the northern rear tomb, as depicted in (Figure 31), and cover the entire tomb structure, including sloping tomb passages, passage holes, patios, corridors, and tomb chambers. On the east wall of the tomb passage, the murals depict blue dragons, hunting scenes, guest envoys, and honour guards, progressing from south to north. In the first passage, three bays on the east and west walls of the cave feature paintings of servants. The second passage shows a 7-bar halberd frame depicting a squire passing through the hole. The front corridor's east and west walls feature attendants, while the internal structure of the former tomb remains consistent with that of Prince Yide's tomb but

with more relaxed and leisurely character dynamics. Palace maids and dwarfs adorn the north and south arches, and the dome structure and content are identical to Prince Yide's tomb. The rear corridor's east and west walls display palace maids and servants, while the back room's layout and structure mirror Prince Yide's tomb but with a more relaxed character depiction.

The guest envoy scenes in the murals of Prince Zhanghuai's tomb provide essential evidence for studying the Tang Dynasty's relationships with surrounding nations and the wider world (Wang Weikun, 1996). The characters depicted in the murals, such as those engaged in hunting trips, polo matches, bird watching, and cicada hunting, are portrayed in natural and graceful postures. The tomb's murals create a courtyard atmosphere that differs from the respectful service state depicted in Prince Yide's tomb.

2.1.3.4 Significance and importance of tang dynasty tomb murals collected by shaanxi history museum

The Tang Dynasty tomb murals collected by the Shaanxi History Museum represent an invaluable inheritance of Chinese culture while providing a unique opportunity for the audience to experience the Tang Dynasty culture firsthand. The Tang Dynasty Mural Treasures Hall at the Shaanxi History Museum has three main functions: to exhibit and display the Tang Dynasty tomb murals, to restore and protect the murals, and to facilitate related academic exchanges and cooperation. As the first museum in China focused on Tang Dynasty tomb murals, the Shaanxi History Museum leverages the professional advantages of modern museums to create a harmonious ecology among space, media, audience, and exhibition (Yan & Linna, 2020).

The museum is continually adapting its exhibition methods to keep pace with the advancements in science and technology and changes in audience aesthetic preferences. Through these efforts, the museum can offer the public an engaging and professional learning experience. Overall, the Tang Dynasty tomb murals at the Shaanxi History Museum are a significant cultural and academic resource, providing a unique opportunity for scholars and the public to gain a deeper appreciation of China's rich artistic and historical legacy (Jianzheng, 2011).

2.1.4 The social significance of tang dynasty tomb murals

The murals found in the tombs of the Tang Dynasty hold social significance that goes beyond their intended purpose. Though created for the "rebirth" ritual of the deceased and meant to be closed and independent, the murals have become a subject of social and popular aesthetic activity, thanks to archaeological discoveries.

Drawing on archaeological data, this article explores the social significance of the Tang Dynasty tomb murals and delves into the social relations and spiritual pursuits that they reflect. Rather than being a comprehensive record of the social state at the time, the murals depict a fusion of the life of aristocrats and commoners, embodying an ideal pursuit rather than a strict adherence to the political colours and etiquette standards of the Tang Dynasty.

By comparing the excavated Tang Dynasty tomb murals with relevant documents from Tang Dynasty society, we find that the life scenes depicted within the murals are not a mere reflection of aristocratic life but instead offer a glimpse of an idealized living state between the nobles and the commoners.

Several aspects should be considered to fully explore the social significance of the murals in the tombs of the Tang Dynasty.

First, the murals vividly portray the life content of Tang Dynasty society in the form of concrete paintings. They depict the lives of the noble class and ordinary people, enriching historical records and validating related documents (Fong, 1984).

Second, the murals reflect the essential attitude of Tang Dynasty society towards life, death, and funeral culture. In contrast to the restoration and reproduction of the deceased's life in the Qin and Han dynasties, the Tang Dynasty developed the concept of "death is like life," which focuses on intercepting the most valuable and beautiful parts of life before death (Dongfang, 2006). The "rebirth" process becomes a pursuit of beauty or a new beginning, and the murals reflect this positive attitude towards life and death.

Third, the Tang Dynasty tomb murals provide a concentrated depiction of the spiritual world of the social strata and a manifestation of the spirit and social style of the Tang Empire. They are based on the ideological realm and spiritual pursuit of the Tang Dynasty social collective, conveying the confidence, stability, and fullness of the

spirit of the Tang Empire (Wang & Cai, 2019). The positive and enterprising social attitude is evident in the figures, animals, architecture, and landscape depicted in the murals.

Fourth, the artistic expression of mural content is based on the portrayal of the characteristics of the times, which dynamically records the cultural and social landscapes of the Tang Dynasty. The murals objectively recorded the evolution of social features and cultural landscapes during the nearly three hundred years of changes in the Tang Dynasty (Lijun, 2008).

In summary, the Tang Dynasty tomb murals are a valuable source for researchers to interpret the social and cultural significance of the Tang Dynasty. They offer a vivid depiction of the life content of the time, reflect the essential attitude towards life and death, and provide insight into the spiritual world and colonial style of the Tang Empire. The artistic expression of mural content records the dynamic changes in social and cultural landscapes, making them a vital historical artefact.

2.1.5 Summary

Tomb murals of the Sui and Tang dynasties are essential carriers of Chinese belief in rebirth, which has evolved from the immortality of bones to the transformation of rebirth in tomb space. Tang Dynasty tomb murals' realistic and philosophical themes embody the Confucian concept of "death is like life." The murals provide a visual record of the Tang Dynasty's cultural landscape, including its laws, regulations, social customs, religious beliefs, and ideas. Tang Dynasty tomb murals not only confirm the images recorded in existing documents but also have historical value (Diagram 7).

The shape and configuration of the mural tombs in the Tang Dynasty continued the style of the tombs in the late Northern and Sui Dynasties, reflecting the belief that "death is like life." High-level nobles and royal families paid great attention to the presentation of the ritual system of tombs, which showed normative solid, class, and epochal characteristics of the time. The Tang Dynasty tomb murals reflect the society's class ideal and social identity and have gradually developed their unique characteristics throughout history.

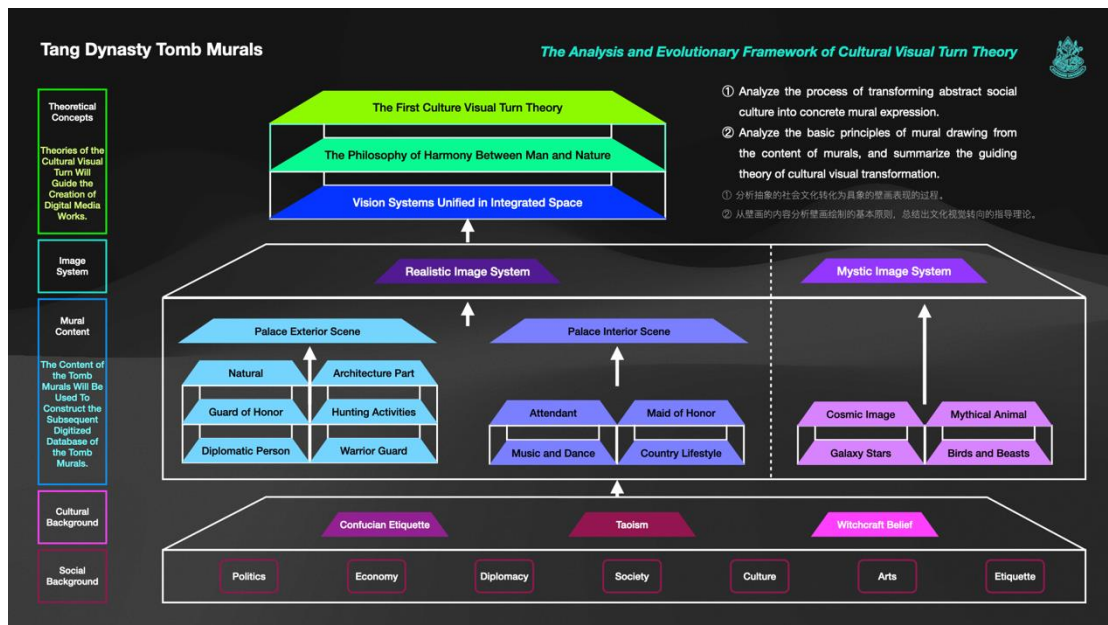


Diagram 7 Summary and model of The First Culture Visual Turn Theory

Source: Drawn by Author, 2023.

The artistic characteristics and social significance of the Tang Dynasty tomb murals can be examined by stripping away the tomb attribute. The murals reveal fragments of Tang Dynasty society and carry its spiritual pursuit. The unified layout of the murals depicts the order and etiquette of the Tang society, while their overall style expresses the confidence and stability of the Tang Empire. The mural content dynamically records the changes in social features and cultural landscapes during the Tang Dynasty's evolution.

Studying the Tang Dynasty's cultural landscape requires a correct understanding of the tomb culture, an accurate grasp of the cultural connotations conveyed by the murals, and a clear understanding of the cultural situation's evolution. The Tang Dynasty tomb murals offer invaluable insights into society's spiritual, artistic, and cultural development, making them important historical artefacts.

2.2 Museums and media

2.2.1 The meaning and importance of museums

Museums have played a significant role in preserving and interpreting tangible and intangible cultural heritage. The International Council of Museums (ICOM) defines museums as not-for-profit, permanent institutions that serve society by researching, collecting, conserving, interpreting, and exhibiting cultural heritage. These institutions are open to the public, accessible, and inclusive, focusing on fostering diversity and sustainability. Museums operate ethically and professionally, with the participation of communities, offering varied experiences for education, enjoyment, reflection, and knowledge sharing (Museums, 2022) (Figure 32).

The modern concept of museums emerged in the late 17th century with the establishment of the British Museum in 1753, which became the first large-scale museum in the world open to the public (Reeve, 2019). Since then, museums have evolved into multi-functional cultural complexes, adapting to the changing social and cultural landscape. The functions, forms, methods, and collection objects of museums have continued to evolve and expand over time. Museums are important institutions that play a crucial role in preserving and interpreting cultural heritage, promoting education and learning, and fostering diversity and sustainability (Hongjun, 2001).

Museums are primarily responsible for collecting and disseminating information. Through their collections and exhibitions, museums establish connections with their audiences, while the media is vital in transmitting information to them (Diagram 8). The content and form of an exhibition are intertwined, with the former playing a decisive role in generating the latter. Therefore, museums must focus not only on the content of their displays but also on the form of expression. To create a meaningful visitor experience, proper media planning can influence audience emotions and integrate their feelings with the museum's expertise in visits, knowledge dissemination, and education (Greenhill, 1992).

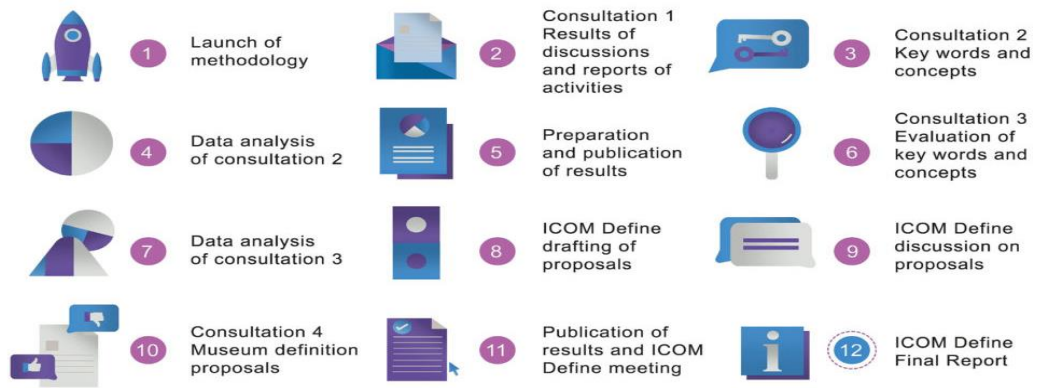


Figure 32 Museum definition: a way forward

Source: The International Council of Museums, 2021.

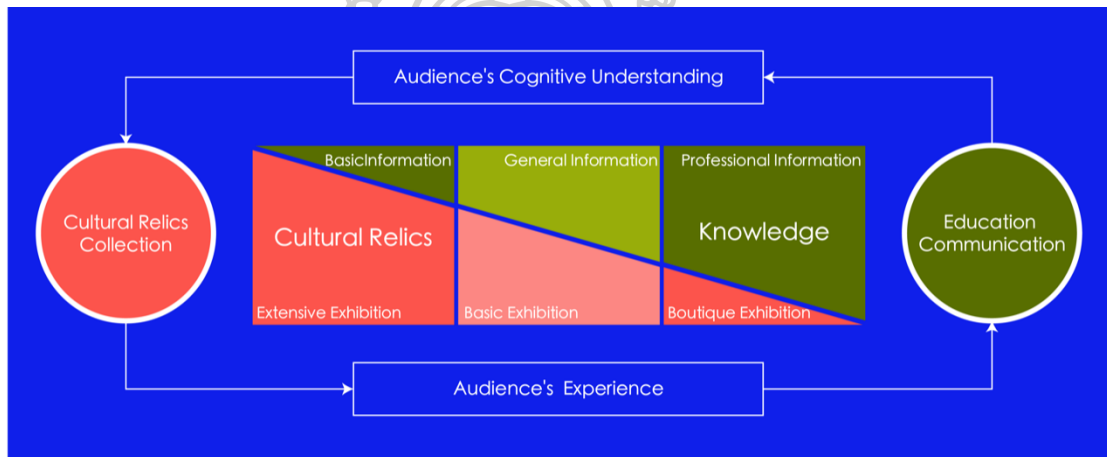


Diagram 8 The relationship between cultural relics collection and information dissemination in traditional museums

Source: Produced by Author, 2021.



Figure 33 The application of digital media technology in museums

Source: Shaanxi History Museum, 2022

As digital technology advances, museums are experiencing constant changes in their collections and media functions. Digital museums are an extension of traditional communication boundaries, providing new media forms and possibilities for museum exhibitions (Bertacchini & Morando, 2013) (Figure 33). A digital museum is an information technology-based medium that manages all aspects of physical collections in digital form and preserves them digitally. An information system delivers digital display, education, and research services to users via the internet (Xiaodong, 2004). Digital museums use sound, image, video, interactive systems, and virtual reality technologies to exchange information with audiences through websites, programs, and virtual spaces. Based on current audience feedback analysis, digital technology has become a powerful tool for museum information dissemination. However, it is crucial to note that digital museums are currently supplementary to traditional museums, as they cannot provide services that replace their status. Visitors prefer on-site observation of cultural relics, face-to-face interaction and communication, and the museum's ambience (Haywood & Cairns, 2006).

As digital technology advances, new forms of digital museums will emerge. On October 29, 2021, Facebook founder and CEO Mark Zuckerberg announced the company's strategic direction to transform Facebook into the Metaverse. The Metaverse is a virtual world created and linked by technological means, which can map and interact with the real world (Hazan, 2010). It is a digital living space with a new social system. Professor Chen Gang and Dr Dong Haoyu from Peking University in China identified five characteristics and attributes of the Metaverse: Social & Space, Technology Tension, Artificial, Machine & AI, Reality & Reflection, and Trade & Transaction (Yanyan, 2011) (Figure 34). Under the Metaverse concept, digital museums will offer visitors a new visiting experience. Although this development direction is promising, its ultimate effect still needs to be tested.

2.2.2 Situational design and media in museums

Situational design and scenario design are two different approaches (Jingbo, 2019b). Scenario design involves designing a specific environment that stimulates the emotions and interests of the audience. It belongs to the branch of environmental design and is tailored to a specific occasion. Situational design, on the other hand, is

not limited to a specific space but is a particular state of the audience when they perform a specific action. It is the product of the internal and external environment interaction and pays attention to people's feelings. Situational design is a design method that prioritizes the audience's experience.

In museums, situational design is based on the cultural relics in the museum's collection. Through the design of the scene and the use of media to create a visiting atmosphere, the museum seeks to mobilize the audience's enthusiasm for visiting, stimulate their active communication, and improve their cognitive experience (Hooper-Greenhill, 2013b). The situational design emphasizes the visitors' experience and pays attention to the linkage among the design elements of space, media, audience, and exhibition in the museum exhibition.



Figure 34 Metaverse features, and attributes START map

Source: Dr. Dong Haoyu and Professor Chen Gang, Peking University, China, 2021.



Figure 35 Rendering of the museum's atmosphere, Qingchuan Earthquake Museum's design scheme

Source: Photographed by Author, 2021.



Figure 36 Shaanxi History Museum Exhibition Situation Design

Source: Photographed by Author, 2021.

A. Museum Situation Design – Induction (Dean, 2002)

Inductive design is a commonly used display method in museums, where items are presented in groups with short texts on exhibition labels. This design approach focuses on exhibiting collections during the exhibition, leading to an antagonistic relationship between the audience and exhibits, resulting in passive and one-way information exchange (Figure 36). Inductive design is cost-effective due to its primary form of displaying collections and lower space requirements. The design method is advantageous because it offers a simple and direct display, allowing for a rich exhibition of exhibits. The audience can intuitively grasp the significance of the exhibits. However, the design's weakness lies in insufficient information support, a weak correlation between exhibits, and a lack of interactive experience, resulting in fatigue and reduced enthusiasm for visiting.

B. Museum Situation Design – Storytelling (Nielsen, 2017)

Storytelling design aims to create a narrative framework that connects exhibits and the environment by rendering the relationship between them (Figure 37). This approach builds upon the inductive design, enhancing the internal connection between exhibits. It achieves this by building situations based on history, geography, and form, resulting in an enriched and engaging visitor experience. Large-scale museums in China, such as those focused on history or science and technology, often use storytelling design to enhance the visitor experience. By presenting complex relationships through design, visitors are encouraged to explore and discover the deeper meaning behind the exhibits, resulting in a stronger attraction to the museum.

C. Museum Situation Design – contemplative (Thompson & Tobin, 2018)

The contemplative design employs artistic means to enhance the exhibition's artistic conception, aiming to inspire the audience to think and construct knowledge during their visit. This design approach deviates from traditional exhibition layouts and incorporates various media to create an immersive atmosphere and elevate the visitor experience. The contemplative design emphasizes formal beauty and requires prior knowledge for full appreciation (Figure 38).

D. Museum Situation Design – Reconstruction (Keil et al., 2013)

Reconstructive design is a fundamental aspect of situational design aimed at providing visitors with an immersive experience by reconstructing historical scenes. This type of design is particularly well-suited for creating a narrative around specific historical events. By incorporating elements such as sound, light, electricity, touch, and smell, visitors can be fully immersed in the situational feeling of a specific historical context. The reconstructive design has achieved great success in museum exhibitions and commercial activities by stimulating participants' enthusiasm and enhancing their understanding and acceptance of information (Figure 39).



Figure 37 Museum Story Style Situational Design,

Source: China Tea Museum, 2021.



Figure 38 Contemplative Situational Design for the Museum

Source: The Imperial War Museum (IWM), London, UK, Dabaoen Temple Site Museum, Nanjing, China, 2021.



Figure 39 Reconstructive Museum situation design

Source: 1911 Revolution Museum, Wuhan, China, 2022.



Figure 40 Discovery Museum situation design

Source: Terra Cotta Warriors of Emperor Qinshihuang's Mausoleum Site Museum in Xi'an, Tash kurgan Stone City Museum in Xinjiang, China, 2022.



Figure 41 Experiential Situational Design for the Museum

Source: Arnhem Open Air Museum, Netherlands, 2021.

E. Museum Situation Design - Discovery

Discovery design prioritizes active audience participation during their visit, allowing them to engage with and learn from the exhibits through exploration (Figure 40). This design approach emphasizes the audience's interests and hobbies, encouraging them to acquire knowledge and enhance their understanding through active involvement. An excellent example of discovery design is the exhibition "The Universe on the Wall - Shanxi Bei Dynasty Tomb Mural Art Exhibition" at the Shanxi Museum, which employs digital media technology and intelligent tablets to facilitate real-time interaction between audiences and exhibits (Ruijun & Yuezhong, 2020). By leveraging their knowledge reserves and exercising their judgment, visitors can explore the secrets behind each exhibit, making the discovery design a non-linear visiting mode that prioritizes the audience's experience.

F. Museum Situation Design – Experiential

Experiential situational design is well-suited to museums that utilize digital media. It prioritizes audience participation and interaction as a means of facilitating the discovery of knowledge. The ultimate goal is for visitors to learn through participation (Figure 41). For example, in the Science and Technology Museum, simulations of scientific phenomena allow visitors to understand the underlying principles through direct experience. The advent of digital technology has expanded the potential for situational experiences in museums, such as virtual reality (VR), augmented reality (AR), immersive, and personalized experiences (Boehner et al., 2005).

A Taiwanese scholar, Liu Wanzhen (Wanzhen, 2011) has argued that a museum's audience consists of not only those who currently visit but also those who may be interested in visiting in the future. Based on the degree of experience demanded, museum audiences can be categorized into four groups: potential, ordinary, loyal, and professional. Other scholars have classified museum visitors as a shuttle, visiting, and research types. These classifications indicate the diverse information-seeking needs of different audiences within the museum situational experience (Diagram 9).

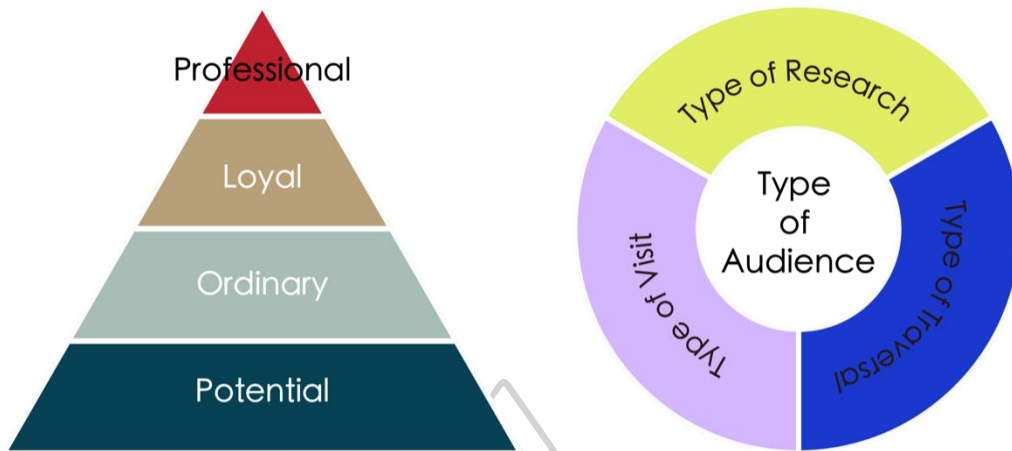


Diagram 9 Different classification criteria for museum audiences

Source: Produced by the Author, 2021.

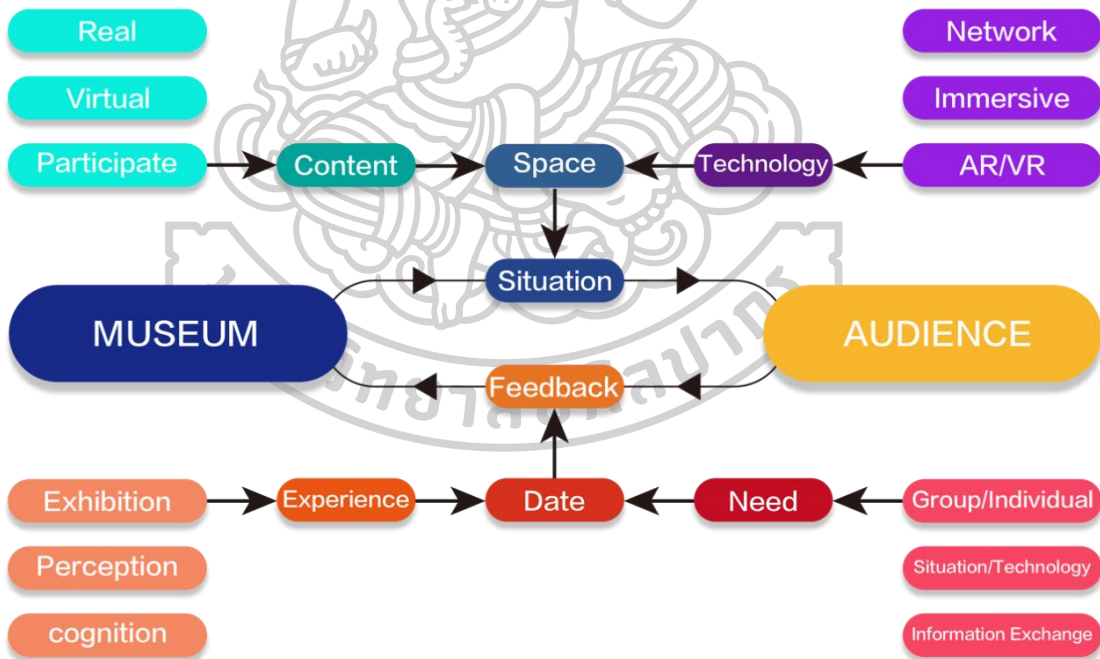


Diagram 10 The relationship between museums and audiences under the intervention of digital media

Source: Produced by the Author, 2022.

The core of situational design with audience experience is transformative, influencing the direction of museum development. In 2010, Nina Simon's online book, *The Participatory Museum*, explained why audience participation is essential for museums and provided principles and practices for participation (Simon, 2010). Cornelia Brueninghaus-Knubel, Head of Education at the Lembruck Museum in Germany, has emphasized the role of museum education and learning. Whether in exhibit design or audience research, museums increasingly measure their success by audience satisfaction and engagement, turning visitors into enthusiastic participants and supporters of museums.

The emergence of digital media technology has breathed new life into museum design. Traditional museums have relied on static and dynamic forms of media communication, which only allow for one-way information flow from the media to the audience, resulting in passive information reception by the audience. In contrast, with its unique technical features, digital media technology can effectively break down the directionality of information dissemination and enable a two-way exchange of information (Diagram 10). By facilitating fundamental interaction between the media and the audience, digital media technology can disseminate information tailored to the audience's needs (Giannini & Bowen, 2019). Moreover, it has the function of collecting information, which can provide the museum with sufficient data support according to the visiting needs of the audience, thereby enabling the systematic and professional iteration of the cultural and exhibition system.

The integration of digital media technology has propelled museums into the cyber era, extending its influence beyond physical spaces. It is essential to recognize the trend of museum development towards the virtual museum (Walczak et al., 2006) (Figure 42). Network technology has allowed the creation of a prototype virtual museum through network museums. The development of Metaverse, artificial intelligence, and virtual reality technology will lead to an immersive virtual museum that offers a novel visiting experience for audiences. The Pew Research Center's *New Media and Museum Audience Engagement* report suggests that the relationship between network and social media and museum exhibitions in the digital media environment will strengthen. The virtual museum will harness the advantages of digital

media and network technology in information dissemination, granting audiences complete and convenient access to information. The introduction of online social media will enrich audience cognition in all dimensions. The museum's information dissemination will transcend the binary space of cultural relics and audiences, facilitating a multi-directional exchange of information between "objects," "individuals," and "society." The virtual museum will overcome time and space constraints, meeting the cognitive needs of diverse audiences to the greatest extent (Schweibenz, 1998).

2.2.4 Challenges posed by digital media in museums

In China, digital media technology has been implemented in museums at various levels. While it has had a positive impact on enhancing the situational design of museums and improving the visitor experience, the use of digital media has also exposed various problems (Ch'ng et al., 2019). It is important to note that technology is only a means to improve the effectiveness of an exhibition and not the core of the situational design. Improper use of technology can reduce the visitor's experience, and museums must only accept successful designs from other museums.

The use of digital media technology has brought about significant challenges to the exhibition design of museums, which are reflected in the following points:

1. The use of digital media technology increases the operating costs of museums. Renovating museum venues, purchasing digital media equipment, designing digital media programs, operating and maintaining digital media, and training digital media technicians increase the daily operating costs of museums.

2. Overusing digital media technology leads to homogenized digital media exhibitions that fail to attract visitors. Focusing too much on entertainment rather than educational purposes can also lower the quality of museum exhibitions.

3. The rapid development of digital media technology leads to the iterative update of the technology, which can leave museums using digital media technology behind in terms of outdated exhibition methods and technology.

4. The exhibition design of museums is at risk of falling into the trap of technical theory. Introducing new technologies requires thoroughly exploring cultural relics and the museum's exhibition goals and paying attention to audience acceptance to ensure the museum design is successful.

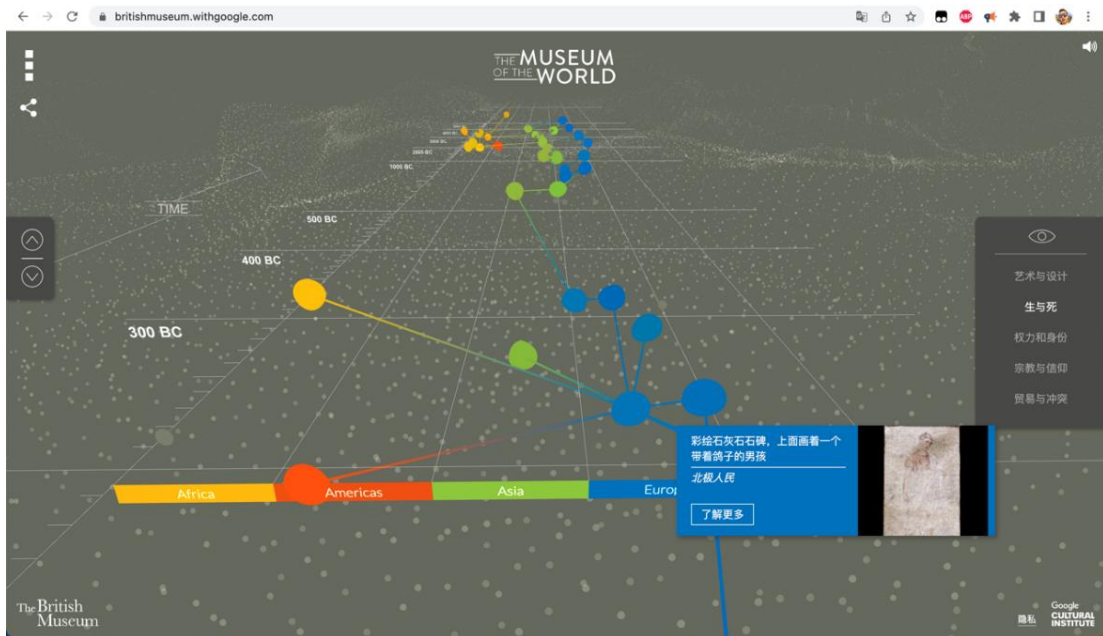


Figure 42 The Museum of the World

Source: The British Museum, 2022.

	Traditional museums	Museums under the intervention of digital media
Work focus	Collection of exhibitions	Audience experience
Core objectives	Knowledge dissemination	Cognitive improvement
Evaluation criteria	Number of exhibits	Audience participation
	Value of cultural relics	Residence time
	Exhibition area	Happiness index
	Number of visitors	Repeat visit

Evaluation system of traditional museums and museums under the intervention of digital media

Diagram 11 Evaluation system for traditional museums and digital museums

Source: Produced by Author, 2022.

In light of these new challenges, museums must recognize that the goal of museum exhibitions is to disseminate information. New technologies should be introduced with consideration for the "people" (Diagram 11). They should become the glue that unifies space, media, audience, and exhibition in situational design, promoting the unified cooperation of all elements. While adopting new technologies, museum designers should pay attention to the rational use of design concepts and methods and achieve the exhibition design goals through a combination of technology and concepts.

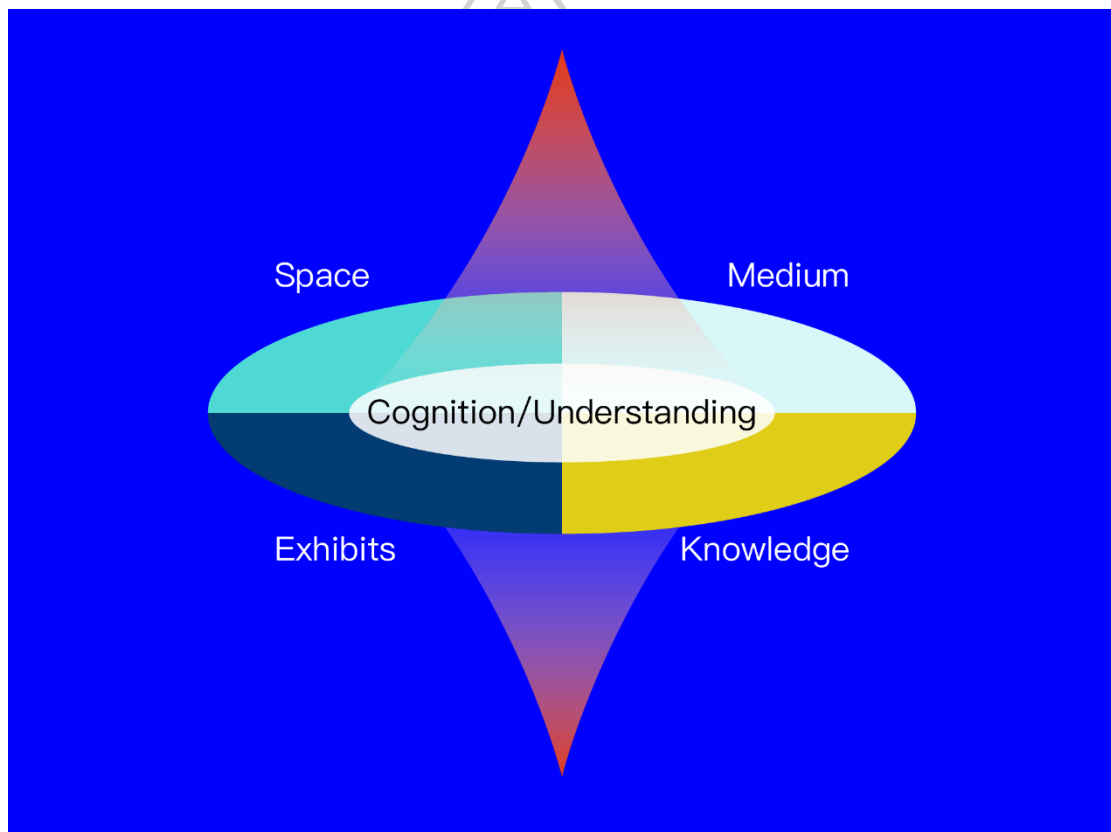


Diagram 12 Museum cognitive enhancement model

Source: Produced by Author, 2022.

2.2.5 Summary

A museum is a permanent not-for-profit institution that serves society by researching, collecting, conserving, interpreting, and exhibiting tangible and intangible heritage. Its core functions are the collection and dissemination of information to the

public. Museums operate ethically and professionally, with the participation of communities, to foster diversity and sustainability. They offer varied experiences for education, enjoyment, reflection, and knowledge sharing and are open to the public, accessible, and inclusive (Varvin et al., 2014).

Museums build a connection with audiences through the exhibition of collections and transmit information to audiences through exhibitions. Exhibition display has become the primary carrier and medium of the museum's information dissemination and the bridge between the museum and the audience. The effectiveness of the information dissemination and reception process determines the relationship between the museum and the audience. Museums use media technologies in exhibition presentations based on the museum's essential positioning of presentations. The traditional cognition of museum media is the extension of museum exhibits, a means of service, and an effective way to promote the exchange of information between audiences and exhibits.

The classification of museums is based on their mission and goals at the beginning of their design. The means and form of museum situation design have also become the standard for museum classification to highlight better the exhibition's theme, the connotation of the exhibits, and the exhibition display needs (Jingbo, 2019b). With the development of digital technology, museums are constantly changing their collection and dissemination functions. Digital museums based on information technology extend the boundaries of traditional museums and bring new forms and possibilities to museum exhibitions.

However, using new technologies has also brought problems and challenges to the museum's exhibitions. Therefore, the museum situation design should pay attention to the rational use of design concepts and methods and achieve the design purpose of the exhibition through the combination of technology and concepts.

2.3 Museum situation design

2.3.1 Importance and significance of museum situation design

With the increasing use of digital media technology in museum exhibition displays, museums have gradually shifted their focus from the traditional collection

and exhibition of cultural relics to creating a more immersive audience experience (JingBo, 2019a). The essential elements of museum situation design are space, media, audience, and exhibition, jointly shaping the digital museum visiting experience with the audience experience at the core (Diagram 12).

Digital situational design poses significant challenges to traditional museum exhibitions but also presents new solutions and opportunities to reconcile the contradiction between museum exhibitions and audience cognition. In China, digital situational design in museums helps integrate museum exhibitions, digital media technology, and audience experience (Dong et al., 2011). The design process attempts to elevate the situational design concept, information interaction mode, and story narrative logic of museum exhibitions through digital media technology to enhance the audience's visiting experience.



Figure 43 Exhibits at the British Museum

Source: The British Museum, 2021.

New exhibition media and interactive forms based on digital technology have enriched the design concept of museum situations in the digital age and provided a new way for museums to enhance the audience's visiting cognition and experience. The digital situational design has become an integral part of the museum exhibition display and has significant implications for the development of museums in the digital age. Therefore, studying the importance and significance of museum situation design is of outstanding academic and practical value (Elgammal et al., 2020).

A. The museum situation design is the inevitable result of the renewal and iteration of the museum design concept.

Cultural relics are the data storage of human civilization, which records fragments of different development stages of human civilization. The museum is the warehouse of the crystallization of human civilization, which brings together the development process of human civilization. The core function of the museum is cultural dissemination, so how to effectively interpret cultural relics and disseminate culture has become the design concept of the museum's renewal and iteration. The core of museum exhibition design is how to enhance the audience's cognition, that is, to make full use of existing technology to interpret the value of cultural relics (Bogle, 2013). From the birth of the first modern museum to the current exhibitions of well-known museums in various countries, various museums are exploring ways and methods to improve museum exhibitions. Based on the exhibition design mode of traditional museums with cultural relics collection and knowledge dissemination as the core of design, it pays attention to the value attributes of cultural relics. With cultural relics as the core, it uses media and exhibition forms to build a connection with the audience through the design of the museum space. The design concept determines the status of the cultural relics and the audience in the exhibition; that is, with the cultural relics as the core, the audience passively receives education. On the basis, the design of significant museums is an adjustment of exhibition forms, exhibition methods, media technology, narrative logic, and innovations in design forms based on design concepts (MacLeod et al., 2015). The exhibition form design is the "materialization" of the exhibition content and must be faithful to the subject and content of the exhibition (Figure 43).

The exhibition theory and practical experience of museums have specific epochal and spatial characteristics and are affected by social development and cognitive level. The museum exhibition design concept reflects the social development stage and the audience's needs. In the digital age, the development of media technology has brought new technological means to museum exhibitions. The audience's knowledge structure and cognitive needs have also undergone significant changes with the support of information technology. The museum's design concept

should adjust the relationship between the audience and the museum, changing from the design concept centered on "cultural relics" in the past to "the visiting needs of the audience" as the core. The audience's visiting experience and cognitive enhancement have become essential criteria for museum design in the digital age (Varvin et al., 2014). Using new forms of digital media technology such as networks, virtual experiences, and immersive experiences, museums have transformed from traditional exhibition design to situational design. The exhibition design of museums develops with the advancement of technology, and digital technology provides a new means for the design of museum exhibitions in the new era. The concept of museum situation design under the intervention of digital media takes the audience as the core, pays attention to the use of technology to enrich the visiting experience of the audience, and raises the audience's cognition to an unprecedented new height.

B. Advances in technology have brought new possibilities for the development of museum situational design.

The development from the traditional museum exhibition form to the museum exhibition form in the digital age is not only an update and iteration of the museum design concept. We should also clearly see the new possibilities brought by the advancement of technology for the development of museum situational design (Ruttkay & Bényei, 2018). Around the museum exhibition design concept, from the analysis of the four elements of the museum situation design, we can see the critical role of technological progress. The museum space is a place for collecting and exhibiting cultural relics. The progress of technology has brought about changes in the spatial structure so that the modern museum has a more spacious exhibition space. The space change adjusts the display method and exhibition layout of cultural relics. It adjusts the spatial structure and the narrative logic of the exhibition based on the audience's needs. The exhibition space fully unleashes the media's potential and gradually develops from the traditional passive, flat, and static means of information dissemination to multi-dimensional dynamic information dissemination means integrating sound, light, electricity, touch, and smell. The intervention of digital media technology makes the museum situation design integrate immersive experience, virtual experience, and various interactive modes of active participation of the audience,

which significantly enriches the dimensions and means of information dissemination and effectively improves the audience's visiting cognition. During the visit, the audience becomes a part of the museum exhibition and integrates with the exhibition through the participation and interaction of smart devices or the museum situation design (Ruiz et al., 2011) (Figure 44).

Technological advancement has broken through traditional museum exhibitions' dimensions and extended the boundaries of museum exhibitions. The most significant feature of digital media technology is to break through the physical limitations of time and space and present museum exhibitions to the audience anytime, anywhere (Figure 45). With the help of intelligent devices, museum exhibitions can break through the limitations of physical conditions and use the form of online museums and virtual museums to bring a new museum visiting experience to audiences in remote areas. Digital collections (NFTs) and digital collections provide a reference prototype for the development of future museums; the development of metaverse technology provides technical references for future virtual museums. With technological advancement, audiences have changed the mode of visiting and learning in museums, from the passive visit in the past to the active exploration of audiences, obtaining the required information in real-time with the help of digital technology. They realized social information with multiple parties through the network, so knowledge recognition has been comprehensively improved (Koushik et al., 2010).

C. Digital Extensions and New Experience Requirements for Future Virtual Museums

The development of museum situational design should fully consider the potential new modes of museum development and prepare for future forms of exhibitions. The museum is a product of history and a carrier of human civilization. Understanding the coexistence and development of both traditional and future museums is essential. While new technologies offer museums new ways of situational design and exhibition formats, the museum's purpose is to spread human civilization (Figure 46). As a result, both physical and virtual museums have equal value and significance, and the choice of form depends on which one can provide a better solution to a specific problem (Schweibenz, 2019).



Figure 44 Digital display of cultural relics
Source: National Palace Museum of China, 2021.

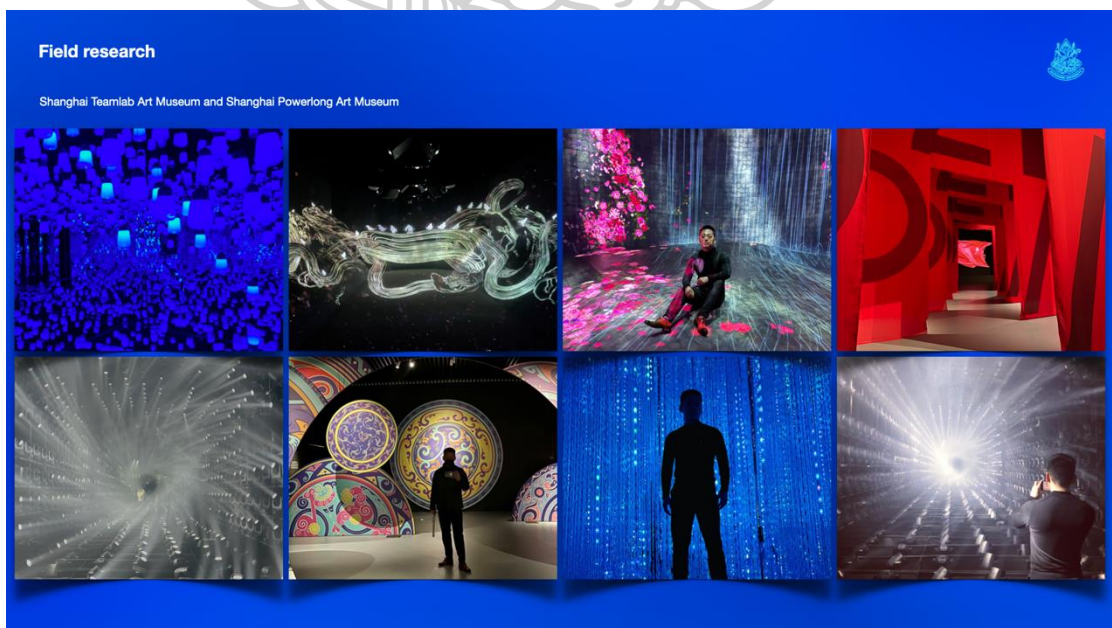


Figure 45 The multiple possibilities digital media brings to museum situational design
Source: Photographed by Author, 2021.



Figure 46 New experiences provided by digital virtual technology

Source: China Dunhuang Museum, 2022.

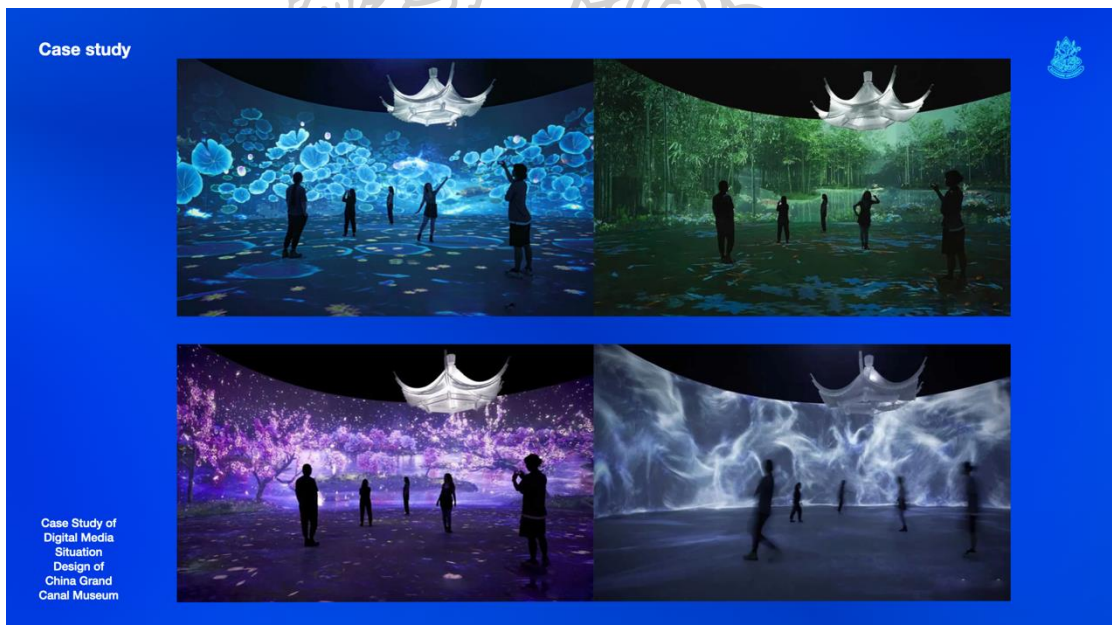


Figure 47 Digital media improves the audience's cognition level for museum situational design

Source: Photographed by Author, 2022.

Future technological advancements will continue to alter human social production structures, and new technologies will offer more convenient and efficient technical support for museum information dissemination. From physical to virtual museums, the design of the museum situation should prioritize the visitors' feelings and needs during their visit and enhance their experience through technology.

2.3.2 Interaction and communication in museum situation design

The concept of museum situation design is centred on the audience's visit and aims to encourage the audience's initiative and participation in the museum's exhibitions to enhance their cognitive experience. Digital media technology provides a powerful toolset for museum situation design, enabling the creation of new visiting experiences through a combination of virtual and physical exhibitions (Dierking & Falk, 1992). In this context, interaction in museum situation design is a two-way exchange of information between exhibits and the audience (Bevan, 2017). Through active exploration, the audience acquires relevant information about cultural relics via the media. Simultaneously, the system provides data push according to the audience's preferences, enriching the audience's visit. It is worth noting that the audience's cognitive improvement is not limited to the closed-loop process of museum visits. With the help of online media, audiences can acquire multi-dimensional information perception through social behaviours and improve their understanding of cultural relics in an all-round way.

The museum situation design in the digital age provides an enhanced and immersive experience for the audience beyond the actual museum, maximizing the use of digital media technology to provide technical support for traditional museum exhibitions (Carrozzino & Bergamasco, 2010). This design approach fully mobilizes the audience's emotions during the visit, increasing their interest in visiting. Digital media technology breaks through the limitations of time and space, bringing a new virtual visiting experience to the museum. With the help of online and virtual museums, the audience can obtain relevant information according to their individual needs in the virtual space, thereby extending and supplementing the museum experience.

2.3.3 Audience experience as a criterion for museum evaluation

In the digital age, the core of exhibition design has shifted from "things" to "people", making the audience the centre of museum situation design. The satisfaction of the audience's experience and enhancing their cognition are now critical criteria for evaluating museum exhibitions (Del Chiappa et al., 2014). With the help of information networks and intelligent equipment, the way audiences acquire and receive information has changed dramatically. No longer, passive learners, audiences have become essential participants in museum situation design, interacting with exhibits and completing the museum's information dissemination purpose. As a result, the audience's visiting experience and feelings have reached an unprecedented new height (Figure 47).

The audience experience is reflected in their attention to digital media technology and interactive participation in the visiting process. Unlike traditional passive learning, audiences' experiences in the digital age involve their mood, activity, thinking ability, and the number of visits. We should recognize the differences in cognition among audience groups and consider the coexistence of commonality and individuality in the evaluation criteria for museums in the digital age. Therefore, the evaluation criteria should be dynamic ranges (Dong et al., 2011).

2.3.4 Summary

Digital media technology has revolutionized the way museum's exhibit their collections. Instead of relying solely on cultural relics, museums have shifted towards creating a visitor-centric experience by incorporating elements such as space, media, audience, and exhibition. This transformation has presented challenges and opportunities for museums to reconcile their exhibition goals with their audiences' diverse needs and preferences.

The evolution of museum design concepts has led to the emergence of museum situation design, which focuses on creating dynamic and personalized visitor experiences. With technology advancing rapidly, museum situation design has become even more crucial in enhancing visitors' learning opportunities and awareness.

To meet the needs of diverse audiences, museums must prioritize the satisfaction of visitors' experience as a critical criterion for evaluating their situation

design. It requires careful consideration of visitors' varying levels of cognitive ability and preferences. The design of physical museum exhibitions must also integrate seamlessly with virtual museum exhibitions, allowing for greater flexibility and access.

In conclusion, the development of digital media technology has ushered in new possibilities and challenges for museum situation design. By actively exploring and adapting to these changes, museums can continue to enhance visitors' learning experiences and promote a deeper understanding and appreciation of our shared cultural heritage.

2.4 Audience cognition improvement under the intervention of digital media

2.4.1 Importance and significance

According to the International Council of Museums, museums should be open, accessible, and inclusive and promote diversity and sustainability (Camara, 2020). One of the critical functions of museums is social education, which can be fully realized through excellent museum situation design. The design of museum situations creates a favourable visiting environment for audiences, using the practical collaboration of space, media, audience, and exhibition elements to promote improved cognition among visitors. By fully utilizing technological advancements and advanced design concepts, digital media technology has unique technical advantages that can stimulate the audience's senses and provide a full-dimensional visiting experience.

Digital media technology allows museums to break through the limitations of time and space and offer visitors new and innovative exhibition forms that provide a unique visiting experience (Saracco, 2019). Unlike traditional museum exhibitions, digital media technology enables two-way or multi-directional information exchange, allowing audiences to engage actively with the exhibits. With the current stage of human society's development, digital media technology has the potential to fully realize the educational function of museums, stimulating visitors' interest in visiting and creating technical support for improving their cognitive experience.

The digital age has brought about a fundamental shift in the museum exhibition design concept from an object-focused approach to a people-centric one. With the aid of digital media technology, museums can design innovative situational experiences,

transforming the museum visit experience. Visitors now play an integral part in the museum experience by participating in situational design, engaging with the museum's space, media, and exhibitions, and expanding their cognition beyond traditional limits. Museum visitors have shifted from passive spectators to active learners who can enjoy personalized and enhanced cognitive learning opportunities through exploration and interaction (Altintas & Yenigül, 2020).

Unlike traditional museums focusing on academic and one-way information dissemination, digital media intervention in situational design stresses audience participation and interaction, explicitly focusing on cognitive improvement. Visitor groups differ based on physiological, age, gender, knowledge, thinking mode, and cultural background. Museum exhibitions must cater to these unique needs to create personalized visitor experiences. Liu Wanzhen, a Taiwanese scholar, notes that most museum visitors are non-visitors, and only a tiny proportion are professional audiences. To enhance engagement, situational designs should consider four perspectives: situational, knowledge, experience, and cognition, and four categories of audiences: potential, ordinary, loyal, and professional. By using digital media to intervene in situational design, museums can stimulate the interests of different audience groups, encourage interaction and participation, facilitate active exploration and learning, and foster cognitive enhancement (Callanan, 2012).

The evaluation of digital media intervention in museum situational design is based on the visitor experience. While traditional museums prioritize cultural relics and exhibition quality, digital media intervention emphasizes the audience's active exploration and learning, highlighting emotions, attention, inspiration, and perception. This approach creates a positive and immersive learning environment for visitors.

2.4.2 Meeting audience needs in the digital age

To cater to the diverse needs of museum visitors, audience groups can be divided into four perspectives: situational, knowledge, experiential, and cognitive. Additionally, museum-goers can be broadly categorized into four groups based on their level of engagement: potential visitors, casual visitors, loyal visitors, and professional visitors (Miles, 1986) (Diagram 13).

Potential audience

Potential audiences are individuals who do not have a habit of visiting museums. To attract and engage potential audiences, the museum's situational design should be able to meet their experience needs. However, potential audiences have individual differences, such as some having high educational backgrounds but needing more habitually visit museums. In contrast, others have low educational backgrounds and may need help understanding the intention of museum exhibitions. Therefore, the museum's situational design should aim to arouse the interest of potential audiences and reshape their enthusiasm for visiting through interesting, meaningful, and valuable visiting experiences. Potential audiences can be transformed into other audience categories (Hooper-Greenhill, 2012). The museum can facilitate this transformation by providing a guided visiting experience while also encouraging audiences to explore and be enterprising.

General audience:

As the leading group of museum visitors, the general audience strongly demands that museums design situations that meet their needs. While this group includes individuals with varying gender, ages, individuality, and education levels, they share the common goal of improving their cognition through visiting museums. However, they prefer a broad range of knowledge to a deep understanding of a single topic, and they desire a fun and friendly visiting process that is manageable cognitively (J. Falk, 2016). As such, traditional one-way information dissemination is unattractive to them. Instead, they prefer interactive experiences that offer an exciting and effective way of enhancing their cognition.

Loyal audience:

Loyal audiences are highly interested in museum visits and experiences. For them, visiting museums is about observing and contemplating cultural relics. The media and exhibition forms used in the museum's situational design effectively supplement their perception of cultural relics. To capture the attention of loyal audiences and deepen their cognition, the museum's situational design should incorporate digital media to activate their enthusiasm and utilize technology to deepen their understanding of cultural relics.

Professional audience:

The professional audience primarily consists of scholars or individuals with a professional interest in the museum's exhibits. With their wealth of knowledge, their visits aim to understand the state of exhibits and discover new insights through relevant research. Their focus is on the exhibits rather than the surrounding environment. Whether traditional or digital media influences the museum's situational design, the target audience remains the same – the professional audience (J. H. Falk, 2016).

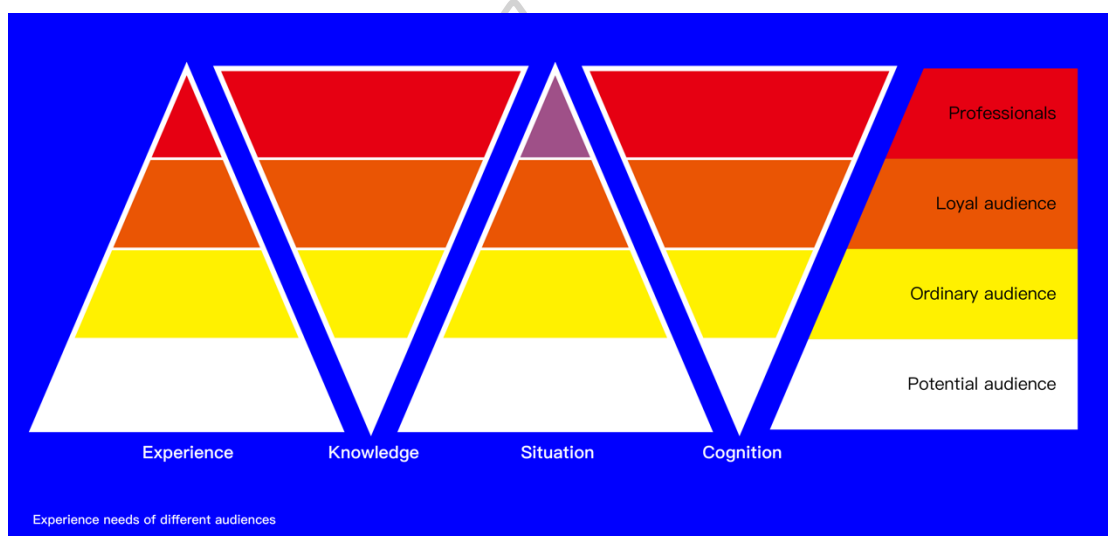


Diagram 13 The different needs of visitors in museum

Source: Produced by Author, 2021.

2.4.3 Methods for enhancing audience cognition

In the digital age, it is essential to leverage the technological advantages of digital media to explore new ways of enhancing audience cognition through design concepts and methods.

The concept of museum design in the digital age is centred on the audience. It aims to improve their cognitive understanding while using cultural relics as the foundation, media as the means, and space as the carrier. Digital media technology is an integral part of the museum's situational design, and it enriches the audience's visiting experience by effectively enhancing the correlation of these elements. The visitor's experience has become the primary criterion for evaluating museum

exhibitions, and the concept of the museum's situational design has evolved to focus on the "people" as the core element of the design (Ayala et al., 2020). During the visit, designers must consider the audience's behaviour, emotions, and cognitive understanding.

The museum design method in the digital age should focus on the audience-centred design concept and build cognitive enhancement based on the museum's situational experience. The intervention of digital media in museum situational design encourages the audience to participate actively, transforming the traditional "education" model into an active and experiential "learning" model (Price et al., 2016). The methods of museum situational design include:

- Multi-narrative design,
- Experience fusion of physical and virtual exhibitions,
- Museum experience design with active audience participation,
- Emotional experiences for happy learning.

The specific design method of museum situational design should be analyzed according to different exhibition needs and goals, focusing on the design concept, the core position of "people" in the information age, and the audience's emotional experience during the visit. The museum's situational design creates a good learning opportunity for the audience through situational experience, emphasizing the process of experience and recognizing the goal of cognition. Designers must promote the concept of audience-centred design throughout the entire design process by leveraging digital media technology (Alelis et al., 2013).

2.4.4 Summary

The advent of digital media has transformed the traditional one-way information transmission mode of museum exhibitions into a two-way or even multi-directional information exchange. With the rapid development of human society, digital media technology can enhance the educational function of museums, stimulate the audience's interest in visiting, and improve their visiting cognition. In the digital age, the concept of museum exhibition design has shifted from focusing on objects to

people as the core. Museum situation design emphasizes the audience's needs and evaluates the success of digital media intervention based on the visitors' experience.

Digital media intervention in museum situation design emphasizes the audience's active participation and interaction, exploration and learning during the visit, and emotional, attentive, inspired, and perceptive experiences. By creating a good learning environment for the audience, museum situation design seeks to enhance visitors' cognition.

Regarding audience perspective, four categories are identified: situation, knowledge, experience, and cognition. The audience atmosphere can be broadly divided into four categories: potential audience, ordinary audience, loyal audience, and professional audience.

The application of digital media technology has a significant impact on the visiting experience of the audience in three aspects: the visiting experience in the museum, the visiting experience that transcends time and space limitations, and the multi-directional visiting experience of information interaction. By taking full advantage of digital media technology, museum designers can explore ways to enhance audience cognition through design concepts and methods.

In conclusion, under the intervention of digital media, museum situation design provides a valuable learning opportunity for the audience through the situational experience. By paying attention to the experience process, recognizing the goal of cognition, and promoting the design concept throughout the entire design method process, designers can create a more engaging and effective museum visiting experience.

2.5 Chapter summary

This chapter provides a literature review and related research in four parts. The first part discusses the relevant knowledge of Tang Dynasty tomb murals, the second part discusses museum situation design and media development, the third part focuses on the intervention of digital media in museum situation design, and the fourth part explores the role of digital media in enhancing audience cognition. Together, these four parts form the main body of the research, which aims to enhance the audience's

experience in visiting the murals of Tang Dynasty tombs through the intervention of digital media.

We review the literature on Tang Dynasty tomb murals in the first part. We analyze the importance of the murals in the Tang Dynasty, the research status of the murals, and the problem of Chinese people's belief in rebirth portrayed in the murals. A literature review on the configuration of mural tombs in the Tang Dynasty lays the foundation for the systematic study of digital media's involvement in designing Tang Dynasty tomb murals.

The second part discusses how museums communicate with their audiences through collection exhibitions and transmit information through exhibition displays. Information dissemination and reception effectiveness are crucial for the museum's relationship with its audience. Therefore, museum situation design should consider the rational use of design concepts and methods to achieve the exhibition's design purpose by combining technology and concepts.

The third part explains how digital media has influenced museum work. Visitor satisfaction has become a critical criterion to test the museum's situation design. The design should fully consider the visiting needs of different groups and provide them with learning opportunities to enhance their visiting awareness. They should pay attention to the cooperation between physical and virtual exhibitions, the importance of audience information acquisition and exchange, and actively explore the digitalization of virtual museums.

The fourth part discusses how digital media's information interaction breaks through museums' traditional one-way information transmission mode. The concept of museum exhibition design has shifted from "things" to "people" as the core of the digital age. Digital media intervention in museum situation design focuses more on audience participation and interaction, active exploration and learning. It emphasizes their emotions, attention, inspiration, and perception during the visit to create a good learning environment for the audience. Therefore, it is essential to fully play the technological advantages of digital media and explore ways to enhance audience cognition from design concepts and methods.

Chapter 3 How To Conduct Research

Digital Media Art:

A New Paradigm for Improving Audience Cognition Through Interaction Design of Computer Information Technology

Interaction Design:

The study and development of the situational design of museums and the development of new digital media art that inspires audience engagement.

This article describes the following ways to design digital media art:

1. Population and Sample
2. Research variables
3. Definition of terms
4. Tools used to collect information
5. Research process
6. Data collection
7. Data analysis

3.1 Population and sample

The audience for this study were experts and the audience of digital media arts.

Group 1: A total of 3 experts were selected as experts in the following fields: Interpretation of History and Narratives of Tang Dynasty Tomb Mural Paintings (1 person), Visual Art and Design (1 person), and Technology and Digital Media Art (1 person).

Group 2 was the evaluation of 5 art creators,

Group 3 was the audience of digital media art of Tang Dynasty tomb murals, with a total of 320 people using voluntary sampling.

Group 4 was five discussion experts, discussing and criticizing the relationship between digital media art and technology.

Group 1: 3 people in related fields, were selected as research experts participating in the digital design of tomb murals in the Tang Dynasty. Researchers conduct research investigations using internationally recognized purposive sampling for specific sampling principles.

Interpretation of the history and narrative of the tomb murals in the Tang Dynasty 1 person

Dr Liu Shuman

Associate Professor, Department of History, Shaanxi Normal University, China,
Research direction: History of the Tang Dynasty in China.

Visual art and design 1 person

Dr Ke Li

Dean and Professor of the Academy of Fine Arts, China Jinzhong University,
Research direction: Chinese traditional culture and digital visual design.

Technology and Digital Media Art 1 person

Dr Duan Niudu

Associate Professor, China Central Academy of Fine Arts,
Research direction: Chinese culture and digital media design.

Group 2: Evaluation of 5 art creators:

The creators used three methods: 1. Data collection and restoration of murals, 2. Digital creation of murals in Tang Dynasty tomb chambers, 3. Prototype exhibition of digital media interaction. The selection criteria are students majoring in design with art design and digital media art creation.

Target sampling: 2 graduate students majoring in art design and three fourth-year undergraduate students majoring in art design from Shaanxi Institute of Design and Art.

Creators: Lin Yongjia, Zhang Junpeng, Yan Ruili, Chen Junfei, Wu Shijie.

Group 3: Visitors to the experimental exhibition of the visual cultural turn of the tomb murals of the Tang Dynasty

A total of 381 people used voluntary sampling.

Group 4: Expert Discussion: Discuss and criticize the relationship between digital media art and technology.

According to the target sampling principal criteria, five experts in related disciplines with industry influence were selected.

Interpretation of the history and narrative of the tomb murals in the Tang Dynasty 1 person

Dr. Cai Changlin

Researcher and professor at Shaanxi History Museum,

Research direction: Chinese Tang Dynasty culture and history.

Visual art and design 2 people

Dr. Qinchuan Zhan

Dean, professor, and doctoral supervisor of the School of Design and Art, Shaanxi University of Science and Technology, China,

Research direction: visual art design and Chinese cultural communication.

Dr. Xia Chen

Dean, Professor, Doctoral Supervisor of School of Fashion, Xi'an Academy of Fine Arts, China

Research direction: Visual art design and costume culture of the Tang Dynasty in China.

Technology and Digital Media Art 2 people

Dr. Michael Gao

Deputy Dean, Professor, Doctoral Supervisor, School of Design and Art, Shaanxi University of Science and Technology, China,

Research direction: digital media design and Chinese national culture.

Dr. Chen Zanwei

Dean, professor, and doctoral supervisor of the School of Animation,
Guangzhou Academy of Fine Arts, China,

Research direction: digital media art and animation design.

The fifth group: audiences of the prototype exhibition where digital media art intervened in the situational design of Tang Dynasty tomb murals.

Using the principle of voluntary sampling, 320 viewers participated in the survey.

Affected by the 2019 coronavirus disease (COVID-19) epidemic, this sampling was conducted through online social media.

3.2 Research variables

The parameters of this study are as follows:

3.2.1 Early variables

3.2.1.1 The form and level of interaction between digital media art and museum exhibitions

3.2.1.2 Interaction design in digital media art development

3.2.2 Variable-based

3.2.2.1 Suitability for Work

3.2.2.2 Efficiency of learning from viewed works

3.2.2.3 Satisfaction with viewing results

3.3 Definition of terms

3.3.1 Paradigm

Refers to adopting ways of thinking, practices, rules, and theories. Form a pattern of interrelated practices that fit the purpose.

3.3.2 Interaction with performance

It means the communication between the audience and the work is based on the various senses of the audience. Interact with the work by communicating with the audience.

3.4 Research tools

3.4.1 Research Instruments

Prototyping works using interactively designed digital media contextual design of Tang dynasty tomb murals to create artefact-based research tools. Researchers created questionnaires and interviews based on the prototype design.

Steps to create a co-construction-based research tool:

3.4.1.1 Research concepts, theories, and research tools related to the history and work of Tang Dynasty tomb mural paintings.

3.4.1.2 Determine the scope and structure of digital media arts research tools to cover and fit the research objectives given in the study.

3.4.1.3 Draft research tools and seek advice from doctoral supervisors and advisors. Check corrections to meet research goals.

3.4.1.4 Improve research tools based on suggestions from doctoral supervisors and advisors. Includes review, comment, and scoring using the Index of Item Objective Congruence (IOC) tool.

3.4.1.5 Prepare a complete research tool for collecting research data.

3.4.2 Tools for evaluating prototypes.

The research tools used to collect data fall into interviews, questionnaires, and behavioural observations.

3.4.2.1 Interview

A structured interview for creating and reviewing digital media art interventions in the contextual design of Tang Dynasty tomb murals.

3.4.2.2 Questionnaire

The questionnaire used in this study is divided into the following three parts:

Part I: Questionnaire about the general conditions of the respondents.

Part II: Digital Media Art Observation Evaluation Questionnaire.

The researchers devised five levels to facilitate the collection and evaluation of feedback:

5 represents the highest level,

4 means high level,

3 means medium,

2 means low-level,

1 indicates the minimum level.

The third part: is an open-ended questionnaire on the prototype exhibition of work feedback digital media involved in the situational design of Tang Dynasty tomb murals.

3.4.2.3 Behavior Observation

This structured observation model records the audience's views on the interaction design of digital media art. Interaction design improves the audience's cognition and is manifested in the viewing process, which is divided into the following two parts:

Part 1: Observe the duration of audience participation in the design of museum situations under the intervention of digital media.

The second part: observe the audience's behaviour and needs in the digital media situational design exhibition.

The researchers devised five levels to facilitate the collection and evaluation of feedback:

5 is the highest level.

4 means a high level.

3 means a medium level.

2 means low level.

1 indicates the lowest level.

3.5 Research Process

This research is research and development. The researchers divided the research process into three stages. as follows:

Phase I study

The design and development of the theory based on the digitization of the tomb murals in the Tang Dynasty

The procedure is as follows:

1. Use literature review to research theoretical concepts and related research papers, analyze and integrate them, and design the elements and steps of the digital media interaction design learning model.

2. Obtain data from analysis and research, integrate relevant elements for design, and outline a conceptual model for intervention in museum situational design through digital media interactive technology. Then, present to a consultant for suggestions for improvement.

3. Create a suitability assessment form to assess the rationality of the design study (Index of Item Objective Congruence: IOC) through the review conducted by experts in the relevant professions.

4. Interview three experts in related fields and use open-ended questions to obtain a feasibility assessment of the knowledge of Tang Dynasty tomb murals using digital media interactive technology. The researchers then used data analysis methods to summarise the experts' recommendations.

Phase II study

The interaction design of digital media is involved in the paradigm design and prototype production of museum situation design.

The procedure is as follows:

1. Analyze the tools and equipment used to create the work.
2. Field trials to evaluate how digital media contextual design engages audiences.

3. Use the interactive technology of digital media to design the exhibition prototype.

4. Research and observe the results of digital media intervention in museum situational design prototype exhibitions. During the 15-day exhibition, relevant data were collected through interviews with experts and a questionnaire survey of 320 people. The audience's behaviour during the exhibition's viewing will also become essential for the researchers to collect data.

Phase III Study

Analyse the use of digital media to intervene in the museum situation design to enhance the audience's cognition.

The procedure is as follows:

1. Scientifically analyse the results of the prototype exhibition of the situational design of the tomb murals in the Tang Dynasty.
2. A paradigm shift in media interaction design that improves and extends digital media.
3. Create the audience's evaluation form for enlightenment knowledge.
4. Research the effect and effect of cultural relics, digital media art, and interactive design technology on enhancing audience cognition.

3.6 Data collection

Gathering information, the researchers performed the following steps.

3.6.1 Data collection from expert interviews

3.6.1.1 Researchers are authorised to apply at the Graduate School of Silpakorn University to find experts for cooperation.

3.6.1.2 The researcher collects data from all interviews, taking further research steps as appropriate.

3.6.2 Data collection using questionnaires.

3.6.2.1 The researcher explains the questionnaire to the audience before the audience visits the design prototype exhibition.

3.6.2.2 The audience answers the questionnaire after watching the prototype exhibition.

3.6.2.3 The investigator collects all the obtained questionnaires and is referred to the procedure for further research.

3.6.3 Collect data using behavioural observation.

3.6.3.1 The researchers observed the audience's behaviour during the prototype exhibition visit.

3.6.3.2 The researcher collects all behavioural information and conducts further research according to the steps.

3.6.4 Expert review data collection

3.6.4.1 Researchers can apply at the Graduate School of Silpakorn University, find cooperative experts, and comment on the exhibition.

3.6.4.2 The researcher continues the research process by collecting data from all collected expert reviews.

3.6.5 Collecting data using comprehension assessment tests.

3.6.5.1 The researchers gave viewers a test to assess their understanding of the content before viewing the prototype exhibit.

3.6.5.2 The researchers gave the audience a test after viewing the prototype exhibit to assess their understanding of the content.

3.7 Data analysis

3.7.1 Analysis method

In the data analysis, the researchers analysed the data as follows.

3.7.1.1 Analyzing interviews.

Using the information gathered from the interviews, the researcher summarises the questions by analysing themes (content analysis).

Analyse information in three areas:

1. The rationality of the combination of Tang Dynasty tomb murals and digital media interactive technology,
2. Use digital media technology to enhance the effectiveness of audience visit cognition,
3. The audience's Satisfaction with the prototype exhibition.

3.7.1.2 Analyzing questionnaires

The researchers analysed data collected from questionnaires. Through a series of steps as follows:

1. Check the completeness of all survey responses.
2. The questionnaire analyses the individual status information of the respondents, and the frequency and percentage values are used to discuss the research results.

3. The questionnaire counts the information on the mean (average) and standard deviation (S.D.) of the audience watching the prototype exhibition.

4. The researchers used an open-ended questionnaire to count the audience's suggestions for the digital media art exhibition and used synthesising opinions with similar meanings for analysis and discussion.

3.7.1.3 Analyzing behavioral observations

The researchers observed and analysed the behavior of the audience.

The analysis content is as follows:

1. Check the completeness of all behavioural observation responses.
2. Calculate the mean (mean) and standard deviation (S.D.) of the data in question.

3.7.1.4 Analysis expert review record form

The researchers analysed experts to review records,

Specific steps are as follows:

1. Recording of the expert review process.
2. Recording of expert comments.
3. Summarize the main points raised and discussed by the experts.

3.7.2 Statistics used in data analysis

In this data analysis, the researcher analyzes the data using a computer program that uses statistics as follows:

3.7.2.1. Frequency and Percentage

1. Data from the questionnaire were used to distribute frequencies, and the data were analyzed as percentages of values, which were then presented in the research in tabular form.

2. Data for open-ended questions are presented in order of frequency in the form presented.

3.7.2.2. Mean

The average (\bar{x}) is calculated using the data from the questionnaire.

3.7.2.3. Standard Deviation: S.D.

The mean (\bar{x}) is computed for each item to measure the distribution of scores. Find each item's standard deviation (S.D.) to centre by a propensity to enter.

3.7.2.4. Compare the arithmetic mean (\bar{x}) and standard deviation (S.D.).

3.8 Chapter summary

The chapter organizes around critical sections, which include the identification of the research population and sample, the definition of variables, the clarification of key terms, the presentation of research tools, the outline of the research process, the methods for collecting data, and the approaches for analyzing data.

The research aims at various audiences of digital media arts, including experts from diverse fields relevant to the topic, art creators, experimental exhibition visitors, and prototype exhibition audiences. The researchers have provided detailed profiles of participants, showcasing their qualifications and expertise. The research also considers the impacts of external factors like the COVID-19 pandemic, leading to necessary adjustments in the sampling method.

The research methodology defines initial and variable-based parameters to understand the interactive design in digital media art. The research clarifies critical concepts such as "paradigm" and "interaction with performance." The research tools encompass prototyping works, questionnaires, and interviews. Data collection in this research follows a multilayered approach, integrating expert interviews, questionnaires, behavioral observation, expert reviews, and comprehension assessment tests.

The chapter provides a comprehensive outline of the research process, broken down into three major phases: the creation and development of the theory based on the digitization of the Tang Dynasty tomb murals, the interaction design of digital media along with prototype production, and an analysis of how digital media intervenes in museum situation design to enhance audience cognition.

The researchers give detailed accounts of the data collection steps for each method. They emphasize how they will utilize expert interviews, questionnaires, behavioral observations, expert review records, and comprehension assessment tests to compile various data for analysis.

The section on data analysis details multiple methods for examining the collected data, which include thematic analysis for interviews, the calculation of means and standard deviations for questionnaire responses, and behavior observations. The research also mentions the use of computer programs for statistical analysis and the comparison of arithmetic means. This diverse, detail-focused approach guarantees the robustness and reliability of the research process and results.



Chapter 4 Research On Design Methodologies For Museum Situation

Design Under Digital Media Intervention

4.1 Why use digital media to intervene in Museum Situational Design?

4.1.1 Situational Design in Museum Exhibition

In the digital age, museums' exhibition design is no longer limited to the Exhibition and display of objective objects. With the development of digital technology, new museum experience forms and contents with interactive attributes, immersive experiences, and virtual reality break through the traditional (Srinivasan et al., 2010a). The concept of exhibition presentation offers audiences a new way to enhance the museum visit experience. The design has shifted from collecting and displaying collections to focusing on the audience experience, a significant change in museum exhibitions in the digital age. It provides unprecedented opportunities and challenges for museum situation design (Li et al., 2012). Exhibits, media, audience, and space together constitute the essential elements of museum situation design, and the intervention of digital media extends the correlation between exhibits and media, breaks the limitations of traditional museum exhibition attributes, and provides an opportunity to enhance the audience's cognition—new experience content and experience mode.



Figure 48 Unity of the environment and content of the museum

Source: Luoyang Museum, China, 2021.

Renewal and iteration of the Museum exhibition concept

Shan Jixiang, former president of the National Palace Museum of China, believes that the museum's exhibition design is a highly comprehensive, professional, and forward-looking work in a specific space (Jixiang, 2015). Based on academic research materials, cultural relics, and specimens, with exhibition space, equipment, and technology as a platform by a particular body, sequence, and art form, disseminate knowledge, information, and culture to the public (Figure 48). Exhibition design builds the connection between the exhibits and the audience by creating vision and space and conveys information, ideas, and emotions through innovation to achieve specific cognitive enhancement purposes. The Exhibition is the core of the museum experience and a generalized experience aimed at the audience's demands (Dean, 2002). The Exhibition presents public relations objects with no added meaning, presented as objects. The Exhibition is a media based on objects and auxiliary elements. It is presented in a predetermined space and uses special interpretation techniques and learning sequences to convey and communicate concepts, values, and knowledge (Boylan & Boylan, 2004).

Societal development and cognitive levels limit museum exhibition theory and practice (Dean, 2002). In different historical stages, the museum's exhibition design presents the characteristics of the times. Combining the development of museum exhibition design helps us better judge the development trend of museum exhibition design in the digital age.



Figure 49 The Ashmolean Museum of Art and Archaeology

Source: Ashmolean Museum, 2021.

In 1683, the Ashmolean Museum of Art and Archaeology of Oxford University opened to the public, marking the birth of the museum of contemporary significance (Knell, 2019) (Figure 49). The museum core function was collection and storage. In the British Arts and Crafts Movement, the famous craftsman Henry Koller first proposed the concept of "an organic combination of arts and crafts and exhibition," which helped audiences better understand the content and focus of the Exhibition (Crawford, 1997). Later, full-time display and exhibition designers appeared in the museum field, which significantly changed the design level of display and exhibition forms and affected the public social image of museums.

In the early 1880s, Sir Charles Owen, the famous British palaeontologist, used taxonomy in the exhibition design of the new South Kensington branch of the British Museum, pioneering the construction of several pavilions with different themes. He led the design concepts of separating exhibits from collections, opening public spaces, and thematic displays, which laid down the basic concepts of subsequent museum exhibition design (Bennett, 2013) (Figure 50).

In the mid-20th century, the theory and practice of museology were continuously improved and enriched. Scholars gradually sorted out the concept of the museum exhibition design into nine different types: Plot type, aestheticism type, participation type, communication type, systematic Exhibition, space creative show, dramatic production, dynamic Exhibition, and green Exhibition (Diagram 14) (Diagram 15) (Jun & Tao, 2014).



Figure 50 The interior of the British Museum

Source: The British Museum, 2021.

Concept	Feature	Deficiency
Plot Type	Exhibits with clear themes and complete plots that are coherent and chronologically organized can be more effective in engaging and informing visitors.	Too rigid and dogmatic, not enough to attract the audience.
Aestheticism Type	Using decorative features and effectively utilising exhibition space, lighting, colour, and audio-visual means can highlight an exhibit's formal and emotional beauty. This approach is primarily used in art galleries.	High cost, excessive focus on artistry, insufficient interpretation.
Participation Type	The focus of museum exhibitions has shifted towards increasing audience participation and entertainment, allowing visitors to benefit from active engagement. This approach has been widely used in exhibitions in nature, science, and technology.	Poor applicability and noisy exhibition space.
Communication Type	There is an increasing focus on social issues with universal implications, emphasising knowledge output and information feedback. This focus also emphasises the interaction between the museum and the audience, creating opportunities for engagement and dialogue on critical social issues.	The selection of topics is more difficult to implement and is subject to many limitations.
Systematic Exhibition	In the Exhibition, the selection of information medium emphasizes the semantic structure and spatial integration of the exhibit, creating an integrated system of knowledge, installation, and space. This approach allows the audience to understand better and	Requires a high knowledge base and tends to cause difficulties in understanding.

	accept the information presented in the exhibit.	
Space Creative Exhibition	By recomposing scenes, the combination of exhibition and space can create a realistically restored environment that gives the audience an immersive sense of the exhibit. This approach allows for exhibitions that extend beyond material culture, even into abstract spaces.	Requires larger site space and higher costs.
Dramatic Exhibition	To achieve the effect, the exhibition exhibits' expressive and infectious power is enhanced through electric devices, digital audio and video, controllable lighting systems, and kinetic cinema systems.	With too much emphasis on entertainment, it is easy to ignore knowledge.
Green Exhibition	To achieve a harmonious symbiosis between exhibitions and the environment, scientific protection and rational utilisation are followed, emphasising energy conservation, environmental protection, and sustainable development of exhibits.	Prior art materials limit us.
Dynamic Exhibition	The effect of a dynamic exhibition, presented to the audience with movements, to enhance entertainment, participation, and interaction. Originally used primarily in science and technology or natural history museums, this has gradually expanded to include art and general museums.	The scope of application is limited, and few exhibits are suitable for adoption.

Diagram 14 Museum exhibition design concept

Source: Content reference Introduction to Museology.

Museum Exhibition Concept	Feature	Deficiency	Space	Medium	Audience	Exhibition	
Episodic Type	Having a Clear Display Theme and a Complete Display Plot.	Too Rigid and Dogmatic, Lacking Appeal to the Audience.	●	●	●	●	
Aestheticism Type	The Decorative Features Emphasize Formal Beauty.	High Cost and Insufficient Explanatory Power.	●	●	●	●	
Participatory Type	Emphasize Audience Engagement and Entertainment.	Poor Applicability and Noisy Exhibition Space.	●	●	●	●	
Communication Type	Emphasize Knowledge Output and Information Feedback.	The Implementation of the Design Is Subject to Many Limitations.	●	●	●	●	
Systematic Display	Emphasize the Information Structure in the Display.	Requires a High Level of Knowledge Reserve.	●	●	●	●	Hard
Space Creation Style	Create Space Through the Reconstruction of Scenarios.	Require a Large Venue Space and High Costs.	●	●	●	●	●
Dramatic Type	Using Electric Devices To Showcase Dramatic Effects.	Excessive Entertainment and Weak Knowledge.	●	●	●	●	●
Ecological Type	Emphasis on Environmental Protection.	Limited by Existing Technical Materials.	●	●	●	●	●
Interactive Type	Emphasize the Participation of the Exhibition.	The Scope of Application Is Limited.	●	●	●	●	●
Situational Design	Cognitive Enhancement Centered on Experience.	High Demand for Creativity and Technology.	●	●	●	●	Easy

Diagram 15 Analyzing the relationship between museum concepts and elements

Source: Drawn by the Author, 2023.

4.1.2 Museum Situation Design under the Intervention of Digital Media

Significant changes have taken place in museum exhibition modes and experience methods in the digital age; the situation design of the museum also adapts to these changes, producing a series of changes in design thinking and design forms that align with the needs of the times (MacLeod et al., 2015). The core work of museums in the digital age differs from traditional museums. While conventional museums focus on exhibitions, museums in the digital age focus on human feelings, learning, and experience during the visit. The audience experience has become the core of the museum's situational Design in the digital age (Meng et al., 2022). Digital technology has brought new possibilities for the professional knowledge of the scene in the museum and made the scene experience extend from the physical space to the virtual world. New exhibition forms, such as online museums, virtual reality exhibitions, augmented reality exhibitions, and digital interactive exhibitions, present the characteristics of virtual and real, dynamic and static, and online and offline (Li et al., 2012).

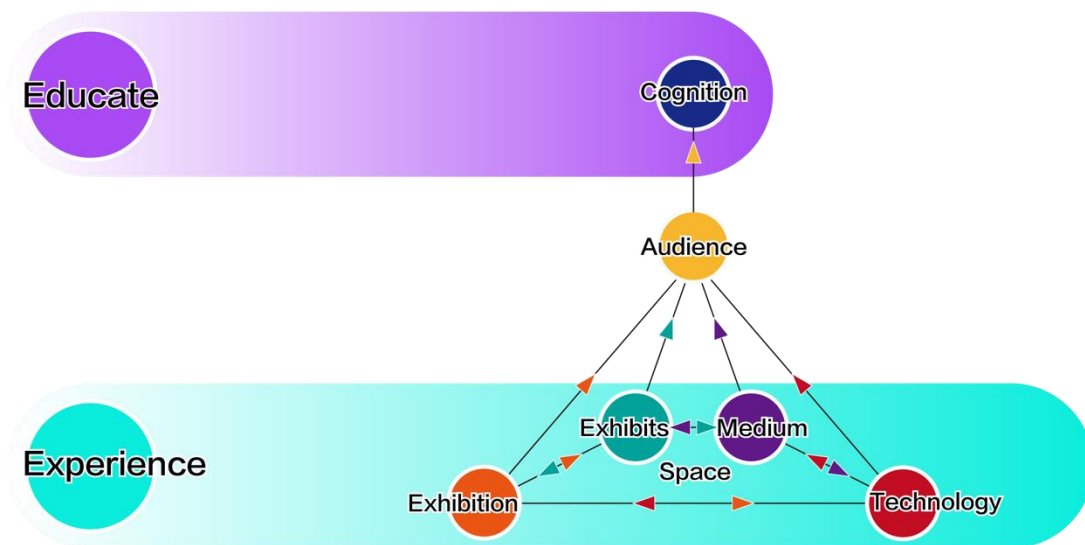


Diagram 16 The audience-centered museum situation design model

Source: Drawn by Author, 2021.

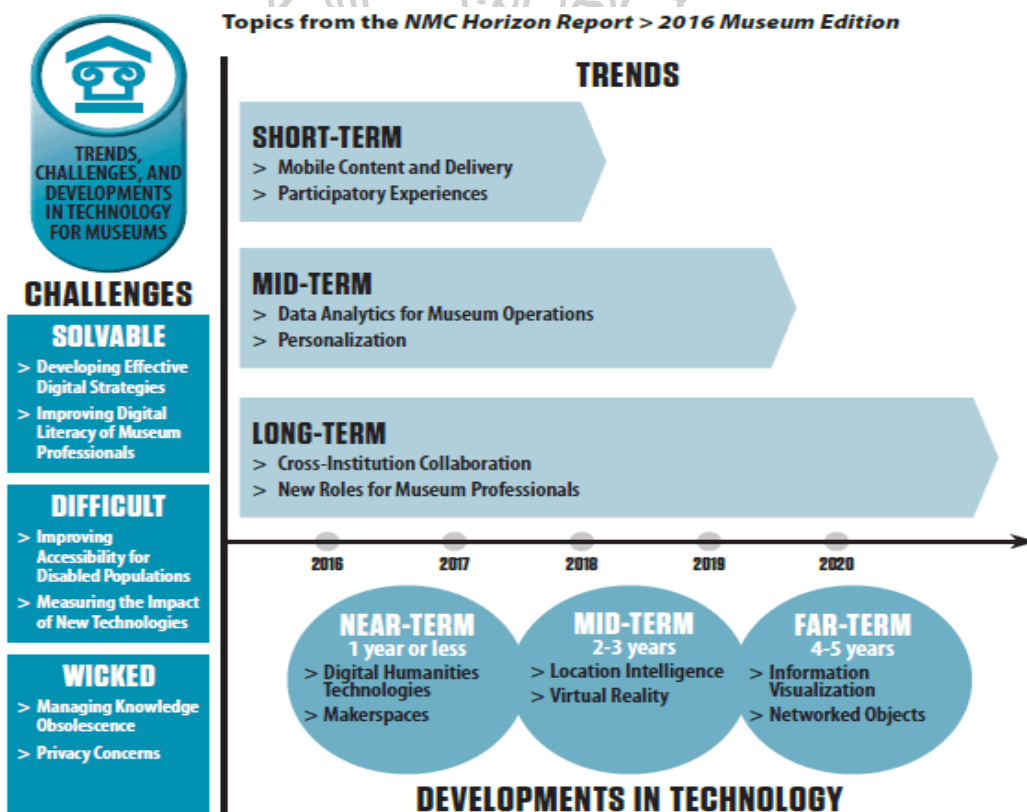


Figure 51 Horizon Report: Museum Edition, 2016

Source: Museum Edition Report, 2022.

Under the intervention of digital media, the museum situation design takes the audience experience as the core, the exhibits as the basis, the medium as the means, the space as the container, and the goal of enhancing the audience's cognition (Diagram 16).

Digital media serves the experience of museums' unique technical characteristics, and various museums are actively adopting digital media technology. In 2016, the New Media Consortium, in partnership with the Balboa Park Online Collaborative, re-released the Horizon Museum Report, the sixth consecutive annual museum series report released by the New Media Consortium (Figure 51). The report believes that the museum experience will be more interactive in the future. At the same time, using smart devices, virtual reality technology, networking, and other technologies will significantly change museum exhibitions (NMC & Collaborative, 2016).



Figure 52 New forms and features of digital museums

Source: National Museum of China, 2021.

Digital museum situation design based on digital media technology makes the museum experience increasingly rich. It was gradually expanding the museum experience from a traditional visual viewing-based expertise to a comprehensive situation experience that includes enhanced experience, immersive experience, virtual experience, and personalized experience (Meng et al., 2022). The integration of the exhibition situation through digital media significantly enhances the audience's visiting expertise and helps the audience to understand the theme and content of the Exhibition. The situation design in the digital age enables the audience to acquire

knowledge in a happy experience through diversified narration, the integration of virtual and natural scenes, and the audience's active participation (Jingbo, 2019c).

Digital media technology provides a new exhibition space for museum situation design. Digital technology breaks through the limitations of time and space so that museum exhibitions are not limited to a specific time and space (Figure 52). Online and virtual museums make it possible to visit museums anytime, anywhere, considerably breaking physical space limitations and extending the boundaries of museum knowledge dissemination (Li et al., 2012). The intervention of immersive experiences such as augmented and virtual reality technology enhances the audience's experience in museum visits. Digital technology activates the multi-sensory stimulation of the audience, making the audience part of the Exhibition and jointly constructing the museum's knowledge system and situational Design. As a medium of information dissemination, digital technology can not only disseminate the information of exhibits to the audience so that the audience gets a quality visiting experience. Digital technology can break through the one-way nature of knowledge dissemination in traditional museum exhibitions through interactive technology to achieve two-way information communication between exhibits and the audience. In the process of knowledge dissemination, collect feedback from the audience on the exhibition information to verify the effectiveness of information interaction, improve and optimize the ways and methods of interaction, and further deepen the effect of interaction between digital media and the audience (Silverman & Bartley, 2013).

Digital technology also has the property of social communication (Russo et al., 2006). Through the dissemination of information, achieve interactive communication between museums and audiences, people and people, to enhance the breadth and depth of information dissemination. The knowledge sharing of the museum and the visiting experience of the audience can realize the multi-directional exchange of information with the help of digital technology and platform to enhance and deepen the audience's understanding of relevant knowledge. Digital technology can fully play the democratic nature of information dissemination and provide a platform for information exchange among different groups, classes, and audiences' perspectives (Drotner & Schrøder, 2013). Essentially, human beings acquire information to enable

the exchange of information. Digital technology can satisfy the closed loop of information dissemination and complete the transformation of knowledge from acquisition, cognition, and communication. In the continuous iteration of digital technology, the change of human information will become more intelligent, and data transmission will become more efficient. The museum situation design based on digital media will enhance the audience's visiting experience, shorten the distance between knowledge and the audience, and realize the purpose of human information dissemination and cognitive enhancement.

4.1.3 Application of digital media in Chinese museum exhibitions

In recent years, with the rapid development of digital technology, Chinese museums have also applied digital media to their exhibition design, gradually enriching the audience's visiting experience and improving the level of museum exhibition design. The application of digital technology in Chinese museum exhibitions is mainly reflected in the following aspects:

Digital exhibition halls: With the help of digital technology, museums can create digital exhibition halls, which can display large-scale exhibits that cannot be displayed in the physical space, such as ancient architecture and large-scale sculptures. The audience can observe these exhibits from different angles and distances, enhancing the immersive experience.

Virtual reality technology: Museums in China have also applied virtual reality technology in exhibition design. With the help of virtual reality technology, visitors can have a more immersive experience, exploring the exhibition space and interacting with exhibits in a virtual environment.

Interactive technology: Interactive technology, such as touch screens and virtual reality glasses, allows visitors to interact with exhibits and acquire knowledge in a more engaging and fun way. Chinese museums have also developed mobile apps and other digital platforms, allowing visitors to explore and learn about exhibits more personalised and conveniently.

Digital preservation: Digital technology also plays an essential role in preserving cultural relics and artefacts. By using digital technology to scan and preserve

artefacts, museums can better protect them from damage or deterioration and share their information and knowledge with a broader audience.

In summary, the application of digital media in Chinese museum exhibitions has gradually enriched the audience's visiting experience, improved the level of museum exhibition design, and promoted the dissemination and preservation of cultural knowledge (Drotner & Schrøder, 2013).



Diagram 17 Number of Museums in China

Source: National Bureau of Statistics of China, Source: Drawn by Author, 2021.

After entering the 21st century, China's museum industry has seen rapid development. As of 2021, the number of museums in China has reached 5,881. With the increase in the number of museums, the quality of museum exhibition design has also continued to develop, and museum exhibitions have played an essential role in China's cultural undertakings and social development. From the analysis of the organizational system of museums, China has formed a national museum system led by the central and local governments, national first-level, second-level, and third-level

museums and key industry museums as the backbone, state-owned museums as the main body, and private museums as supplements (Group, 2022).

Despite the impact of COVID-19, from the analysis of the changes in the number of new museums in China each year from 2014 to 2021, the number of unique museums in China is in a relatively stable fluctuation range, reflecting the overall trend of the development of China's museum industry (Group, 2022) (Diagram 17).



Diagram 18 Changes in the number of new museums in China

Source: National Bureau of Statistics of China, Source: Drawn by Author, 2021.

The number of audiences to the museum is also increasing year by year (Diagram 18). According to statistics from the Ministry of Culture and Tourism of China, the number of visitors to Chinese museums will reach 1.3 billion in 2021, equivalent to China's population base (Diagram 19). At the level of national cultural development, the state encourages museums to open to tourists free of charge, which has extensively promoted the increase in the number of visitors to Chinese museums. At the same time, the rise in the number of visitors also reflects the increase in Chinese people's consumption of spiritual and cultural life. From a macro-level analysis,

museums play an essential role in condensing national identity, enhancing cultural self-confidence, and promoting cultural exchanges. Therefore, in developing museums, they should have a sense of the future, integrate Internet thinking into museums, and realize online and offline dual-track linkage.

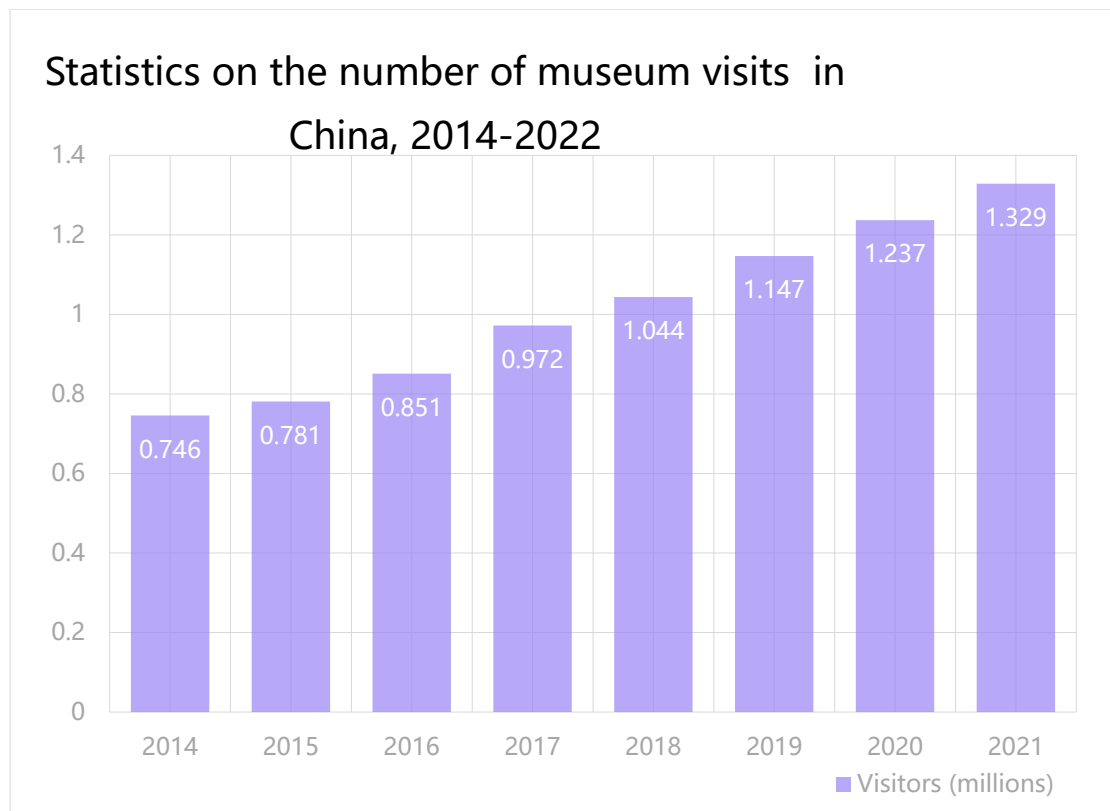


Diagram 19 Statistics on the number of museum visits

Source: Ministry of Culture and Tourism of China, Source: Drawn by Author, 2021.

The rich collections of traditional museums are the main target of audience visits. Along with the growth of the number of visitors and the promotion of national policies, traditional museums gradually show problems such as lack of space and declining experience. Although the new museums try to improve the museum visiting experience by expanding the building space and exhibition space, the visiting experience of the audience could be better. To encourage the rapid development of the museum industry, the State Administration of Cultural Heritage of China issued the "Outline of the Medium and Long-term Development Plan for the Museum Industry

(2011-2020)" in 2012 and put forward the overall goals of the industry: By 2020, the basic formation of distinctive, optimized structure, reasonable layout of the museum system, the essential modernization of museum management and operation, the primary establishment of a collaborative process, benefit all the people of the museum public cultural services system, museum culture in the hearts of the people, into the ranks of the world's advanced museum countries (Heritage, 2011). Under the promotion of sound policies, the construction and operation of museums will have better development prospects. Under the guidance, new technologies represented by information technology have injected vitality into the exhibitions of Chinese museums. By 2021, 40% of museums in China have tried to adopt digital media technology, and more and more museums were using digital technology in the situation design of museums to enhance the audience's visiting experience, effectively strengthening the audience's enthusiasm for participation (Diagram 20).

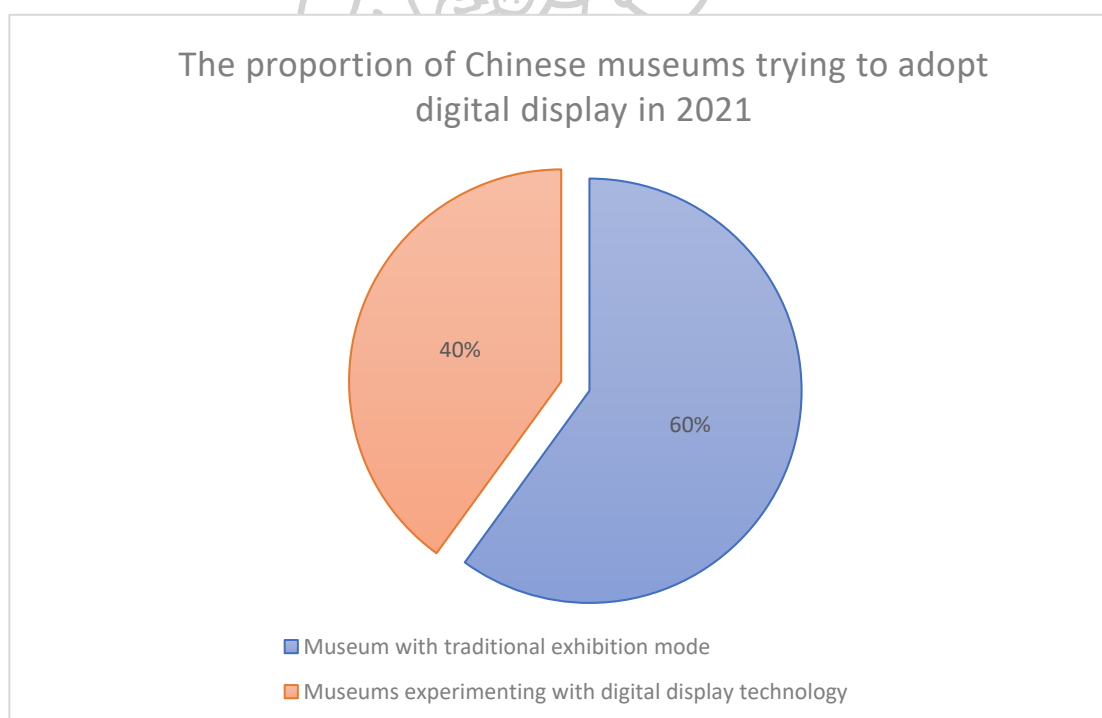


Diagram 20 The proportion of Chinese museums trying to adopt digital display in 2021

Source: Museum Digitization Professional Committee of China Association of Museums, 2022.

In 2021, Shenzhen held an exhibition of cultural relics without physical objects (Figure 53) (Figure 54). Based on decades of cultural relics digitization achievements in the Forbidden City of China and digital technical support from China's Tencent, the audience achieved an immersive experience of ultra-high-precision digital national treasures with the help of AR and VR technology and panoramic sound technology (Figure 55).



Figure 53 Digital cultural relics exhibition jointly organized by Tencent and the Forbidden City in Shenzhen, China

Source: Tencent, 2022.



Figure 54 Part of Situation design supported by digital technology

Source: Tencent, 2022.



Figure 55 Digital cultural relics exhibition jointly organized by Tencent and the Forbidden City in Shenzhen, China

Source: Tencent, 2022.

Status of museums in your country

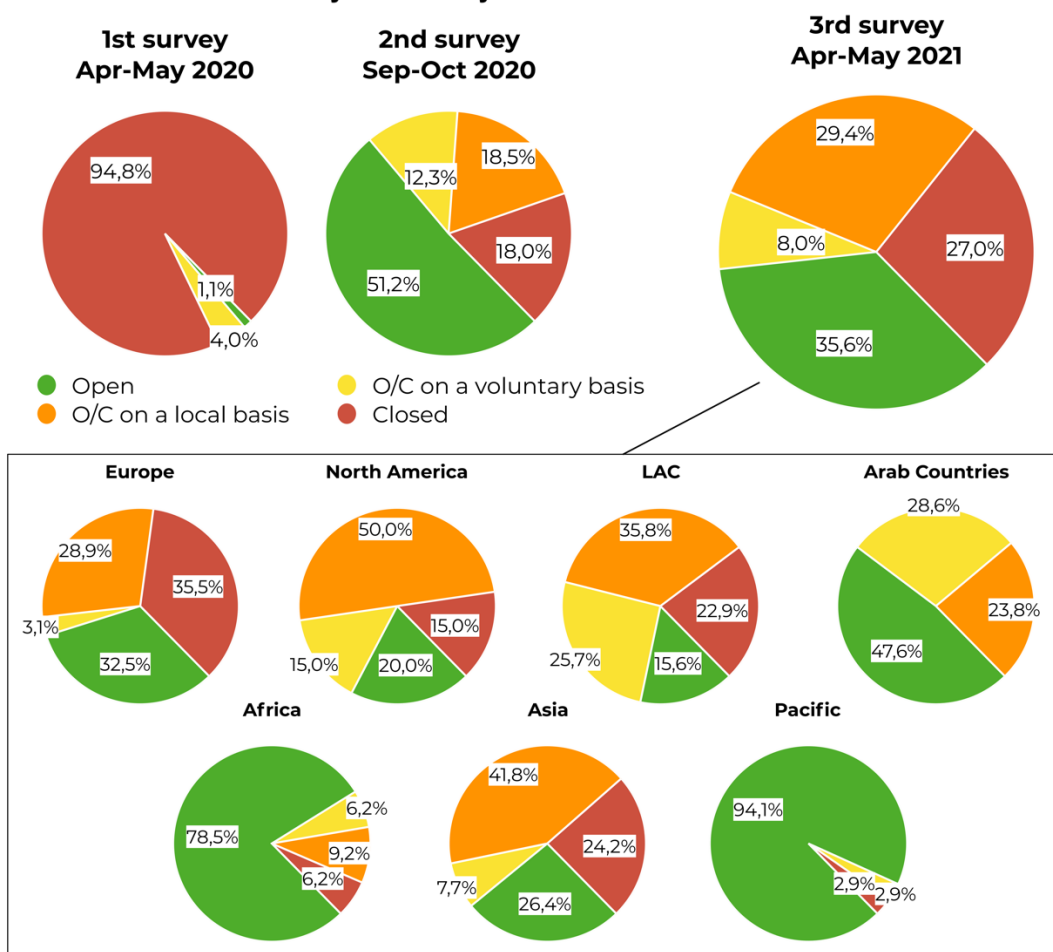


Diagram 21 A survey of Global Museum openings

Source: Museums professionals and Covid-19: the third ICOM report, 2022.

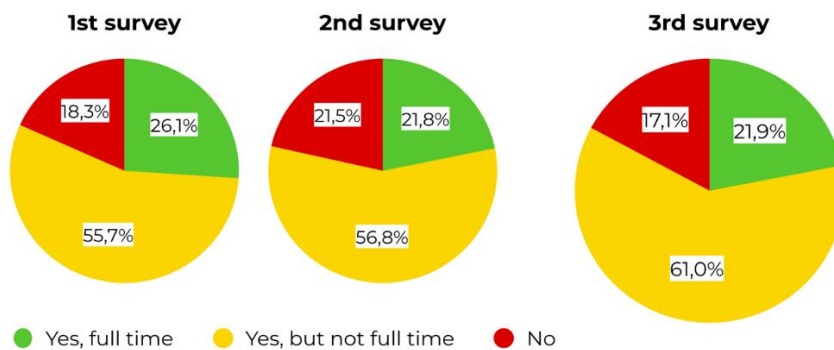
4.1.4 Under the influence of COVID-19, the dilemma and digital opportunities of museum development

A report from the International Association of Museums shows that the COVID-19 crisis has accelerated the speed of museum artefacts embracing cutting-edge technology. Museums using online exhibition collections, exhibitions, and live broadcasts increased by more than 15% in 2020. In May 2021, ICOM conducted the third survey (Meusems, 2021). A Laishun, Vice President of the International Association of Museums, shared the survey results. He pointed out that "affected by COVID-19, the unprecedented connection between digital technology and museums, the application of digital technology has played a role. Many museums regard improving the level of digital services as an important and strategic choice." Museums began to explore the application of digital technology in the "new normal" of the epidemic, and museums have gradually established different digital communication Channels. The following data came from the global museum survey conducted by ICOM from April 2020 to May 2021 (Museums, 2020) (Diagram 21).

1. From the perspective of strategic adjustment related to the digitalization of museums (Diagram 22). Among the museums surveyed, the changes from September 2020 to May 2021 were: "Revisiting digital strategies" increased from 76.6% to 83.4%; "Increased specialized staff" increased from 38.7% to 41.9%; "Increased "Digital budget" increased from 43.2% to 52.1%; "Increase digital service content" increased from 74.8% to 78.6%; Strengthen employee training increased from 53.8% to 64.6%.

2. From the perspective of human resources investment related to digital museum activities. Those with full-time digital employees accounted for 26.1%, 21.8%, and 21.9% in April, September, and May 2021, respectively. For those with part-time digital personnel, the proportions of these three-time points were 55.7%, 56.8%, and 61.0%, and the proportion gradually increased in less than a year. Those without specialized digital personnel accounted for 18.3%, 21.5%, and 17.1% at the three-time points. From trends in the data, an increase in the proportion of part-time employees working in digital jobs indicates a shift in the allocation of museum human resources towards communications and digital activities. In contrast, the proportion of museums without full-time digital employees has declined (Diagram 23).

Do you have dedicated staff for digital activities?



What percentage of your overall budget is dedicated to communication and digital activities?

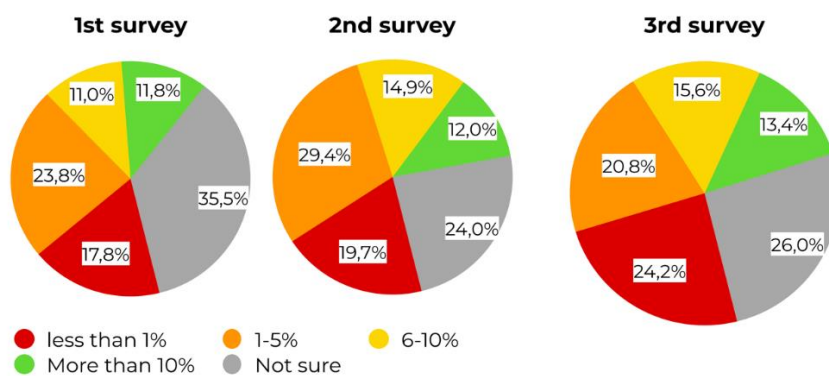


Diagram 22 Strategic adjustment related to digitalization of museums
 Source: Museums professionals and Covid-19: the third ICOM report, 2022.

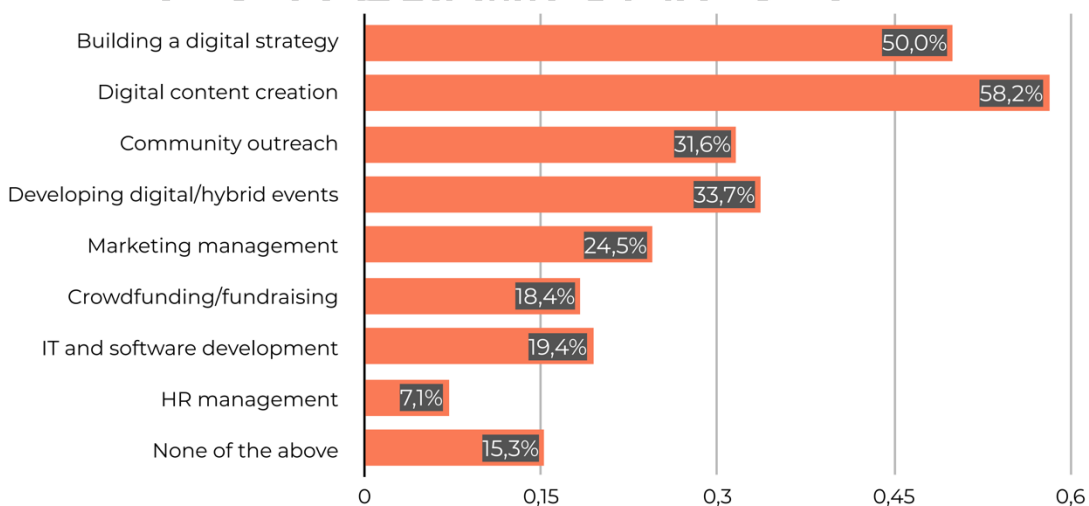


Diagram 23 Skills demand in museums under COVID-19
 Source: Museums, museum professionals and Covid-19: the third ICOM report is online, 2022.

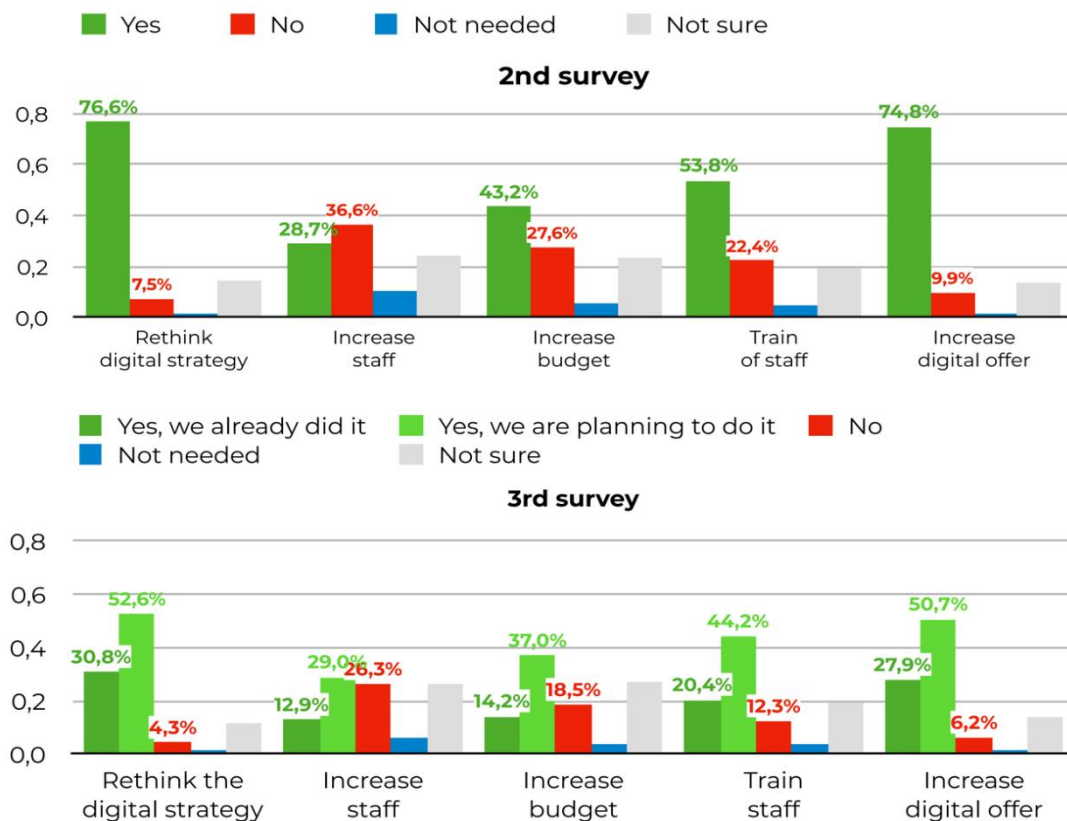


Diagram 24 Changes in the proportion of each item in the total museum budget
 Source: Museums, museum professionals and Covid-19: the third ICOM report is online, 2022.

3. From the perspective of the proportion of communication and digital activities in the total budget of the museum (Diagram 24). Among the surveyed museums, where the budget for communication and digitalization activities exceeded 10% of the total budget, the proportions in April, September, and May 2021 were 11.8%, 12.0%, and 13.4%, respectively. Between 6% and 10%, the proportions of the three-time points are 11.0%, 14.9%, and 15.6%. Between 1% and 5%, the proportions of the three-time points are 23.8%, 29.4%, and 20.8%. For less than 1%, the proportions of the three-time points were 17.8%, 19.7%, and 24.2%. Despite the deteriorating financial situation, the museum's budget for digital and communication activities has increased by 6.2%.

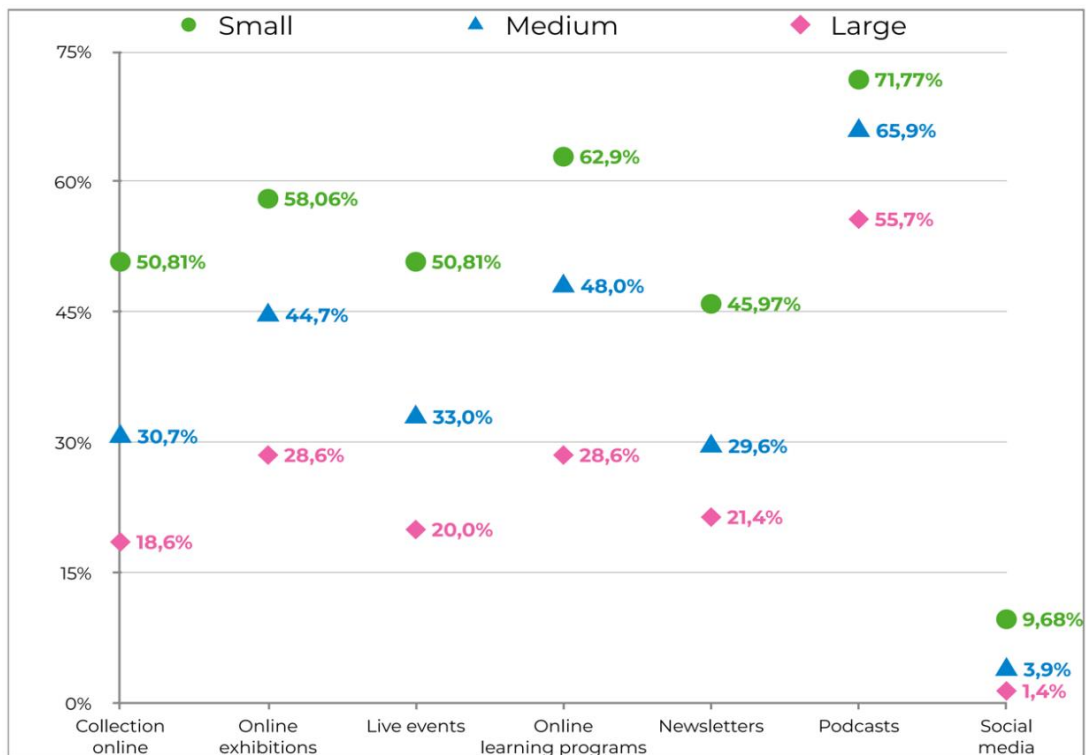


Diagram 25 Museum online events

Source: Museums, museum professionals and Covid-19: the third ICOM report is online, 2022.

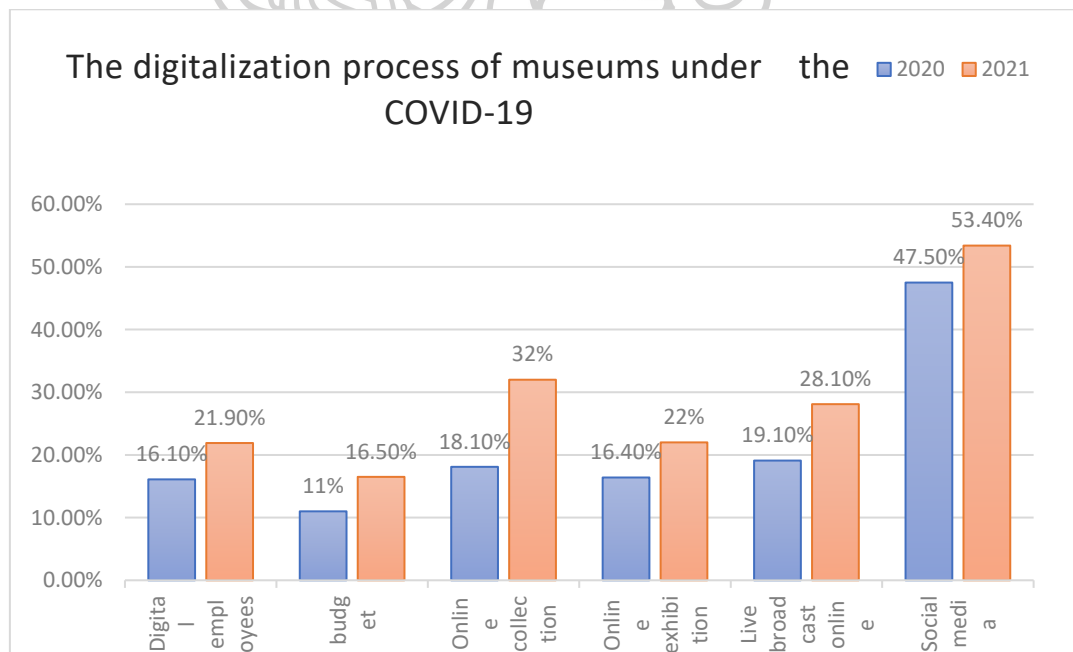


Diagram 26 The digitalization process of museums under COVID-19

Source: Museum digitalization Committee of China Museum Association, 2022.

In China, the operation of museums has also undergone significant changes under the influence of COVID-19. The proportion of digital staff in museums has increased from 16.1% in 2020 to 21.9% in 2021, which shows that the museum industry has gradually increased the management of Museum digitalization. From the budget perspective, the proportion of digital applications has increased from 11% in 2020 to 16.5% in 2021, indicating that the museum items used for digitization and dissemination are gradually increasing. In the two years since COVID-19 raged, the online activities of museums have increased significantly, mainly reflected in the use of online collections, exhibitions, live broadcasts, and social media. The proportion of museums adding online groups was 18.1% in 2020, 32% in 2021; Museums increased online presentations by was 16.4% in 2020, 22% in 2021; museums using online live broadcasts was 19.1% in 2020, 28.1% in 2021; Museums using social media was 47.5% in 2020, 53.4% in 2021 (Diagram 26).

4.1.5 Summary

Significant changes have occurred in museum collection methods, exhibition methods, and experience methods in the digital age, providing digital solutions for developing museum situation design. The addition of interactive media, immersive experience, social media, and many other technologies makes the museum situation design in the digital age more centred on the audience experience as the core, focusing on the audience's cognitive improvement in the process of visiting and information interaction. In recent years, researchers can conclude that Chinese museums have widely accepted the design concept of digital media in their development, and digital media technology has injected a strong impetus into designing museum situations. Museum exhibitions have evolved from the traditional offline exhibition model to various new modalities such as online exhibitions, real-time communication and interaction, and online collections. Researchers will improve the museum system with a reasonable layout through the structural optimization of online and offline modes. The public cultural services of museums will benefit the whole people.

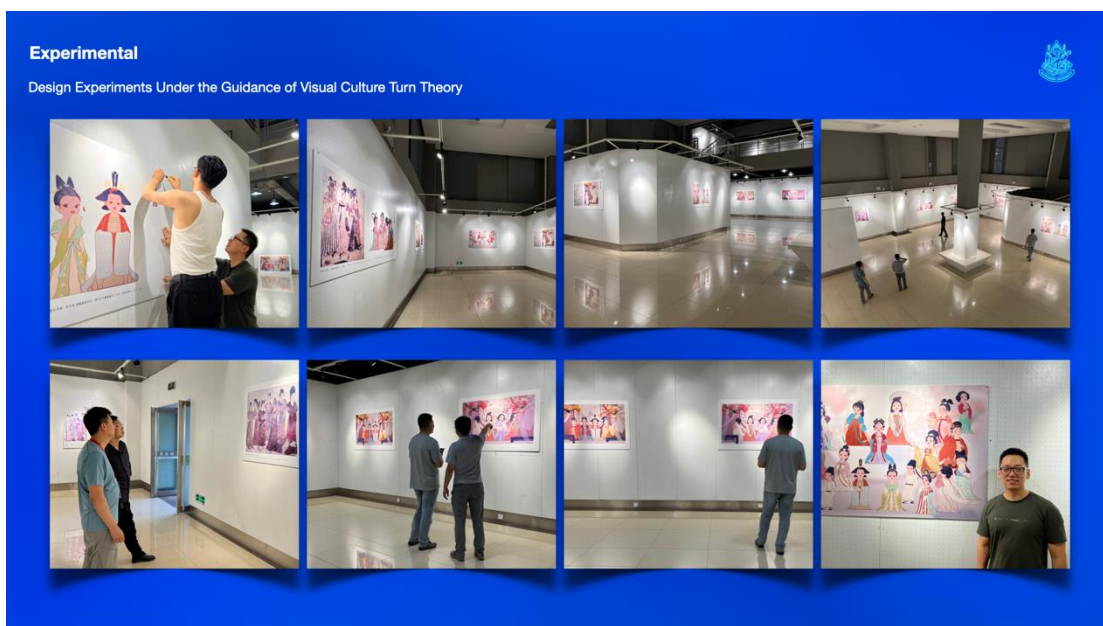


Figure 56 Interactive Design of dynamic digital murals experiments under the guidance of visual culture turns theory

Source: Photographed by the Author, 2022.



Figure 57 Along the River During the Qingming Festival 3.0, Digital Art Hong Kong Exhibition

Source: National Museum of China, 2021.

Digitalization also brings new problems to the development of museums. The introduction of digital technology requires the introduction of professionals into the museum staff system; The construction of the digital situation design of the museum needs to increase the museum's budget expenditure. The Exhibition of digital situation design has unique requirements for exhibition equipment and venues. These will pose considerable challenges to traditional old-fashioned museums or small and medium-sized museums. In addition, with the widespread use of digital media technology, problems such as the rigid implantation of technology, the homogenization of content, and the surface cation of experience have also become prominent. Therefore, researchers try to experiment to optimize the relationship between digital situational design and museum exhibitions and find a suitable way to develop research and apply it to museum digital situational design.

4.2 Experiments of digital media situational design

4.2.1 The concept of interactive Design of dynamic digital murals

The concept of digital dynamic mural interaction is the work of researchers to research digital media situational design (Lange et al., 2016). It is a vibrant mural exhibition using interactive technology. It includes using the visual elements of murals and the interactive characteristics of interactive technology to study the audience's perception behavior during the visit. Through the dynamic display of mural components, realizing the interaction between visual information and the audience, audiences gain new experiences and enhance the cognition of the visit (Figure 56). The Design is based on the murals' original materials, maintaining the murals' original artistic style and using digital interactive technology and animation technology to realize the dynamic display of the murals. During the visit, the audience can recognize the interaction with the relevant elements in the works through the interactive program and comprehensively obtain the relevant knowledge information of the details through the interaction (Figure 57). The Design of the work restores the original art style of the mural and expands the visual dimension of the digital mural display. The digital media situation design intensely stimulates the audience's vision, hearing, touch, and feel for an all-around immersive visiting experience and encourages the audience to

explore and seek knowledge about murals. It takes the audience's visiting experience as the core to deeply perceive the artistic value of the murals and enhance the audience's visiting cognition (Du et al., 2021).

4.2.2 Questionnaire survey and conclusion of digital dynamic mural interaction design experiment

The researchers carried out a questionnaire survey around the digital dynamic mural interaction project. The questionnaire includes the interviewee's information (age, education, occupation). (Scores from low to high are 1, 2, 3, 4, and 5) The details are as follows:

4.2.2.1 Whether the visitors like the work.

4.2.2.2 Whether the audience can understand the meaning and content of the work.

4.2.2.3 The overall feeling of the audience on the work.

4.2.2.4 Whether the addition of animation and sound helps to enhance the interest of the visit.

4.2.2.5 Whether the audience thinks that digital media technology is helping to improve their cognition.

4.2.2.6 Whether the audience thinks it is necessary to integrate digital media technology into the Exhibition.

Based on the data collected from 320 questionnaires, according to different social and educational backgrounds, the participants were roughly divided into four groups: 18-30 years old, 30-40 years old, 40-50 years old, and over 60 years old. Among them, people aged 18-30 account for 62% of the total number, people aged 30-40 account for 18%, people aged 40-50 account for 12%, people over 60 account for 2% of the total number, and the remaining 6% are minors. Statistics show that the proportion of people participating in the interaction tends to decline with age. The researchers believe that in addition to the dynamic mural project's design level, the participants' education also affects the audience's participation. The project's positive evaluation statistics show that the audience has widely praised the integration of digital technology into the traditional Exhibition. The satisfaction of the audience of different ages has exceeded 50%, which shows that integrating digital technology into the

conventional arrangement has enabled the audience to obtain a better visiting experience. In the statistics of cognitive improvement, more than 60% of the interviewed audience believed that the dynamic mural project was beneficial for them to recognize murals. Most audiences thought integrating digital media technology into exhibitions was necessary for future museum exhibitions (Diagram 27).

This study discovered that learning is the primary purpose of visiting museums across all age groups, particularly in the 19-25 age group, accounting for as high as 82.10%. Young individuals (under 18 and 19-25 years old) concentrate on expanding their horizons and enjoying leisure, while visitors aged 36-45 primarily focus on entertainment, representing 59.26%. Social purposes are generally lower in all age groups. Audiences over the age of 61 pay attention to broadening their horizons. These results suggest that although the primary motivation for visiting museums varies among age groups, learning remains the core driving force. Museums should offer a rich and diverse range of exhibition content for audiences of different age groups to meet their needs in learning, expanding horizons, leisure, and entertainment. This finding is crucial for museums when planning exhibitions and enhancing audience experiences (Diagram 28).

Through the analysis of questionnaire survey data, this study found significant differences in the channels through which audiences obtain information about museum exhibitions, mainly reflecting age differences, information channel preferences, and the influence of traditional and digital media. Young people tend to acquire information through social media platforms, while middle-aged and older people, in addition to social media, also obtain information through other channels such as friends' introductions, official websites, newspapers, and magazines. Social media is generally the most popular information channel in all age groups. Traditional media such as newspapers, magazines, television, and radio have relatively lower usage rates across age groups but still have a particular influence among older populations. Therefore, museums should fully consider these differences when promoting exhibition information and adopt targeted publicity strategies to attract more audiences of different age groups. This finding provides a valuable reference for museums to develop effective publicity strategies, helping to promote interaction and

communication between museums and audiences of different age groups and further enhancing the social impact of museums (Diagram 29).

Based on the questionnaire survey data, this study found significant differences in the distribution of museum visits among audiences of different age groups. In the age group of 18 and under, 46.67% of visitors made their first visit, while 40% had visited between 2 and 5 times. In the 19-25 age group, the most visitors (66.67%) visited 2-5 times, much higher than in other age groups. The distribution of visits in the 26-35 and 36-45 age groups is relatively balanced, with 2-5 visits accounting for 46.03% and 46.30%, respectively. In the 46-60 age group, the highest proportions were for those who visited once (45.45%) and 2-5 times (40.91%). In the age group of 61 and above, the highest proportion (50%) was for visitors who had visited once, with the remaining relatively even distribution. This finding indicates that audiences of different age groups have varying visitation frequencies to museums, providing an essential basis for museums to develop more targeted visitation strategies and improve audience satisfaction.

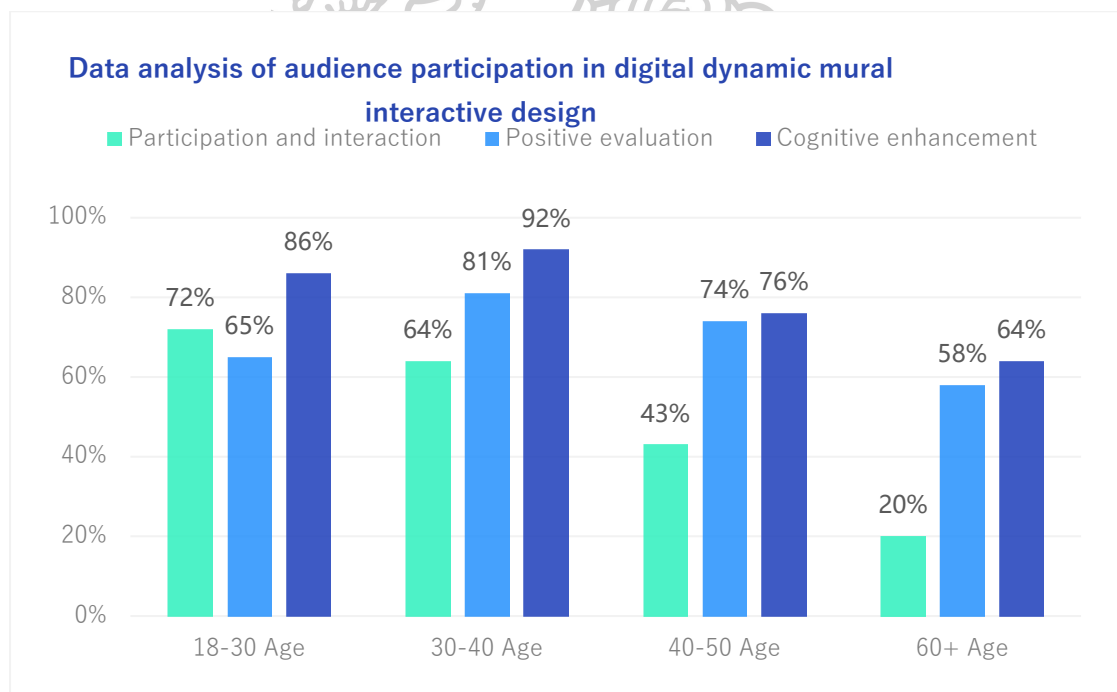


Diagram 27 Data analysis of audience participation in a dynamic digital mural interactive design exhibition

Source: Drawn by Author, 2022.

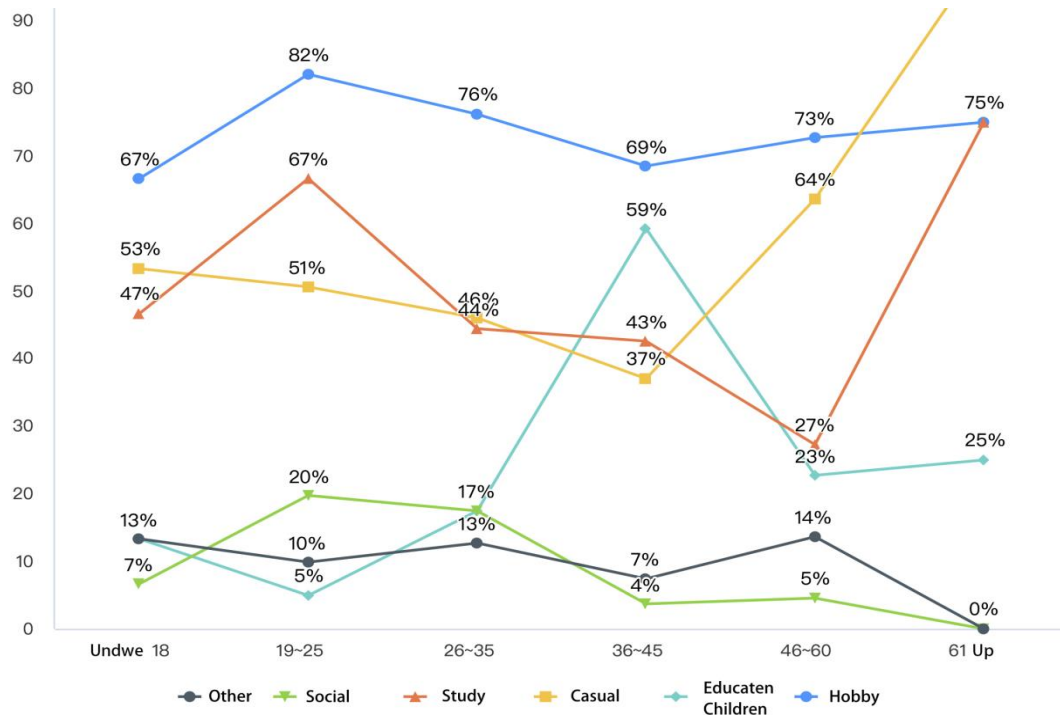


Diagram 28 Analysis of the Purpose of Visiting Museums by Different Age Groups

Source: Drawn by Author, 2022.

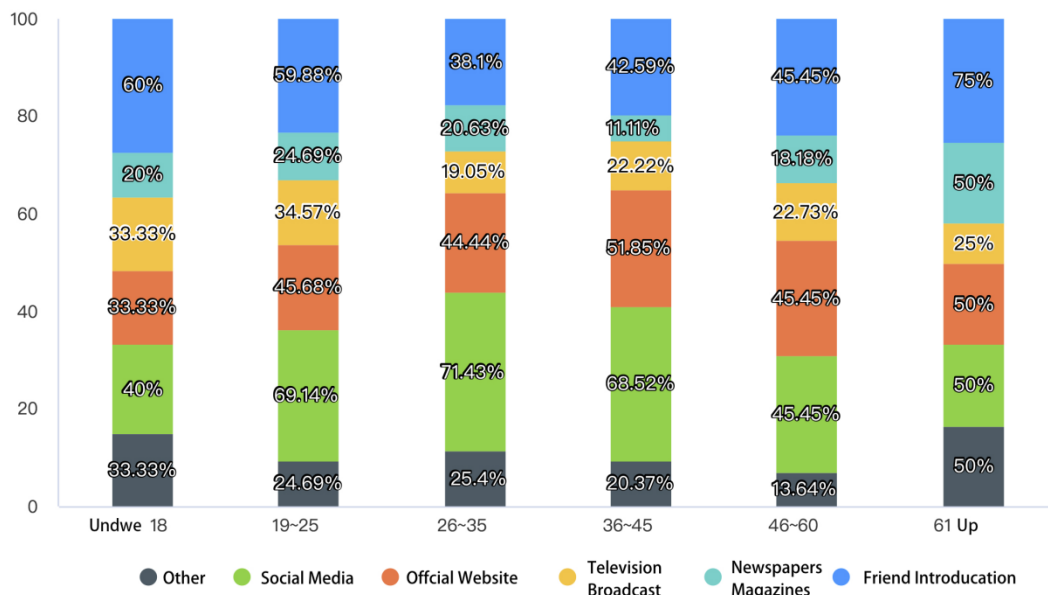


Diagram 29 Channels through which audiences acquire information about museums and related exhibitions

Source: Drawn by Author, 2022.

Through the analysis of the questionnaire survey data, it can be concluded that there are differences in the dwell time of audiences visiting museums. This difference mainly manifests in the choices of dwell time among audiences of different age groups. Specifically, in the age group of 18 and under, more audiences choose to determine their dwell time based on the situation. In the 19-25, 26-35, and 36-45 age groups, many audiences choose to stay for 2-3 hours. Particularly in the 36-45 age group, 70.37% of audiences opt to stay in the museum for 2-3 hours. In the 46-60 age group, the distribution of dwell time is relatively balanced, while in the age group of 61 and above, 50% of the audience chose to stay in the museum for 2-3 hours.

According to the provided questionnaire survey data, there are differences among audiences in understanding the information presented in museum exhibitions. This difference is mainly reflected in the varying levels of comprehension of exhibition information among audiences of different age groups. For example, in the 36-45 age group, 77.78% of the respondents can mostly understand the exhibition information, while in the 19-25 age group, this proportion is 69.14%.

The differences in understanding museum exhibition information among audiences are mainly due to the variations in knowledge reserves and comprehension levels among different age groups. To improve the understanding of exhibition information for audiences, museums can better optimize exhibition design, explanatory texts, and interactive experiences to meet the needs of audiences of different age groups and enhance their visiting experience (Diagram 31).

According to the provided survey questionnaire data, there are indeed differences in attitudes toward multimedia integration in museum exhibitions among audiences of different age groups. This difference is mainly reflected in the degree of recognition of the importance of multimedia integration. Among the audiences in the 36-45 age group, 77.78% consider multimedia integration in museum exhibitions essential, while in the 19-25 age group, this proportion is 54.94%. In the 46-60 age group, 54.55% of respondents believe multimedia integration is necessary. Museums should fully consider these differences when planning exhibitions and rationally use multimedia technology to meet the needs of audiences of different age groups and enhance their visiting experience (Diagram 32).

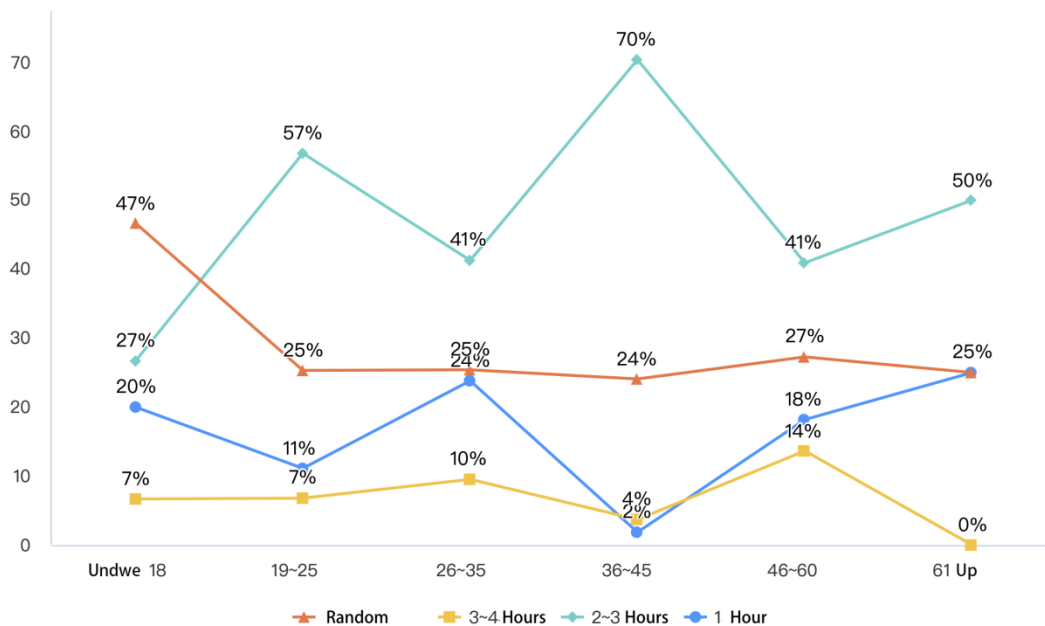


Diagram 30 Analysis of audience dwell time in museums
Source: Drawn by Author, 2022.

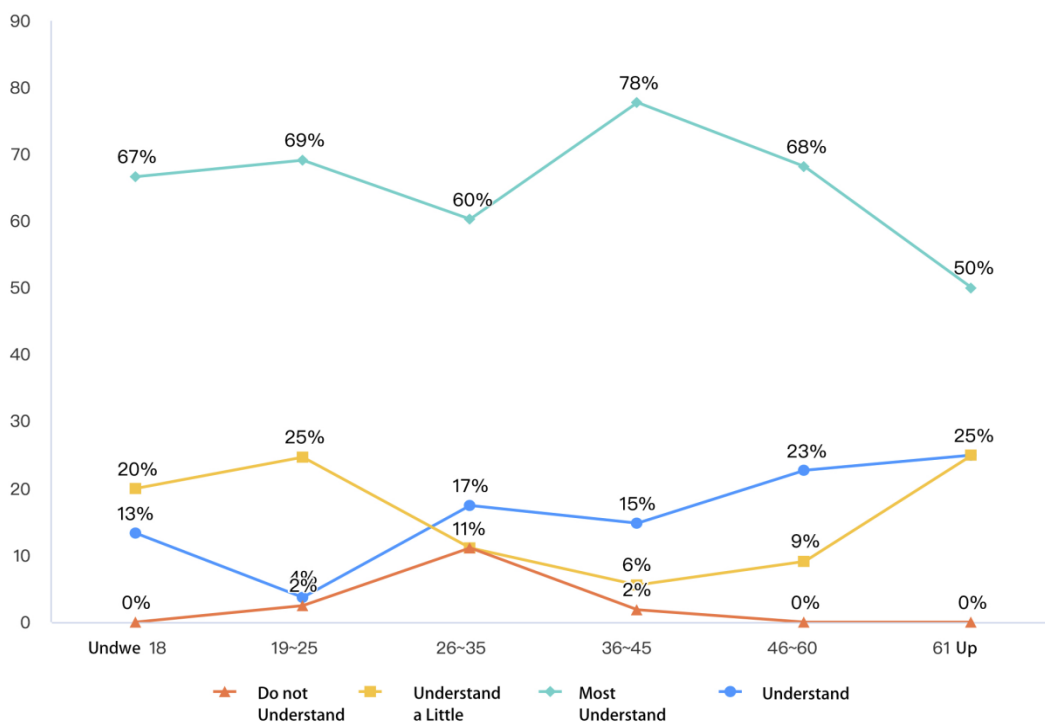


Diagram 31 The extent to which audiences can acquire relevant knowledge during their museum visits
Source: Drawn by Author, 2022.

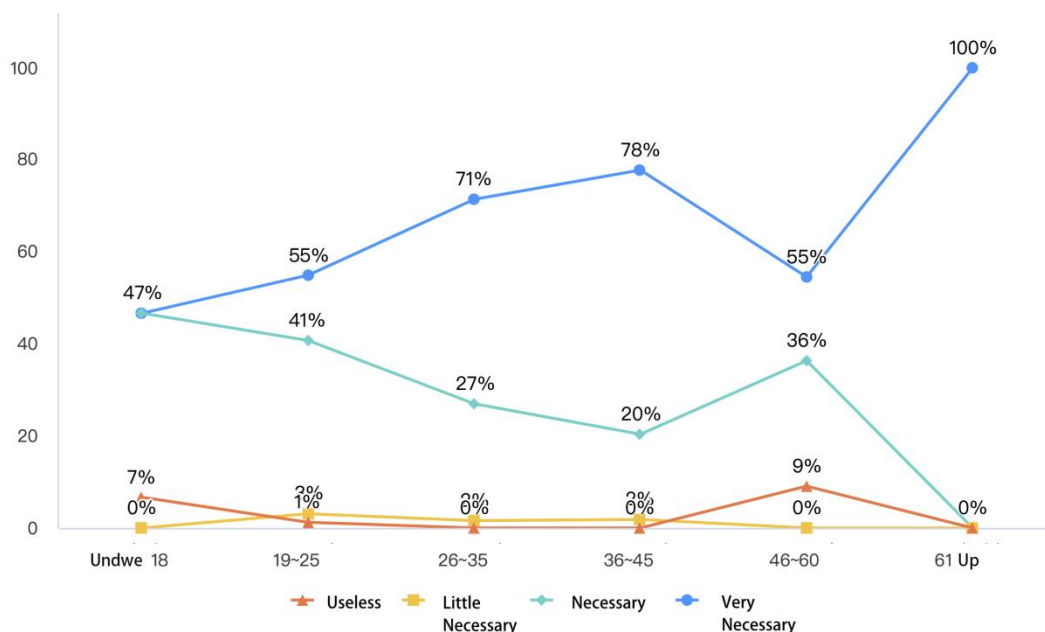


Diagram 32 Attitudes of audiences toward multimedia integration in museum exhibitions

Source: Drawn by Author, 2022.

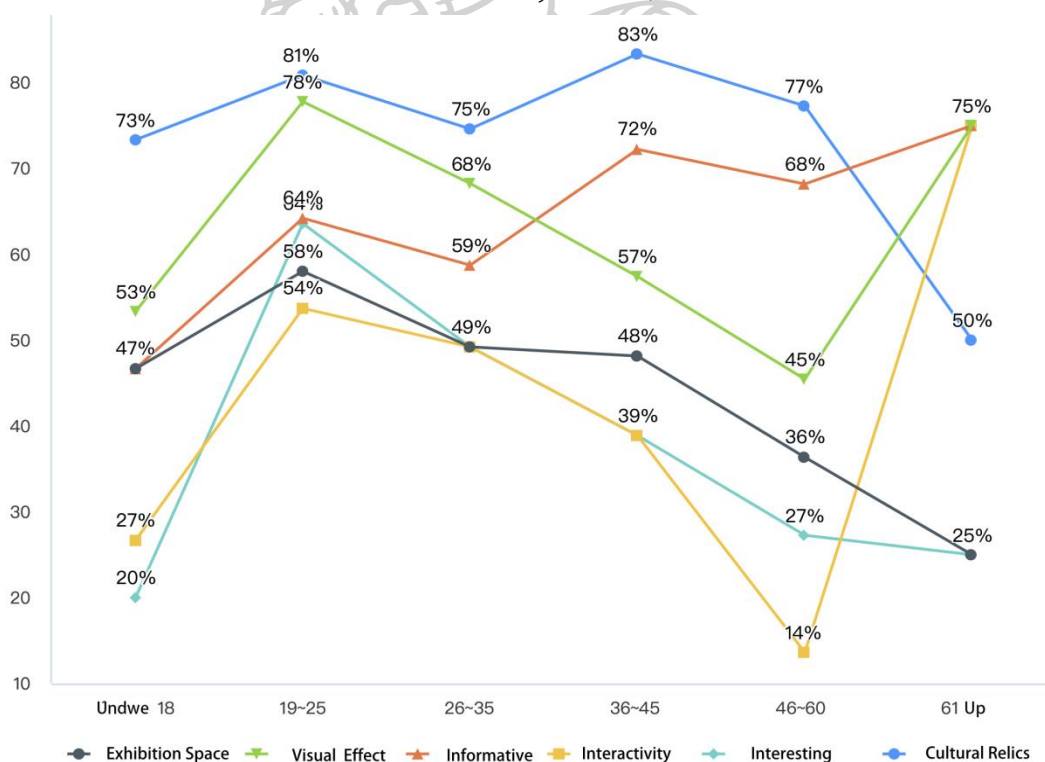


Diagram 33 In what ways does the museum leave an impression on the audience

Source: Drawn by Author, 2022.

According to the provided questionnaire data, there are specific differences in the impressions of various aspects of museum visits among audiences of different age groups. In terms of the exhibits themselves, more than 70% of audiences in all age groups, except for those over 61 years old (50%), indicated that they were impressed by the exhibits themselves. Among the 19-25 and 36-45 age groups, 80.86% and 83.33% reported being impressed.

Regarding interest, the 19-25 age group had the highest proportion (63.58%). Regarding interactive participation, the highest proportion was in the audience over 61 years old (75%). Regarding knowledge, the 36-45 age group had the highest proportion (72.22%). Regarding visual experience, the 19-25 age group had the highest proportion (77.78%). As for exhibition space, the highest proportion was in the 19-25 age group (58.02%).

In conclusion, based on the above data, audiences of different age groups have varying impressions of different aspects during their museum visits. Museums should consider the needs and preferences of audiences of different age groups and consider various aspects when planning exhibitions to enhance the visiting experience (Diagram 33).

By analyzing the questionnaire mentioned above data, it is evident that there are differences in the perceived shortcomings of museum visits among audiences of different age groups. Regarding monotony in presentation, the 26-35 and 19-25 age groups had higher proportions, at 57.14% and 57.41%, respectively. For lack of interest, the 26-35 and 36-45 age groups provided more feedback, with proportions of 52.38% and 46.30%, respectively.

Regarding excessive entertainment, the proportion of audiences under 18 was 13.33%; for those aged 46-60, it was 22.73%; the proportions for other age groups were below 20%. Regarding a lack of visual appeal, the 26-35 age group had the highest proportion (31.75%). For insufficient information, the 26-35 age group had the highest proportion (49.21%). Regarding insufficient professionalism, the 19-25 and 26-35 age groups had relatively higher proportions, at 21.60% and 26.98%, respectively, while the highest proportion was among those over 61 years old (50%).

Regarding immature digital interactive technology, the highest proportion was among audiences over 61 years old (75%). For lack of user-friendly digital interaction, the 19-25 age group had the highest proportion (32.10%). Regarding a lack of logical interaction, the 36-45 age group had the highest proportion (33.33%).

Audiences of different age groups have varying views on the shortcomings of museum visits. Museums should improve exhibition formats, increase interest and interaction, and enhance information explanations based on the needs and feedback of audiences from different age groups to improve the visiting experience (Diagram 34).

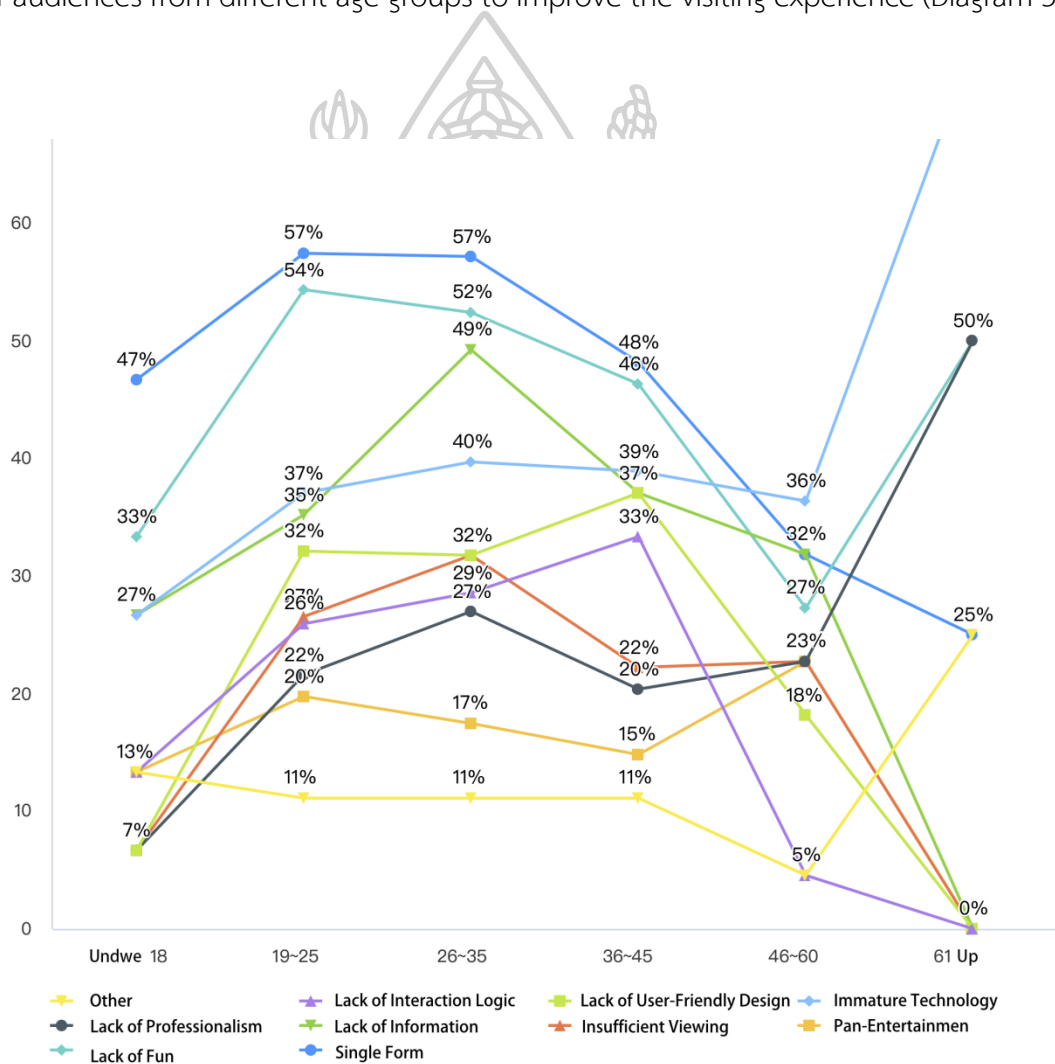


Diagram 34 Shortcomings in current museum exhibitions

Source: Drawn by Author, 2022.

Through the analysis of the questionnaire mentioned above data, it is evident that there are differences in the aspects that audiences of different age groups believe need improvement in the museum visiting experience. Regarding the number of exhibits, the 26-35 and 36-45 age groups provided relatively more feedback, with proportions of 41.27% and 38.89%, respectively. For visual effects, the 19-25 and 36-45 age groups had higher proportions of feedback, at 70.99% and 66.67%, respectively, while the proportion for those over 61 years old was 75%.

Regarding interactivity, the proportion for the 36-45 age group was 55.56%. For interest, the 19-25 age group had a proportion of 51.85%. Regarding participation, the proportion for those over 61 years old was 75%, and for those aged 19-25, it was 46.30%.

For content guidance, the 26-35 and 36-45 age groups had relatively higher proportions, at 50.79% and 48.15%, respectively. Regarding ease of sharing, the highest proportion was among the 19-25 age group, at 19.75%, and for those over 61 years old, it was 25%.

In conclusion, audiences of different age groups have varying views on the aspects that need improvement in the museum visiting experience. Museums should address the needs and feedback of audiences from different age groups and improve areas such as the number of exhibits, visual effects, interactivity, interest, participation, content guidance, and ease of sharing to enhance the visiting experience for all age groups. In practice, museums can adopt measures such as a more diverse range of exhibits, innovative visual designs, increased interactive experiences, the introduction of exciting elements, encouraging audience participation, improving guidance systems, and providing convenient sharing features (Diagram 35).

Most of the audience has heard of but never seen Tang Dynasty tomb murals, especially among the 19-25 and 36-45 age groups. Comparatively, the proportion of the audience who have visited tomb murals is relatively lower, particularly in the 46-60 age group. These data suggest that increasing the display and promotion of Tang Dynasty tomb murals holds significance in attracting more visitors. Most respondents expressed interest in Tang Dynasty tomb murals, particularly in the 36-45 age group. In all age groups, the proportion of the audience looking forward to gaining an in-depth

understanding of tomb murals is relatively low. These data reveal that Tang Dynasty tomb murals highly appeal to audiences of all age groups. However, there is still a need to enhance the depth of display and interpretation to meet the audience's demand for a deeper understanding of tomb murals. When learning about Tang Dynasty tomb murals, audiences generally pay attention to the historical context and visual effects of the murals, with a higher focus on the excavation, conservation, and related knowledge of the murals. To meet the audience's needs, these aspects should be fully considered when displaying and interpreting Tang Dynasty tomb murals to enhance the audience's visiting experience and understanding of the murals (Diagram 36) (Diagram 37) (Diagram 38).

The researchers held expert interviews for the experiment. Through the experts' visit feedback and report discussion, this experiment was approved by experts (Figure 58).

The experimental results show that audiences of different ages have recognized the dynamic mural exhibition with interactive attributes. The active mural project emphasizes the situation design of the collection, pays attention to the audience's interaction during the visit, and enhances the audience's understanding of the work through the interaction between the audience and the work. The Design of interactive programs should also be as simple and direct as possible to lower the technical threshold for audience participation. The visit's fun and interactivity increased the audience's activity during the visit. 86% of the participants considered the project a success and expected to experience more new experiences by digital situation design in future visits.



Figure 58 Obtain feedback of the experiment through expert interviews
 Source: Photographed by the Author, 2022.

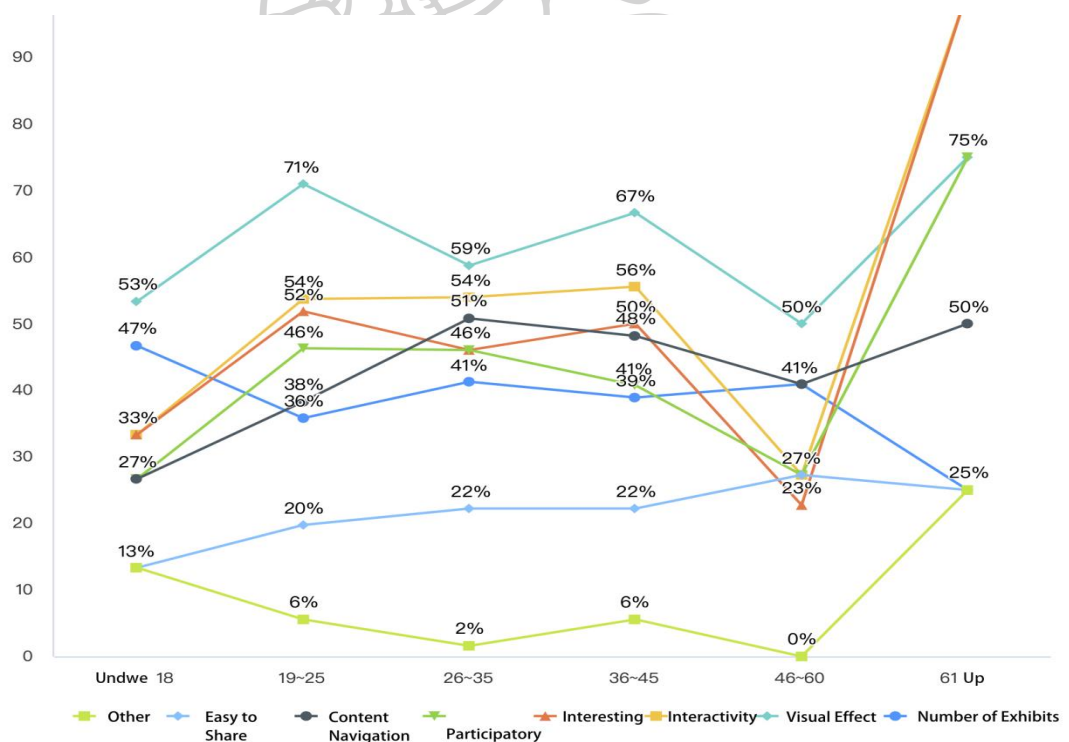


Diagram 35 Aspects in which audiences believe museum exhibitions need to improve the visiting experience
 Source: Drawn by Author, 2022.

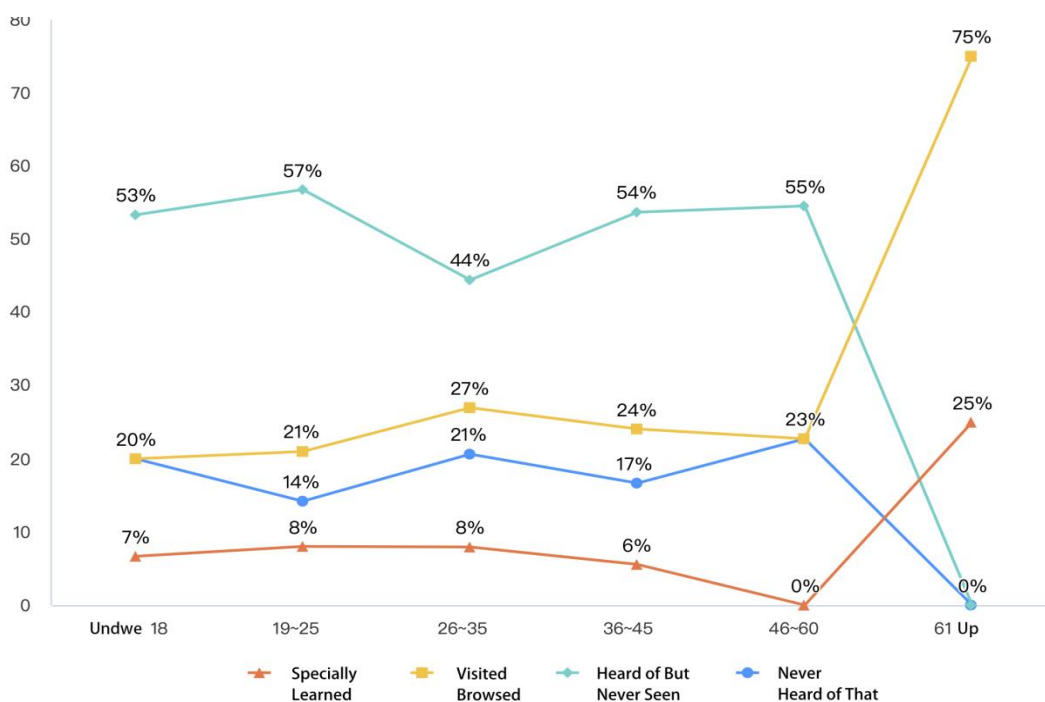


Diagram 36 Whether the audience has heard of Tang Dynasty tomb murals

Source: Drawn by Author, 2022.

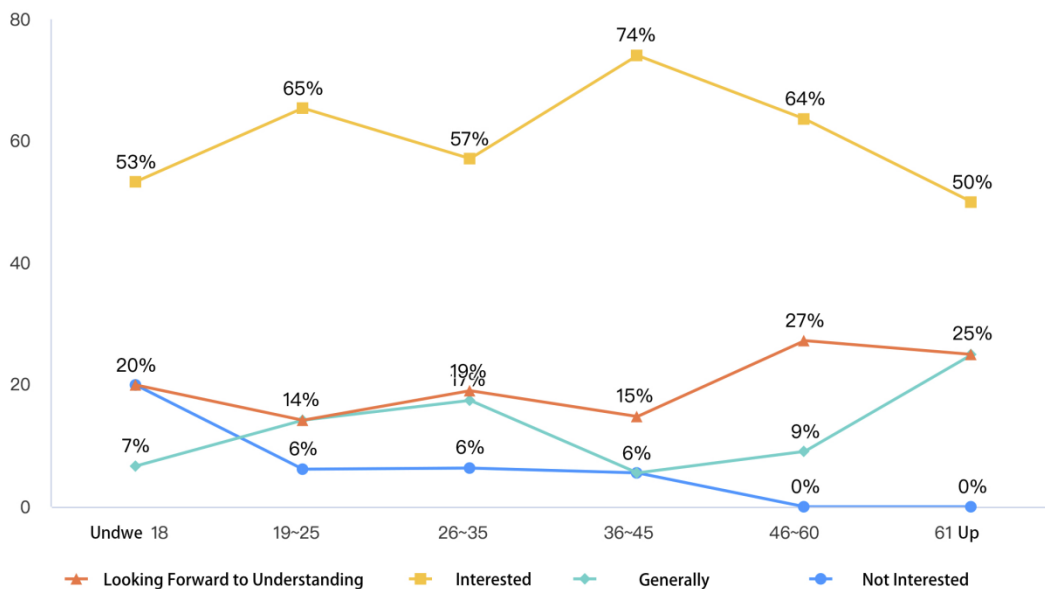


Diagram 37 Whether they wish to learn about Tang Dynasty tomb murals

Source: Drawn by Author, 2022.

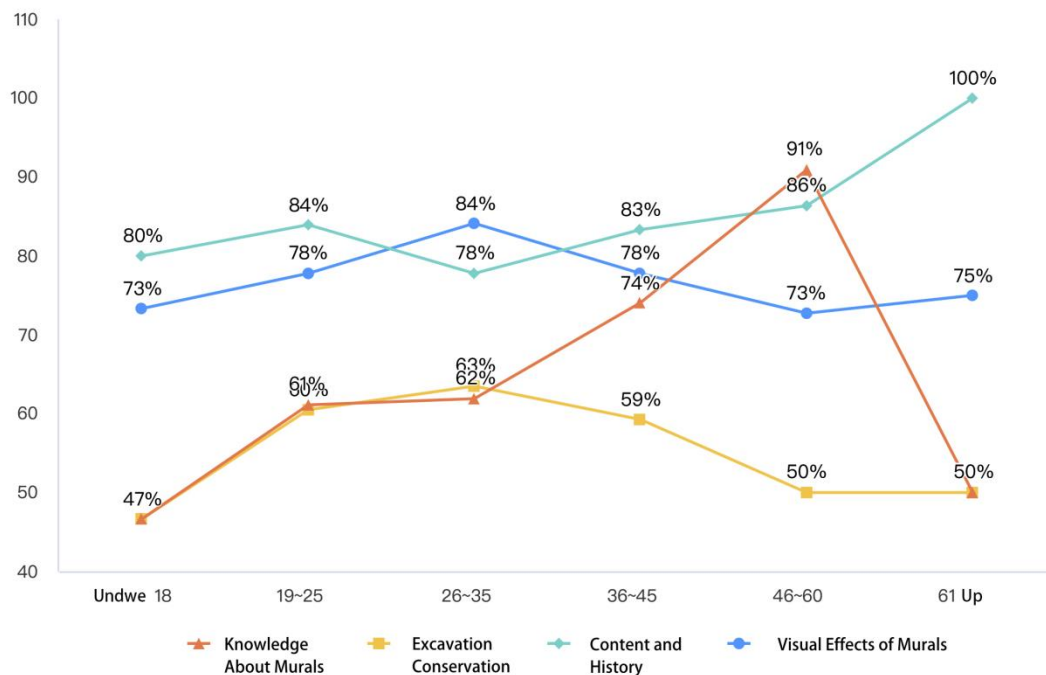


Diagram 38 What aspects of the murals they were interested in

Source: Drawn by Author, 2022.

4.2.3 Conceptual analysis of design experiments

The concept of digital dynamic mural design is to innovate the traditional static mural with the help of digital interactive technology to enhance the audience's experience of the Exhibition through enhanced visual perception, auditory perception, and digital interactive Design (JianJun et al., 2022). The purpose of the experiment is to improve the situational understanding of the mural exhibition through the intervention of digital media technology. Researchers need to start from the original state of the murals and strive to ensure the objectivity of the mural exhibition. Control of the rules of the movement of objects, written action scripts to realize the digital dynamic transformation of the mural content, using computer system controls the operation of the interactive program. The exhibition equipment includes monitors, computers, and speakers, and the installation in the exhibition hall realizes the exhibition effect.

4.2.4 Summary

The experiment studies the feasibility of digital media technology intervening in situational Design through the dynamic Exhibition of murals and analyzes the interactive relationship between the audience's cognitive behavior and the experiment through experimental data collection. Through the experiment, the researchers formed a summary of the following questions:

1. The purpose of digital media intervention in the Exhibition is to disseminate knowledge and culture better. Therefore, in digital murals, designers should maintain the consistency of artistic expression style between digital artworks and original murals.

2. In the process of digital art exhibition, we should start with creativity, equipment, and space and consider the audience's visiting experience in the comprehensive collection.

3. Most of the respondents were satisfied with the works of the dynamic mural exhibition. In their questionnaire survey, they suggested that researchers should integrate digital media art into the situation design of the museum to help the audience improve their understanding of the museum's cultural relics.

4. Based on the success of the dynamic mural exhibition, explore new experiences and approaches to situation design suitable for museums.



Figure 59 The murals of the Tang Dynasty

Source: Shaanxi History Museum, 2021.

4.3 Elements of museum situation design under the intervention of digital media

4.3.1 Background of the conceptual model

The unearthed Tang Dynasty tomb murals belong to the aristocratic culture. Creation time was around the 8th century AD; the image reflects the cultural landscape of the laws and regulations, social customs, religious beliefs, ideological concepts, and other aspects of the society at that time. It is the mainstream culture of Tang Dynasty society (Xingming, 2005). Currently, The Shaanxi History Museum of China has collected most of the exquisite murals in the tombs of the Tang Dynasty, which provides a good experience environment for audiences to visit, understand and learn about the paintings and culture of the Tang Dynasty (Figure 59). Due to the particularity of the mural's attributes and the natural weathering of thousands of years, the museum has strict requirements for collecting and exhibiting murals. The murals must be collected and exhibited in the exhibition halls in the basement.

The show has almost harsh conditions for lighting, temperature, humidity, air, and the number of audiences. To control the number of visitors, the museum adopted an expensive fare system in the mural museum. The aspect ensures control of the number of visitors. Still, it has also given many audiences who are interested in murals to give up the opportunity to visit the mural museum. During the visit to the mural museum, the audience must be in a low-light source environment. There is a thick glass between the murals and the audience. The kind of Exhibition has a good role in protecting the murals, but the audience cannot watch exhibits at close distances during the visit. The glass's reflection and the standard light source environment seriously affected the audience's visit to the mural museum (Figure 60). In addition, the contents of the murals of the Tang Dynasty tomb are the cultural landscape of the Tang Dynasty society a thousand years ago. In the historical changes of more than a thousand years, the social background, cultural situation, and cultural form have undergone tremendous changes (Figure 61).



Figure 60 The exhibition status of the murals in the tombs of the Tang Dynasty

Source: Shaanxi History Museum, 2021.



Figure 61 The excavation site of the Tang Dynasty tomb murals

Source: The Excavation of Han Xiu's Tomb of the Tang Dynasty in Xi'an City, 2021.



Figure 62 Restoration and Protection of Tang Dynasty Tomb Murals

Source: The Excavation of Han Xiu's Tomb of the Tang Dynasty in Xi'an City, 2021.



Figure 63 Immersive digital Exhibition of China Grand Canal Museum

Source: China Grand Canal Museum, 2021.

The audience must have corresponded cultural knowledge when visiting the museum to resonate with the value of cultural relics (Figure 62). Ordinary visitors need more reserve of relevant expertise. It is difficult for them to have cultural resonance with the murals during the visit, so they lose interest in the Exhibition. They ultimately need a more pleasant visitor experience. We should also realize that the digital media technology's situational Design involved in the Tang Dynasty tombs' murals must consider the museum environment's transformation. Researchers need to extend the value of cultural relics through systematic and specialized research on digital media and related interdisciplinary collaborations. The museum's necessary budget expenditure and the audience's acceptance will also become the research's problems.

Many museums are developing and using new digital technologies to enhance the museum exhibition situation. In the China Grand Canal Museum, which opened in June 2021, in the "Love of the River" digital thematic exhibition hall with the theme of

displaying canal culture, the 360-degree ultra-high-resolution images created by NEC laser engineering projectors make many tourists linger. The video images of the four chapters "Water," "Fortune," "Poetry," and "Painting" in the exhibition hall convey the charm and characteristics of the canal culture to the audience. The 450-square-meter exhibition hall surrounds the audience with a circular layout without partitions, and the sizeable immersive CAVE space brings a strong visual sense of immersion and impact. The heavy sense of history subtly integrated the technological sense of cutting-edge projection technology. It made the canal scenes displayed by the Grand Canal Museum no longer limited to abstract and obscure words and pictures (Figure 63). The canal, with a thousand-year history, relies on the means of modern science and technology to lay out the image in front of the audience, allowing the audience to observe history to experience history, from contact with history to in-depth history, time, and space, humanities, nature, and other dimensions. There are many cases in China where digital media intervene in the situation design of museums, such as the National Palace Museum of China and Shanghai Wujie Art Museum. The digital media intervention in the museum situation design provides a development model for the exhibition of the Shaanxi History Museum. The researchers believe that using digital technology can effectively enhance the audience's understanding of the murals and enhance the experience during the visit. We should also realize that the situational design of digital media technology involved in Tang Dynasty tomb murals must consider the transformation of the museum environment.

4.3.2 The concept of digital media intervention in museum situation design

Researchers analyzed the museums of existing digital media art to improve the exhibition situation and clarified the effectiveness of digital media technology in enhancing the audience's cognition of the Exhibition. Due to the influence of objective factors such as scale, capital, and audience, some museums in China that use digital media art have problems such as rigid technology implantation, homogenization of exhibitions, and simple Design (Li et al., 2012). These inappropriate technical applications will not only fail to enhance the audience's cognition during museum visits but will also affect the audience's visiting experience. According to the researcher's ideas and guidelines, determine the design situation with the audience

experience as the core, extend the connotation of the exhibits through digital technology, and effectively improve the museum situation design with the help of digital technology, to enhance the cognition of the audience during the visit. According to the researcher's conceptual analysis, the research will intervene in the situation design of the murals of the Tang Dynasty tombs from five aspects. To ensure the grasp of the essence of the murals in the digital media works and to ensure that the digital media works have the visiting value and educational value of cultural relics. The situation design of the Tang Dynasty tomb murals, under the intervention of the media, can enhance the audience's understanding of the tomb murals. The research can provide experience and reference for the Exhibition of related cultural relics.

1. To build a digital database of Tang Dynasty tombs and tomb murals. The murals of the Tang Dynasty tombs are based on the Tang Dynasty tombs and present the social tomb cultural phenomenon of the Tang Dynasty. Combining murals and tomb structures is a significant issue in studying ancient tomb murals. A comprehensive discussion will help us understand the characteristics and shapes of the Tang Dynasty tomb murals and then accurately grasp the cultural connotation (Xiaoyang, 2018c). Tang Dynasty tomb structures and tomb murals have strict normative and transparent parts of the times (Bai, 1982). Through literature and field investigation, the research makes an archaeological division and stage study on the mural tomb and tomb mural configuration in the Tang Dynasty, constructing a Spatiotemporal primary sequence that can show the general evolution law and facilitate further research. Field investigation of mural tombs and tomb murals in the Tang Dynasty, including Tang Dynasty Mural Tombs with investigation conditions, Tang Dynasty mural treasures Museum of Shaanxi History Museum, relevant museums, and art galleries, use digital technology to realize the digital collection of Tang Dynasty Mural Tombs and tomb murals. By arranging the information on the time sequence, tomb shape, mural content, mural configuration, and other characteristics of mural tombs and tomb murals, build a systematic digital database of Tang Dynasty tomb murals.

2. Refine the theoretical system of visual cultural transformation from the social etiquette system of the Tang Dynasty to the performance of murals. As the carrier of cultural connotation, the tomb murals of the Tang Dynasty present the differences in

various forms of visual information. Straightening out the murals' imaging system in the Tang Dynasty's tombs and further analyzing the combination relationship between the image systems and the mural images' content will help extract the cultural connotation behind the murals. Based on the mural tombs' shape of the Tang Dynasty, according to location, content, and scenes of murals, the murals of the tombs in the Tang Dynasty are divided into a realistic image system that expresses the places inside and outside the aristocratic mansions. The mystical image system of the universe represents the universe's themes and immortality (Xingming, 2005). The realistic image system expresses real life as material and social rank and etiquette under Confucian ethics; the universe mysterious image system uses the spiritual life as the material and tells the cosmology and world outlook of the Tang Dynasty people under the traditional religious belief. The integration of the two systems and a set of Tang Dynasty tomb murals reflects the spiritual realm and philosophical concept of the "Philosophy of the unity of man and nature" in Tang Dynasty society (Qingliang, 1998). Through the analysis of the themes of the murals in the tombs of the Tang Dynasty, the researcher deduced the etiquette system and cultural connotation of the Tang Dynasty society inversely. The paper analyzes how the Tang Dynasty tomb murals were transformed from the artistic concept of the Tang Dynasty to the image language through painting technology. Straightened out the first cultural visual turn theory of transforming the Tang Dynasty social etiquette system into tomb murals.

3. Improve the guiding theory for the situational Design of the Tang Dynasty tomb murals under the intervention of digital media. The digital art creation of the Tang Dynasty tomb murals should be based on situational Design as much as possible in line with the cultural relics' historical background and cultural origin and should be testable and scientific. Guided by the cultural vision turning the theoretical system of the transformation of the social etiquette system in the Tang Dynasty to the mural expression, it will help to standardize the direction and scientificity of the digital art creation of the tomb murals in the Tang Dynasty and give better play to the digital media's recognition of the audience in the situation design—the role of knowledge enhancement (Burton & Scott, 2007). Situation design should align with the audience experience as the core (Coffee, 2007), the purpose of improving audience cognition,

and the goal of creating an emotional experience based on happiness through multiple narratives. Researchers Combined with the characteristics of digital media art, with the audience experience as the core, with the help of multi-dimensional situational design methods, the digital visual turn of the Tang Dynasty tomb murals is realized. Based on the first cultural visual turn of the transformation of the tomb murals in the Tang Dynasty, using the technical characteristics of digital media, the research realizes the second cultural visual turn of the tomb murals to improve the guiding theoretical application of digital media art design. In the design practice and audience information feedback, further supplement and improve the theoretical model.

4. Practical exploration of the situational Design of tomb murals in the Tang Dynasty under the intervention of digital media (Olesen, 2015). Consider the advantages of digital media in augmented reality (AR) technology, virtual reality (VR) technology, information interaction, and immersive experience technology. The personalized experience combines the visiting needs of the audience. It takes the audience experience as the core to create a design that fits the museum exhibition situation in the digital age (Ayala et al., 2020). In terms of method, we can combine virtual and real scene design, multiple narrative modes, and interactive participation in the experience process to improve the audience's cognition when visiting the museum. With the help of information technology's social attributes and user feedback through data collection and processing, researchers realized that the dynamic digital media exhibition practice combines online and offline exhibitions, synchronizing physical and virtual exhibits, and information interaction.

5. Demonstrative promotion of the digital protection and Exhibition of cultural relics in Chinese museums through the situation design of the murals in the tombs of the Tang Dynasty under the intervention of digital media. The study provides a broad experience of digital media intervention for Chinese museum exhibitions (Jie & Chaetnalao, 2022). It helps to find a design concept based on the origin of shows in the current complex digital technology design of museums. The digital visual Design of the murals in the tombs of the Tang Dynasty provides a new idea for the museum situation design. Break through the traditional concept of Museum situation design with cultural relics as the center, and build a new concept of Museum situation design with

the audience as the center and audience experience as the core. Digital media technology should not become an auxiliary and extension of traditional museum situation design. Still, it should pay attention to the characteristics of the era of digital media technology and break through the conventional museum concept situation design (Alivizatou, 2006). The research is popularized, has reference value for helping the transformation of Chinese Museum situational design, and provides a vivid case for the digital protection and Exhibition of Museum Cultural Relics.

Digital media intervenes in the situational Design of the Tang Dynasty tomb murals, On the one hand, it can meet the particular requirements of murals as cultural relics in traditional exhibitions, for example, the preservation and protection of murals, the needs of murals for the exhibition environment, the current situation of murals and the visiting experience of the audience, with the help of the dynamic, interactive, immersive and other technical characteristics of digital media technology, make up for the lack of situation design in traditional museum exhibitions; On the other hand, digital media art creation for tomb murals can satisfactorily complete the dissemination and exchange of cultural relics information, break through the static and passive characteristics of traditional mural exhibitions, with the help of sound, light and shadow, interaction and interaction, create an active atmosphere, create an exciting environment, promote the mutual attraction between the audience and cultural relics, and achieve the effect of improving the audience's visit cognition (Wang et al., 2009).

4.3.3 Research framework of situation design (Diagram 39)

The use of digital media to intervene in the mural museum situation design begins with the study of the related theories of murals, digital interactive technologies, and different perspectives of the audience. The relevant theoretical research on murals needs to systematically sort out their time sequence, painting content, artistic connotation, and artistic style to strive to summarize the cultural visual transformation theoretical system from social etiquette system to mural picture performance (Xian, 2004). Sort out the messy archaeological data and relevant research literature, and build a digital database of tomb murals. Integrate the existing digital media technology, combine it with the theory of cultural visual turn, and carry out the digital graphic Design of the tomb murals with the help of the digital database of the tomb murals.

Ensure that digital media extends the connotation of cultural relics with educational and visiting value. The installation environment of the digital situation design needs to consider the characteristics of cultural relics exhibitions, special requirements for cultural relics preservation, and the participation experience of the audience. The atmosphere of visual and sound environment simulation and the interactive characteristics of digital technology enhance the latitude of content presentation, the interest, and participation of visitors and create an excellent visitor experience.

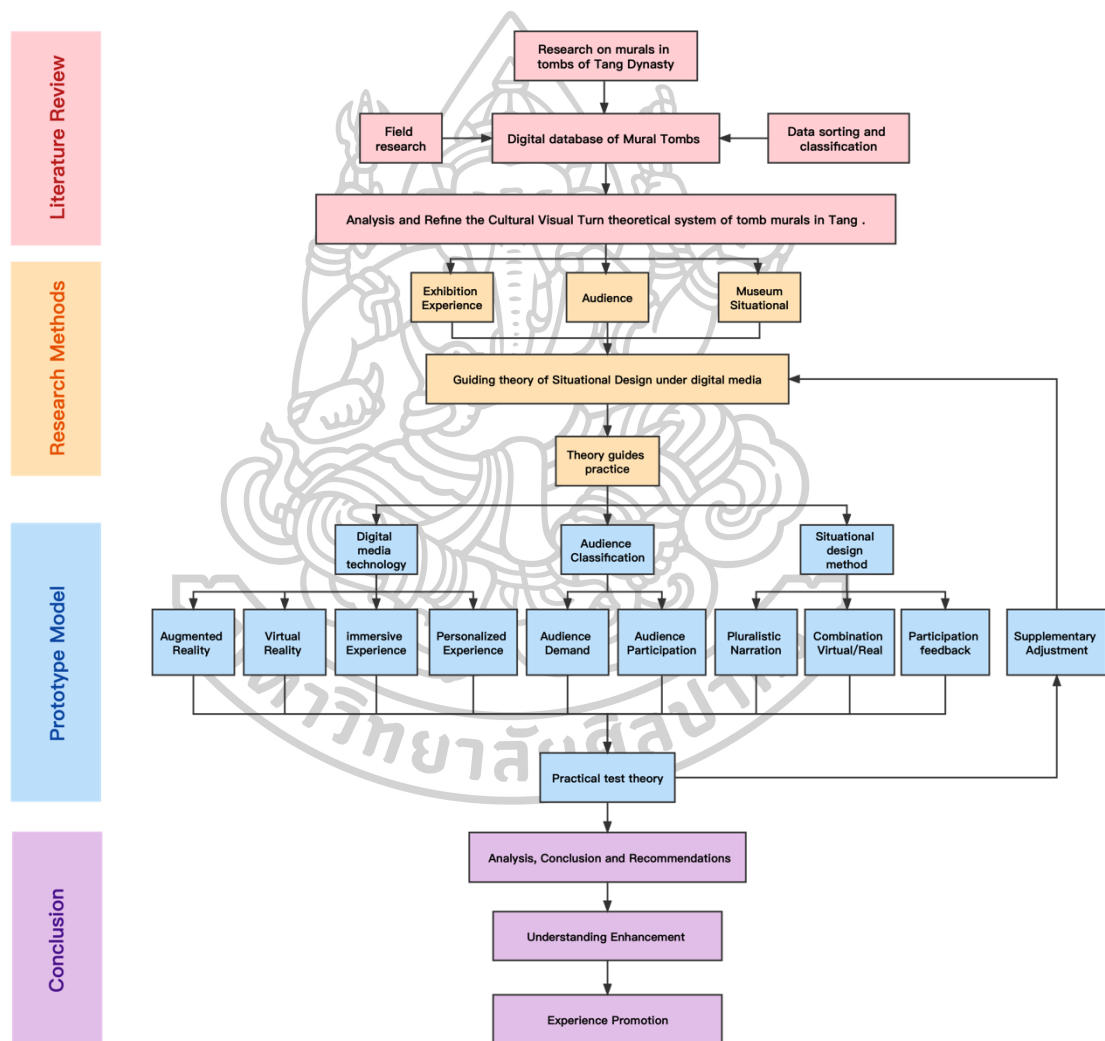


Diagram 39 A research framework for digital media intervention in the situational Design of mural museums

Source: Drawn by Author, 2022.

Selecting a suitable situational design for the mural exhibition requires using digital technology to simulate the environment of the tomb to achieve the purpose of an immersive experience. The choice of digital media technology needs to consider the cognitive level of the audience, and the digital situation design needs to meet the cognitive differences of people with different learning levels, ages, ethnicities, and cultural backgrounds as much as possible. They serve audiences through natural, universal, and popular digital exhibitions. The education level, knowledge reserve, and cognitive style of different audiences will affect the audience's final visiting experience. Whether the audience can accept the intervention of digital media will also become a massive challenge for the Exhibition's success (J. Falk, 2016). Collecting visit data and information feedback, further adjust and revise reasonable digital media exhibition methods and provide a wide range of digital media intervention experiences for Chinese museum exhibitions.

4.3.3.1 Framework of the digital database

The digital database provides academic materials and references for artistic Design in digital media. The content of the digital database includes the collection of archaeological discoveries and distribution data (the excavated murals of the Tang Dynasty tombs), the collection of data on the murals collected by the Shaanxi History Museum's Tang Dynasty Mural Treasures Museum, the collection of the structure data of the Tang Dynasty tombs, the configuration and distribution of the murals. Data collection of layouts, figures, architecture, the environment in murals, social phenomena, and meanings in the murals. The information will serve the digital Design of murals and ensure that the mural situation design with the involvement of digital media has educational and reference value.

4.3.3.2 The framework of cultural visual turn theory

The cultural visual turn theory is to restore culture's social meaning through murals' images (Xian, 2004). The thesis needs to straighten out the imaging system of the Tang Dynasty tomb murals. By analyzing the combined relationship between the image systems, the cultural phenomenon and cultural connotation under the social background of the Tang Dynasty presented by the murals are extracted and summarized. The cultural visual turn should rely on the theoretical summary of

relevant documents and materials to ensure the accuracy of the interpretation of the murals' content in modern culture. Mural information dissemination's professional and academic nature provides educational support for audience cognition improvement. The theoretical framework of cultural visual turn is the core content of the research, which plays a connecting role in the study. Ensure the rationality of the artistic visual turn theory, accurately interpret the cultural connotation of murals, ensure the professionalism and academic nature of the digital Design of murals, and ensure the cognitive improvement of the audience during the visit.

4.3.3.3 The framework of digital situational design theory

The theory of digital situational Design is a design concept based on the audience experience. Digital technology is an extension of the connotation of cultural relics exhibits and a powerful tool for communicating situational Design between audiences and exhibitions. The original intention of applying digital technology is to enhance the audience's cognition more intuitively and conveniently. Therefore, researchers generally use interactive media technology to build an immersive situational environment supported by digital technology by simulating the scene. From technology development to technology application, the theoretical model and design prototype are continuously improved in the audience participation and feedback to enrich the theoretical basis of digital situation design.

4.3.3.4 Framework of prototype exhibition

The collection and display of cultural relics is the core mission of most established museums. There is an antagonistic relationship between cultural relics and the audience. Considering the limitations of many conditions, such as the preservation of murals and the objective conditions of the Exhibition, the mural museum has unique requirements for designing the exhibition environment and situation. The researchers must comprehensively consider the exhibition space, environment, props, lighting, colors, materials, and other factors to ensure the protection of murals and the limitations of exhibition conditions. Ensure the digital scenario design with audience experience as the core is going well (Meng et al., 2022). By shaping the overall environment and atmosphere to create a particular exhibition space, the design can carry out in the original space of the mural exhibition and possibility in other spaces.

In addition, with the help of digital remote access technology and virtual reality technology, digital museum situation design can also realize remote and non-time-limited exhibitions with the help of smart devices. It breaks through the limitations of time and space for disseminating mural art.

4.3.3.5 Framework of the budget

In China, essential collections and exhibitions of cultural relics embody the country's soft power and the manifestation of national self-confidence. Therefore, in Chinese law, cultural relics collection is a state act, and ordinary people are not allowed to buy or sell critical cultural relics. The budget of China's national museums comes from the financial expenditure of the government. The funding required for the construction, management, and renewal of museums need to be uniformly allocated by government departments after the application of museums. Museums must provide more constructive opinions from the professional field to persuade the government to invest. The government will judge by weighing the effect between museum construction and cultural promotion. The researchers believe that the digital situation design must be able to achieve the purpose of enhancing the audience's cognition to obtain a reasonable budget for the museum, and the digital situation design must consider the maturity of the technology, the foresight of the technology, and the cost of post-maintenance of the technology.

4.3.3.6 Framework of audience participation experience

The critical change of museums in the digital age is to change from "object" as the center to "human." The audience becomes the core of the museum's situation design, and the audience's visiting experience and gains become an essential criterion for testing the museum's situation design (Waltl, 2006). According to the audience's cognitive ability and education level, classify the audiences at different levels, and analyze the attention levels of the audiences at various levels of the situational Design. Researchers need to clarify the main groups served by situational Design, explain the connotation of the Exhibition through multiple narratives, and try to meet the particular requirements of audiences at different levels for situational Design.

4.3.3.7 Framework for the coexistence of cultural relics and interactive media technology

Cultural relics are objective entities, and interactive media technology is the way and means of information dissemination (Sullivan, 2015). The coexistence of cultural relics and interactive media technology enhances the audience's viewing experience through more conventional means, so there is no contradiction between the two. Restricted by the requirements of preservation and Exhibition, the Exhibition of murals is challenging to display, which is different from the Exhibition of ordinary cultural relics. The core work of the existing mural museums is the protection of cultural relics; the show needs more attention to the audience's visiting experience, so it is difficult for the audience to comprehend the murals' content accurately. Researchers believe that digital technology can not only effectively solve the problem of mural preservation. With the help of the theory of cultural visual turn, the dynamic digital Exhibition of murals helps improve the connotation display of murals that the traditional murals failed to show due to the limitations of painting. The emotional and interactive digital media exhibition will help enhance the audience's interest in visiting and increase the audience's attention to the murals. The audience can get an immersive visiting experience in the tomb chamber situation simulated by digital technology to improve the cognition of visiting. Significantly, digital situational Design extends the content of murals limited by painting technology and more abundantly presents designers' original intentions at the beginning of mural creation.

4.3.3.8 Framework for digital media situation design to increase exhibition vitality and new experiences for the audience

Digital media situation design takes audience experience as the core; with the help of multiple narratives, virtual and real integration, interactive participation, and immersive experience, it creates new experiences for the audience during the visit (MacLeod et al., 2015). The researchers take the as the working framework, with the help of the characteristics of digital technology and information technology, to create vitality and realize the museum's emotional experience of the audience based on happiness.

4.3.3.9 Framework for connotation extension of exhibits in the digital age

The extension of the connotation of the exhibits in the digital age mainly extends the definition from the mural's content and the audience's cognition. Through

the theoretical system of digital technology and cultural visual turn, researchers ensure digital media mural design's academic and professional nature. Break through the static performance of traditional murals with the help of the theory of cultural visual turn, use digital technology to endow murals with a dynamic exhibition that conforms to the conventional culture connotation, and increase the dimension of the mural content exhibition. From the perspective of audience cognition, professional and academic digital dynamic art creation can further reduce the cognitive difficulty of visitors. Through the dynamic and interactive immersive situational Design, the exhibits in the digital age ensure the design purpose of taking the audience experience as the core. It is easier for the audience to grasp the core content of the mural exhibition, ensure the accuracy of mural information transmission, and improve the cognitive needs of the audience.

4.3.3.10 Framework of museum space experience in the digital age

The museum space experience in the digital age has the characteristics of reality and virtuality. A realistic digital museum should change the traditional situation design concept centered on the collection and Exhibition of cultural relics, pay attention to the visiting experience of the audience, and carry out the situation design of the museum in the digital age with the audience experience as the core (Meng et al., 2022). The virtual digital museum strives to break through traditional museums' time and space limitations and meets the audience's cognitive needs anytime, anywhere through virtual visits, online visits, and network interaction. The virtual digital museum realizes multiple information exchanges through interactive behaviors such as social media and deepens the audience's understanding of cognition (Schweibenz, 2019). Realistic and virtual digital museums can also achieve linkage by combining online and offline and improve audience cognition through offline visits and online interaction (Diagram 40).

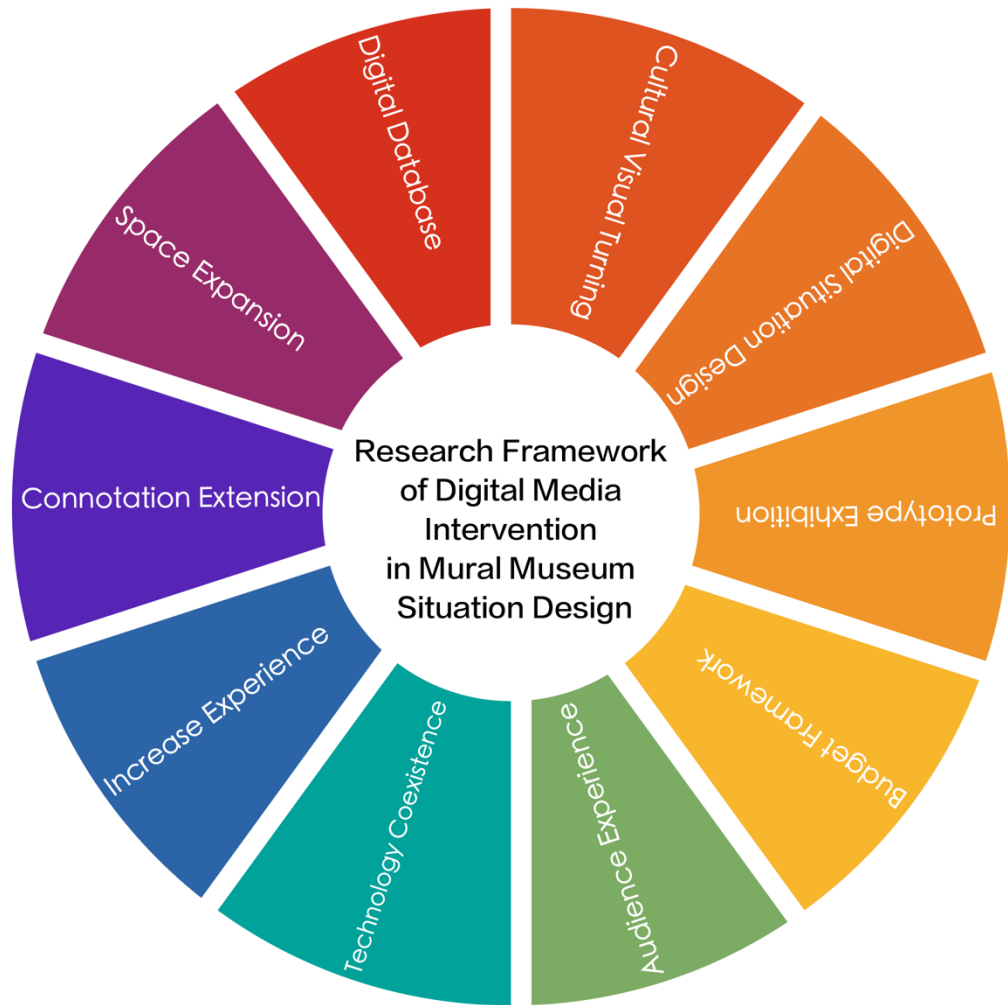


Diagram 40 Research framework of digital media intervention in mural museum situation design

Source: Drawn by Author, 2022.

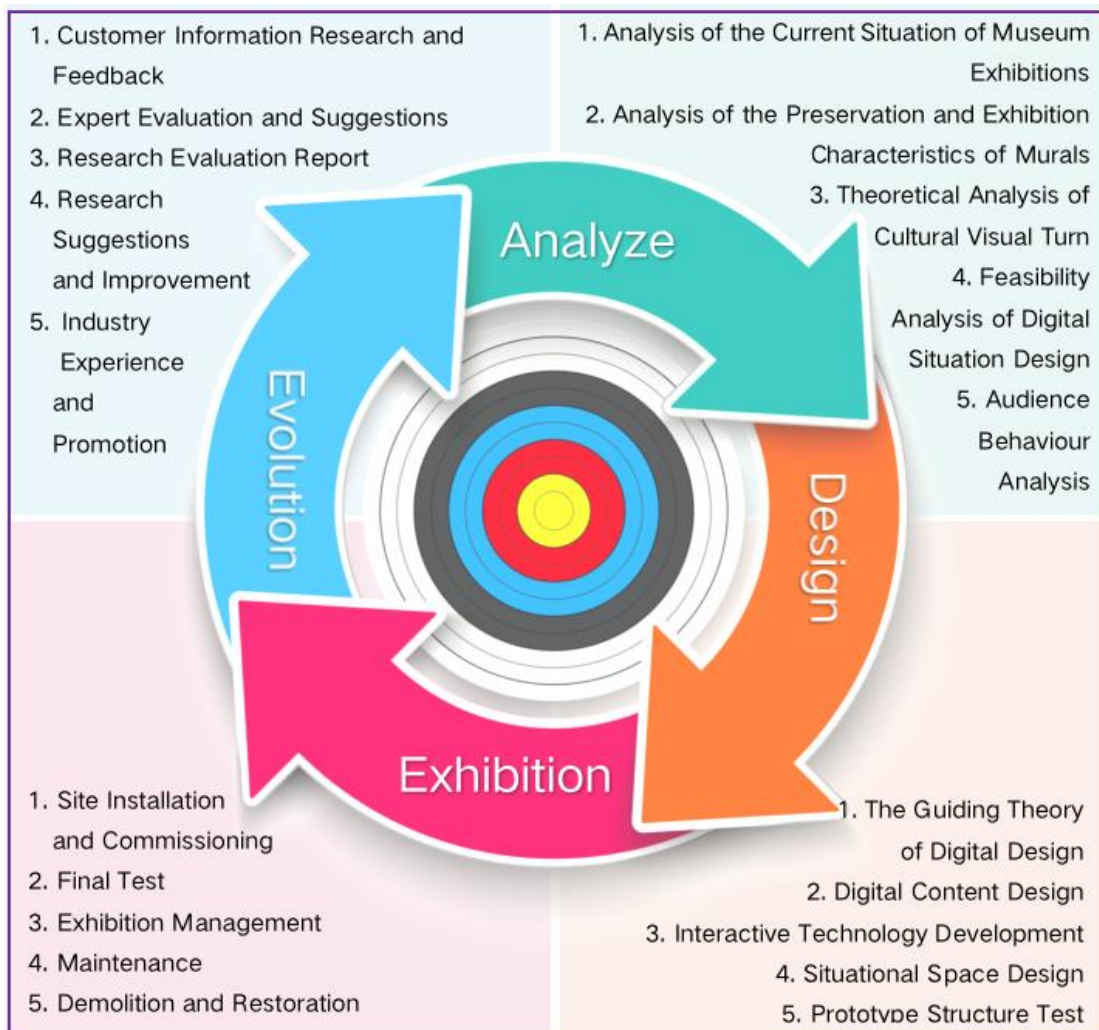


Diagram 41 The design process model of museum situation experience design under the intervention of digital media

Source: Produced by Author, 2022.

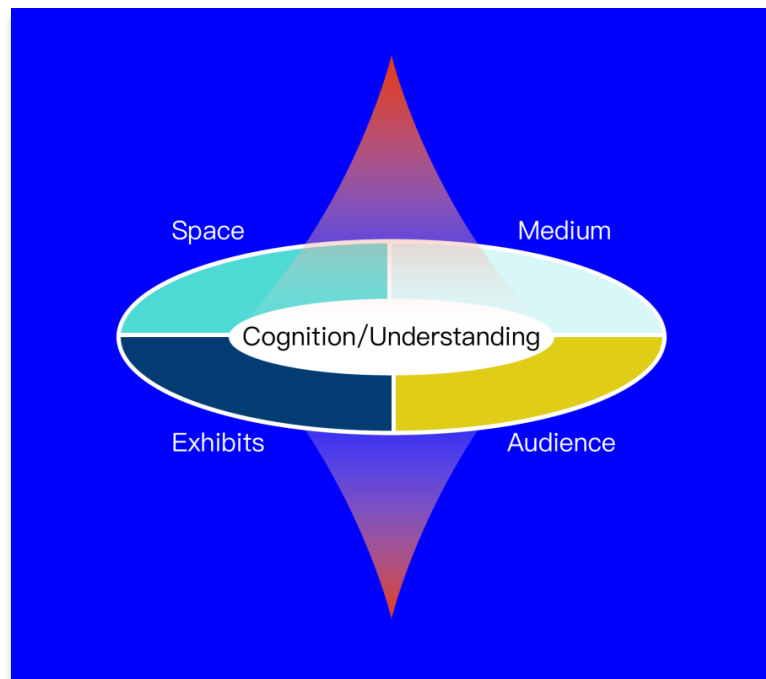


Diagram 42 Factors Affecting Museum Situation Design

Source: Produced by Author, 2021.

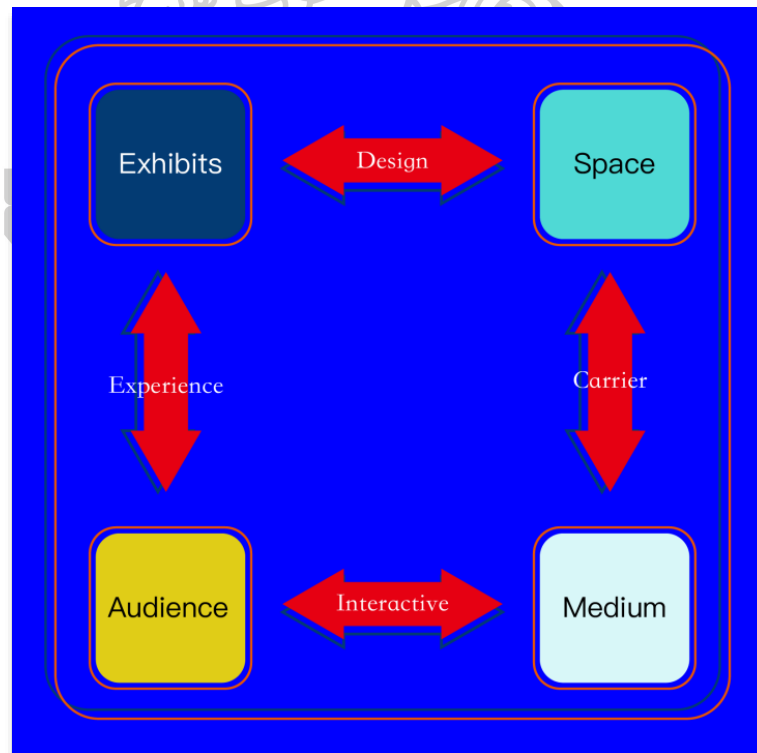


Diagram 43 Relationships among factors related to museum situation design

Source: Produced by Author, 2021.

4.3.4 The design process model of museum situation experience design under the intervention of digital media (Diagram 41)

4.3.4.1 Analysis

An analysis is the foundational step of the research process, providing a theoretical basis to ensure the research's smooth progress and practical design. A comprehensive, systematic, and objective study of relevant factors is essential to finding the optimal path for research. It includes analyzing factors such as the exhibition status of museums, requirements for mural exhibitions, media usage in presentations, digital media development, personal audience factors, and exhibition design. Researchers must analyze these factors to determine the best path for the effect of digital media intervention in museum situation design on audience cognition. Researchers will analyze relevant factors in the research to ensure the effect of digital media intervention in museum situation design on audience cognition (Ayala et al., 2020) (Diagram 42). It will become the core framework of the research and form a research method (Diagram 43). The specific ways are as follows:

Methodology:

To accomplish this goal, we propose the following research method:

Analysis of the current situation of museum exhibitions: This analysis will be based on relevant national policies and regulations, museum management and rules, future development plans of museums, objective status quo of museum exhibitions, exhibition models, and related factors.

Analysis of mural conservation requirements: This analysis will be based on the physical properties of murals, objective conditions of mural exhibitions, existing mural exhibition models, and problems in collections analysis of mural preservation and exhibition characteristics.

Theoretical analysis of the cultural visual turn: This analysis will examine the particularity of mural exhibitions and the difficulties modern people face in interpreting the etiquette system and ideological content in tomb murals. The analysis of the cultural visual turning theory of murals will help researchers understand the information about murals, standardize the scope of digital media art creation, and ensure the academic and data accuracy of the digitalization of murals.

Feasibility analysis of digital situation design: This analysis will include the digital media technology applicable to murals, the interactive design mode of murals, the environmental design of immersive situations, and other factors. It will provide an overall plan for comprehensive information, objectives, project framework, and operation plans such as technology, space, and exhibition conditions.

Analysis of audience behaviour: This analysis will be based on the audience's visiting experience and summarizes objective factors such as the audience's knowledge reserve, hobbies, audience participation, and feedback. It will also use the analysis of customer behaviour to intervene in the situation design of the museum to serve the audience's needs (Diagram 44).

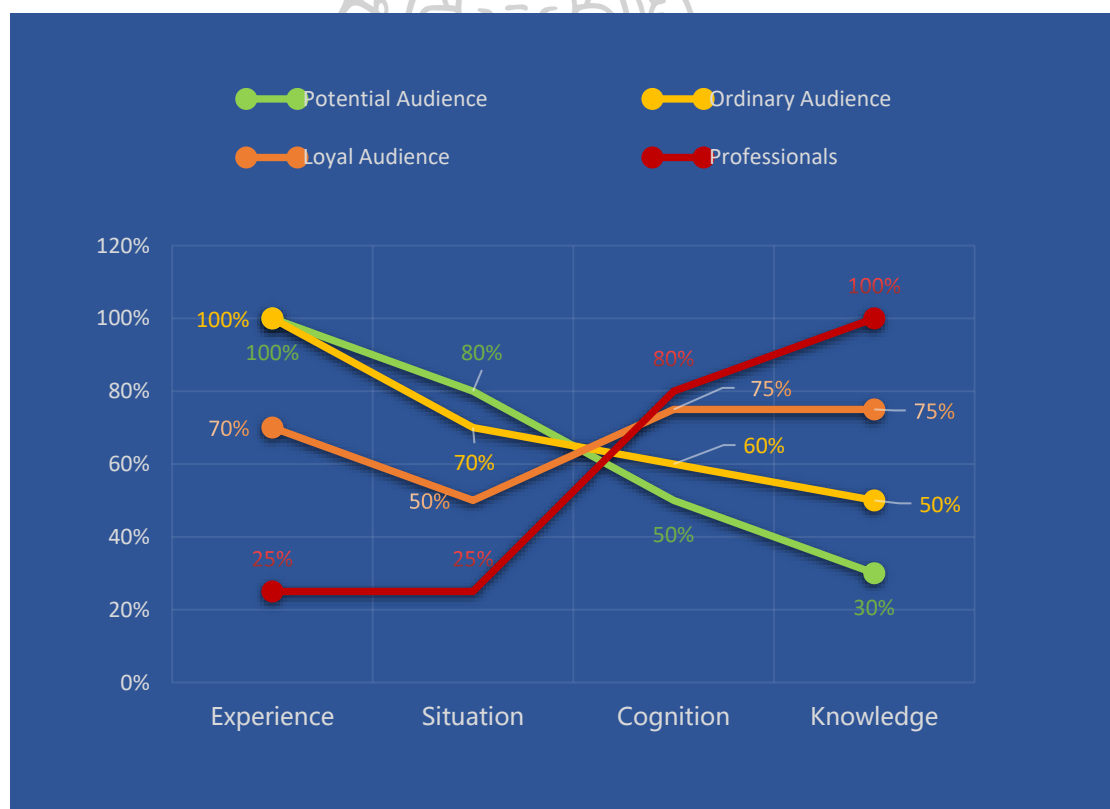


Diagram 44 Experience needs of Different Audiences

Source: Produced by Author, 2021.

In analysing museum exhibitions, it is essential to consider the physical space and the influence of related factors (Hillier & Tzortzi, 2006). The museum space serves

as the foundation for project implementation and progress. The design of museum situations must be based on the physical space available. However, with the advent of the digital age, museums are no longer confined to a specific physical area. They can create virtual spaces that serve as the carriers of exhibitions in the audience's minds.

The medium is the primary mode of connection between the museum and its audience (Hooper-Greenhill, 2013a). It serves as the information carrier and forms the core of situation design. The medium carries the knowledge of cultural relics and establishes a connection with the audience through interaction. In the digital age, the medium has evolved beyond the traditional one-way information dissemination of traditional media. With the help of digital media technology, the medium and audience can engage in a two-way exchange of information. This exchange, referred to as information exchange, is conducive to more effective communication between museum exhibitions and audience needs, ultimately improving museum exhibitions and enhancing audience cognition.

In conclusion, when analysing museum exhibitions, it is essential to consider the impact of digital media and the audience's interaction with the medium. Through digital media technology, museums can expand their reach and facilitate interactive engagement with their audiences, resulting in improved museum exhibitions and enhanced audience cognition.

4.3.4.2 Design

To design a successful museum exhibition, it is necessary to consider several factors. The first step is determining the theme and content of the exhibition. Using the theory of the cultural visual turn can guide the design process and ensure the academic and professional nature of the digital murals.

The next step is to utilize the spatial structure of the museum or virtual space and select appropriate interactive technology to create digital exhibition content. Optimizing the museum situation design can ensure the design's feasibility through prototype structure tests.

When developing museum interaction technology, it is essential to consider the specific requirements of the mural exhibition and customer participation.

Researchers should develop plans for specific issues to ensure coordination between digital content, interactive technologies, and the exhibition.

In summary, designing a museum exhibition requires careful consideration of the exhibition theme and content, the use of appropriate interactive technology, and optimization of the museum situation design. It is also essential to develop plans for specific issues, coordinate digital content and interactive technologies, and ensure the feasibility of the design through prototype structure tests. By following these steps, a successful museum exhibition can be created.

4.3.4.3 Exhibition

The exhibition is the final presentation of the design plan on-site, which involves the installation of the device structure, technology, and content, as well as planning and maintenance of the exhibition management.

Once the exhibition is completed, it is essential to evaluate the effectiveness of the research. It can be achieved through customer information research, feedback, interviews, and expert suggestions. Based on this data, a research evaluation report can be developed summarizing the effectiveness of the research.

4.3.4.4 Evolution

The evaluation report should detail the exhibition's success in achieving its intended goals, such as enhancing audience cognition and engagement, showcasing cultural relics effectively, and improving the museum experience. The report should also highlight any areas that may need improvement, providing suggestions for future exhibition development.

By conducting a thorough evaluation, museums can ensure that their exhibitions meet their audience's needs and achieve their intended goals. This approach leads to the creation of more effective and engaging museum exhibitions.

4.3.5 Conceptual model of museum situation design under the intervention of digital media (Diagram 45)

This research examines the relationship between the design model of a museum's situational experience under the intervention of digital media and the various factors that impact the museum's situational design. This study aims to create a feasible conceptual model of museum situation design under the intervention of

digital media that takes the audience's visiting experience as the core by integrating the attributes of the museum exhibition status and the objective conditions of the mural exhibition.

The digital creation of murals must preserve the murals' original cultural and artistic value, while digital technology must serve the audience's visiting experience and cognitive understanding. Therefore, the digital creation of murals must accurately express their original attributes. Digital media art should fully utilize technical characteristics that objectively present the essential qualities of murals through dynamic visual exhibitions, sound rendering, light effects, environments, and interactive behaviours to expand the cognitive latitude of the audience during their visit (Jie & Chaetnalao, 2022). The audience actively participates in the interactive exhibition based on their own knowledge needs and acquires knowledge from it. Through virtual and immersive situation presentations, the audience can immerse themselves in the murals in the museum exhibition, thereby enhancing the visitors' visiting experience (Lee et al., 2020). The involvement of digital media has enhanced the situational understanding of the museum. Digital technology has overcome time and space constraints for visitors to visit the museum, improving the connection between visitors and cultural relics and communication and interaction between visitors and potential visitors.

The researchers have tested the rationality of the research theory through the project's practice and summarised the research's effectiveness through the feedback and suggestions received from the project experiment. They formed a research evaluation report, analyzed the research suggestions, made improvements, provided experience references for the digital situation design exhibition of the relevant museum industry, and offered a broad experience of digital media intervention for collecting Chinese museums.

In conclusion, this research presents a conceptual model of museum situation design under the intervention of digital media that enhances the visitors' visiting experience and cognitive understanding and promotes communication and interaction with cultural relics.

The proposed conceptual model for museum situation design under the intervention of digital media serves as a valuable tool for explaining the concept and development process of digital media intervention in museum design, guiding design practices and assessing the effect of digital media on audience cognition enhancement.

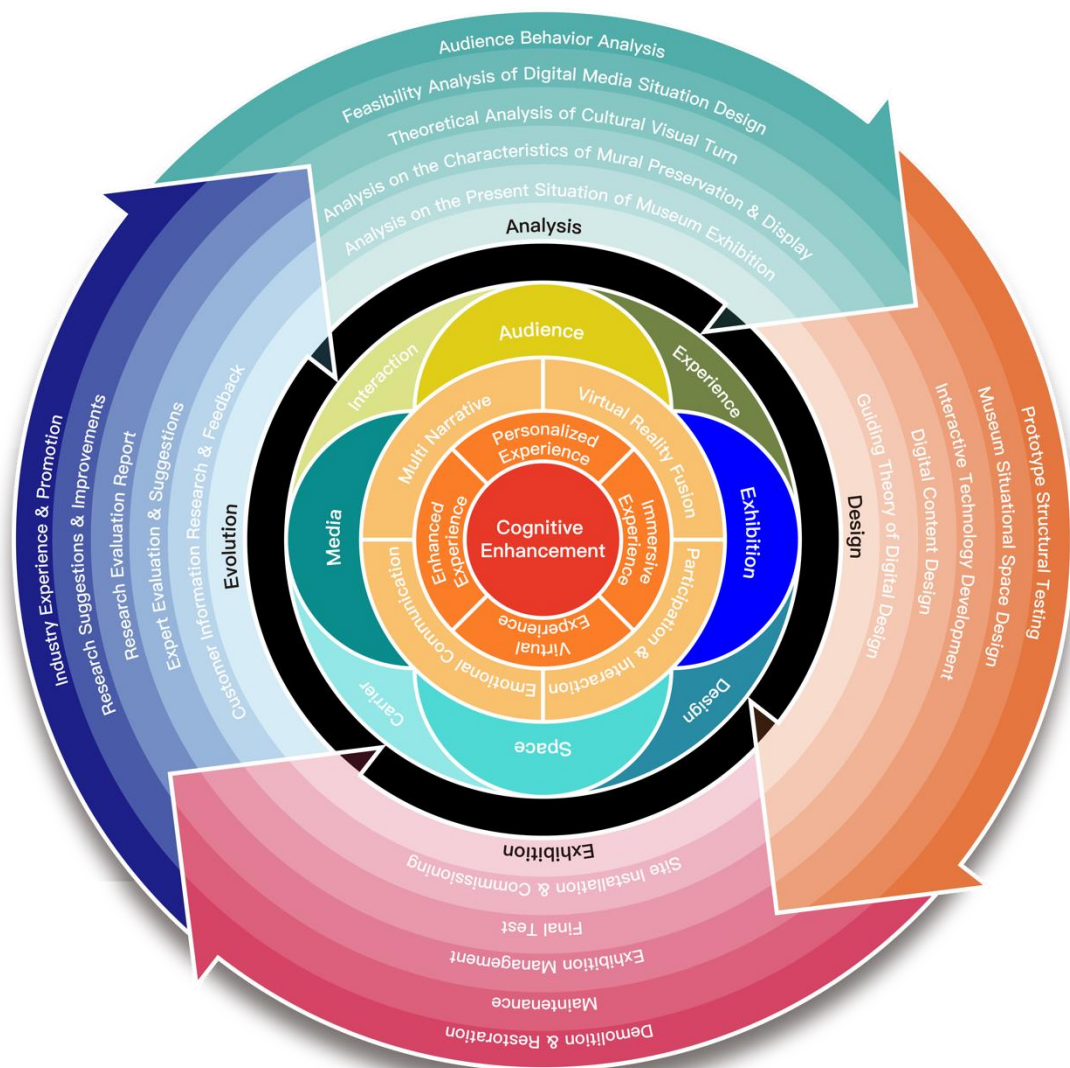


Diagram 45 Conceptual model of Museum situation design with the involvement of digital media

Source: Produced by Author, 2022.

Step 1: Research Objectives

To effectively utilize this model, the research objectives should be clearly defined. The model considers four main factors in museum situation design: space, media, audience, and Exhibition. These four components are essential to the study and form the model's core. By thoroughly researching and understanding these factors, researchers can develop a robust research consciousness, explore new and creative ways to enhance audience cognition, propose innovative theories, and provide a reference for digital media intervention in museum exhibitions.

Step 2: Research Framework

The research framework comprises four main factors: Space, Media, Audience, and Exhibition, which are central to the museum situation design under digital media intervention. The interaction between these factors is studied to enhance audience cognition through creative thinking and innovative research theories. To achieve this goal, the researchers have divided the research framework into three progressive levels that explain the role of digital media in situational design for different groups. This concept of museum situation design with digital media intervention takes the audience's experience as the core, with digital media as the support, design innovation as the driving force, and the improvement of the audience's cognitive ability as the ultimate goal.

Level 1: Relationship among the four factors affecting museum exhibitions.

a. The carrier of an exhibition is the necessary means to carry the form, and the museum space serves as the medium carrier. The architectural space of the museum serves as the carrier of traditional exhibition forms. The museum exhibition space affects media usage and the audience's situational experience. A suitable carrier should consider the impact of space and media on it, for example, the transformation of museum areas, virtual space, and immersive space combining virtual and real. While traditional media is ideal for single information transmission (paper media, video, audio), interactive media facilitates multi-directional information transmission, and digital media enhances multi-directional information transmission and Interaction. Digital media involved in museum situation design should fully consider the conditions of

museum space and media to enhance the audience's experience with the help of information carriers that meet the objective needs (Hooper-Greenhill, 2013a).

b. Design is the exhibition's presentation method, and the exhibition's space and content limit the design method. The museum space can display traditional exhibition content through specific exhibition situation design and can achieve its renovation design by changing the relationship between space and cultural relics. When the nature of space and exhibition changes, such as virtual space and digital cultural relics, exhibition design will have significant differences. Researchers must produce methods adapted to specific conditions as they change (Hillier & Tzortzi, 2006).

c. Interaction refers to the information transmission between the information dissemination medium and the audience receiving the information. The form of media affects the direction of the Interaction. For example, traditional media only allows for one-way communication of information, while interactive media enables two-way transmission of information through the participation of audiences. Digital media has more diversified and in-depth information interaction. Interactive behaviour is affected by the hardware of the press. At the same time, the audience's self-knowledge reserve, participation, and cognitive ability also affect the smooth progress of the Interaction (Giannini & Bowen, 2019).

d. experience is the audience's subjective identification with the exhibition and is the direct influencing factor of cognition. The audience is the subject of the experience, and the experience is intensely personal. The experience will be affected by the audience's conditions, such as cultural identity, cognitive patterns, and acceptance of new things. To improve the audience's experience, the museum should change the traditional thinking of passive participation in the exhibition. Through the guiding ideology with the audience experience as the core, research should emphasize the active exploration of the audience, and the researcher should pay attention to the audience's emotional experience (Park, 2013).

Level 2: Method of Digital Media Intervention in Museum situation design

a. Diversified Narration: diversified narration structures based on digital media technology, such as linear narration, compound narration, nonlinear narration, visual narration, and information narration, provide a complete knowledge system for the

audience and better meet the diversified experience needs of the audience in the digital age (Wolff et al., 2012).

b. Virtual reality integration: the strength of digital media art is that it can create specific exhibition situations through technology, integrate exhibits in Design, and endow situations to displays. Digital media brings unprecedented experience (enhanced experience, immersive experience, virtual experience, and personalized experience) to the audience through the situation design of virtual and actual integration. Integrating the exhibits with the virtual situation enriches the Exhibition's design language, which is more conducive to the audience's immersion in the show and more accessible for the audience to absorb knowledge.

c. participation and interaction: in the situation design of the museum with the involvement of digital media, the audience is not only a participant but also an essential builder of the situation. The two-way transmission with the audience activated the audience's creativity and imagination and helped realize the purpose of the audience's active exploration of the museum situation.

d. Emotional communication: the museum situation design, with the involvement of digital media, should pay attention to the emotional contact with the audience, which is a higher goal of the museum situation design. Museum exhibition design can convey different thoughts and emotions and affect the audience's cognitive behaviour, knowledge structure, emotional orientation, and value judgment. The museum's situation design with the involvement of digital media should better mobilize and stimulate the inner feelings of the audience so that the audience can get enlightenment and perception.

e. Gamification: Gamification uses game design principles and techniques in non-game contexts to engage and motivate people to participate in activities. In the museum context, Gamification can enhance the audience's experience and make the museum visit more fun and interactive. Digital media can create gamified experiences encouraging exploration, learning, and exhibit interaction.

f. Accessibility: digital media intervention in the museum situation design can also improve Accessibility for visitors with disabilities. For example, digital technology

can provide audio and visual descriptions of exhibits for visitors with visual impairments or to provide interactive experiences accessible to visitors with physical disabilities.

g. Multilingual support: digital media can also provide multilingual support in museum situation design, making exhibits and information accessible to visitors who speak different languages. Through digital technology, museums can provide audio and visual translations, interactive displays, and other features that support visitors who speak different languages.

h. Social media integration: social media integration can be used to extend the museum experience beyond the physical visit. By encouraging visitors to share their experiences on social media, museums can increase their reach and engagement with audiences. Social media integration can provide real-time updates, share additional information, and facilitate communication between visitors and museum staff (Fletcher & Lee, 2012).

i. Data analysis and evaluation: digital media intervention can also provide valuable data for museum evaluation and improvement. By collecting data on visitor behaviour, preferences, and engagement with exhibits and activities, museums can better understand the audience's needs and preferences and adjust their exhibition design and content accordingly. This data can also help museums to evaluate the effectiveness of their digital media intervention and identify areas for improvement.

Overall, digital media intervention in museum situation design can enhance the visitor's experience and provide new and innovative ways for museums to engage with their audience. It can provide personalized experiences, improve Accessibility, and facilitate communication and engagement with visitors. It can also provide valuable data for evaluation and improvement and can be used to create unique and immersive experiences for visitors.

Level 3: Experience characteristics of digital media intervention in museum situation design

a. Enhanced experience: Enhanced experience connects the real world with the virtual world through digital technology and combines necessary exhibition information with natural exhibits through virtual images or videos to expand the latitude of information exhibitions. Augmented reality brings audiences unprecedented

content and form of experience. The audience can understand the exhibit's information through virtual models, relevant background information about the shows, and virtual interaction. The virtual content and displays work together to create an exhibition that combines virtual and real, dynamic and static, increasing the audience's visiting experience and enriching the audience's cognition.

b. Immersive experience: Use digital technology to express information in physical and non-physical ways and increase the information presentation of exhibits from the perspectives of cognitive science sense, pain, touch, and smell. Break through the limitations of time, space, and specific conditions to achieve an immersive situational experience of the exhibits with multiple senses. Further activate the audience's sensory system and cognitive system to enhance the audience's cognition during the visit.

c. Virtual experience: virtual experience is an information exhibition presented through virtual space. With the development of technology, the virtual experience can carry out situational experiences through specific devices and programs. In addition, the development of naked-eye technology can also enable viewers to realize virtual situational experiences without the help of external devices. The continuous progress of digital technology enriches the concept of virtual technology. For example, VR, naked-eye 3D, and other technologies give the audience a unique situational experience during the visit by assisting the traditional exhibition forms. With the help of new digital formats, such as the concept of a meta-universe, the idea of an online museum, and the notion of a Virtual Museum of digital technology, the exhibition mode has broken through the tradition of time and space, making the Exhibition more independent and more accessible.

d. Personalized experience: digital media intervention in Museum situation design is a situation design with audience experience as the core. "People" has become the core of future digital museum exhibitions. Visitors' visiting experience and harvest have become necessary standards for testing Museum situation design. Digitalization will break through the physical limitations of traditional museums and cultural relics, and visitors can formulate the visiting situation and process it according to their needs. Personalized experience will significantly increase the audience's interest in

participation and explore a path suitable for self-awareness improvement from their preferences and experiences.

e. Interactive experience: Interactive experience is an essential feature of digital media intervention in Museum situation design. It includes interactive digital devices, such as touch screens, projections, and augmented reality. Visitors can use these devices to interact actively with exhibits and explore information about them. The interactive experience can break through the limitations of traditional exhibition forms and create an immersive and interactive environment for the audience. It allows visitors to participate in the Exhibition actively, encouraging them to explore, interact, and learn. This feature significantly improves the audience's engagement with the Exhibition and enhances their overall visiting experience.

f. Social experience: Social experience is another critical feature of digital media intervention in Museum situation design. It emphasizes the importance of social interaction and communication among visitors, creating a shared experience that enhances visitors' sense of community and belonging. Social experience can be achieved through various digital technologies, such as social media platforms, mobile apps, and virtual reality. These technologies can facilitate visitor communication and interaction, allowing them to share their opinions, feedback, and experiences. Social experience not only improves visitors' engagement with the Exhibition but also creates a sense of community among visitors, encouraging them to return to the museum and participate in future exhibitions.

Step 3: Research Process

The research process revolves around the core area of the conceptual model, showing the arrangement of sectors. The research process comprises four steps: analysis, Design, Exhibition, and evolution. They are progressive and interrelated.

1: Analysis

The analysis discusses the operation of the design media. It works in the original museum environment and background and the feasibility of digital situation design from the four factors that affect the museum situation design (space, Exhibition, media, and audience).

a. Analyze the current situation of museum exhibitions, understand museums' original space and collections, and analyze whether the research can improve the deficiencies of existing shows and productions while ensuring the minimum impact on the museum.

b. Starting from the preservation of murals and the particularity of the Exhibition, the study analyzes the mandatory requirements that the mural exhibition must comply with and how to solve the practical problems in the mural exhibition through digital media design while ensuring the safety of the murals.

c. Analyze the feasibility of digital media intervention in museum situation design. How to solve the problems of how digital technology can improve the exhibition quality of mural museums, how digital technology can solve existing exhibition problems, how to ensure the academic and professional nature of digital media art, and the existing contradiction between the application of digital technology and audience participation expectations.

d. Analyze the behavior of the audience during the Exhibition. From the audience's point of view, understand the audience's needs, preferences, emotions, and other appeals, and explore the impact of digital technology intervention in museum situation design on audience cognition.

e. To ensure the academic and professional nature of digital media art creation, it is necessary to summarize murals' cultural visual turning theory.

2: Design

The design part starts from the digital content of the mural to ensure the scientific rationality of the guiding digital design theory. Determine the relationship between digital content and interactive technology development, the interaction between the two, the form of interaction, and the linkage between the two. Through the coordination of digital content and interactive technology, explore the spatial Design of museum situations under the intervention of digital media, focusing on the collaborative development among exhibits, interactive technology, environment, and audience. Complete test prototype structure, including the overall planning of the device's structure diagram, the equipment's installation steps, and the management and maintenance of the Exhibition.

3: Exhibition

It is the installation steps designed in the actual area to ensure the installation and coordination work of the site, the final test work after the installation, the exhibition management and equipment maintenance during the exhibition process, and the dismantling and restoration work after the Exhibition is over.

4: Evolution

During the Exhibition, collect the information from the audience, complete the questionnaire survey of the audience, and summarize the information feedback of the audience; organize experts to hold discussions and seminars, and listen to the opinions and suggestions of the experts; complete the research evaluation report and form a summary of the research.

Step 4: Evaluate Summary

The evaluation summary step is an essential part of the research process. In this step, the researcher needs to analyze the audience's feedback and expert opinions and objectively evaluate the benefits of the research in improving the audience's awareness of visiting the museum. The analysis should be systematic and cover all the parts that affect the benefits of the research. Based on the analysis, the researcher should design improvement plans, write research summaries and suggestions, and provide reference experience for related industries.

The evaluation summary should also include a summary of the research and its outcomes, including the research methodology, research questions, and research findings. The researcher should also identify the limitations of the research and provide recommendations for future research.

Overall, the evaluation summary step is crucial as it helps the researcher understand the research's impact on the audience and the industry. It also helps to identify areas for improvement and provides a basis for future research.

4.4 Using the model

Based on the concept of Museum situation design and the model concept of digital media intervening in Museum situation design, this study explores the potential benefits of combining tomb murals and digital media. The following hypotheses are proposed:

a. The integration of digital media in the museum situation design can enhance participation and interaction between the museum and the audience, leading to an improved visiting experience.

b. Digital media integration in Museum situation design can facilitate personalized experiences for visitors, providing a unique and immersive experience while simultaneously enhancing the audience's understanding and appreciation of the exhibits.

c. Systematic research on the subject can provide practical references for the digital development of Chinese museums. A systematic approach to design and practice can also provide invaluable experience for relevant industries and facilitate successful cases.

Through the research data analysis, the study aims to validate the above hypotheses and explore the potential of digital media integration in Museum situation design, providing empirical evidence to support the potential benefits of such an approach.

4.5 Chapter summary

The continuous advancement of information technology is transforming the way people acquire information. Traditional museum exhibitions are being challenged with the network, media, and interactive technology maturity. The audience's demand for data has become more personalized and professional, and their exhibition requirements have shifted towards participation, interest, and interaction. Digital cultural relic exhibitions hosted by the Forbidden City in China and Tencent, and the China Grand Canal Museum, have successfully used digital media art and interactive media, which were unanimously recognized by the audience. These exhibitions provide an excellent case for the development of Chinese museums.

The digital situational design of museums requires the upgrading and transforming of existing museums, which poses significant challenges to traditional museums in terms of budget, design, equipment, and management. The digital format of museums also challenges the exhibition form of conventional museums. The development of technologies such as museums, virtual museums, and applications force traditional museums to keep pace with the times and attract audiences by leveraging their collection advantages and situational design.

In this study, we have analyzed the design methods to improve the situational design of museums, starting from the four essential elements of museum exhibitions: space, media, audience, and exhibition. By studying the audience's points of interest and focus during the visit, we have deepened the design concept and created the concept of museum situational design under the intervention of digital media. We have also summarized the experience through the derivation of conceptual models and the analysis of practical cases.

In conclusion, the application of digital media in museum situational design can enhance the audience's visiting experience, encourage personalized experiences, and enhance the audience's cognition during the visit. The systematic research conducted in this study will provide a practical reference for the digital development of Chinese museums and promote successful cases for the relevant industries.

Chapter 5 Prototype Development For Museum Situation Design Under Digital Media Intervention

5.1 Why are the murals in the tomb of the Tang Dynasty

5.1.1 Background and significance

The Tang Dynasty (618-907 AD) is widely recognized as a significant period in Chinese history due to its openness, prosperity, and cultural achievements. This dynasty marked the pinnacle of development and influence for ancient Chinese society, with far-reaching impacts felt global. The integration of various ethnic groups and in-depth exchanges of Chinese and foreign cultures were notable features of the Tang Dynasty, contributing to cultural diversity and eclecticism. This openness and diversified development of culture shaped the self-confidence mentality of Tang Dynasty society (Guangda, 1986).

The Tang Dynasty's contributions to cultural prosperity and the far-reaching influence of the dynasty on China and the world make the study of its society and culture significant to China's current social development. The period was characterized by artistic, literary, and technological advancements, including the invention of printing, gunpowder, and the compass, which profoundly impacted Chinese and world history. The Tang Dynasty was an important exchange period between the East and the West, where different cultures learned from and influenced one another.

Foreigners referred to Chinese people as Tang people and areas where they lived as "China Towns," indicating the strength and confidence of the Tang Dynasty, which was felt far and wide along the Silk Road (Rui, 2020). Therefore, continued academic inquiry into the society and culture of the Tang Dynasty is necessary for deepening our understanding of the past and present and promoting national self-confidence and identity in China's ongoing social development.

The Tang Dynasty's capital, Chang'an City, exemplified the period's open-mindedness and tolerance, serving as the world's political, economic, and cultural center (Figure 64). The dynasty implemented a cultural policy that embraced the inclusivity of Confucian, Taoist, and Buddhist traditions in the ideological field, with

society having freedom of religious belief. As a result, local religions, such as Zoroastrianism and Manichaeism from Persia and Christianity and Islam from the West, developed in parallel in Chang'an (Copp, 2012).

Cultural life in the Tang Dynasty was characterized by the pinnacle of Chinese social and cultural development, with poetry being a prominent feature. The music and dance of the Tang Dynasty integrated elements from India, Central Asia, and Europe, showcasing the integration of foreign cultures into Chinese culture. The style of the Western Regions, which became a popular fashion in ancient Chang'an, also significantly influenced Chinese art. The concave and convex paintings of the Western Regions, inspired by ancient Greek culture, spread to Chang'an, enriching Chinese painting and shaping the subject matter, content, and expression.

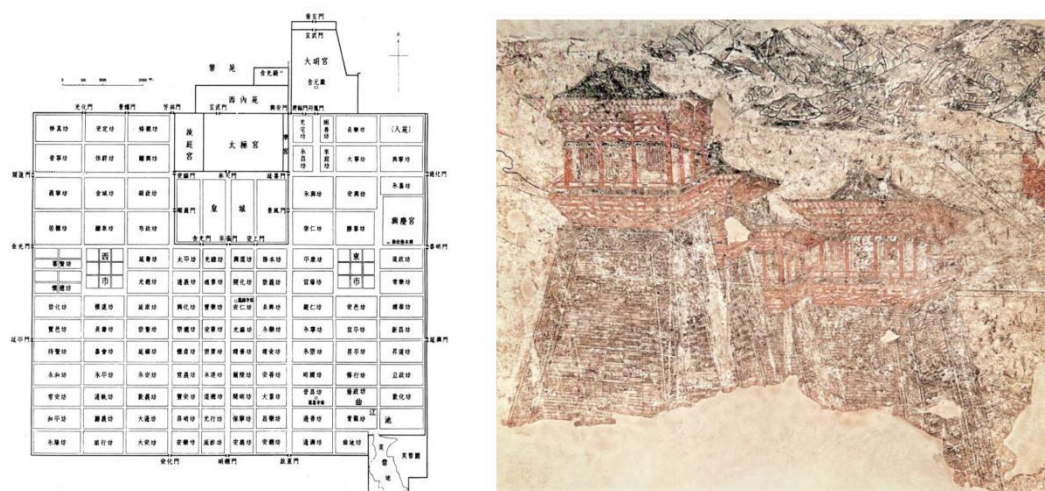


Figure 64 Map and Architecture of Chang'an City in the Tang Dynasty

Source: Shaanxi History Museum, 2021.

Tang Dynasty tomb murals are an invaluable representation of Tang Dynasty culture, primarily belonging to prominent royal families and nobles of the era (Xingming, 2005). Over 80% of all Tang Dynasty mural tombs are concentrated around Chang'an. The Shaanxi History Museum of China houses an extensive collection of Tang Dynasty tomb murals excavated around the city. The murals' content records the Tang Dynasty's etiquette system, serving as an important cultural relic for future generations to study the era's social development. Tang Dynasty tomb murals vividly portray the

cultural landscape of the era's regulations, social customs, religious beliefs, and ideas, providing valuable insight into the aristocratic culture of the time (Xingming, 2005). The evolution of tomb murals illustrates the development of painting during the Tang Dynasty, with a gradually complete system and a maturing style.



Figure 65 Aerial photography of Xi'an city

Source: Shaanxi History Museum, 2021.



Figure 66 Part of Murals of Prince Zhanghuai's tomb

Source: Shaanxi History Museum, 2021.

Xi'an, formerly known as Chang'an, was the Tang Dynasty's capital, regarded as one of the most culturally significant periods in Chinese history (Figure 65). As a result, Xi'an has become a hub for scholars researching Tang Dynasty culture. The Shaanxi History Museum, located in the city, is a valuable resource for researchers studying the period's art, architecture, and social structures.

Xi'an's rich historical and cultural environment provides an ideal setting for researchers to contribute significantly to studying the city's cultural heritage. The Shaanxi History Museum's exhibition and the international conference on Tang Dynasty tomb murals have provided valuable resources for scholars to conduct their investigations.

Furthermore, recent research has highlighted the importance of engaging with local communities to understand the city's cultural heritage better. To this end, the researcher's questionnaire survey and case analysis have received positive feedback from residents and audiences, catalyzing future research. These findings demonstrate the need for more collaborative efforts between researchers and local communities to ensure the preservation and promotion of Xi'an's rich cultural heritage.

5.1.2 Appropriateness of the research concept from an exhibit content perspective

The purpose of this study was to evaluate the appropriateness of the research concept and methods for studying the social life of the Tang Dynasty through the murals displayed in the Tang Dynasty Tomb Mural Treasures Hall of the Shaanxi History Museum. Specifically, the researchers summarized the contents of the murals and assessed how well they could be applied to the physical properties of the museum exhibit.

The Tang Dynasty tomb murals provide a unique glimpse into the ceremonial norms, living customs, clothing features, entertainment methods, and architectural styles of the Tang Dynasty. The researchers noted that the murals depict buildings with unique styles, simple and vivid figures, distinctive utensils, concise and lively landscapes, and lifelike animals and plants, making them crucial image material for studying the social life of the Tang Dynasty, particularly the life and spiritual pursuits of the nobles. Figure (Figure 66) illustrates an example of a Tang Dynasty mural.

However, the researchers acknowledged that the Tang tombs' murals are fragile and require high preservation conditions (Jia, 2019) (Zilin & Xiaotong, 2019). Moreover, the Chinese cultural relics management law restricts research directly involving cultural relics within the museum. Thus, the existing museum exhibition halls must meet the necessary physical conditions for the research.

To address these limitations, the researchers consulted with the museum's administrators and redesigned the exhibit space to fit the physics of the model study. The new exhibition space takes full advantage of digital technology to create an immersive experience that enhances the audience's visiting cognition. Through digital interaction and dynamic image technology, the murals' content interacts with the audience and enriches their visiting experience. The researchers believe that the new exhibition space will fully demonstrate the characteristics of digital technology and can serve as a case study for developing the research model.

Overall, this study contributes to understanding the Tang Dynasty's social life through an innovative approach that combines historical artifacts with digital technology.

5.2 Treasure hall of tang tomb murals in shaanxi history museum

5.2.1 Analysis of traditional exhibitions in the shaanxi history museum's tang tomb mural treasures hall

The Tang Dynasty Mural Treasures Museum, an important cultural institution in China, focuses on collecting, researching, and exhibiting Tang tomb murals. Constructed underground on the east side of the Shaanxi History Museum to adhere to strict mural preservation requirements, the museum opened to the public in 2011 (Figure 67). The museum boasts a collection of 97 murals, considered treasures unearthed from the tombs of the royal family and nobles during the Tang Dynasty.

The exhibitions are arranged chronologically, displaying tomb murals from the early Tang Dynasty. Painters serving the royal family created these exquisite murals found in the tombs of Princess Yongtai, Prince Yide, and Prince Zhanghuai. Despite being over 1,300 years old, the murals are well-preserved and occupy half of the Mural Gallery's exhibition space.

The museum's underground construction provides a controlled environment that helps to maintain the ideal temperature and humidity levels for the long-term preservation of the murals. The museum employs advanced air-filtration systems and digital monitoring devices to safeguard the murals against damage.

The Tang Dynasty, Mural Treasures Museum is a remarkable cultural institution that offers visitors a rare insight into the artistic and cultural heritage of China's Tang Dynasty. Its collection of well-preserved murals and state-of-the-art preservation techniques make it a unique and valuable contribution to the academic community.



Figure 67 Photos of Shaanxi History Museum

Source: Photographed by Author, 2021.

展览介绍

唐墓壁画是陕西历史博物馆独具特色的珍贵藏品，共有20多座唐墓的壁画精品近600幅，达1000多平方米。其中69件（组）82幅被定为一级品。唐墓壁画以风格独特的建筑、简约传神的人物、特色鲜明的器物、简洁明快的山水与栩栩如生的动植物，描绘了当时的仪礼规范、生活习俗、服饰特色、娱乐方式与建筑风格，是研究唐代社会生活尤其是贵族生活和精神追求的重要形象资料。同时，唐墓壁画又极其脆弱，对保存条件要求很高，为了保护和利用好唐墓壁画，我们决定建设一座集保护研究和观赏为一体的唐墓壁画馆。

20	600	1000	69
多座唐墓的壁画	精品近600幅	达1000多平方米	69件被定为一级品

Figure 68 Shaanxi History Museum official website exhibition introduction

Source: Shaanxi History Museum, 2021.

Visitors follow a predetermined path along a long corridor, viewing murals excavated from different tombs. Video-capable devices, including cameras and smartphones, are prohibited from protecting the murals. The murals are displayed in glass-enclosed spaces, organized by the tomb they were discovered in, and accompanied by detailed descriptions in Chinese and English. A navigation map or tourist information guide is provided, and some murals feature digital numbers for voice interaction, allowing visitors to rent audio equipment to listen to the corresponding information.

Despite the museum's best efforts to provide visitors with an enjoyable experience, numerous factors may affect their enjoyment. The murals on display were created over 300 years, resulting in significant differences in shape, themes, and content. The preservation conditions of the tombs have also resulted in significant differences in the quantity and quality of the unearthed murals. Natural forces have damaged most of the murals, resulting in blurry images. To protect the murals, the lighting in the Mural Museum is very dim, which may negatively affect visitors' viewing experience due to the glass showcases used to protect the murals from reflecting light.

In addition to these technical limitations, cultural and spiritual beliefs expressed in the murals, as well as the time and space background and cultural customs, differ significantly from the lives of Chinese people today (Jie, 2021). Despite the high artistic value of the murals, researchers have observed that many visitors need clarification about visiting the Mural Museum.

In conclusion, the Tang Dynasty Mural Treasures Museum provides a unique opportunity to view valuable and well-preserved murals from China's Tang Dynasty. While the museum provides visitors with detailed information and audio equipment, various factors may affect their enjoyment, including technical limitations and cultural differences. Therefore, the museum should consider providing additional information and guidance to visitors to enhance their experience.

5.2.2 Analysis of the exhibition contents of the Shaanxi History Museum's Tang Tomb Mural Treasure Hall

The Tang Tomb Mural Treasures Museum, located within the Shaanxi History Museum, displays nearly 600 intricate murals from over 20 Tang tombs. Among them,

5 groups and 18 individual murals have been designated national treasures, while 69 groups and 82 individual murals have been designated first-class artefacts (Museum., 2020) (Figure 68). These murals offer a vivid glimpse into the cultural landscape of the Tang Dynasty, documenting everything from social customs and regulations to religious beliefs and ideological concepts.

The Shaanxi History Museum's Tang Tomb and Mural Treasures Museum are divided into two areas. The first area displays murals from severely damaged tombs, where only remaining traces of the murals are visible. Despite the difficulty in discerning the overall appearance of these murals due to their damage, they offer valuable insights into the cultural landscape of the Tang Dynasty, providing incomplete information about social customs, food, clothing, and military equipment.

The second area showcases well-preserved murals that offer the audience complete information about the murals. Among these murals, the museum houses three relatively complete murals from the royal mural tombs of the Tang Dynasty: the tomb of Princess Yongtai, Prince Yide, and the tomb of Prince Zhang Huai. As the tombs of the royal family, these three tombs represent the highest standard of tombs in the early Tang Dynasty (Bai, 1995), with apparent regularity in the shape of the tombs and the configuration of the murals.

Social class, aesthetics, and regional differences influenced the shape and configuration of Tang Dynasty mural tombs. Two different image systems are present in Tang tomb murals. The first system depicts scenes inside and outside aristocratic mansions, expressing the theme of the natural world. The second system mysteriously portrays the universe, expressing the theme of the spiritual world. These two systems are relatively independent but unified in tomb murals, reflecting the ancient Chinese spiritual concept of "harmony between man and nature" (Yong & Bo, 2015). The real-world image system expresses the spiritual sustenance of "death is like life," with the expectation that the tomb owner will enjoy the same life as the natural world in another world. On the other hand, the spiritual world image system expects the tomb owner's soul to ascend to the fairyland (Xiaoyang, 2018a).

The imaging system of the tombs of the Tang Dynasty provides a fascinating glimpse into the culture and society of ancient China. This research aims to explore

the different components of the imaging system, including exterior and interior scenes and the various images that make up these scenes.

The exterior scenes of the tombs of the Tang Dynasty are replete with images of traveling ceremonies and guards, including the parade honor guard team and the guards standing guard (Xiu & Qi, 2003). These images reflect the identity and status of the tomb owner and showcase the noble's life content. Murals of guest envoys on hunting trips, playing polo and receiving foreign embassies painted on the wall before the guard of honor on the tomb road provide additional insights into the lives and interests of the tomb owner (Figure 69).

Meanwhile, the interior scenes of the tombs are composed of images of serving the inner house, including the maid, servant, music, dance, and the image of the screen. These images divide the tomb's structure into different spaces and express the life interests of the tomb owner. The screen is an important display furniture and an important carrier of murals. One of the painted screens in the tomb separates the space, and the other reflects the tomb owner's taste and sentiment by depicting the screen's contents. The music and dance images represent the tomb owner's emulation of the noble life situation, highlighting their status and privilege (Figure 70) (Figure 71).

In addition, the imaging system of the tombs includes astronomical images and images of the Four Gods. The celestial map at the top of the tomb draws the sun, moon, stars, and the Milky Way. The sun and moon depict representative animals, such as the golden blackbird and laurel or toad. The images of the Four Gods, including the Blue Dragon, White Tiger, Rose Finch, and Tortoise, governed the four directions in ancient China and guided the immortals, increasing the mysticism of the tomb murals (Figure 72).

Finally, the tomb murals contain elements that express the environment, such as architecture, landscape, and garden scenery. Together with the other imaging systems, they enrich the spiritual situation of the tomb murals, providing a comprehensive view of the culture and society of ancient China.

In conclusion, the imaging system of the tombs of the Tang Dynasty provides valuable insights into the life and society of ancient China through its different components.



Figure 69 Part of the mural of the guard of honor
Source: Shaanxi History Museum, 2021.



Figure 70 Part of the mural of court ladies
Source: Shaanxi History Museum, 2021.

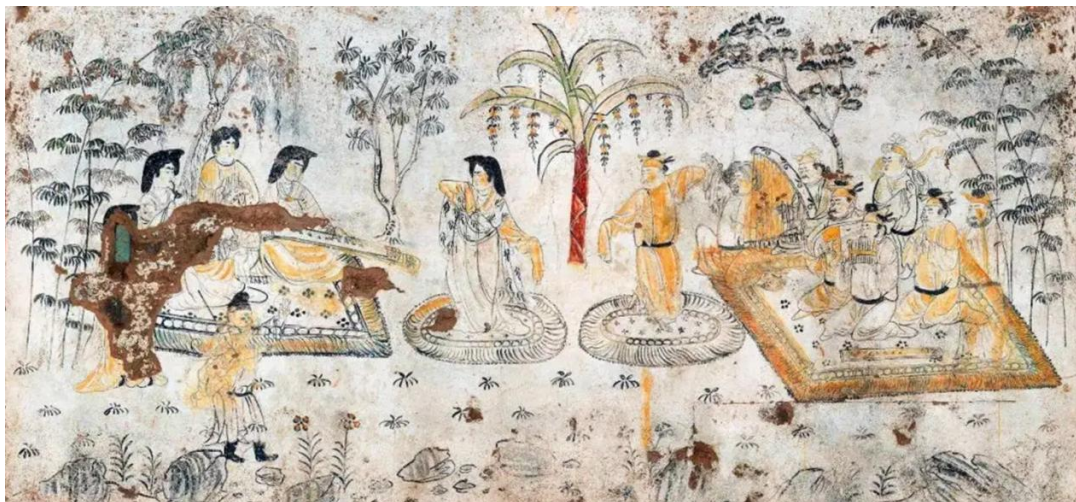


Figure 71 Part of the music and dance mural

Source: Shaanxi History Museum, 2021.

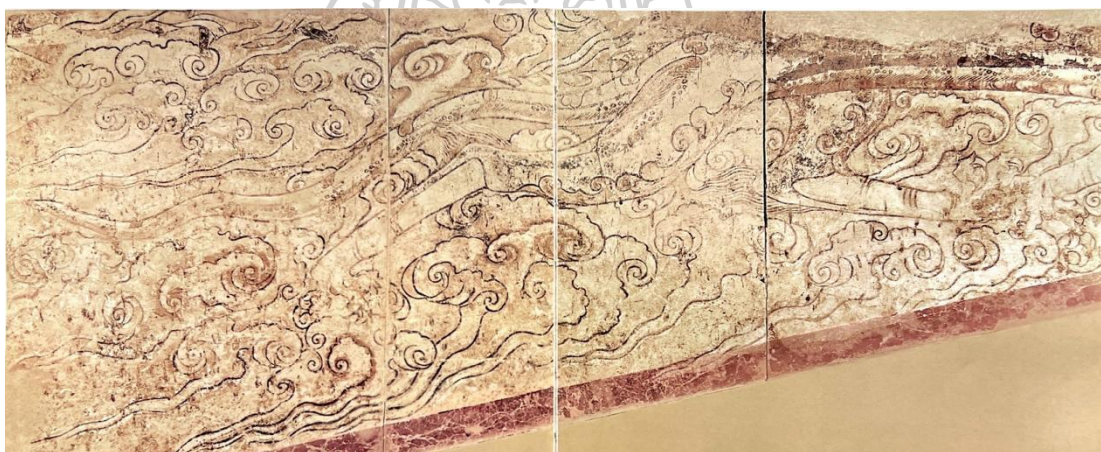


Figure 72 Part of the blue dragon mural

Source: Shaanxi History Museum, 2021.



Figure 73 Mural Museum Exhibition Situation

Source: Photographed by Author, 2021.

5.2.3 Analysis of the Physical Space of the Shaanxi History Museum's Tang Tomb Mural Treasure Hall

The Shaanxi History Museum's Tang Tomb Mural Treasure Hall is an enormous exhibition space of over 1,000 square meters, designed as a corridor-shaped gallery that directs visitors through a linear visiting route from the entrance to the end (Figure 73). The original design of the pavilion considered the visiting properties of the mural pavilion, drawing on the conventional gallery exhibition mode. The museum displays murals of the same tomb on the same side wall for the audience's convenience. While this linear route benefits visitors to view the mural display in an all-around way, the long-distance visiting route challenges visitors' physical strength and patience.

Through field observation, the researchers found that visitors were initially interested in the murals upon entering the exhibition hall. However, as they progressed through the long-distance visit, the broken and blurred murals negatively affected their visiting experience, leading to a loss of interest in the content of the second half of the pavilion. Notably, the latter part of the exhibition contains the most valuable murals in the museum.

Following the field survey, the researchers analyzed the traditional exhibition space and the audience's visit path, evaluating the study's concept and research method. They believe that the design of promenade exhibition halls of traditional museums is beneficial to visitors' viewing experience but that it is essential to address the challenges posed by long-distance visits. The display of murals should also differ from the exhibition mode of traditional galleries, focusing on presenting the structure and the configuration of the murals in the tomb.

To better adapt to the physical characteristics of digital technology model research and implement the research concept and method, the researchers propose redesigning the space of the mural exhibition hall. This redesign should address the challenges of long-distance visits and prioritize the presentation of the structure and configuration of the murals.

Analyzing the physical space of the Shaanxi History Museum's Tang Tomb Mural Treasure Hall highlights the need to redesign the exhibition space to serve better the visitors' viewing experience and the presentation of the murals' historical significance.

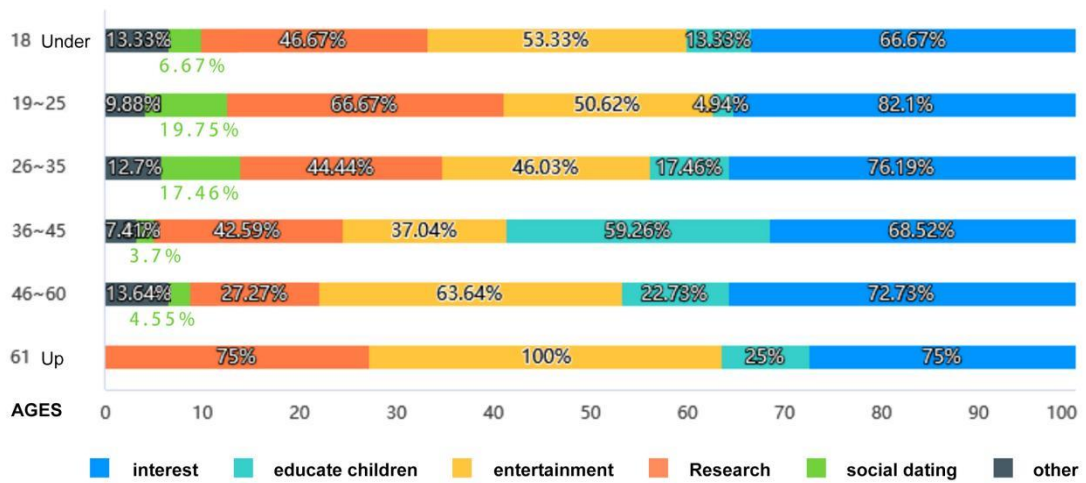


Diagram 46 Age and purpose of museum visitors

Source: Drawn by Author, 2022.

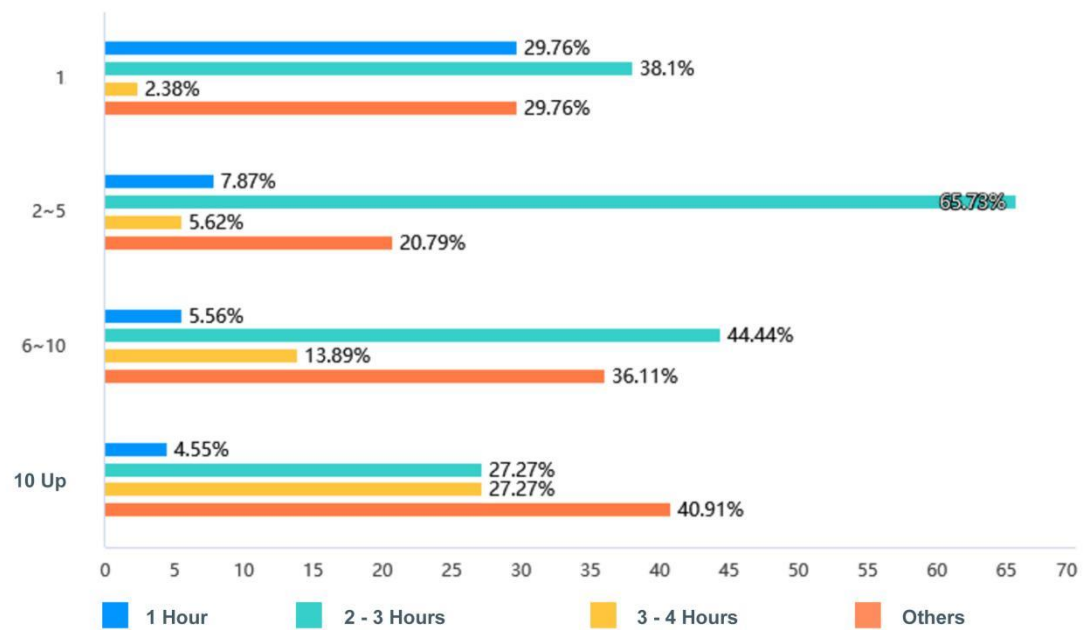


Diagram 47 The number and time of visits by visitors to the museum

Source: Drawn by Author, 2022.

5.2.4 Analysis of the audience

The research presents an audience analysis for the mural gallery and the Shaanxi History Museum based on field observations, interviews, and a questionnaire survey. The analysis aims to provide insights into the two museums' audience demographics, motivations, preferences, and experiences.

The mural gallery had a relatively small audience, observed during nearly four hours of on-site observation, where fewer than 100 spectators were present. Interviews with the audience revealed that the high-ticket price (RMB 300 per piece) was a significant barrier to access for ordinary people, which limited the number of visitors. The primary audience of the mural gallery was young people aged between 22 and 45 who visited the museum out of personal hobbies or invitations from friends.

The Shaanxi History Museum had a more diverse audience, as evidenced by a questionnaire survey of 320 visitors. The survey focused on the audience's motivations for visiting the museum, demographics, and preferences for the museum experience. The results show that the audience includes different groups of people and different age ranges, with a significant proportion of highly educated individuals aged between 18 and 45 (86%) (Diagram 46). The main motivation for visiting the museum was to gain knowledge (77%), followed by having a quality visiting experience (69%). The average frequency of museum visits was two to five times a year (55%), and the average duration of each visit was about two to three hours (53%) (Diagram 47). During the visit, the audience paid attention to observing cultural relics and the visual experience of museum visits. They also used tools to increase their visiting experience (76%). However, many audience members found the current museum exhibitions to need more interest (49%), information and explanations (37%), and digital interactive media technology (37%). Most audiences believe museums should improve the quality of exhibitions, visual effects, interactivity, and fun to enhance the visiting experience (Diagram 48) (Diagram 49).

Regarding the Tang Dynasty tomb murals, more than half of the audience had heard of them (52%) but had not seen them. They were interested in learning about Tang Dynasty tomb murals (64%). The results suggest that the Shaanxi History Museum has the potential to attract more visitors interested in the Tang Dynasty tomb murals

by improving the exhibition quality and making it more accessible to a broader range of people (Diagram 50).

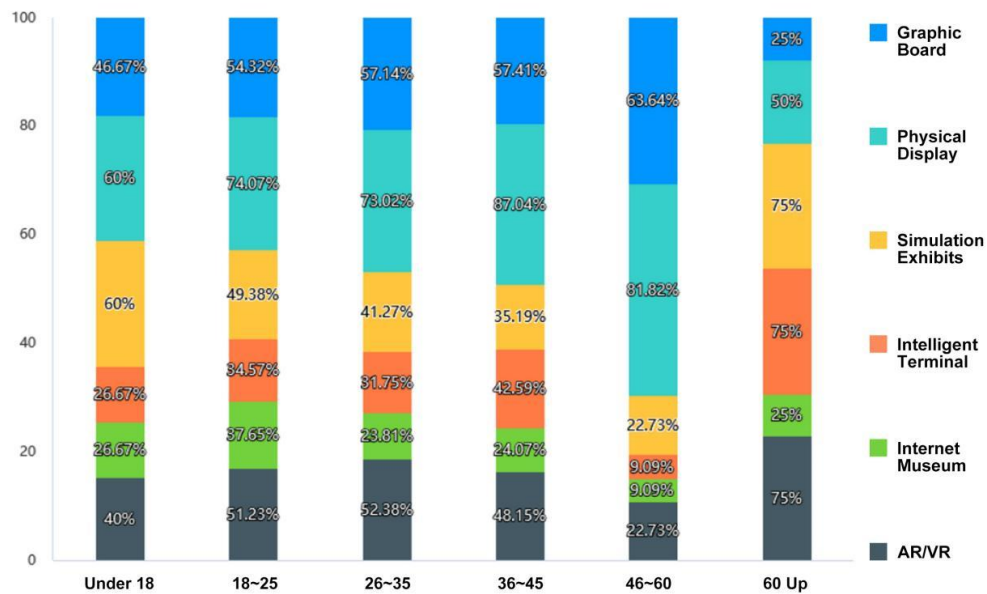


Diagram 48 The attention of museum audiences of different ages to the exhibition format

Source: Drawn by Author, 2022.



Diagram 49 The perceived inadequacy of museum exhibits by museum audiences of different ages

Source: Drawn by Author, 2022.

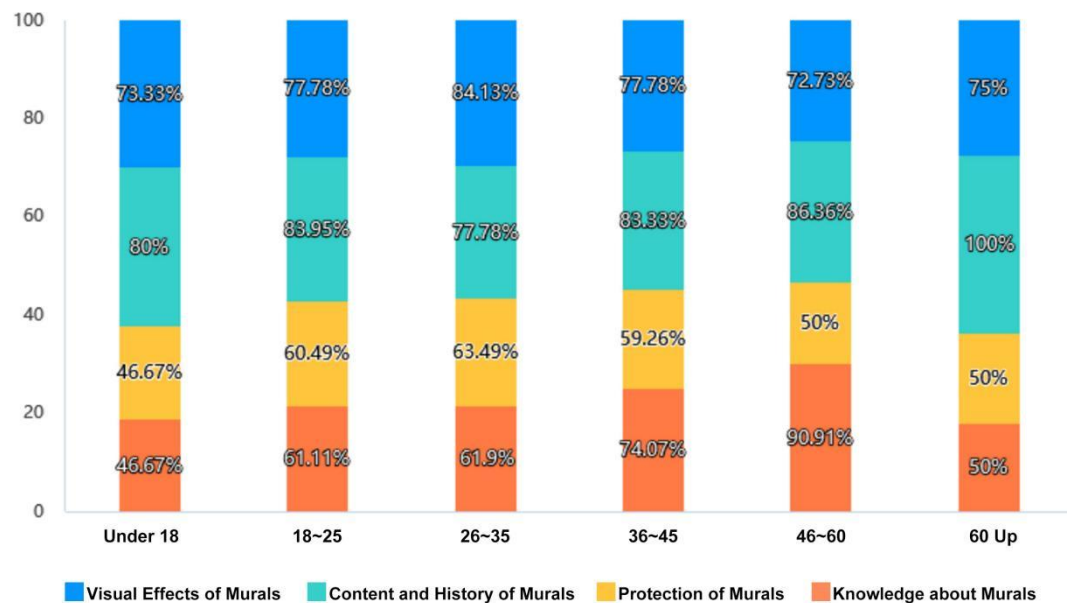


Diagram 50 The cognitive needs of museum audiences of different ages on tomb murals

Source: Drawn by Author, 2022.

Based on a field questionnaire survey and a review of relevant literature, Wanzhen (Wanzhen, 2011) proposes a framework for categorizing museum visitors into four distinct groups based on their visiting needs: potential, ordinary, loyal, and professional audiences. This framework can provide valuable insights into visitor behavior, needs, and preferences, enabling museums to develop targeted strategies to attract and retain visitors and create a more personalized visitor experience.

The first group, potential audiences, includes individuals who have expressed some interest or potential to visit the museum but have yet to do so. The second group, ordinary audiences, includes individuals who have visited the museum once or a few times but have yet to form a strong attachment or loyalty. The third group, loyal audiences, includes individuals who visit the museum regularly and have a strong attachment to it. Finally, the fourth group, professional audiences, comprises experts in the field related to the museum.

By categorizing visitors into these groups, museums can better understand how each group interacts with the museum's content, services, and facilities. This knowledge can help museums develop targeted marketing and engagement strategies to attract and retain visitors, create opportunities for deeper engagement, and improve the overall visitor experience.

Categorizing museum visitors into potential, ordinary, loyal, and professional audiences provides a useful framework for museums to understand their audiences better and tailor their services accordingly. By analyzing visitor behavior, needs, and preferences, museums can develop effective strategies for engaging visitors and creating a more personalized visitor experience.

JingBo (JingBo, 2019a) argues that potential museum audiences are important to attract, as they have expressed interest in visiting museums but have yet to form a habit. However, these potential audiences may be deterred from visiting museums because they perceive museum environments as needing more fun and excitement. Furthermore, potential audiences may have lower levels of education or be less accustomed to acquiring knowledge through museum visits.

To address these issues, JingBo proposes using digital media situation design to create more engaging and dynamic museum exhibitions that align with the needs and preferences of potential audiences. Digital media situation design uses digital media technologies, such as virtual reality or interactive displays, to create immersive and interactive exhibition environments that enhance the visitor experience.

The effectiveness of this approach is supported by the findings of JingBo's study, which suggest that potential audiences are more likely to visit museums if they perceive the exhibitions as relevant, interesting, and interactive. By creating a digital situation design that aligns with the needs and preferences of potential audiences, museums can provide an effective means of attracting this group to visit the museum.

The use of digital media situation design can help museums create exhibitions that are more engaging and dynamic and that align with the needs and preferences of potential audiences. By doing so, museums can attract more visitors and provide a more enriching experience for all.

Wanzhen (Wanzhen, 2011) identifies the general museum audience as the primary group of museum visitors. This audience is typically well-educated and strongly interested in gaining knowledge through museum visits. However, traditional museum exhibitions that lack interactive elements and necessary information may fail to engage ordinary audiences, resulting in decreased enthusiasm for visiting museums.

To address this issue, the researchers suggest using digital media situation design to create participatory and exciting exhibitions that stimulate the enthusiasm of ordinary audiences and increase the immersion of museum visits through the rendering of situations. Through digital media, museums can provide interactive elements that align with the needs and preferences of ordinary audiences and enhance their experience of visiting the museum.

The effectiveness of this approach is supported by research that suggests that the participatory and exciting performance of digital media situation design can increase the immersion and engagement of visitors and improve their overall experience of visiting the museum. By creating a more interactive and engaging exhibition environment, museums can attract and retain the interest of ordinary audiences and provide a more enriching experience for visitors.

The Authors further suggest that museum exhibitions should be exciting and informative for ordinary audiences. Ordinary audiences want exhibition forms to be lighter, which can bring a cognitive burden. Rather, museum exhibitions should be designed to balance excitement and information, creating an enjoyable experience for visitors.

Loyal audiences have a strong interest in museum visits and experiences. They focus on cultural relics and strive to gain in-depth knowledge through their visits. These audiences are typically well-versed in the cultural significance of the relics, and their purpose in visiting museums is to enhance their knowledge further. As such, they strongly demand cognitive stimulation during their visits. Loyal audiences prioritize the quality of their visiting experience. They pay attention to the situation of visiting museums, hoping to use effective methods to break through the limitations of cognitive ability and obtain a richer understanding of the exhibits.

Professional audiences are typically individuals or groups with expertise in studying cultural relics. They possess a comprehensive understanding of cultural relics and the cultural context surrounding them. Their museum visits are primarily focused on furthering academic research in related fields about the cultural relics exhibited by the museum. Professional audiences prioritize gaining knowledge over seeking a fun and engaging experience during their visits. While situational design can enhance the visiting experience of professional audiences, it does not alter their visiting purpose.

Research on audience surveys reveals that most visitors fall into the general audience group, comprising potential audiences, ordinary audiences, and loyal audiences. Their purpose for visiting museums is to acquire knowledge in an engaging environment, which makes them highly attentive to the situational design of the museum and open to incorporating new technological means to enhance their experience (Jingbo, 2019c). Professional audiences are a minority group whose primary aim is to deepen their academic understanding of the related fields. Nevertheless, a good museum situational design can still improve their visiting experience. Categorizing audiences allows researchers to evaluate research concepts and methods based on the diverse needs of different populations.

5.2.5 Summary

The Tang Dynasty was a crucial period in Chinese history, noted for its prosperity and openness. The study of Tang society and culture is of great significance to understanding Chinese national identity and self-confidence and its impact on global culture. The tomb murals of the Tang Dynasty provide valuable insight into the aristocratic culture and offer a necessary cultural relic basis for future generations to study the social development of the Tang Dynasty.

The Shaanxi History Museum boasts an extensive collection of nearly 600 delicate Tang Dynasty tomb murals from more than 20 tombs. The collection includes five designated national treasures and 18 other groups designated as national treasures, with 69 groups of murals considered first-class products. The murals feature two image systems, reflecting the ancient Chinese spiritual concept of "harmony between man and nature" and representing the themes of the natural and spiritual worlds.

Despite its impressive collection, the Tang Dynasty tomb murals exhibition at the Shaanxi History Museum faces several issues that detract from the visitor experience. For example, the long corridor design of the Mural Museum, along with the broken and blurred murals, causes visitors to lose interest in the exhibit. Although the murals have detailed instructions in Chinese and English, there is a need for a navigation map or tourist information guide for visitors to the museum.

The use of dim ambient light and glass showcases to protect the murals further detracts from the visitor experience. The exhibition follows a chronological narrative, but the content depicted in the murals is far removed from the daily life of the ordinary visitor, and the interpretation of the mural's content has a blind area of knowledge.

To address these issues, the researchers surveyed visitors to the Shaanxi History Museum and identified areas for improvement in the museum's exhibition form, visiting situation, and atmosphere. Visitors expected to increase the fun and interactivity during the exhibition to deepen their memory and cognition of the museum visit. Incorporating digital and information technology was suggested to enrich their knowledge acquisition and sharing demand. Most visitors agreed with the research concept and method proposed by the researchers to use digital media technology to intervene in the situational design of museums. They believed that museum visits should stimulate the visitor's thinking and emphasize their active exploration during the visit.

In conclusion, while the Shaanxi History Museum's Tang Tomb Mural Treasures Museum holds an extensive collection of Tang Dynasty tomb murals, improvements can be made to enhance the visitor experience. Incorporating digital and interactive technologies can provide a more engaging and informative exhibition, stimulating visitors' thinking and emphasizing their active exploration during the visit.

5.3 Field test of the content, technology, and space of the exhibition design of the mural museum

5.3.1 Phantasmagoria: digital situational design exhibition of chinese tang dynasty tomb murals

Phantasmagoria: The Digital Situational Design Exhibition of Tang Dynasty Tomb Murals in China represents a novel approach to enhancing audience engagement with cultural heritage. By incorporating digital media into the museum's situational design, this exhibition aims to improve visitors' understanding and appreciation of the artefacts on display (McLean, 1993). Drawing on visitors' prior knowledge as a foundation, digital media serves as a means of conveying information about cultural relics. At the same time, space is used as a carrier for this information, and situational design provides a framework for its presentation (Bogle, 2013). For example, NFC interactive displays and immersive experience technology can give visitors additional context and background information about the Tang Dynasty Tomb Murals (Chaetnalao & Sirivesmas, 2014).

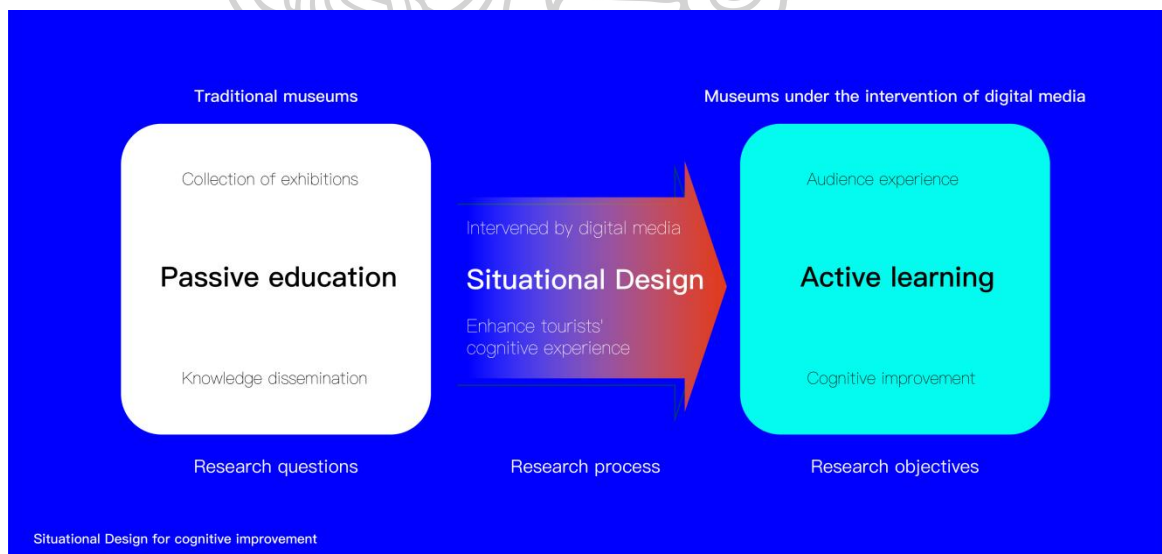


Figure 74 Situational Design for cognitive improvement

Source: Drawn by Author, 2021.

The core of the Phantasmagoria exhibition is the audience's experience, which emphasizes the importance of improving audience satisfaction and cognition in museum exhibitions (Figure 74). In this approach, the audience is a participant and a constructor of the exhibition design, becoming an integral part of the museum's situational design (Danjing, 2021).

The Phantasmagoria exhibition employs cutting-edge digital media technology to enhance audience engagement and participation. By utilizing technologies such as NFC near-field communication and mobile networks, this exhibition facilitates information exchange and sharing among visitors (Shike, 2022). This approach represents a departure from traditional museum exhibition practices, offering new possibilities for interactive and immersive experiences (Dierking & Falk, 1992). Furthermore, the Phantasmagoria exhibition combines dynamic and static displays and draws on traditional Chinese cultural concepts such as yin and yang theory. In this way, digital media is used to interpret traditional Chinese culture in a contemporary context (Zhang et al., 2019).

The Phantasmagoria exhibition offers an immersive digital experience that brings visitors closer to cultural artefacts (Danks et al., 2007). This exhibition encourages active exploration and engagement by facilitating communication and dialogue between visitors and mural cultural relics. Through its emphasis on audience participation and interaction, the Phantasmagoria exhibition enriches visitors' understanding of the fashion and culture of the Tang Dynasty. The digital situational design of this exhibition represents a solution to the challenges museum exhibitions face in a rapidly changing technological landscape.

Phantasmagoria's design inspiration comes from the deconstruction and redesign of the muraled tomb structure of the Tang Dynasty, which served as a ceremony site for the Tang Dynasty Chinese to realize the transformation of life and death under the guidance of the belief in rebirth (Xiaoyang, 2018a). By combining traditional knowledge about Tang Dynasty tomb murals with contemporary exhibition design concepts and techniques, this exhibition reimagines the space and context of Tang Dynasty tomb mural displays for a digital age.

Digital media technology in museum exhibitions aims to enhance the audience's visiting experience and cognition of cultural relics. The Phantasmagoria exhibition offers new ideas for the digital situational design of Tang Dynasty tomb murals, providing a model for digital protection.

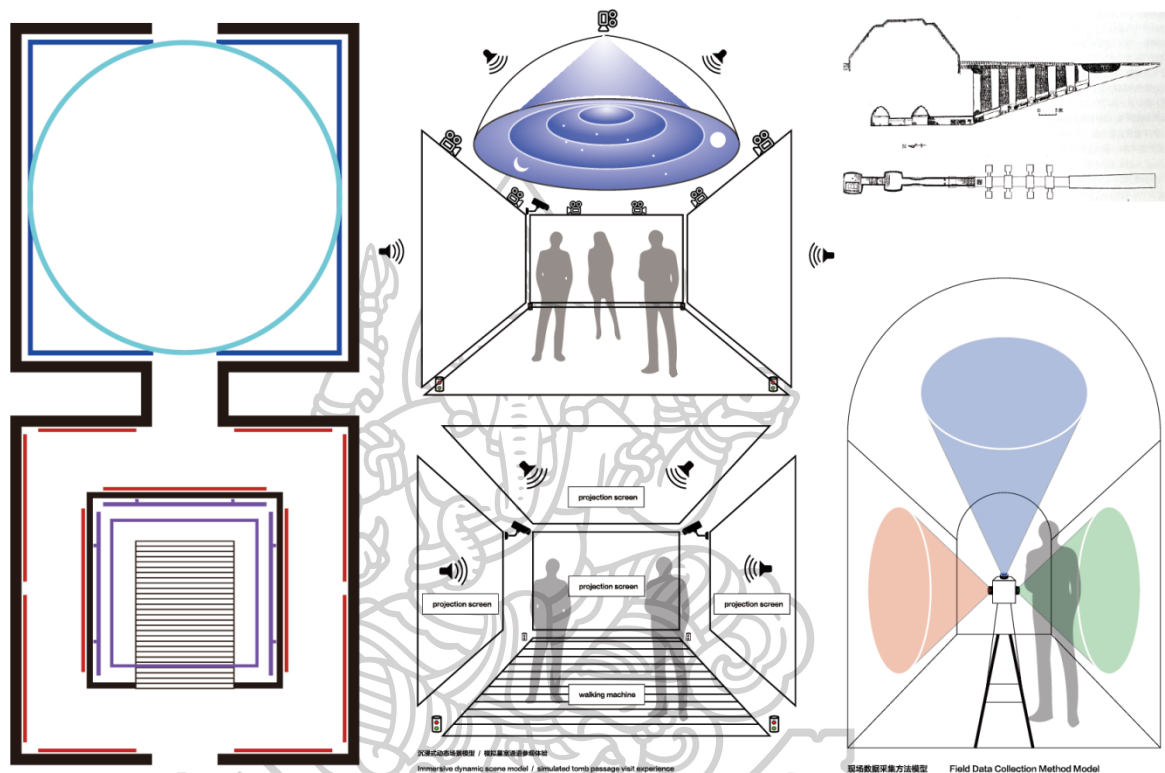


Figure 75 The sketch of content and Interactive technology for the experiment

Source: Drawn by Author, 2021.

5.3.2 The concept of exhibition design of the Mural Gallery

1. The Authors thoroughly analyzed the mural tombs from the Tang Dynasty, both on-site and through a study of historical documents. Their investigation included an examination of the structure of the tombs, as well as the measurement of relevant dimensional data and an analysis of the characteristics of the tomb chamber structure (Bai, 1982). Based on this research, the Authors performed a classification study of the shape and characteristics of the Tang Dynasty mural tombs, identifying the key elements with structural features that were used in designing the exhibition space for the tomb murals at the museum. The Authors also determined the appropriate size

of the museum exhibition space, developed a layout plan and loaded the content into the new design space.

2. This research presents the first draft of the mural exhibition and digital media technology design for showcasing the Tang Dynasty tomb murals. The design, depicted in (Figure 75), incorporates various strategies to enhance visitors' experience and understanding of the murals.

Firstly, the design integrates the Tang Dynasty mural tomb structure into the new exhibition space design, considering the inner meaning of the space layout and planning.

Secondly, the design utilizes a walking simulator and panoramic display technology to simulate the dynamic process of visitors visiting Tang Dynasty mural tombs. Through this panoramic exhibition method, the researchers hope to present the content structure and story narrative of the Tang Dynasty tomb murals to visitors, making it easier for them to have a preliminary understanding of the exhibition of the murals and arousing their interest in visiting (Hong & Surin, 2018).

Thirdly, the researchers arranged the digital high-definition inkjet mural replicas in the corridor of the exhibition hall according to the original order of the Tang tomb murals. Visitors can use the NFC function of their mobile smart device to communicate with the NFC chip buried behind the mural to the part of the mural that they are interested in during the visit. This design aims to enable visitors to obtain the content information in the murals in real time and efficiently.

Fourthly, digital media technology restores the damaged and incomplete parts of the Tang Dynasty tomb murals, and visitors can interact with the digital media to improve their visiting cognition.

Lastly, the new exhibition area of the museum adopts the digital media dynamic display technology integrating projection to provide visitors with a systematic and panoramic dynamic image immersion experience. The dynamic demonstration of projection technology will break through the shackles of the traditional static exhibition of murals. The visual multi-angle display and assistance of audio information will elevate visitors' experience of visiting the murals in the tombs of the Tang Dynasty.

The presented design aims to provide visitors with an immersive and informative experience while visiting the Tang Dynasty tomb murals.

3. In this research, to ensure that the digital interaction technology used in the design of the mural exhibition and digital media technology achieves the design goals, it is necessary to systematically test the technology involved in the design process. This research outlines the testing process for the digital media interaction technology, which focuses on the audience's safety, the accuracy of the digital interaction technology, and the exhibition design and guarantee. This thesis outlines our methodology and findings.

First, researchers should test the design space's human sensor and security imaging system to ensure the audience's safety. During a tour of the walking simulator, it is essential to ensure that the human sensors are working accurately to monitor the audience. Researchers may combine the CCTV system to eliminate possible safety hazards and ensure the smooth operation of the dynamic mural simulator. During the installation and debugging process, researchers must test the installation position, lumen setting, and image clarity of the projection instrument to ensure the regular operation of the projection image system.

Second, the researchers should test the installation location of the NFC chip and the sensor's sensitivity to ensure the accuracy of the digital interaction technology. The NFC chip will connect the audience's smart device and the mural database. The correct and regular operation of the NFC chip will directly affect the friendliness of the audience's visiting experience (Figure 76).

Finally, the exhibition hall's lighting system, the light's brightness, and the emergency system must also become essential to the exhibition design and guarantee. Researchers should test these systems to ensure they operate correctly and provide a comfortable and safe environment for the audience (Figure 77).

In conclusion, this research outlines the testing process for the digital media interaction technology involved in designing the mural exhibition and digital media technology. By systematically testing the technology, researchers can ensure that the digital interaction technology used in the design process achieves the expected goals

of the design, provides an accurate and friendly experience for the audience, and guarantees a safe and comfortable environment in the exhibition hall.



Figure 76 The use of NFC interactive technology in art exhibitions and daily life

Source: Drawn by the Author, 2021.



Figure 77 Comparison of traditional museum exhibition lighting based on cultural relics protection and lighting effects based on digital media exhibitions

Source: Drawn by the Author, 2021.

4. The new exhibition area is divided into real-world and virtual-world concepts, each requiring different digital media technology to enhance the visiting experience. The digital media technology should be tailored to the display needs of each space. In the real-world concept, digital technology is integrated with visual and auditory

sensations to enhance the audience's perception. For instance, panoramic displays and walking simulators give visitors an immersive experience of the Tang Dynasty tomb murals. In the virtual world concept, digital media technology creates a dreamlike environment stimulating the audience's imagination. It is achieved through projection technology and audio equipment, creating a multisensory visitor experience. These technologies offer a novel visitor experience by transforming how visitors interact with and understand the murals (Qi, 2020).

5.3.3 Space design inspiration:

Phantasmagoria refers to a constantly changing medley of real or imagined images. In the Tang Dynasty, the Chinese placed significant importance on constructing tombs, believing them to be ceremonial sites for transforming life and death under the belief in rebirth. With the continuous improvement of the structural form of Mural Tombs during this period, the Tang Dynasty finally determined that the architectural structure of the grave consisted of six parts, namely the slope tomb, the passage, the patio, the small niche, the corridor, and the burial chamber (Bai, 1995) (Figure 78).

The architectural structure of the mural tombs in the Tang Dynasty has served as a source of inspiration for the design of the new exhibition space at the Mural Museum (Figure 79). The high-level tombs of the ancient Tang Dynasty mural tombs typically adopted the form of double chambers. To redesign the spatial structure of the mural museum, researchers deconstructed and reorganized the tomb structure and combined the needs of modern museum space display, leading to the development of a new pavilion in two parts (Figure 80).

The utilization of digital technology with projection and audio technology has transformed the way researchers create situational experiences in the exhibition space. The design concept is centred around providing the audience with a direct and authentic experience of the real-world space through participatory activities. The virtual world experience is based on the movement state of the real-world space and primarily relies on the interaction of feelings and thinking.

Digital technology plays a crucial role in creating the situational design of the virtual world, where the audience can maximize their imagination and extend their understanding of mural art. Both designs perfectly represent the dynamic and static

combination in Chinese Yin-Yang theory, which is an abstract expression of Chinese culture and a subconscious expression of the audience's cultural identity (Lei, 2013). By enhancing the audience's cognition via vision, hearing, and imagination, the combination of both designs provides an immersive and interactive experience.



Figure 78 The structure of the mural tomb in the Tang Dynasty
Source: Photographed by the Author, 2021.

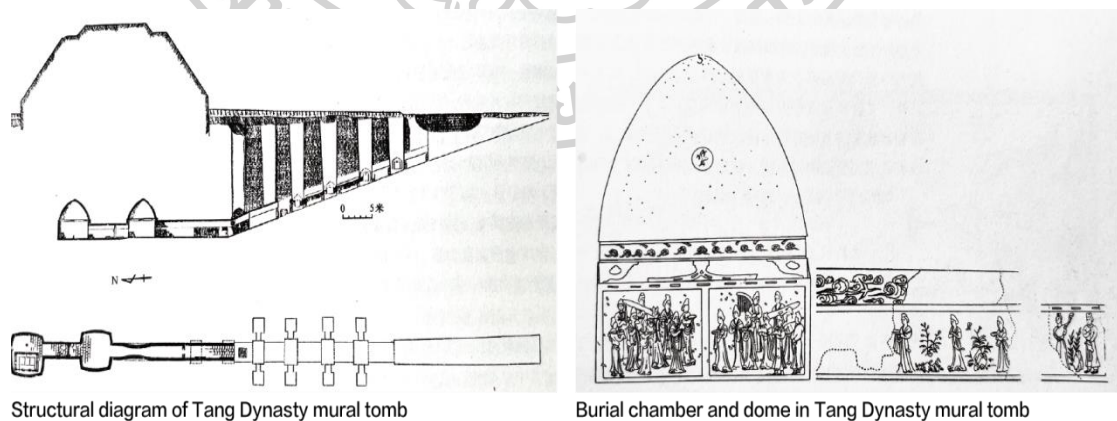


Figure 79 Structural diagram of Tang Dynasty mural tomb
Source: Drawn by the Author, 2021.

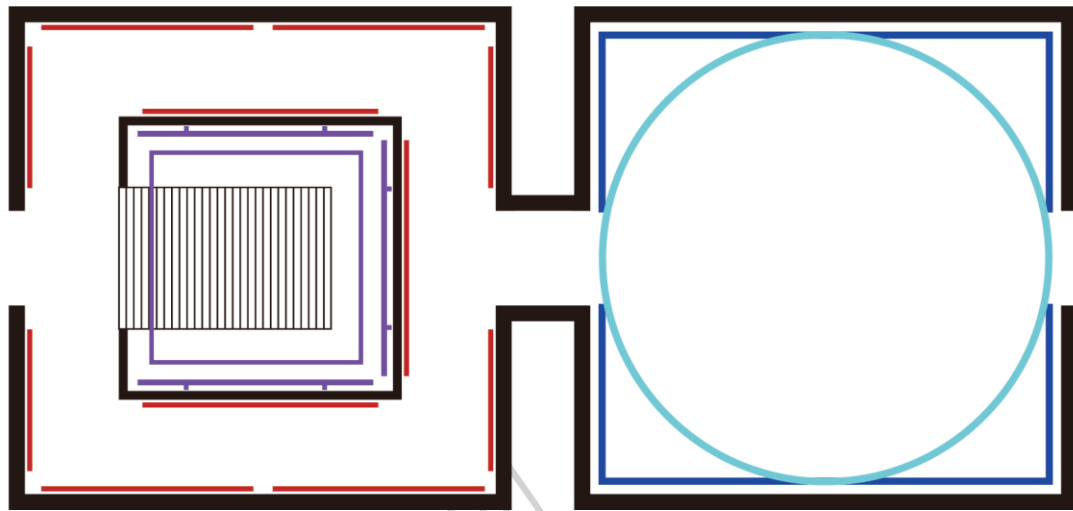
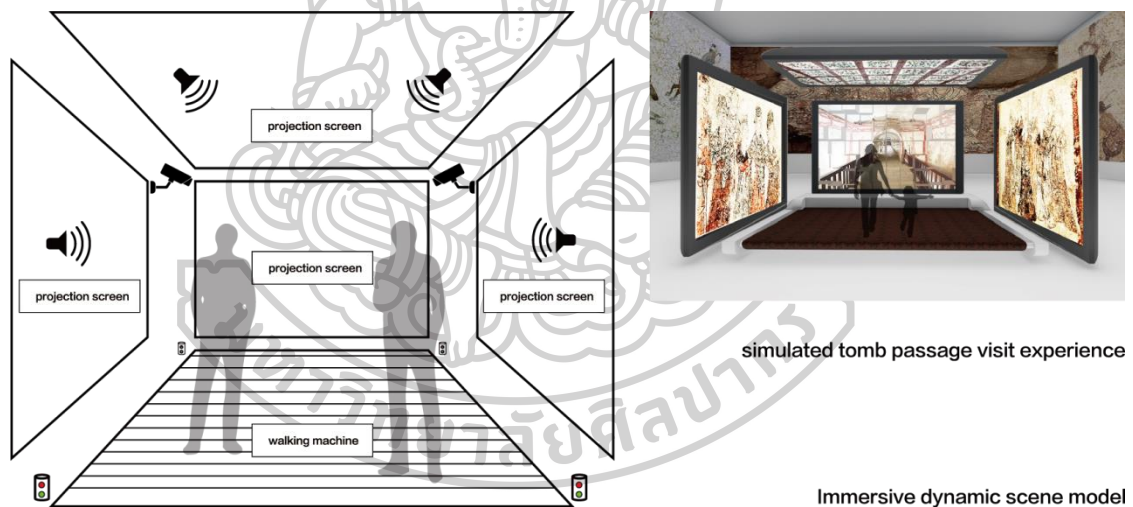


Figure 80 Plane structure drawing of the new exhibition hall of the Tang Dynasty mural tomb

Source: Drawn by the Author, 2021.



simulated tomb passage visit experience

Immersive dynamic scene model

Figure 81 Display and install the walking simulator, rendering the presentation scene

Source: Drawn by the Author, 2022.

5.3.4 Prototype: Walking Simulator

This paragraph describes the digital situation design of a Tang Dynasty mural tomb that uses a walking simulator and panoramic display technology. This design is the first digital media interaction project that allows the audience to participate in an exhibition hall (Figure 81).

The walking simulator is used to simulate a visit to the tomb passage of the Tang Dynasty mural tomb. The audience can visually observe the video works presented by the equipment in front, above, left, and right. The movement frequency of the audience is monitored through a human sensor, and the coordination of motion, video, and audio data is adjusted to ensure movement speed, video presentation, and audio synchronization during the visit.

The security imaging system of the network camera matches the image information of the human sensor data to ensure the regular operation of the device. The content of the video presentation starts from the entrance of the Tang Dynasty mural tomb. It sequentially demonstrates the process of passing through the slope tomb, the passage, the patio, the small niche, the corridor, and the burial chamber according to the architectural structure of the Tang Dynasty mural tomb.

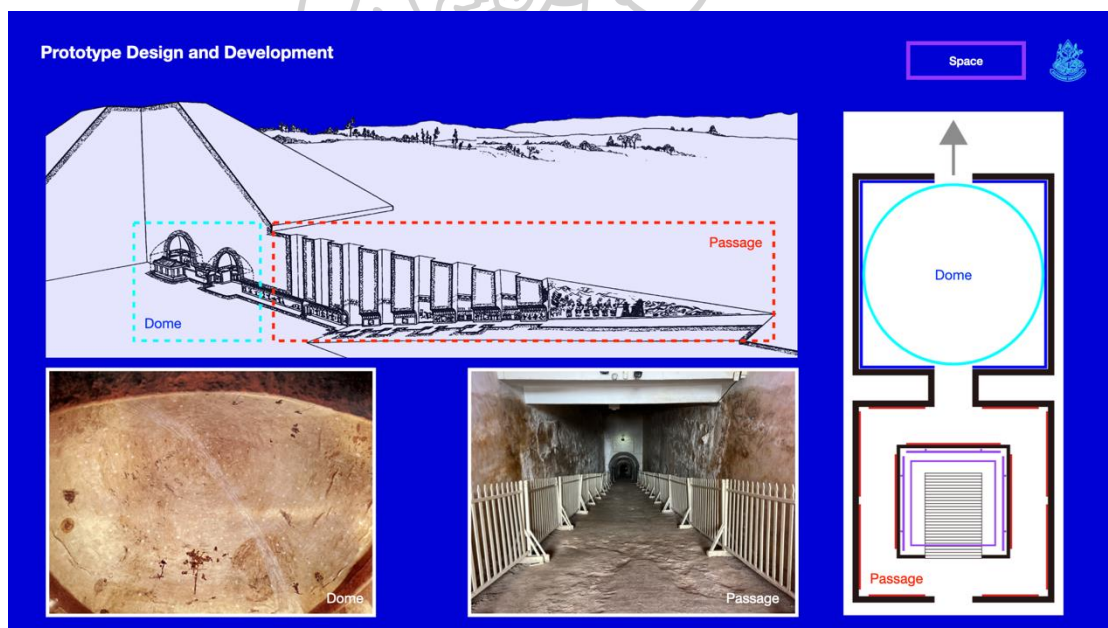


Figure 82 The design of the exhibition space for the museum was based on the division of the space into two parts

Source: Drawn by the Author, 2022.

The video demonstrates the tomb murals in the corresponding tomb passage building structure. The introduction of the auxiliary audio system allows the audience to intuitively experience the imaging system inside and outside the mansion carried by the tomb murals of the Tang Dynasty (Figure 82).

The Walking Simulator was inspired to recreate a visit to a Tang Dynasty mural painting tomb by presenting the tomb murals in their original state. The researchers' original intention for the scenario design of the walking simulator was to allow the audience to understand Tang Dynasty mural tombs and tomb murals through a panoramic information display and lay the cognitive foundation for subsequent visits.

Overall, this paragraph highlights the use of digital technology to enhance the audience's understanding of a historical site and its cultural significance. The design creates an immersive experience that allows visitors to learn about the Tang Dynasty mural tomb and its architecture in an informative and engaging way.

Design and Development

The walking simulator uses the control system to process the motion data of the audience obtained from the human sensor and network camera monitoring, adjust the output speed of the image and audio data in real-time, and realize the collaborative work of the walking simulator equipment (Congqi, 2016). According to the function classification, the walking simulator consists of three systems: movement, information transmission, and data monitoring.

In recent years, walking simulators have become increasingly popular in providing immersive experiences for museum visitors and other attractions (Lindgren et al., 2016). These simulators use advanced technology to create a realistic environment where visitors can explore and interact with the surroundings. The motion system of walking simulators is a critical component of the technology, providing safe and adjustable movement for users (Figure 83).

The development principle of the motion system is based on airport moving walkways (Auto walk) designed to provide a slow-moving conveyor mechanism for people's movement over short distances. The walking simulator's motion system adjusts the movement angle and can drive users to move at a horizontal or inclined plane angle, creating a realistic and immersive experience for visitors (Figure 84).

Safety is a top priority in the design of walking simulators, given the nature of the technology and the potential for accidents. Researchers thoroughly analyze the museum's visiting population composition to identify user groups' movement needs, such as children, the elderly, and adults. Through multiple data collection, analysis, and summaries, researchers determine the appropriate movement speed for different groups of people.

This part of the research aims to ensure that the walking simulator meets the visiting needs of different user groups. The walking simulator uses human sensors and webcams to collect data on human motion state and audience age. The walking simulator adjusts motion speed appropriately for different ages. After experimental verification, the final data for the motion system's design speed will be written into the computer control program to ensure it meets the visiting needs of different user groups.

In addition to the motion system, walking simulators comprise two other critical systems: information transmission and data monitoring. The information transmission system enables the walking simulator to transmit data between different systems and devices. In contrast, the data monitoring system allows operators to monitor and control the walking simulator's real-time performance.

Overall, the development of walking simulator technology requires a motion system that prioritizes safety and adjustable movement for different user groups. Researchers can collect data and analyze user needs to develop a motion system that meets the visiting needs of different user groups. By understanding the importance of safety, motion system design principles, and how to determine the appropriate movement speed for different user groups, researchers can develop walking simulators that provide a safe and immersive experience for visitors to museums and other attractions. (Chaetnalao, 2014).

The researchers designed an acquisition system to collect high-quality image data of the mural paintings in the tomb passage of the original Tang Dynasty mural tomb (Figure 85). The system's cameras are positioned on the front, top left, and right of the device to ensure that images are captured from every possible angle. Additionally, slide rails on the tomb passage provide uniform motion during the image

acquisition. The use of slide rails prevents any jerky or shaky movements, which could otherwise lead to the production of blurry or distorted images.

Additional lighting equipment was installed to ensure adequate light was available during image acquisition. The researchers used high-quality lighting equipment to produce optimal lighting conditions that enabled the cameras to capture accurate and vivid images of the murals.

The image information acquisition system ensures smooth image acquisition through uniform motion, and multiple shots are taken to obtain enough image samples for analysis. By taking multiple shots, researchers can increase the likelihood of capturing high-quality images, even if one or two shots do not turn out as expected (Figure 86).

After the image data has been collected, it undergoes post-processing on a computer. The post-processing includes color correction and speed matching to ensure that the images are high quality and ready for use in the demonstration system. The color correction process adjusts the images' brightness, contrast, and color balance to enhance their quality and accurately depict the original murals (Diagram 51).

Mural image restoration is repairing damaged or missing areas in a mural image to restore its visual appearance. While existing image inpainting methods have successfully repaired specific objects like human faces, fabric textures, and printed words, they are unsuitable for restoring murals with diverse themes, especially those with large damaged areas (Singh & Bansal, 2020). This study proposes a novel approach to mural restoration using a source code called "MuralNet," which guides progressive restoration based on line drawings of damaged murals. The inpainting process is divided into structure reconstruction and colour correction, performed by the structure reconstruction network (SRN) and colour correction network (CCN). SRN uses line graphs to guarantee large-scale content authenticity and structural stability in structural reconstruction. In colour correction, CCN performs local colour adjustments for missing pixels to reduce the negative effects of colour bias and edge jumping. The proposed approach effectively restores murals with diverse themes and large damaged areas, and the experimental results demonstrate its superior performance compared to existing methods.



Figure 83 The application of digital immersion experience in sports

Source: Drawn by the Author, 2022.

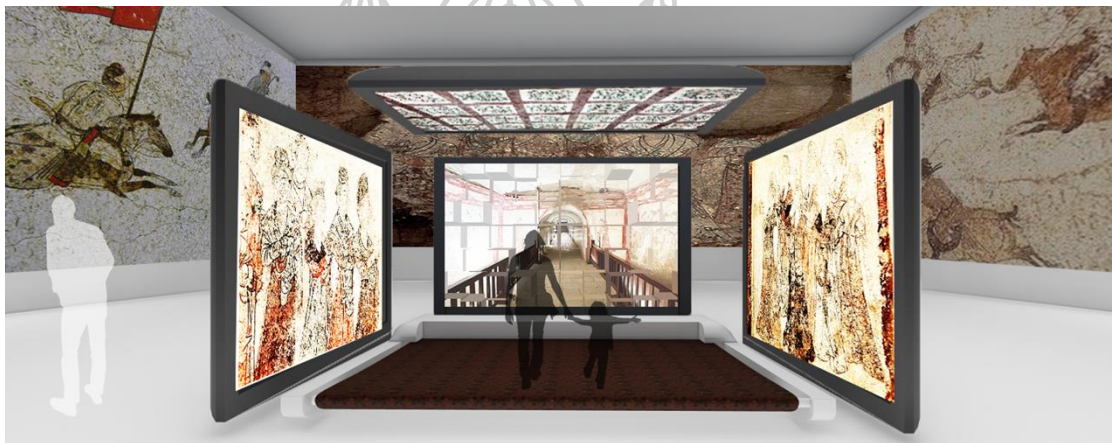


Figure 84 The design sketch of the walking simulation system for the digital exhibition of Tang Dynasty tomb murals

Source: Drawn by the Author, 2021.

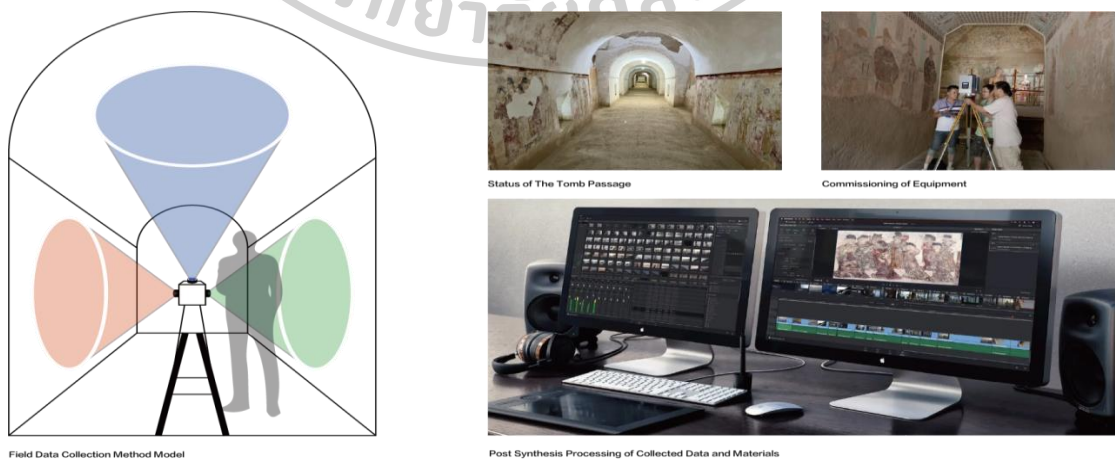


Figure 85 Image information acquisition system

Source: Drawn by the Author, 2021.



Figure 86 Data collection of murals in Tang Dynasty tomb chambers

Source: Photographed by the Author.

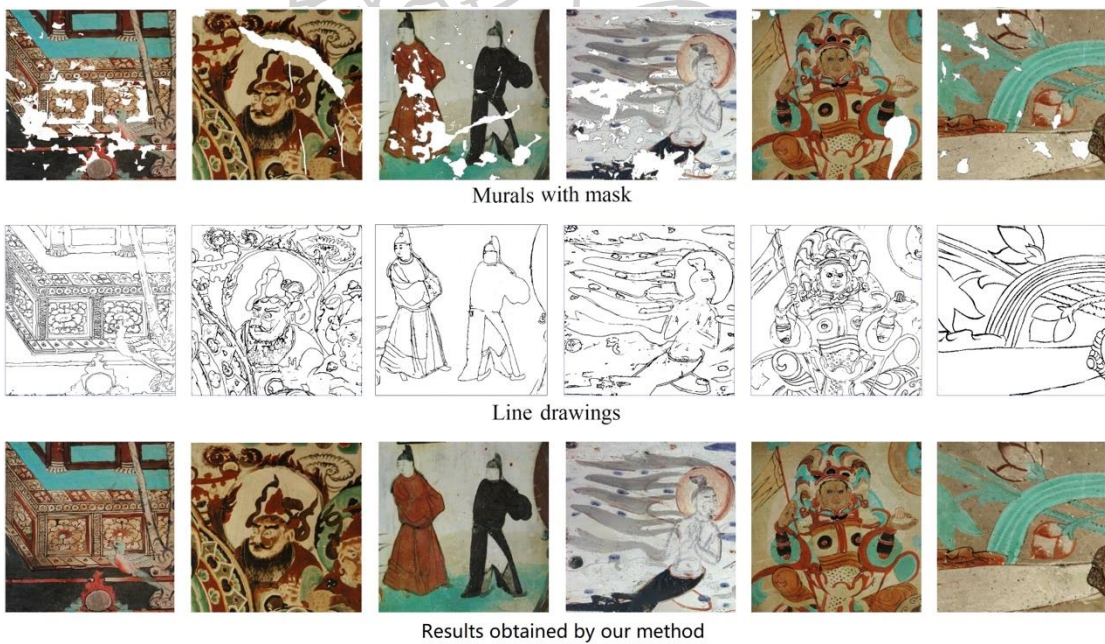


Diagram 51 The mural restoration based on the MuralNet software code, and the line drawing of the damaged mural guide the progressive restoration

Source: Drawn by the Author, 2023.

Analysis

Analyze the murals' preservation state and define damaged or missing areas.



Summary

A computer-aided line-drawing-guided progressive approach to mural painting for a definition of structural reconstruction and colour correction.



Restoration

In the restoration of the structure, using the software code, the line drawing is used to guarantee the authenticity of the large-scale content and the stability of the structure. In colour correction, software codes adjust the colour of missing pixels locally, reducing the negative effects of colour deviation and edge jumping.



Diagram 52 Schematic diagrams of the mural restoration process based on the MuralNet software code

Source: Drawn by the Author, 2023.

The restoration process of Tang Dynasty tomb murals can be divided into three main parts: analysis, induction, and restoration (Diagram 52). During the analysis phase, the murals' preservation state is assessed to identify damaged or missing areas. This information is then used to guide the subsequent restoration process.

In our restoration approach, we employ a computer-aided line-drawing-guided advanced method for structural reconstruction and colour correction. This approach involves using software code to create line drawings that guarantee the authenticity of the large-scale content and the stability of the structure. Additionally, colour correction is achieved by locally adjusting the colour of missing pixels to reduce negative effects such as colour deviation and edge jumping.

Our approach offers a highly effective means of restoring murals, especially those with diverse themes and extensive damage. By utilizing digital technology, we ensure that the restored murals maintain their original style and cultural value and are suitable for display as digital relics.



Figure 87 Walking Simulator

Source: Drawn by the Author, 2023.

Furthermore, our findings contribute to the ongoing exploration of digital innovation in Tang Dynasty tomb murals with cultural communication value. We have determined the basic principles of restoring Tang Dynasty tomb murals through our methods. These principles involve the intervention of digital technology to ensure that the original style of the murals is maintained and that they retain the value attributes of cultural relics. Our approach also realizes the digital visual transformation of the tomb murals, which can be explored further to meet the needs of different groups of people.

The digitized content generated by our research will be used in subsequent digitized visual displays of Tang Dynasty tomb murals and forms an essential part of this doctoral research. Overall, our approach offers a highly effective means of restoring Tang Dynasty tomb murals, with the potential to inform future research and contribute to the exploration of digital innovation in cultural heritage preservation.

In addition to the image data, the audio part of the demonstration system includes playing music in the Chinese Tang Dynasty style and explaining the tomb murals. The researchers completed synthesizing sound effects and audio tracks on the computer. They then adjust and merge the video and audio files to create a seamless presentation of the tomb murals (Figure 87).

To complete the development of the demonstration system, the programming team tests and debugs the software thoroughly. They ensure that all aspects of the demonstration system, including image acquisition, post-processing, and audio tracks, work together seamlessly. Through this comprehensive process, the researchers create a user-friendly, educational, and visually stunning demonstration system that showcases the beauty and significance of the Tang Dynasty mural tomb (Figure 88).

This study's image acquisition and post-processing system are crucial for preserving and sharing cultural heritage. The system's ability to capture high-quality images of historical murals provides researchers with valuable data for analysis and helps to promote cultural awareness and understanding. Developing such systems highlights the importance of technological innovation in preserving and disseminating cultural heritage. This technology is especially important for inaccessible historical sites and artifacts or with limited visiting times (Wei et al., 2007).



Figure 88 The sketch display of the situation design of the tomb murals of the Tang Dynasty restored by digital technology
Source: Drawn by the Author, 2023.

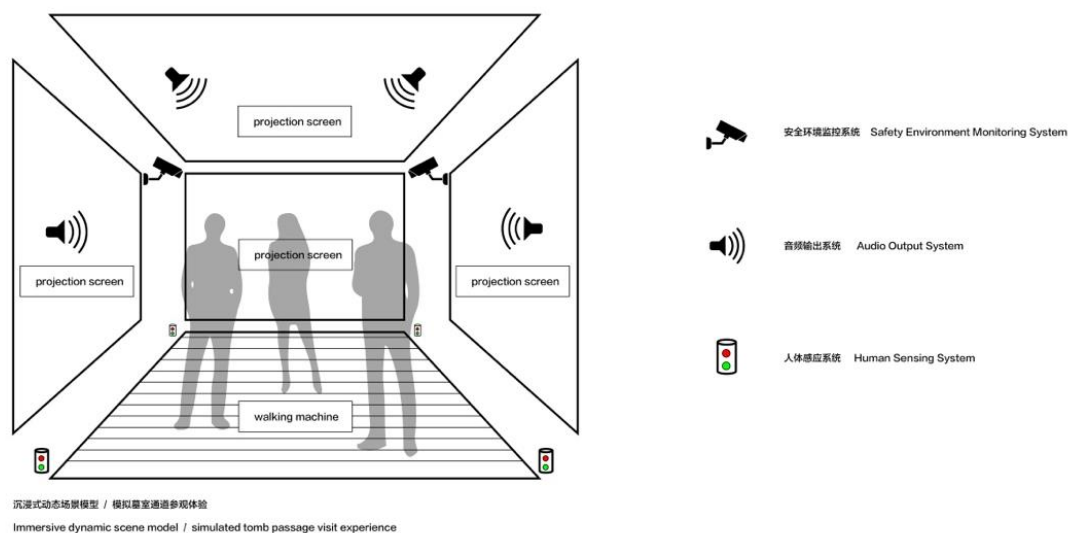


Diagram 53 Schematic diagram of the structure of the data monitoring system and the human body sensor system
Source: Drawn by the Author, 2023.

The data monitoring system is a crucial component of the walking simulator equipment, functioning as its nervous system that coordinates data and safety monitoring. The system comprises two subsystems, namely the human body sensor system and the safety monitoring system, working in tandem to ensure the safe and optimal operation of the simulator.

The human body sensor system is attached to the side of the walking simulator. Its purpose is to detect the entry and exit of visitors and monitor their movement state. The system collects and transmits data in real-time to the computer operating the motion and information systems based on a programmed algorithm. It enables the walking simulator to adjust its speed and angle to match the visitors' movements, providing a safe and comfortable experience (Diagram 53).

The image monitoring system works in conjunction with the human body sensor system by performing a secondary comparison of the data returned by the sensors. It ensures that the human body sensor system functions correctly and provides accurate data. The image monitoring system also plays a vital role in monitoring the visitors' movements and ensuring their safety during the visit. Networking the image monitoring system with the museum security system further enhances the monitoring capabilities and effectively responds to emergencies during the visit.

The safety monitoring system ensures that the walking simulator operates safely and optimally. It checks for any malfunctions in the system and provides timely warnings to prevent accidents or injuries. The safety monitoring system is vital in ensuring the simulator operates within safe parameters, such as speed limits and angle ranges.

Overall, the data monitoring system is critical for museum walking simulators' safe and efficient operation. The system's ability to collect and transmit real-time data on visitor movements and ensure the simulator's safe operation makes it an invaluable technology component. It highlights the importance of technological innovation in designing and developing museum exhibits, especially in providing visitors with an immersive and educational experience while ensuring their safety.

Media technology: moving walks, projectors, human sensors, webcams, computer.

5.3.5 Prototype: digital mural and NFC technology

The concept of digital murals presented in this research represents a significant departure from previous forms of digital technology interventions in painting exhibitions. According to the current data collection and research in Chinese museums,

museum exhibitions that combine digital and painting concepts typically utilize digital media technology's dynamic characteristics to intervene in the painting exhibition. In other words, they extend the traditional form of painting by displaying it through the media characteristics of digital technology (Figure 89).

However, the digital murals presented in this research aim to emphasize the digital information interaction between the painting itself and the audience. Therefore, this research on digital murals seeks to improve the audience's understanding and appreciation of tomb murals through digital technology, utilizing more convenient digital interaction to provide visitors with a professional and intuitive visiting experience.

To achieve this goal, the researchers developed a digital mural system combining multimedia technology principles, interaction design, and information visualization (Figure 90). The system uses various digital technologies, such as interactive projection, sensing technology, and multimedia database technology, to create an immersive and interactive exhibition environment.



Figure 89 An exhibition using the media characteristics of digital technology to display traditional paintings

Source: Tokyo National Museum, Japan, 2022.

Visitors can interact with the tomb murals through this digital mural system in new and engaging ways. For example, visitors can use hand gestures to zoom in and out of the murals, rotate them, and explore different angles. They can also interact with the murals through touchscreens, which provide detailed information about their historical context, artistic features, and cultural significance.

Moreover, the digital mural system can dynamically generate three-dimensional images based on two-dimensional murals. These three-dimensional images give visitors a more comprehensive understanding of the tomb murals and allow them to explore them in greater detail.

The researchers also conducted a user study to evaluate the effectiveness of the digital mural system. The results showed that the system significantly improved visitors' understanding and appreciation of the tomb murals. The visitors also reported higher engagement and satisfaction with the exhibition experience.

The development of the digital mural system presented in this research represents a significant advancement in digital technology in museum exhibitions. By emphasizing the digital information interaction between the painting and the audience, the system provides visitors with a professional and intuitive visiting experience. It promotes a deeper understanding and appreciation of tomb murals. This research demonstrates the potential of digital technology to revolutionize how we approach and experience cultural heritage.

The use of digital technology in museums will revolutionise the way visitors experience art and cultural heritage. Among the latest trends, digital murals are gaining attention in Chinese museums as an innovative way to enhance visitors' immersion and interaction with tomb murals. This research aims to provide a detailed analysis of digital murals and their unique features compared to other digital technology interventions in painting exhibitions. Moreover, it highlights the exhibition hall's design and structure, emphasising the circular corridor's role in improving visitors' immersion and interaction with the murals. The research discusses the role of NFC technology in simplifying the interaction process between the audience and cultural relics, making the visit more participatory.



Figure 90 A design sketch of a digital mural exhibition system that combines multimedia technology principles, interaction design and information visualization

Source: Drawn by the Author, 2022.



Figure 91 Feasibility exploration of digital restoration of tomb murals in Tang Dynasty

Source: Drawn by the Author, 2023.

Digital Murals:

The concept of digital murals differs from previous digital technology interventions in painting exhibitions. While traditional digital exhibitions involve integrating digital media technology with traditional art forms, digital murals emphasise the interaction between the painting and the audience. The aim is to improve the audience's cognition of tomb murals through digital technology, enabling them to obtain a professional and intuitive visiting experience (Figure 91). The digital murals in the research emphasise the digital information interaction between the painting itself and the audience, providing a unique way to enhance the audience's visiting experience in Chinese museums.

Exhibition Design:

The exhibition of digital murals is displayed in a circular corridor, simulating the tomb passage structure of ancient Tang mural tombs (Diagram 54). The reproduced high-definition tomb murals are arranged in the circular corridor in a clockwise order according to the murals' form and the story's narrative order so that visitors can plan their travel direction according to the narrative of the murals. This design lets visitors experience the tomb's murals' situational space, increasing their immersion in the visiting experience. The circular corridor structure of the exhibition hall is unique and well-suited to display the murals. The design concept of the corridor derived from the Chinese people's national belief in the reincarnation of life and death guided by the belief in rebirth, which is a spiritual identity shared by oriental culture, especially oriental civilisation with the background of Buddhist culture (Figure 92).

NFC Technology:

Researchers installed high-definition digital inkjet-painted tomb mural replicas on the corridors' walls and NFC chips behind the replicas to facilitate interaction between the audience and the murals. NFC technology simplifies the interaction process between the audience and cultural relics, making the visit more participatory. All the murals with interactive functions mark with NFC-touch icons, and visitors only need to lift the intelligent device with NFC function to touch the icons, quickly obtaining the relevant information about the murals. Compared with the similar interaction mode of existing museums, NFC technology has many advantages, such as

fast response, accurate information, and saving power consumption of smart devices. The audience's interaction with the help of NFC technology increases participation in the museum visit, and the audience survey data helps researchers plan the installation location of the NFC chip to ensure that the audience can effectively obtain the information content of the mural part of interest during the visit (Han & Yan, 2012).

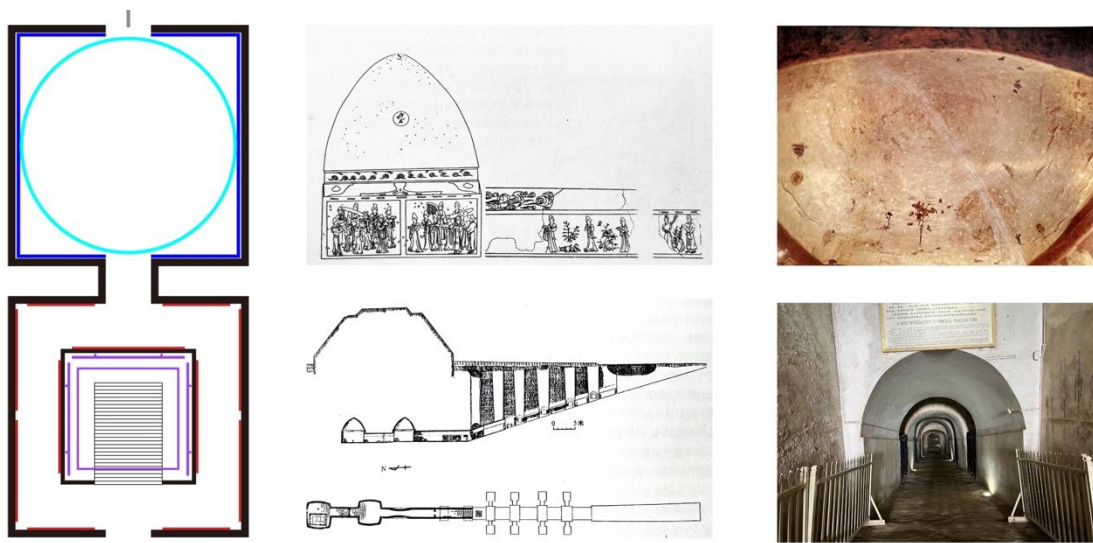


Diagram 54 The exhibition of digital murals is displayed in a circular corridor, simulating the tomb passage structure of ancient Tang mural tombs, Dynasty

Source: Drawn by the Author, 2022.

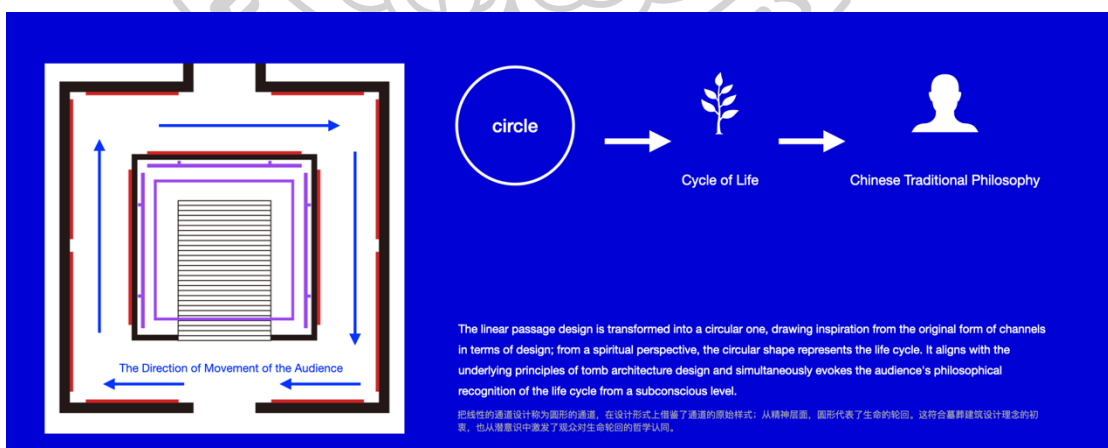


Figure 92 The design of the corridor of the exhibition hall embodies the concept of reincarnation in traditional Chinese culture

Source: Drawn by Author, 2021.

The use of digital murals in Chinese museums is a novel approach to enhancing visitors' interaction and immersion with tomb murals. The exhibition's circular corridor structure and NFC technology simplify the interaction process between the audience and cultural relics, making the visit more participatory. This paper's research on digital murals aims to improve the audience's cognition of tomb murals through digital technology. This new form of exhibition is gaining popularity in China's museums. The concept of digital murals represents a new and innovative way to showcase art, which provides a unique and immersive experience to visitors.

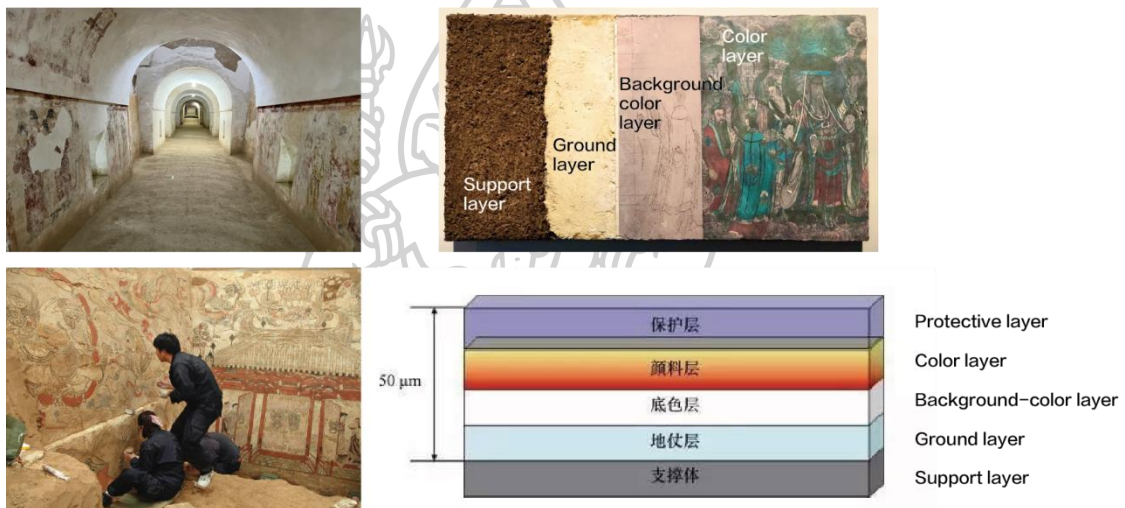


Figure 93 Layer structure of murals

Source: Drawn by the Author, 2021.

Design and Development:

Researchers in two distinct parts developed the corridor digital mural exhibit. The first component involved the restoration of the museum wall's original texture. In contrast, the second component was integrating interactive NFC (near-field communication) technology into the digital mural exhibition (Shuangshuang, 2015). This innovative approach allowed for a unique and immersive experience for visitors, providing a new dimension to the traditional concept of a museum exhibit. The use of NFC technology, in particular, enabled visitors to interact with the exhibit and access additional information about the artworks displayed. Overall, the digital mural exhibit's

design and implementation provided museum visitors with a modern, engaging, and informative experience, highlighting the possibilities of integrating technology and art meaningfully.

The research provides insights into the basic structure of ancient Chinese mural walls and the use of modern technology to reproduce high-precision replicas for exhibitions. It can be further developed to provide more details and enhance the logical flow of ideas.

Ancient Chinese mural walls are composed of three layers: a support layer, a ground layer, and a pigment layer. The support layer typically contains coarse mud and wheat straw, while the ground layer comprises fine mud and lime. The top layer is the paint layer used to adorn the tomb murals. In the modern exhibition environment, the ground layer Produced using traditional techniques is divided into a matrix of equal proportions. This division facilitates the positioning of later image printing using a positioning system and digital printing equipment (Figure 93).

Using the system, researchers can spray high-precision restored tomb mural details onto the ground layer (Figure 94). These high-quality reproductions are available for viewing to enhance audience interaction during the exhibition visit. While visitors are allowed to touch them, it is not encouraged due to the potential for damage. However, touching the replicas can enhance the audience's sense of participation in the exhibition.

In the event of damage to the replica murals during the exhibition, digital inkjet technology can use the positioning of the digital matrix system to accurately and quickly repair the damaged area. Using ground layers and high-definition digital inkjet technology reduces the maintenance cost of the murals and relieves pressure on the museum's operating budget.

By reproducing high-precision murals using modern technology, museums can provide visitors with a more immersive and interactive experience. It enhances the audience's enjoyment of the exhibition and reduces the need for costly maintenance and repair of ancient murals. It is essential to balance audience engagement and preserve the authenticity and historical significance of the murals.

The second aspect of the exhibition's innovation lies in applying NFC (Near Field Communication) technology to enhance visitor interaction with digital murals (Figure 95). NFC is a short-range, high-frequency radio technology that allows contactless identification and data exchange with compatible devices. Unlike digital interactive technologies, such as scanning QR codes and using voice devices, NFC provides faster response times, more accurate information feedback, and higher security.

The researchers strategically installed NFC chips behind sections of the murals that would interest the audience, as indicated by the previous questionnaire survey and statistical analysis. Visitors can obtain relevant information about the murals using their smart devices, including pictures, audio, and video. It allows for a more immersive and engaging experience for visitors exploring the exhibition.

The research to ensure the security of the mural database, the system does not allow visitors to modify the information. However, they can share knowledge of interest on social media platforms via mobile communication networks. The exhibition's reach extends beyond traditional time and space limitations, allowing for broader dissemination and exposure.

NFC offers several advantages compared to other digital interactive technologies used in existing museums. Its faster response speed, more accurate information feedback, and lower energy consumption make it an ideal choice for enhancing visitor engagement (Shike, 2022). Additionally, NFC technology offers advantages in security, which can effectively protect the system scheduling of intelligent devices and personal data protection.

By using NFC technology in the exhibition, visitors are encouraged to engage with the murals in a more interactive and immersive way, which enhances their enjoyment and appreciation of the exhibition. Moreover, this innovation aligns with the trend towards incorporating digital technology into traditional museum exhibitions to create a more engaging and memorable experience for visitors.

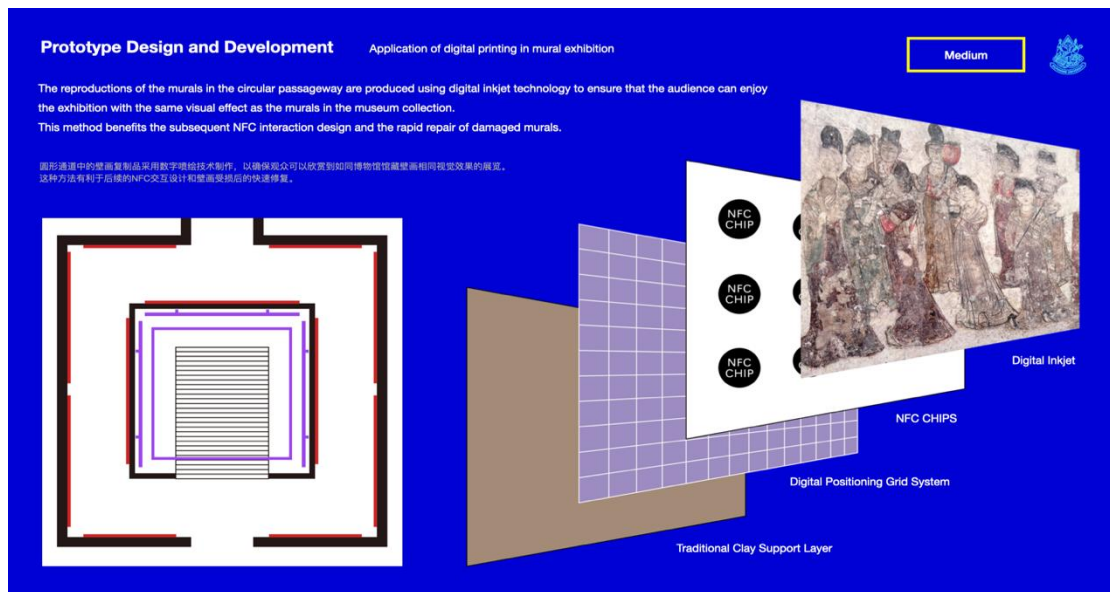


Figure 94 Flowchart of digital printing technology used in the production of tomb murals

Source: Drawn by Author, 2022.

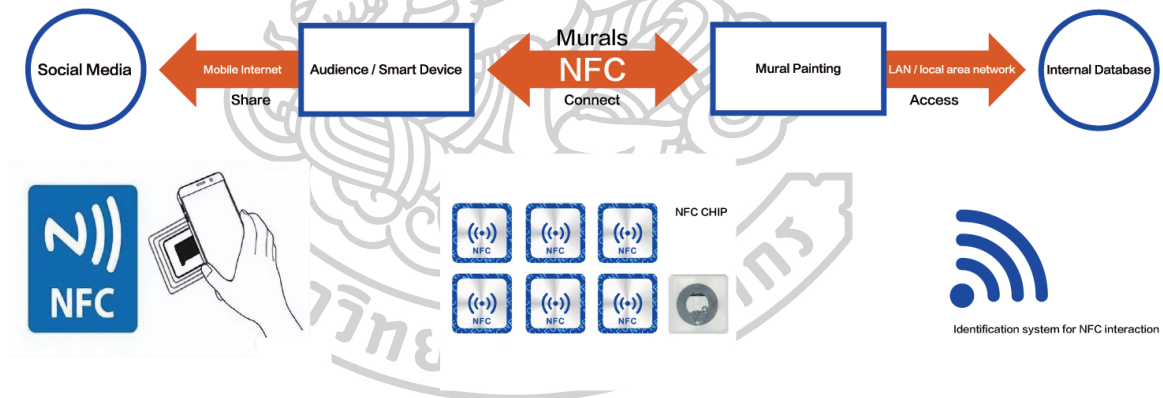


Figure 95 NFC near field communication technology

Source: Drawn by Author, 2022.

Advanced technologies such as high-definition digital inkjet printing and NFC technology can significantly enhance the exhibition interaction of digital murals, thereby improving visitor engagement and expanding the exhibition's reach. These technologies provide faster response times, more accurate information feedback, and higher security but also reduce the maintenance cost of murals and the museum's operating pressure. These technologies can lead to better preservation and exhibition

of ancient Chinese mural walls, enriching our cultural heritage and promoting cultural exchange.

Media technology: webcam, computer, NFC chip, HD digital inkjet printer

5.3.6 Prototype: Image interaction design for the virtual world (Figure 96)

Tomb murals have always been considered an essential form of human spiritual activity, and they represent the ultimate image of people's reincarnation world. These murals reflect not only the cultural and artistic achievements of the past but also provide a window into ancient people's beliefs, aspirations, and imaginations. The Tang Dynasty mural tomb is one of the most well-known examples of such murals, and it has been the subject of extensive study and analysis.

In recent years, with the development of digital technology, researchers have used digital techniques to restore the mural's damaged lines and colours to their original state. It has not only helped preserve these precious cultural relics but also allowed for the dynamic presentation of their contents. Digital technology has made it possible to create immersive virtual experiences for visitors, enabling them to interact with murals in new and exciting ways.

The second exhibition space in the new hall is a prime example. The structure of exhibition space is designed to simulate the dome structure of the Tang Dynasty mural tomb, with a dome at the top and walls on all sides. As visitors enter the hall, the projection equipment displays a simulated cosmic scene within the dome. The background music depicts four mythical beasts wandering the universe, evoking a mysterious and immersive atmosphere for the audience. The four mythical beasts move from the dome to the four walls of the exhibition hall, presenting the interior and exterior scenes of the mansion in the tomb murals in order.

This ingenious form of expression combines the two major themes of the murals: The Cosmic Mystery Image System, representing the unknown world, and the imaging system of scenes inside and outside the mansion, representing the world theme. The dynamic presentation of the murals' contents, such as birds in flight, flying flags, parades on horseback, and singing and dancing ladies all in motion, expands the audience's imagination and association with the mural's content, made possible by the digital technological situation design.



Figure 96 The exhibition effect of image interaction design in the virtual world

Source: Drawn by Author, 2022.

The use of digital technology has revolutionized how we can interact with and appreciate the cultural and artistic achievements of the past. The combination of the Tang Dynasty mural tomb's dome structure, projection equipment, background music, and dynamic presentation of mural content is an excellent example of how digital technology can create immersive and engaging cultural experiences. Through these experiences, we can better understand our ancestors' beliefs, aspirations, and imaginations and appreciate the beauty and complexity of their cultural and artistic achievements.

Design and Development (Diagram 55)

The operation of human body sensors is responsible for controlling the virtual world image interaction. As the audience enters the second exhibition hall, the human body sensor detects the audience's presence and transmits the perceived information

to the central processing unit. Subsequently, the projection equipment displays the image on the dome roof. This process involves four key phases:

- 1. Design of narrative sequence and projection position of video story**
- 2. Editing and production of the video content**
- 3. System debugging between sensors, computers, and projectors**
- 4. Installation and debugging of the equipment**

The video storytelling technique is a way to rearrange the mural content's presentation, providing viewers with a new perspective. The murals in the Tang tomb reflect the Chinese people's belief in rebirth, which is presented through a cosmic and mysterious image system reflecting the unknown world, and a scene image system inside and outside the mansion, expressing the theme of the world. In traditional Chinese culture, the circle represents the sky, while the square represents the Earth. The narrative of the mural stories in the new pavilion unfolds from the vaulted ceiling space that simulates the tomb's structure. The circular design on the top of the dome and the square structure on the four walls is a collection of Chinese cosmology concepts. The simulation of cosmic images and the display of the four mythical beasts presented the Chinese cultural exposition of the creation of the universe.

The image extends from the top of the dome to the four walls, showing the extension from the unknown world to the present world and interpreting the cultural concept of "harmony between man and nature" in Chinese culture. To transform the Tang tomb murals from the narrow and long tomb passage space to the square exhibition hall, the researchers used the dynamic panoramic technology of digital media and the telephoto narrative technique of the film. They made full use of the architectural structure of the dome to organically unify the imaging system representing the unknown world and the imaging system representing the present world in the same space, greatly enhancing the experience of the museum's exhibition situation (Qi, 2019).

This approach offers a new way for visitors to engage with the murals, providing a more immersive and interactive experience. Combining digital media and film techniques offers a novel approach to preserving and sharing cultural heritage, making it accessible to a broader audience. Moreover, the utilization of the architectural

structure of the exhibition hall demonstrates the importance of considering the spatial context in designing an exhibition. Through this innovative approach, the researchers present the murals in a new way and offer insights into Chinese cosmology and culture.

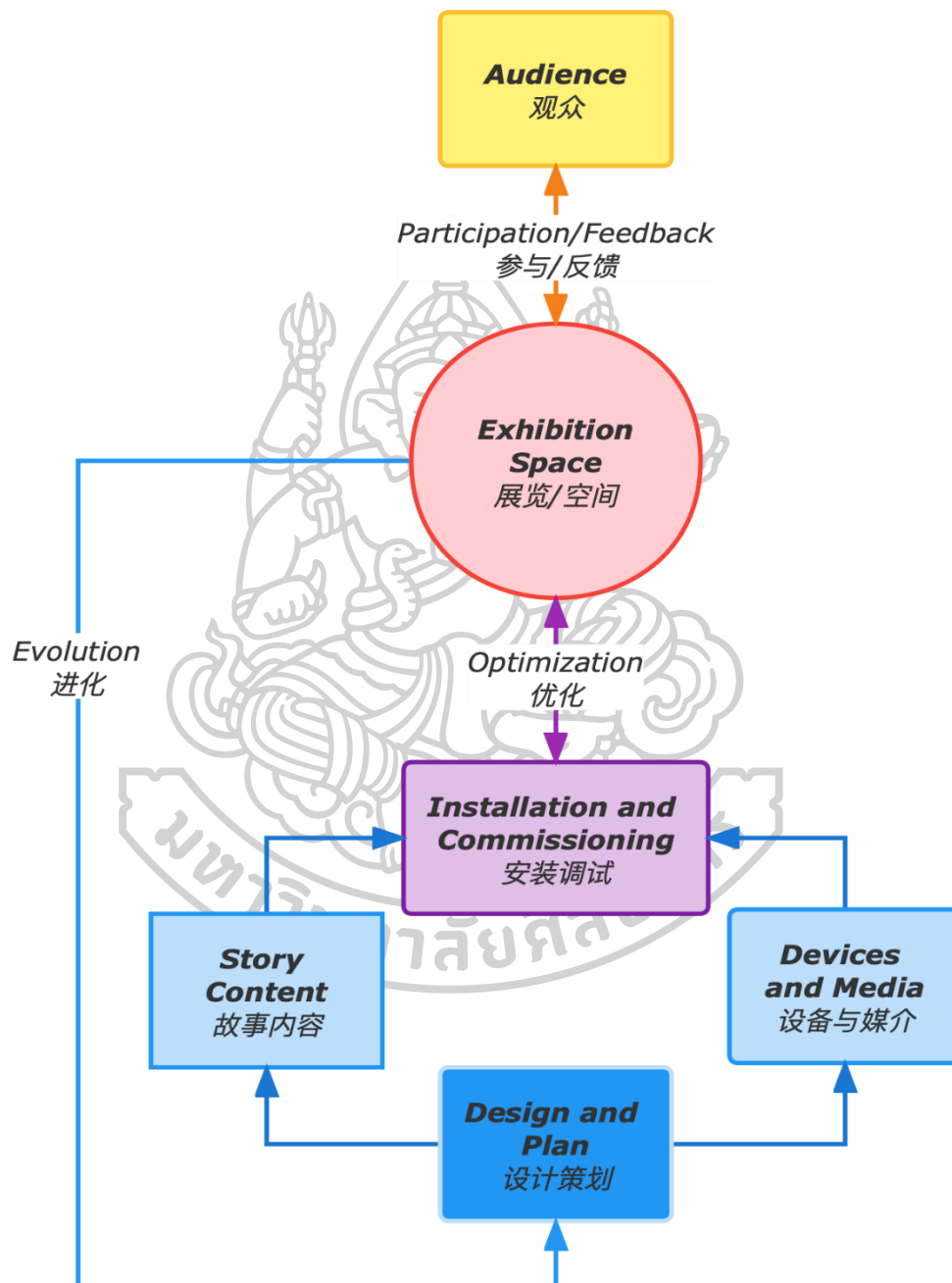


Diagram 55 The relationship between the various design elements of the virtual world image interaction system

Source: Drawn by the Author, 2022.

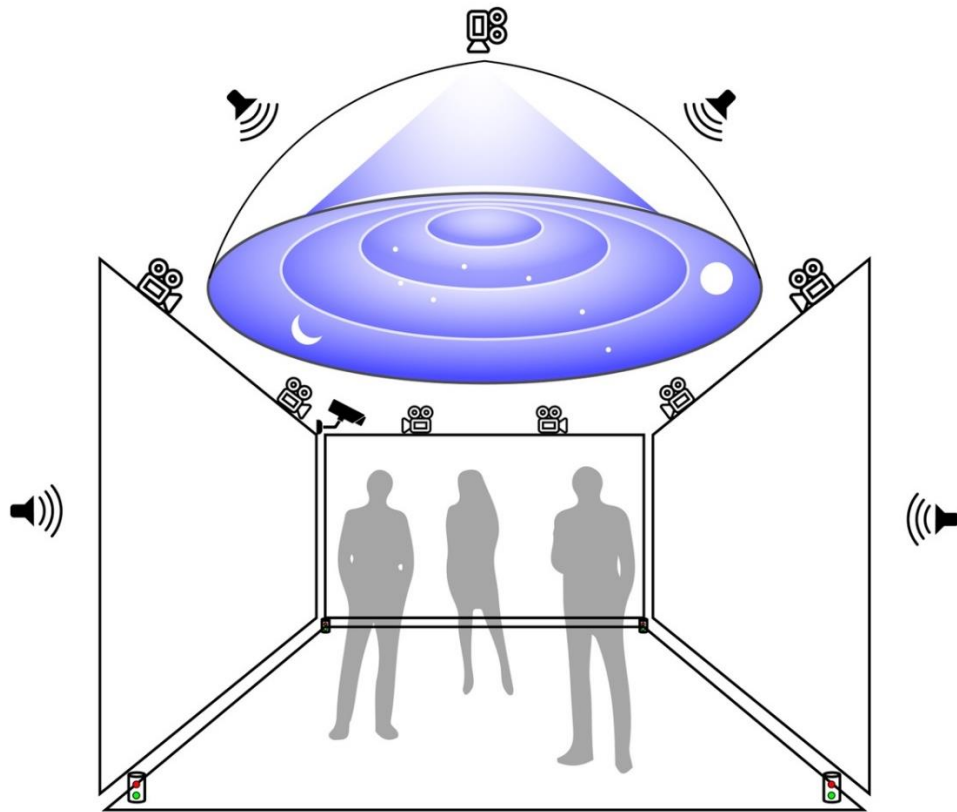


Diagram 56 Human sensor and imaging system in the virtual world image interaction system

Source: Drawn by the Author, 2022.

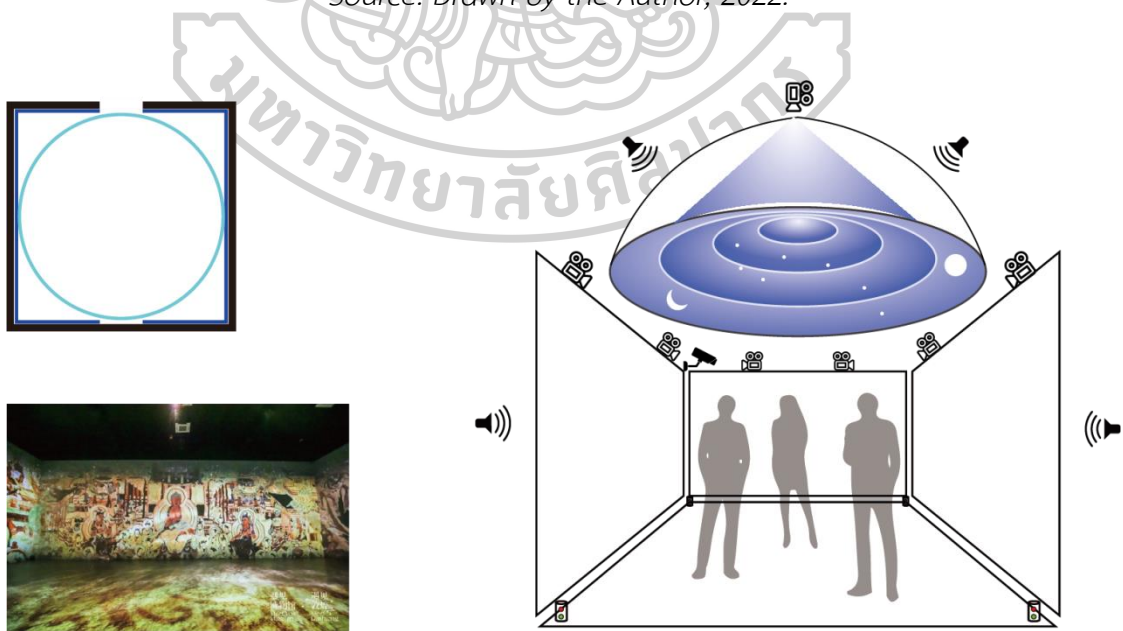


Figure 97 Display and installation of image interaction design in the virtual world

Source: Drawn by the Author, 2022.

The production and editing of image content for motion simulators are distinct from those for tomb murals in image interaction. In order to achieve the highest quality image effect that accurately represents the original murals, the tomb murals require redrawing through graphics software. To achieve this, researchers need to use Adobe software to edit the video content, restore the actual state of the murals by integrating the lines and restore the colours of the tomb murals based on digital high-definition pictures of the murals in the Tang Dynasty.

The researchers utilized two-dimensional animation software to design the animation aspect of the mural and Adobe After Effects software to add visual effects. The audio in the video, including mixing, editing, controlling clips, and other audio products, was edited and processed using Adobe Audition. Adobe Premiere was then used to integrate and save the newly created mural material and edit the video according to the predetermined storyboard.

During the production of the video, it is essential to consider the exhibition hall's size, width, and spatial attributes. Finally, the file should be outputted according to the requirements of the exhibition and imported into the computer database.

By utilizing Adobe software and digital high-definition pictures of the tomb murals, the research team restored and enhanced the murals, creating a vivid and immersive experience for viewers. This process highlights the importance of combining traditional art and modern technology to create accessible and engaging audience experiences.

Sensor, computer, and projector technological advancements have revolutionized interactive image presentations in recent years (Diagram 56). The research tries to ensure the smooth operation of such systems. An essential step is the process of system debugging. This process involves a series of steps illustrated in (Figure 97) (JianJun et al., 2022).

An ActionScript application sends the playback information to the projector and audio system once the computer has determined that the projection system needs to start. During the video playback, the human body sensor and security video system continuously monitor the audience's status to ensure the exhibition's safety. The human body sensor does not send control signals to the computer system during

video playback. This arrangement helps to ensure that the video playback is not interrupted unnecessarily.

Once the video ends, the system judges the sensor signal and restarts the video loop to ensure the integrity of the video playback for viewers during the tour. This process of system debugging is essential in ensuring that the interactive image presentation systems operate optimally and that visitors have a memorable experience during their tour.

To further optimize the system's performance, it is crucial to consider the hardware and software components' specifications, such as the quality of the projectors and audio systems, the computers' capacity, and the sensors' reliability. Additionally, proper maintenance and regular updates of the software and hardware components are crucial in ensuring the system operates optimally.

In conclusion, system debugging is crucial in successfully operating interactive image presentation systems. Using sensors, computers, and projectors helps ensure that visitors have an immersive and interactive experience during their tour. By considering the system components' specifications and maintenance requirements, the system's performance can be further optimized, leading to a more enjoyable experience for visitors.

The process of setting up a multimedia exhibition requires careful planning and execution to ensure the seamless operation of equipment and the safety of the audience. Before installation, the researchers identified suitable locations to install human sensors, ensuring they were placed in areas that could monitor the audience in real-time while also being safe for attendees.

Regarding projector installation, the researchers considered several factors that could affect the audience's experience. These factors included the projection distance and the potential impact on the audience. To address these concerns, the researchers installed the projector on top of the dome and a light-transmitting dome-shaped screen below the projector. This setup allowed the projection of images to create a movie-viewing effect on the wall when the image started.

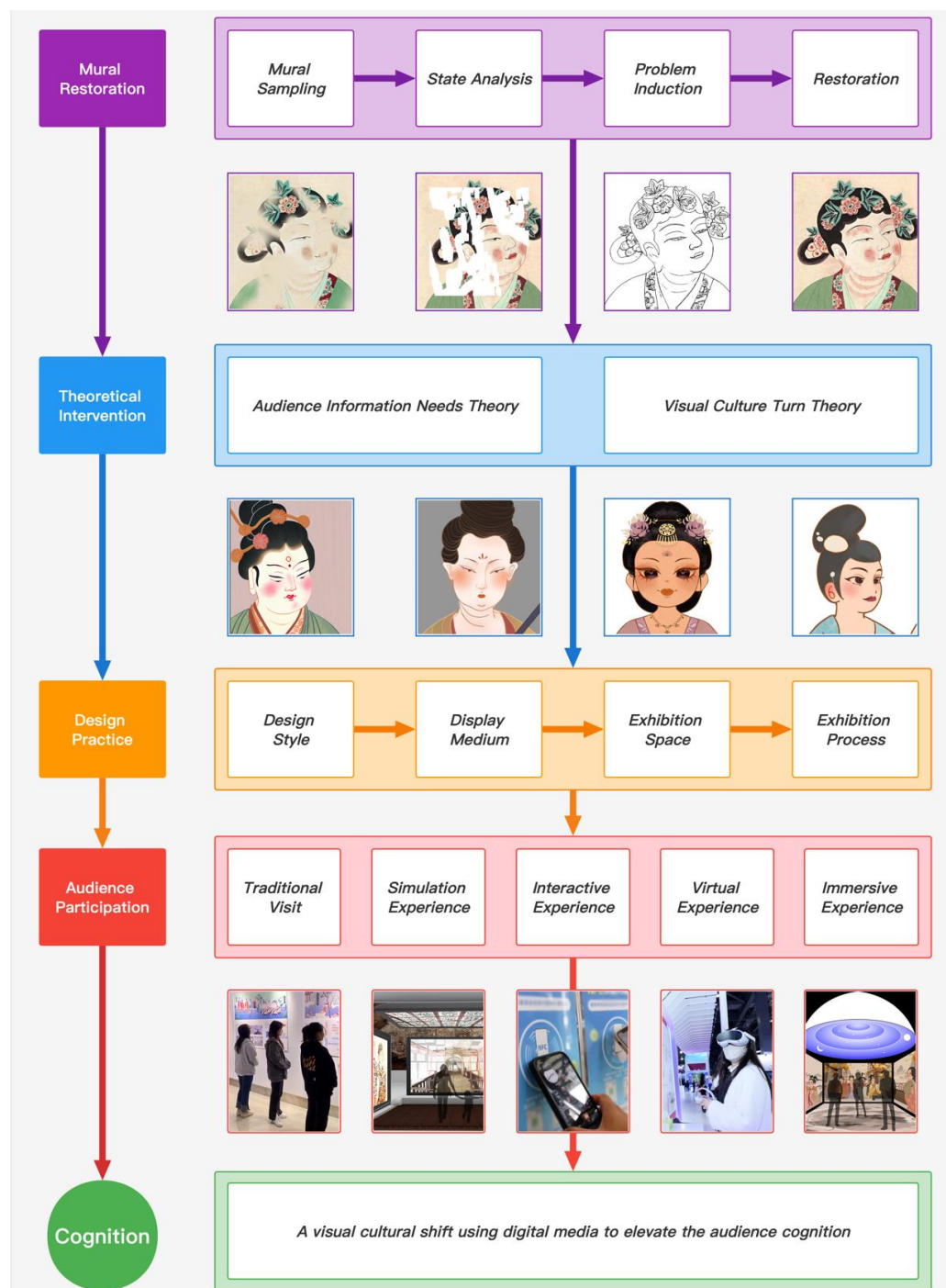


Diagram 57 Flowchart of Digital Visual Turning of Contents of Tomb Murals in Tang Dynasty

Source: Drawn by the Author, 2023.

To ensure the integrity of surveillance images, the researchers installed a security imaging system on top of the exhibition hall walls. This system was designed to capture footage of the audience and the exhibition area, ensuring that any issues arising during the exhibition could be addressed quickly and effectively.

Finally, system debugging was conducted to ensure that each unit could operate normally and that the system could complete the established exhibition tasks with the cooperation of each team. The researchers carefully checked each unit to ensure they were functioning correctly and made necessary adjustments to optimize the system's performance.

In conclusion, successfully implementing a multimedia exhibition requires careful planning, attention to detail, and precise execution. Through installing and debugging equipment, researchers can ensure that the exhibition is a safe, enjoyable experience for all attendees.

Media technology: human sensors, projectors, computers, webcams

5.4 Exploration of digital visual turning of contents of tomb murals in tang dynasty

Exploring the digital visual transformation of the content of the tomb murals in the Tang Dynasty is a process of systematically coordinating the elements and links of the visual design (Diagram 57) (Marini & Agostino, 2022). First, it is necessary to satisfy that digital murals have the attributes of cultural relics and the value of visiting (Bertacchini & Morando, 2013). Secondly, the creation of digital visual content should focus on the audience's visit needs and be guided by the cultural visual turn theory summarized in this study (Jones, 2015). Then, the created digital content must consider the visit differences of different groups and the combination of the digital mural's content and the exhibition's form. Researchers ensure the effect of digital media display by coordinating the cooperation of digital mural content, display media and display space. Finally, through the intervention of a variety of digital technologies, such as the design of simulated situations, the method of digital interactive situations, the creation of visits in virtual situations and the design of immersive visit experiences,

technical means are used to enhance the audience's visitor experience and improve their understanding of Tang Dynasty mural content.

5.4.1 Use the digital source code to restore the murals and retain the value attributes of cultural relics.

This study proposes a novel approach to mural restoration using a source code called "MuralNet," which guides progressive restoration based on line drawings of damaged murals. The inpainting process is divided into structure reconstruction and colour correction, performed by the structure reconstruction network (SRN) and colour correction network (CCN). SRN uses line graphs to guarantee large-scale content authenticity and structural stability in structural reconstruction. In colour correction, CCN performs local colour adjustments for missing pixels to reduce the negative effects of colour bias and edge jumping. The proposed approach effectively restores murals with diverse themes and large damaged areas, and the experimental results demonstrate its superior performance compared to existing methods.

The restoration process of Tang Dynasty tomb murals can be divided into three main parts: analysis, induction, and restoration (Diagram 58).

In our restoration approach, we employ a computer-aided line-drawing-guided advanced method for structural reconstruction and colour correction. This approach involves using software code to create line drawings that guarantee the authenticity of the large-scale content and the stability of the structure. Additionally, colour correction is achieved by locally adjusting the colour of missing pixels to reduce negative effects such as colour deviation and edge jumping. Our approach offers a highly effective means of restoring murals, especially those with diverse themes and extensive damage. By utilizing digital technology, we ensure that the restored murals maintain their original style and cultural value and are suitable for display as digital relics.

These principles involve the intervention of digital technology to ensure that the original style of the murals is maintained and that they retain the value attributes of cultural relics.

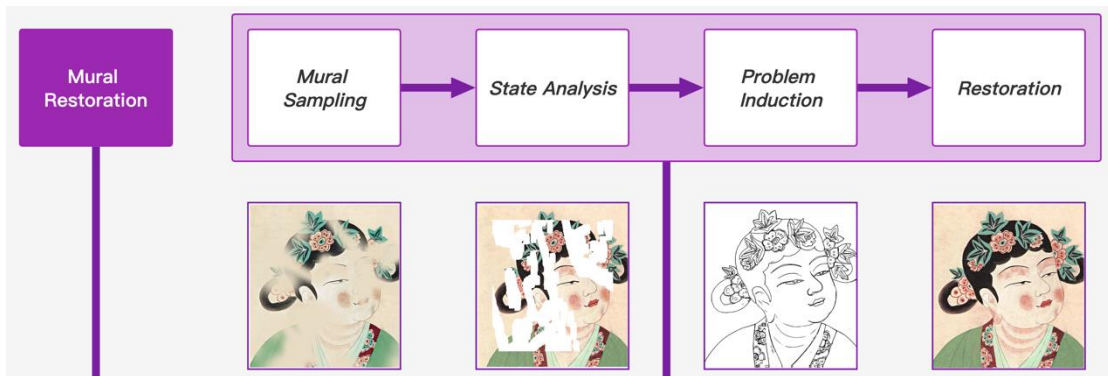


Diagram 58 Restoration of the murals using digital source codes

Source: Drawn by the Author, 2023.

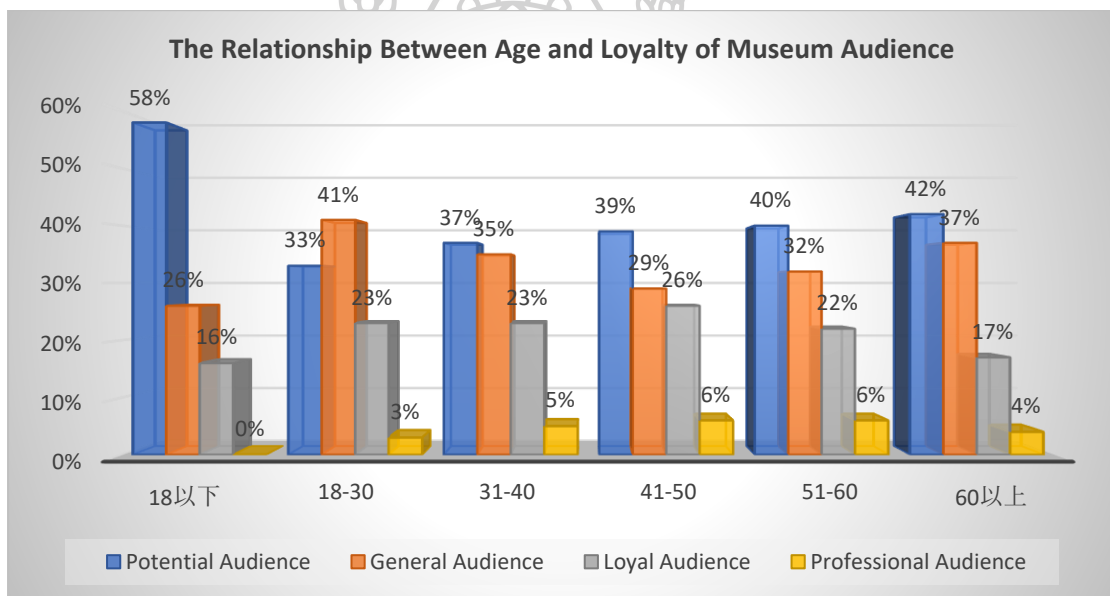


Diagram 59 The Relationship Between Age and Loyalty of Museum Audience

Source: Drawn by the Author, 2023.

5.4.2 Digital visual exploration of tang dynasty tomb murals based on Audience Demand Theory and Visual Turning Theory.

Designing a highly engaging and interactive digital visual solution for Tang Dynasty tomb murals requires an analysis and design process centered on the target audience's needs. This study analyzes different target audience groups' unique needs and concerns, including potential, general, loyal, and professional audiences (Wanzhen,

2011). The second chapter of this study presents a literature review of the behavioral needs of these groups to provide theoretical support for the design stage.

When analyzing the digital visual design needs of the tomb murals in the Tang Dynasty, it is essential to consider the age and education level of the target audience. This study considers the educational background, preferences, behaviors, and social interactions of audiences of different age groups to develop tailored design solutions. In the early stage of the study, the researchers conducted a quantitative analysis of museum visit behavior using a questionnaire survey (Diagram 59). The researchers cross-analyzed the data to obtain the basic reference rules to guide the design process, ensuring that the digital presentation meets the audience's expectations and enhances their experience.

Moreover, a comprehensive analysis is necessary to analyze different classification standards, the correlation between target audience groups, age, and education level, and to use cross-analysis and comparison to summarize the design coordinate system model suitable for digital visual design (Diagram 60). Guided by the visual design coordinate system model, the design team developed digital visual content for Tang Dynasty tomb murals tailored to meet the unique needs of each target audience group. This digital visual content serves the design plan in the early stage of this study. It enhances the museum visiting experience according to different situational requirements, equipment requirements, media requirements, space requirements, and target audience needs.

Based on the preliminary questionnaire survey and analysis, the researchers found that age and education level significantly impact the audience's visit behavior. The overall distribution of museum audiences indicates that potential audiences comprise the largest social population (Jones, 2015). It suggests that museum visits and learning behaviors still need to be established as important ways for people in social groups to acquire knowledge. Most potential visitors have yet to make museum visits a regular practice. To attract potential audiences, museums must offer creative programs and interventions, including special exhibitions with significant impact and the use of digital media.

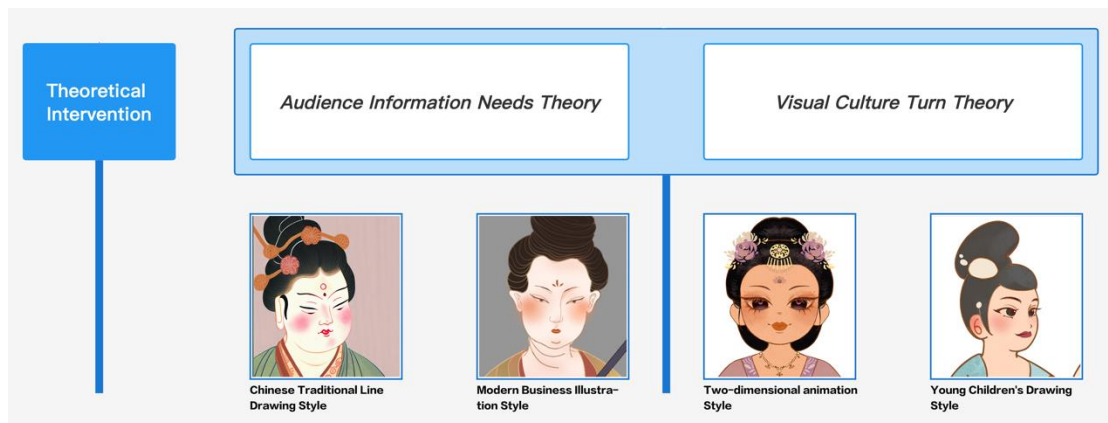


Diagram 60 Digital Visual Exploration of Tang Dynasty Tomb Murals Based on Audience Demand Theory and Visual Turning Theory

Source: Drawn by the Author, 2023.

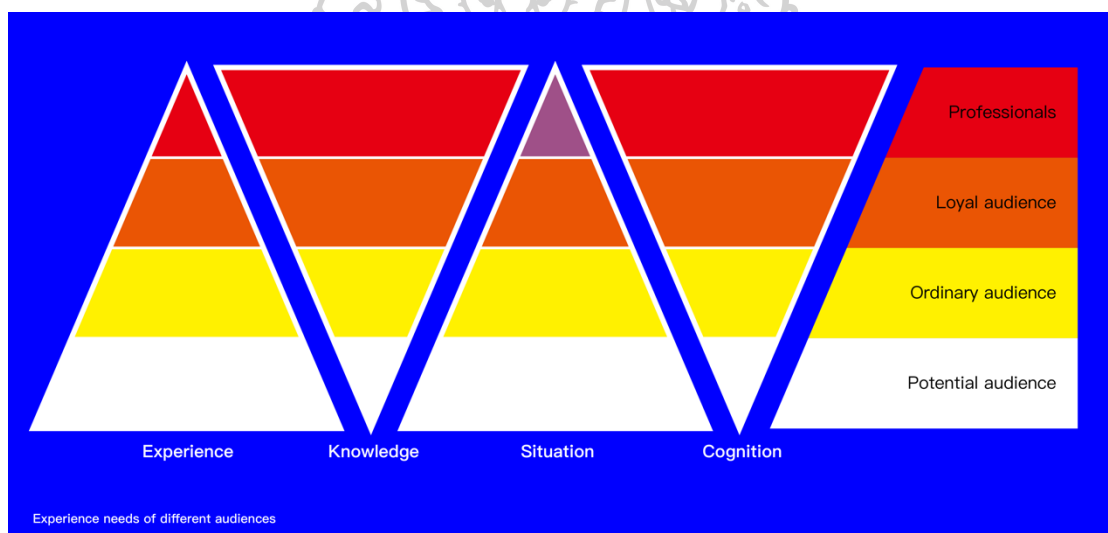


Diagram 61 Experience needs of different audiences

Source: Produced by the Author, 2021.

The questionnaire summary revealed that age and education affect the audience's visit behavior and preferences. The proportion of the general audience declines with age and education level, while the proportion of loyal audiences increases with age and education level (Wanzhen, 2011). Some audiences even become professional audiences as they grow. However, from the perspective of the overall distribution of museum audiences, the distribution still follows a pyramid-like

progressive structure, with potential audiences comprising the largest group, general and loyal audiences, and professional audiences being the smallest (Diagram 61).

Considering the distribution of museum audiences and the influence of age and education level, this study establishes a design coordinate system through a comprehensive analysis of the overall conditions. The researchers have concluded that digitized visual transformation of the tomb murals in the Tang Dynasty should focus on meeting the general needs of the public and enriching the audience's visiting experience by providing interactive and educational participatory interactions. The audience's growth background, behavioral characteristics, and social habits are important entry points for this study's content design of digital murals.

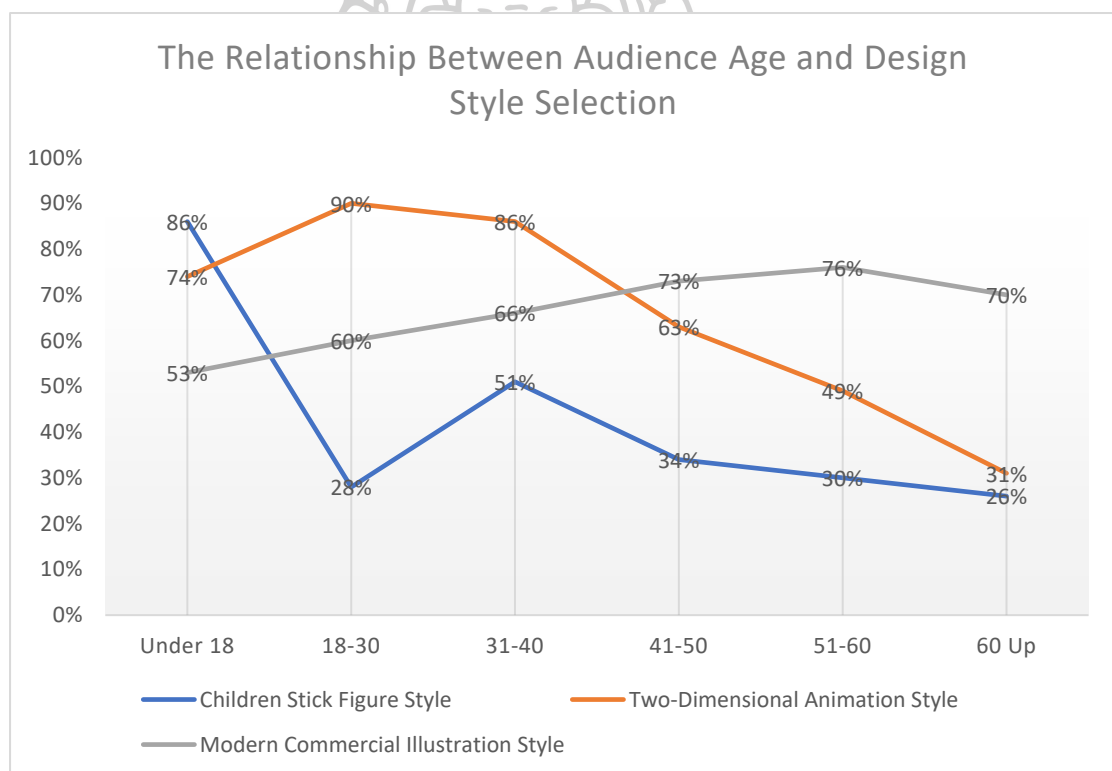


Diagram 62 The Relationship Between Audience Age and Design Style Selection

Source: Drawn by the Author, 2023.

In conclusion, this study provides important insights into the impact of age and education level on the behavior and preferences of museum audiences (Diagram 62). The results suggest that museums need to develop creative programs to attract

potential audiences and enhance the visiting experience of the audience. Further research is required to explore the best practices for designing digitized visual transformations of the tomb murals in the Tang Dynasty to meet the needs and preferences of different audience groups.

This comprehensive analysis better focuses on the target audience's needs and concerns and supports designing digital display solutions that meet the audience's needs with clearer goals. By intervening with the design coordinate system, this study meets different groups' cognitive needs, protection of cultural relics, and inheritance (Karp, 2014).

5.4.3 Design case exploration——digital visual turning design of tang dynasty tomb murals

This study selects modern commercial illustration, 2D animation style painting, and children's simple style painting as the carriers of digital visual design for Tang Dynasty tomb murals, aiming to explore the digital inheritance relationship of Tang Dynasty tomb mural content to meet the needs of different audience groups and consider the impact of exhibition relevance factors.

The painting style of Tang Dynasty tomb murals adopts traditional Chinese painting from - Chinese painting. Chinese painting does not aim for realism as the final goal of painting (Clunas, 2017). Artists pay attention to integrating brushwork, brush meaning, and techniques to express abstract ideas and artistic conception (Da-Wei, 2012). The brushwork of Chinese painting converges with the expression form of Chinese calligraphy, and the most prominent characteristic of the modelling is the expression of lines. Artists outline the contours of objects through lines and then combine the colouring and rendering techniques in Chinese painting to complete the picture.

Modern commercial illustration, 2D animation style painting, and children's simple style painting all emphasize the expression of line contours in design and achieve design goals by creating lines and colours. The modern commercial illustration presents a trend of overall linearization. Line illustrations make the picture concise and elegant, which conforms to the public's aesthetic needs. 2D animation and children's simple style painting also show the above characteristics in visual effects

and emphasize the relationship between lines and shapes. Although these three painting forms did not originate from traditional Chinese painting, they show consistency with traditional Chinese painting in the use of brushwork and lines. Therefore, this study selects these three painting forms as carriers of digital visual design for Tang Dynasty tomb murals.

As a visual communication form originating from the field of painting, commercial illustration can display artists' unique artistic charm and style and provide reliable expressiveness. A commercial representative can meet the aesthetic needs of different audiences by presenting multiple painting styles. The application of digital technology makes the design of commercial illustrations more diversified and has made significant progress in the depth and breadth of design themes. Digital media has enabled commercial illustration to be no longer limited to traditional paper media. Commercial illustration can achieve rapid and extensive dissemination through digital and social media platforms. Therefore, commercial illustration is very suitable for display in new media exhibitions. The combination of commercial and digital technology has generated new innovative methods in the illustration field, providing greater possibilities for artists to create and express themselves.

Two-dimensional animation style painting and children's stick figure style painting also have the artistic characteristics and communication advantages of commercial illustrations. This study regards these two styles as thorough research different from commercial illustrations, mainly because the audience and information needs differ. Meeting the needs of different audience groups can improve the audience's visiting experience and cognitive level.

Under the guidance of this research theory, the researchers carried out design exploration, trying to use digital painting to present the digital visual design of the content of the Tang Dynasty tomb murals in this study.

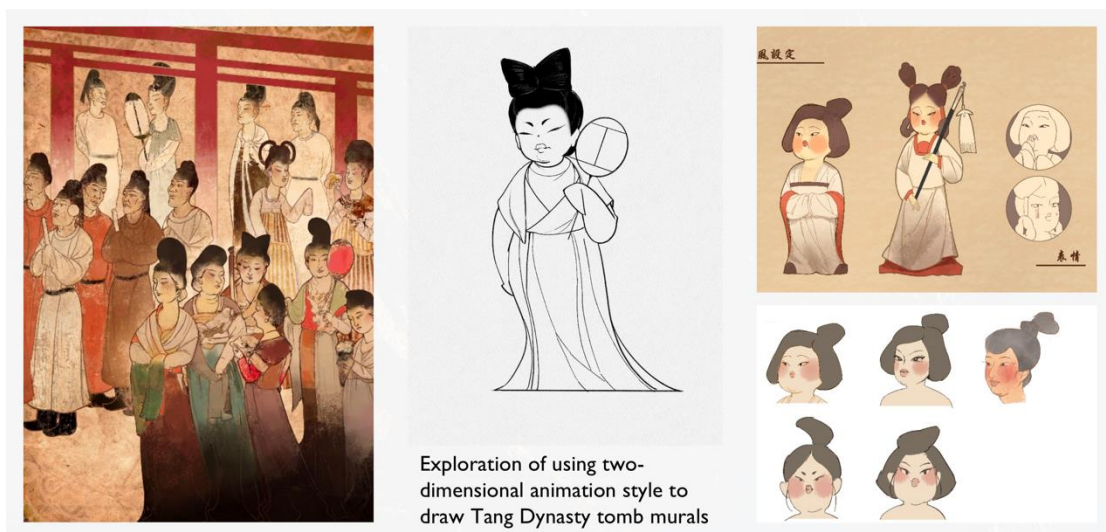


Diagram 63 Exploration of using two-dimensional animation style to draw Tang Dynasty tomb murals

Source: Produced by the Author, 2023.

Exploration on the Digital Visual Design of the Contents of the Tomb Murals in the Tang Dynasty: Modern Commercial Illustration Style Design (Figure 98) (Figure 99) (Figure 100) (Figure 101).



Figure 98 Exploration of Using Modern Commercial Illustration Style to Draw Tang Dynasty Tomb Murals

Source: Produced by the Author, 2023.

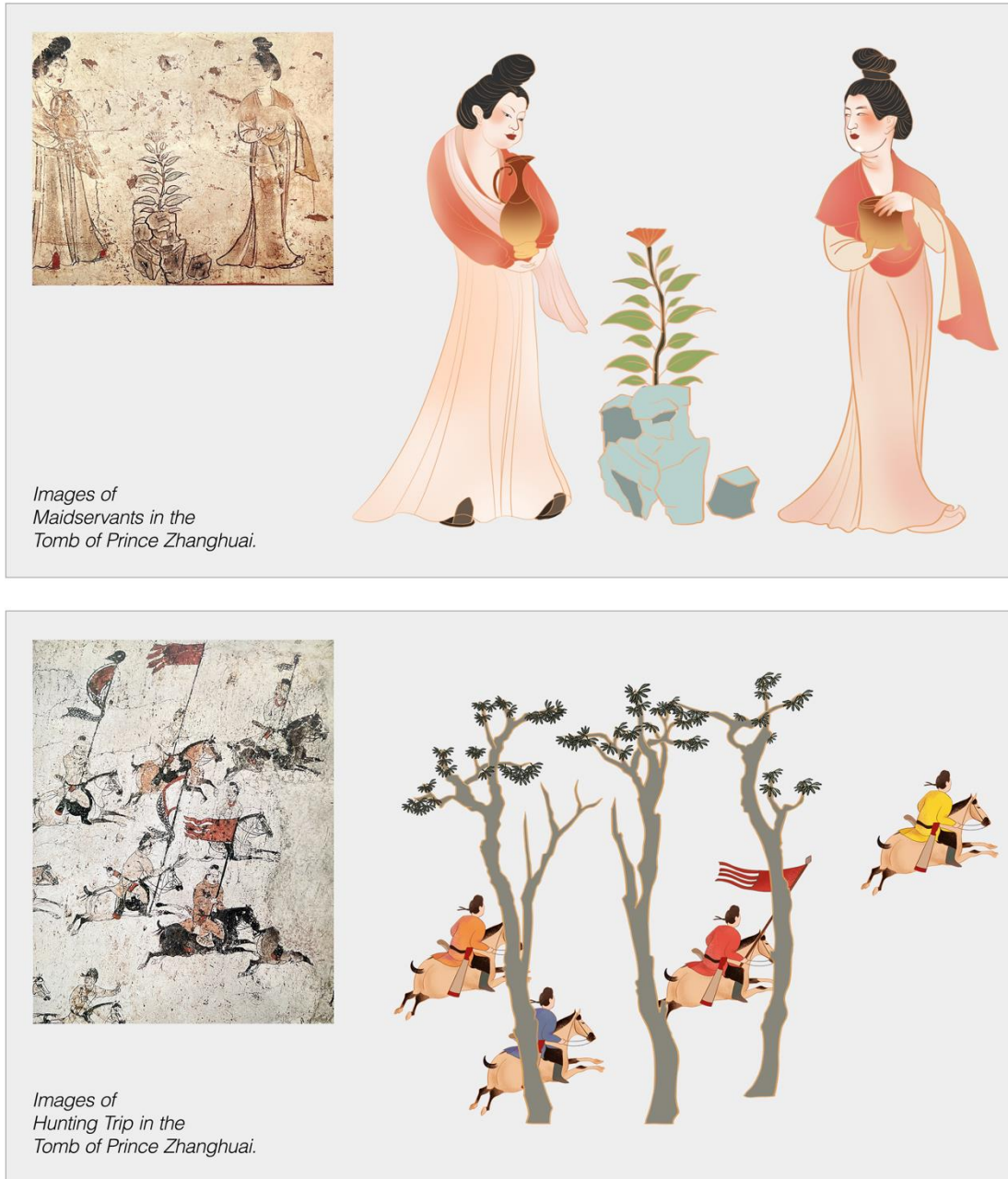


Figure 99 Exploration of Using Modern Commercial Illustration Style to Draw Tang
Dynasty Tomb Murals

Source: Produced by the Author, 2023.



Figure 100 Exploration of Using Modern Commercial Illustration Style to Draw Tang Dynasty Tomb Murals—Characters

Source: Produced by the Author, 2023.

Exploration of the digital visual design of the content of the tomb murals in the Tang Dynasty: two-dimensional animation style design (Diagram 63) (Figure 102) (Figure 103) (Figure 104) (Figure 105) (Figure 106).



Figure 101 Exploration of using modern commercial illustration style to draw Tang Dynasty tomb murals

Source: Produced by the Author, 2023.

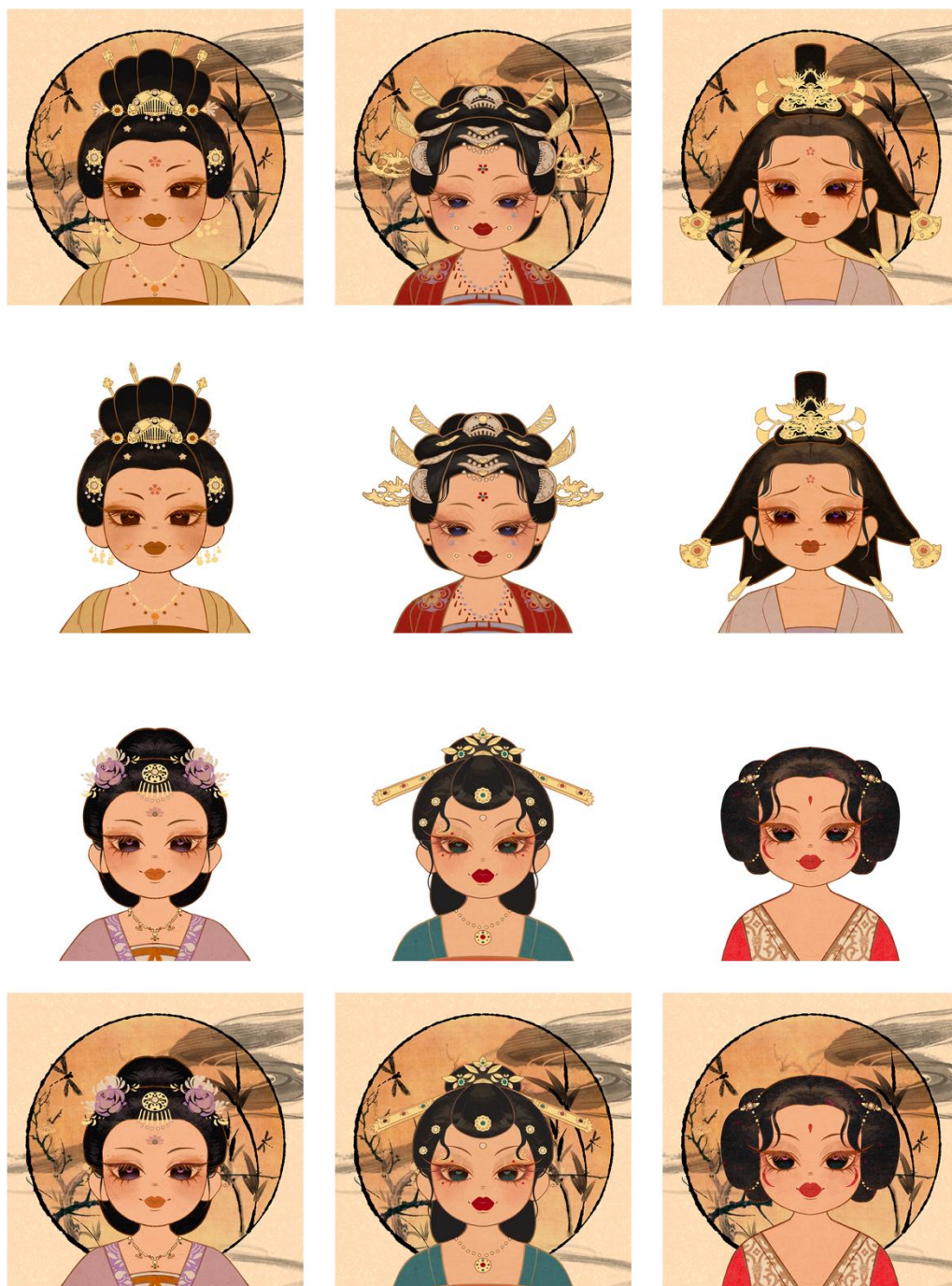


Figure 102 Exploration of using two-dimensional animation style to draw Tang Dynasty tomb murals - Characters

Source: Produced by the Author, 2023.

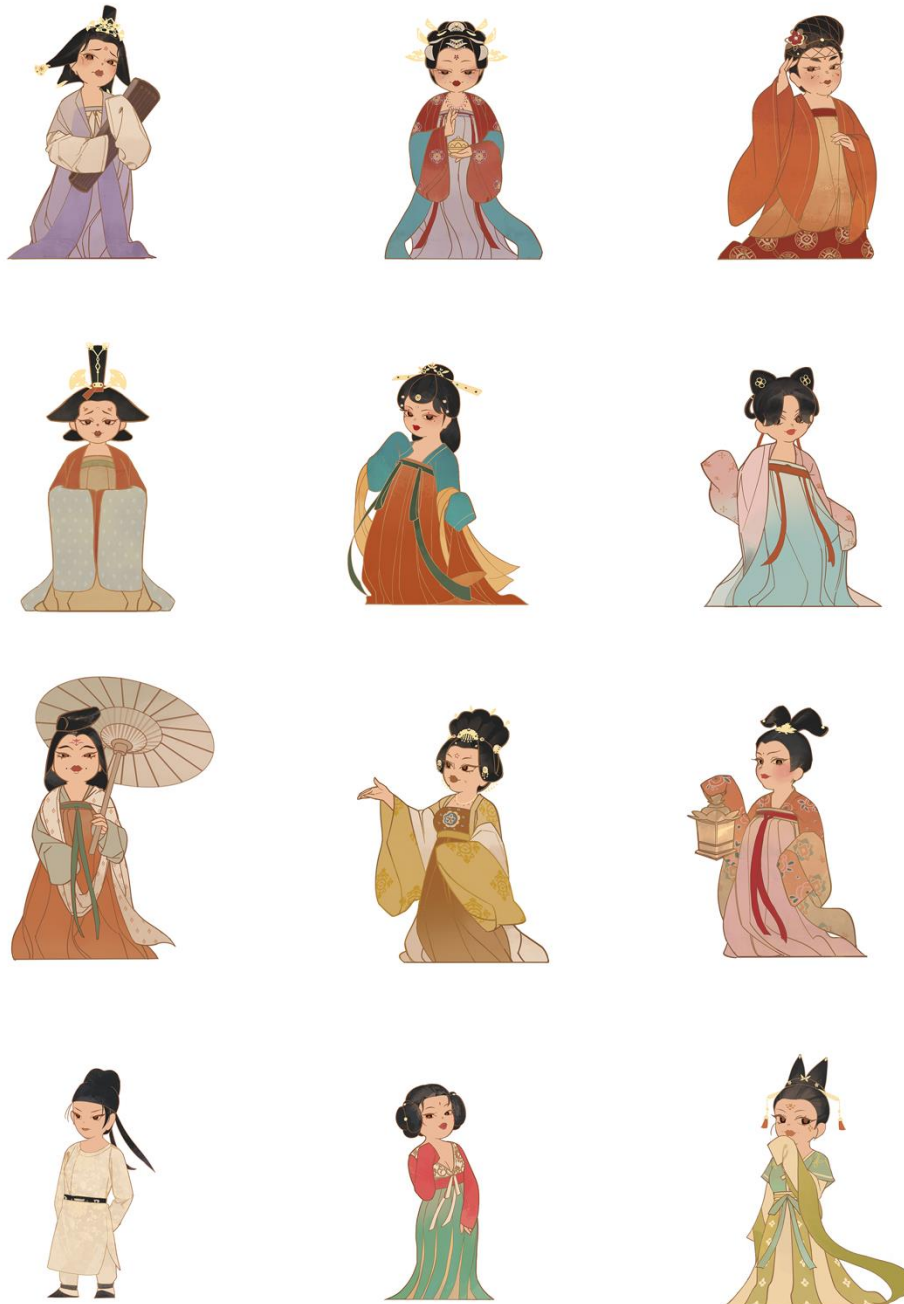
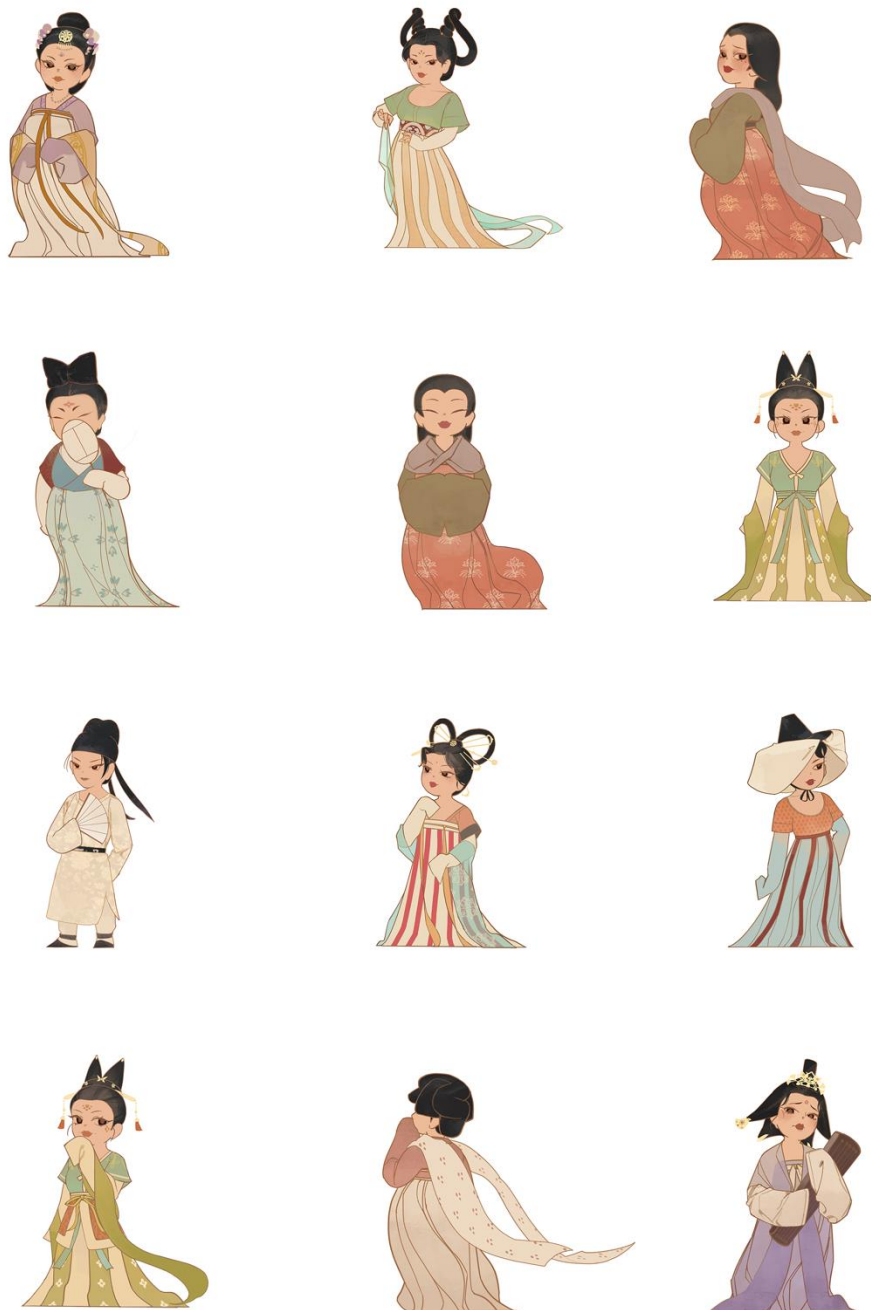


Figure 103 Exploration of using two-dimensional animation style to draw Tang Dynasty tomb murals - Characters

Source: Produced by the Author, 2023.



*Figure 104 Exploration of using two-dimensional animation style to draw Tang
Dynasty tomb murals - Characters
Source: Produced by the Author, 2023.*



Figure 105 Exploration of using two-dimensional animation style to draw Tang Dynasty tomb murals - Group

Source: Produced by the Author, 2023.



Figure 106 Exploration of using two-dimensional animation style to draw Tang Dynasty tomb murals - Group

Source: Produced by the Author, 2023.

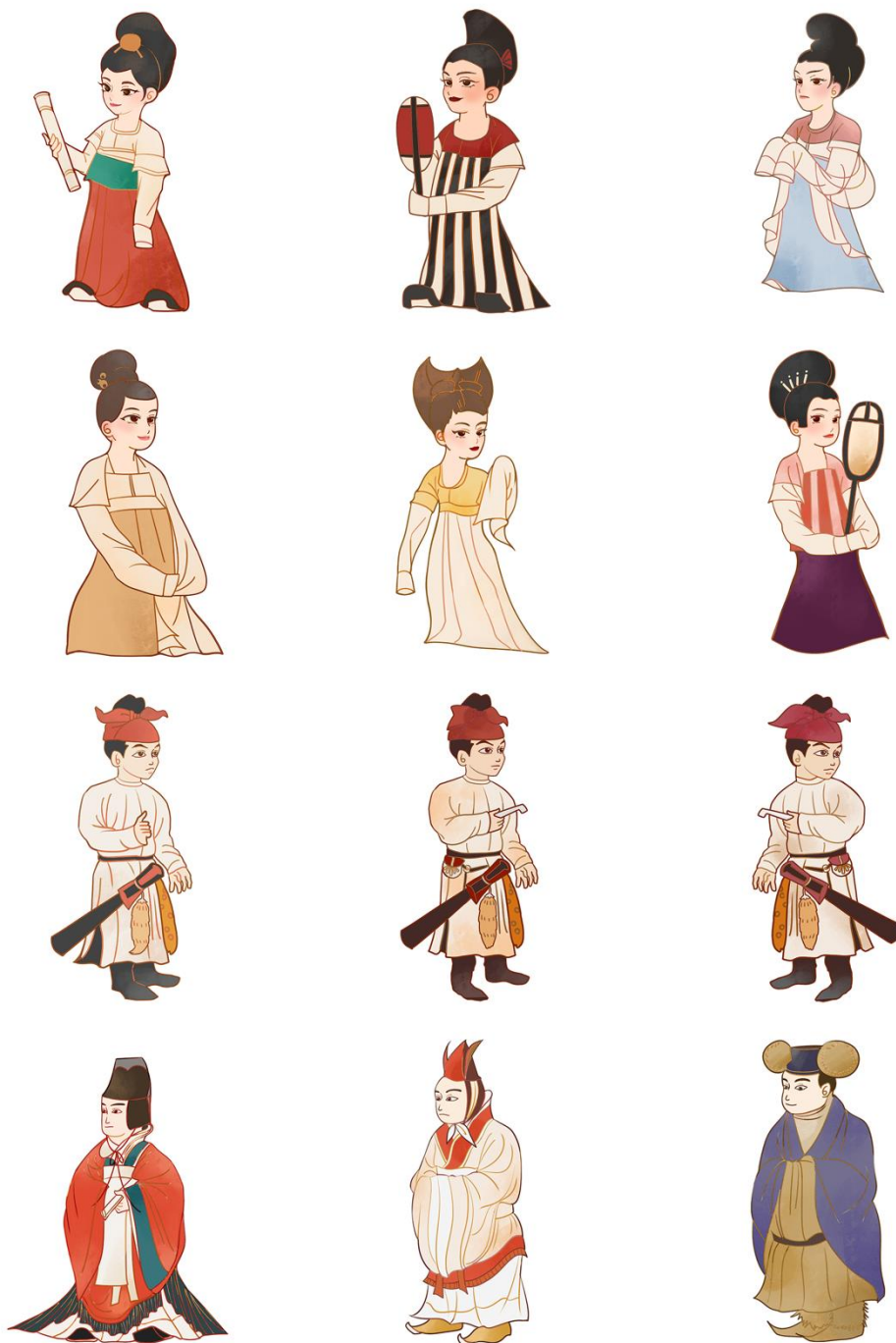


Figure 107 Exploration of using children's stick figure style to draw Tang Dynasty tomb murals

Source: Produced by the Author, 2023.

Exploration of the digital visual design of the content of the tomb murals in the Tang Dynasty: Children's simple strokes style design (Figure 107) (Figure 108).



Figure 108 Exploration of using children's stick figure style to draw Tang Dynasty tomb murals

Source: Produced by the Author, 2023.

5.5 Research results: analysis of digital visual prototype exhibition of tang dynasty tomb murals

5.5.1 Audience feedback and summary

This study aims to explore a digital situation design model prototype for Tang Dynasty tomb murals (Figure 109) (Figure 110) (Figure 111). It demonstrates the diversity and convenience of digital technology for exhibition display and validates the study's rationale through audience participation and feedback (Figure 112) (Figure 113) (Figure 114). The prototype exhibition of design models, held in March 2023, presented a range of design prototypes to the audience. Their feedback and opinions were collected through surveys, group discussions, and on-site interviews (Diagram 64). By analyzing this data, we found that the digital situation design model prototype for Tang Dynasty tomb murals exhibits extensive diversity and adaptability. We propose several improvement suggestions to optimize the research outcomes further. The results of this study will contribute to enhancing the audience's awareness of Tang Dynasty tomb murals and expanding the research perspective and methodology in relevant fields.



Figure 109 The design rendering of digital situation design model prototype for Tang Dynasty tomb murals.



Figure 110 Photos of the exhibition scene of digital situation design model prototype for Tang Dynasty tomb murals

Source: Photographed by Author, 2023.



Figure 111 Photos of the exhibition scene of digital situation design model prototype for Tang Dynasty tomb murals

Source: Photographed by Author, 2023.



Figure 112 Photos of the audience visiting the prototype exhibition of digital situation design model prototype for Tang Dynasty tomb murals
 Source: Photographed by Author, 2023.



Figure 113 Photos of the audience visiting the prototype exhibition of digital situation design model prototype for Tang Dynasty tomb murals
 Source: Photographed by Author, 2023.



Figure 114 Photos of the lecture scene of digital situation design model prototype

for Tang Dynasty tomb murals

Source: Photographed by Author, 2023.

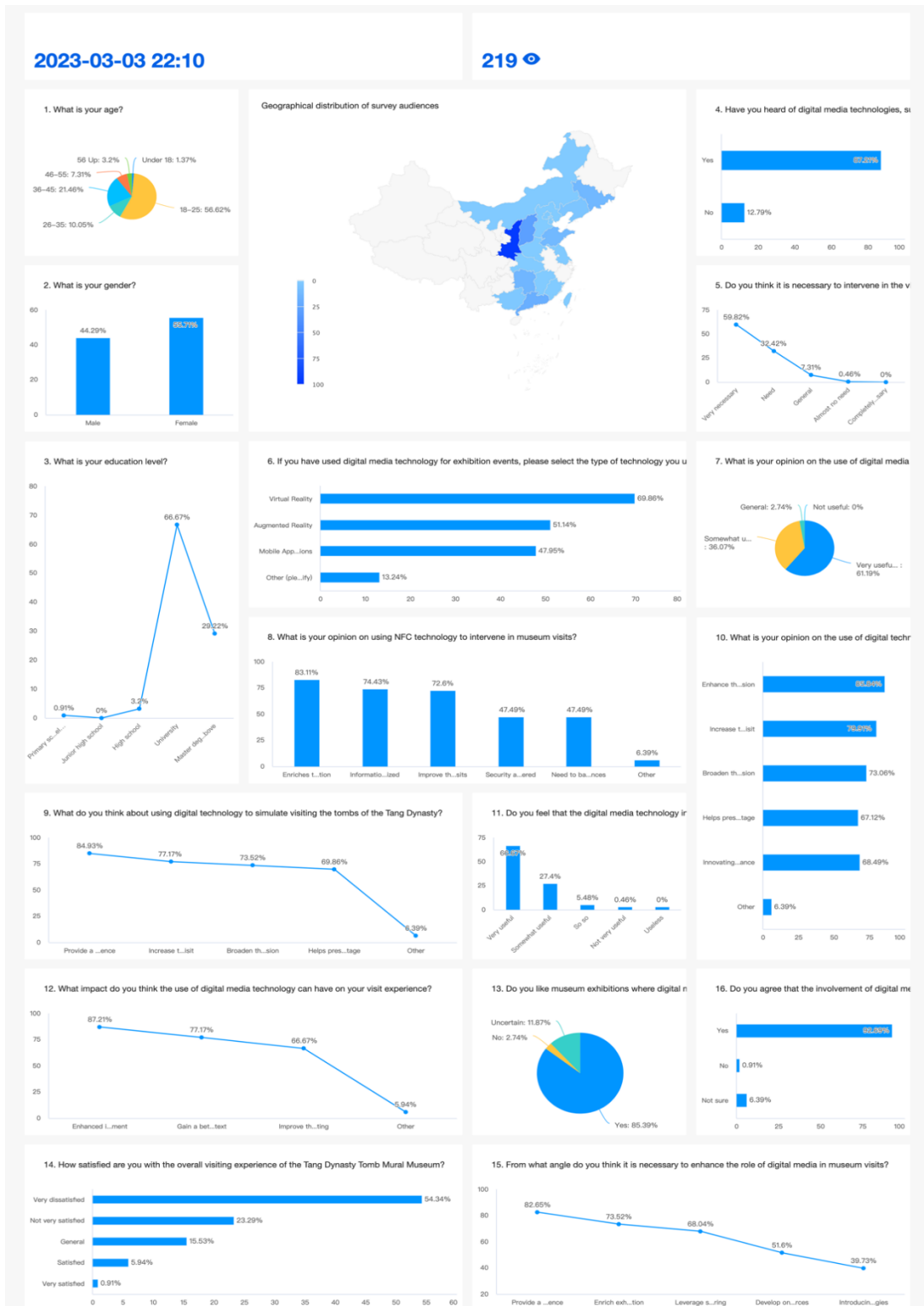


Diagram 64 A Preliminary Analysis of the Questionnaire of Digital Media Intervening in the Exhibition of Tang Tomb Murals

Source: Drawn by Author, 2023.

Table 1 Cross-analysis of audience age and technology types of participating digital media intervention exhibition,

Source: Drawn by Author.

Ages\Digital Tech	Virtual Reality	Augmented Reality	Mobile Applications	Other	Total
Under 18	2(66.67%)	1(33.33%)	2(66.67%)	0(0.00%)	3
18-25	92(74.19%)	67(54.03%)	65(52.42%)	19(15.32%)	124
26-35	12(54.55%)	11(50%)	7(31.82%)	3(13.64%)	22
36-45	33(70.21%)	23(48.94%)	19(40.43%)	4(8.51%)	47
46-55	7(43.75%)	5(31.25%)	8(50%)	3(18.75%)	16
56 Up	7(100%)	5(71.43%)	4(57.14%)	0(0.00%)	7

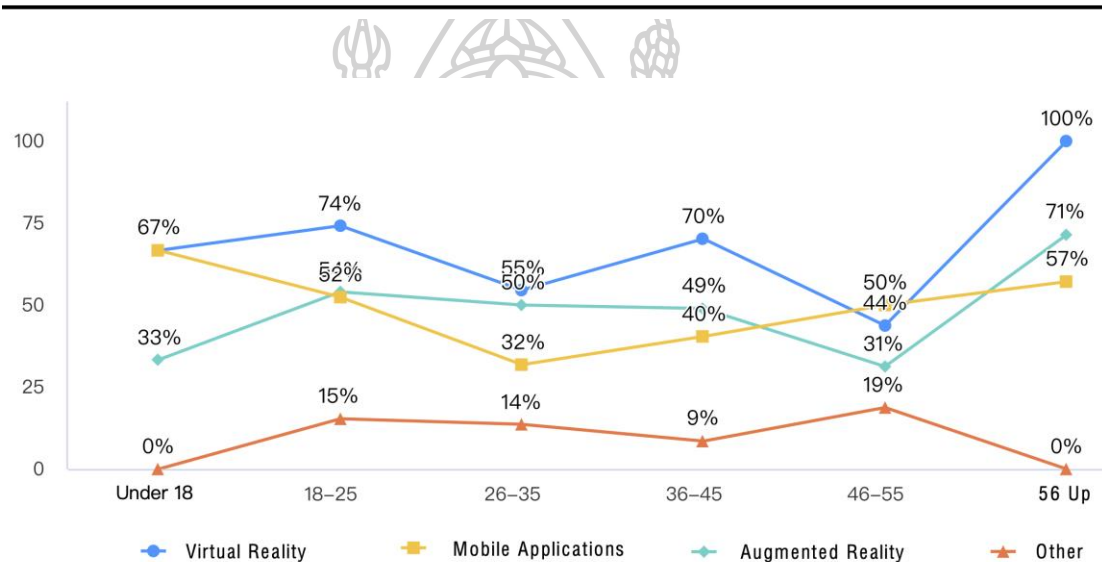


Diagram 65 Cross-analysis of audience age and technology types of participating digital media intervention exhibitions

Source: Drawn by Author, 2023.

Table 1 analyzes the distribution of technology types used by participants in digital media intervention exhibitions across various age groups (Table 1). The table reveals that virtual reality and mobile applications are the most commonly used technologies, while other types of technology are employed less frequently.

Specifically, participants aged 18-25 exhibit the highest proportion of usage for virtual reality (74.19%), augmented reality (54.03%), and mobile applications (52.42%). The 36-45 age group also shows a relatively high proportion of usage for these

technologies (70.21%, 48.94%, and 40.43%, respectively). In contrast, other age groups prefer virtual reality and mobile apps (Diagram 65).

These findings indicate the popularity and application of digital media technologies in exhibitions, underscoring the importance of considering audience members' age-related preferences and habits in exhibition design.

Table 2 reflects the experience and cognition of audiences with different educational levels when visiting digital and simulated murals (Table 2). As shown in the table, there is a specific correlation between higher educational attainment and a better experience visiting digitally simulated murals.

Table 2 Cross-analysis of audience education level and digital-simulated mural visit

Source: Drawn by Author.

Education/ Cognitive	More interactive and vivid visiting experience	Increase attractiveness of the visit	Broaden the channels of cultural transmission	Helps to protect cultural heritage	Other	Total
Primary School	2(100%)	1(50%)	1(50%)	1(50%)	0(0.00%)	2
Middle School	4(57.14%)	6(85.71%)	3(42.86%)	2(28.57%)	0(0.00%)	7
University	125(85.62%)	110(75.34%)	106(72.60%)	105(71.92%)	11(7.53%)	146
Master Degree and Above	55(85.94%)	52(81.25%)	51(79.69%)	45(70.31%)	3(4.69%)	64

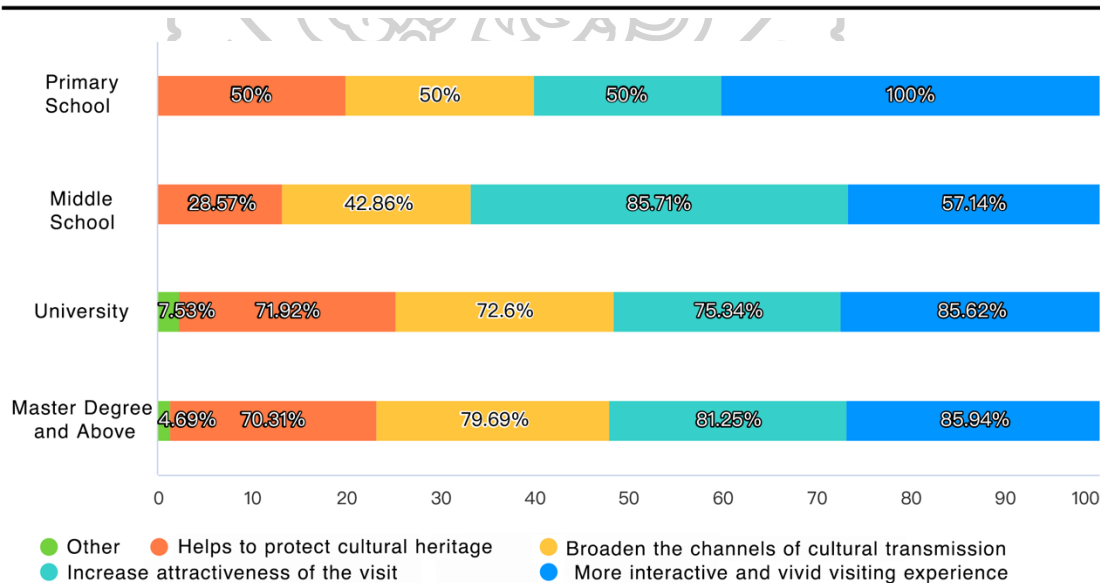


Diagram 66 Cross-analysis of audience education level and digital-simulated visit

Source: Drawn by Author, 2023.

Audiences with different educational backgrounds have slightly different preferences regarding digital and analogue mural-visiting experiences. Primary school students prefer a more interactive and vivid visiting experience. In contrast, middle school students pay more attention to the attractiveness of digital and simulated mural visits and the expansion of cultural inheritance channels. College and postgraduate students generally believe that digital simulation murals can provide a richer visiting experience, increase the attraction of visiting, broaden the channels of cultural inheritance, and help protect cultural heritage (Diagram 66).

These data reflect the application of digital and analogue technology in exhibitions and audiences' preferences. Researchers suggest that exhibition planners should consider the preferences and habits of audiences with different educational levels when designing exhibitions. These results provide a reference for applying digital simulation technology in exhibitions and support and inspiration for the in-depth study of digital simulation mural exhibition design.

Table 3 provides information on the audience's views on using NFC, VR, and immersive experience digital exhibition technology to participate in the Tang Tomb Mural Exhibition (Table 3). The results indicate that most respondents found NFC, VR, and immersive experience digital exhibition technology to be very practical or effective, with the highest percentage of positive responses from the 36-45 age group. Younger participants under 18 also showed a high percentage of positive responses, indicating that these technologies can effectively engage a diverse age range of visitors.

The study's educational value lies in its insight into the potential of NFC, VR, and immersive experience digital exhibition technology for enhancing visitors' experiences at cultural exhibitions. The data could inform decisions on incorporating these technologies into cultural exhibitions to increase visitor engagement and satisfaction (Diagram 67).

The study provides valuable information on the potential effectiveness of NFC, VR, and immersive experience digital exhibition technology in engaging visitors at cultural exhibitions, highlighting the importance of incorporating technology in cultural experiences to attract and engage a diverse audience.

Table 3 Views of the audience on the use of NFC, VR, and immersive experience digital exhibition technology to participate in the Tang Tomb Mural Exhibition

Source: Drawn by Author, 2023.

Ages \ Opinion	Very Effective	Effective	General	Useless	Total
Under 18	2(66.67%)	1(33.33%)	0(0.00%)	0(0.00%)	3
18-25	70(56.45%)	52(41.94%)	2(1.61%)	0(0.00%)	124
26-35	13(59.09%)	6(27.27%)	3(13.64%)	0(0.00%)	22
36-45	35(74.47%)	11(23.40%)	1(2.13%)	0(0.00%)	47
46-55	9(56.25%)	7(43.75%)	0(0.00%)	0(0.00%)	16
56 Up	5(71.43%)	2(28.57%)	0(0.00%)	0(0.00%)	7

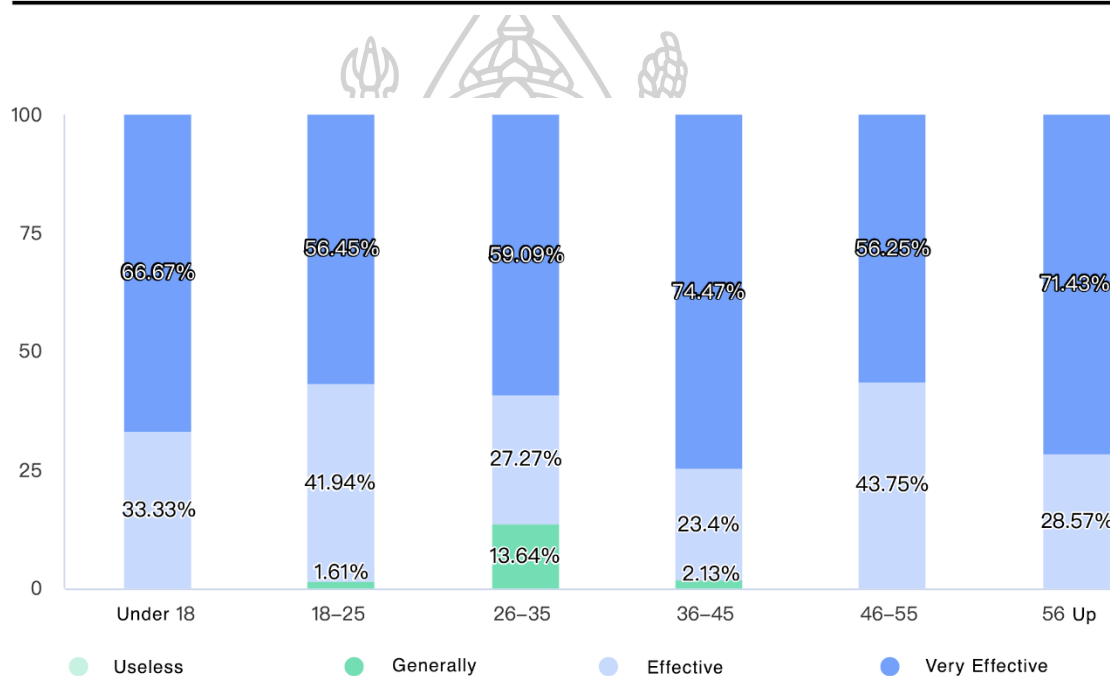


Diagram 67 Views of the audience on the use of NFC, VR, and immersive experience digital exhibition technology to participate in the Tang Tomb Mural Exhibition

Source: Drawn by Author, 2023.

Table 4 presents data showing that NFC technology can effectively enhance museum experiences for visitors of all age groups. Most respondents from all age groups agreed that NFC technology could provide personalized information acquisition, enrich their visiting experience through interaction, and improve museum management efficiency (Table 4).

Table 4 Views of audiences using NFC (Near Field Communication) technology to intervene in museum visits

Source: Drawn by Author, 2023.

Ages \ Opinion	Enrich the visiting experience through interaction	More personalized information acquisition	Improve the efficiency of museum management	Need to consider security and privacy issues	Need to balance digital and physical experiences	Other	Total
Under 18	3(100%)	3(100%)	3(100%)	2(66.67%)	2(66.67%)	0(0.00%)	3
18-25	103(83.06%)	95(76.61%)	92(74.19%)	66(53.23%)	65(52.42%)	12(9.68%)	124
26-35	16(72.73%)	15(68.18%)	14(63.64%)	10(45.45%)	10(45.45%)	1(4.55%)	22
36-45	40(85.11%)	32(68.09%)	33(70.21%)	19(40.43%)	17(36.17%)	1(2.13%)	47
46-55	13(81.25%)	12(75%)	12(75%)	5(31.25%)	6(37.5%)	0(0.00%)	16
56 Up	7(100%)	6(85.71%)	5(71.43%)	2(28.57%)	4(57.14%)	0(0.00%)	7

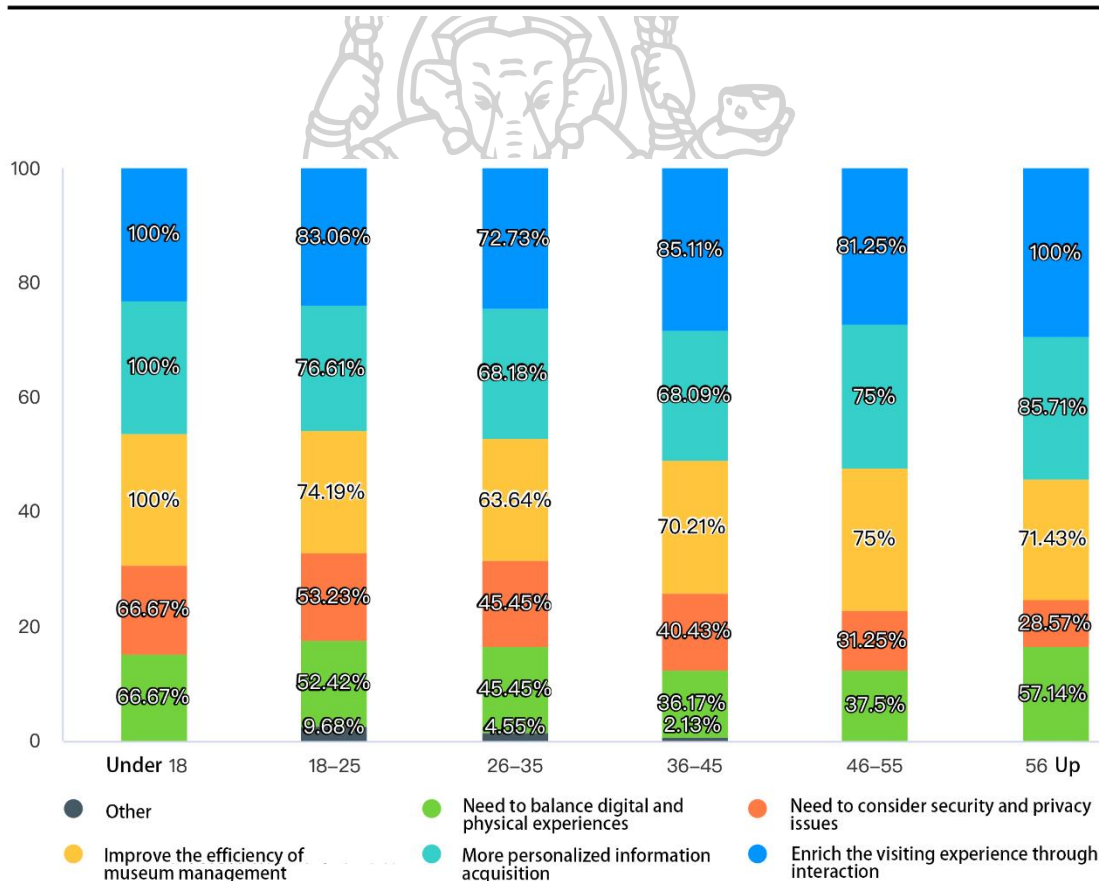


Diagram 68 Views of audiences using NFC (Near Field Communication) technology to intervene in museum visits

Source: Drawn by Author, 2023.

Table 5 Audience opinion of immersive digital media experience

Source: Drawn by Author, 2023.

Ages \ Opinion	Enhance the exhibition experience	Increase the fun and attraction of visiting	Broaden cultural transmission channels	Helps to protect cultural heritage	Innovative ways of cultural inheritance	Other	Total
Under 18	3(100%)	3(100%)	3(100%)	2(66.67%)	2(66.67%)	0(0.00%)	3
18-25	106(85.48%)	104(83.87%)	94(75.81%)	83(66.94%)	87(70.16%)	13(10.48%)	124
26-35	18(81.82%)	17(77.27%)	16(72.73%)	16(72.73%)	17(77.27%)	0(0.00%)	22
36-45	43(91.49%)	32(68.09%)	30(63.83%)	32(68.09%)	28(59.57%)	1(2.13%)	47
46-55	11(68.75%)	13(81.25%)	11(68.75%)	10(62.5%)	10(62.5%)	0(0.00%)	16
56 Up	7(100%)	6(85.71%)	6(85.71%)	4(57.14%)	6(85.71%)	0(0.00%)	7

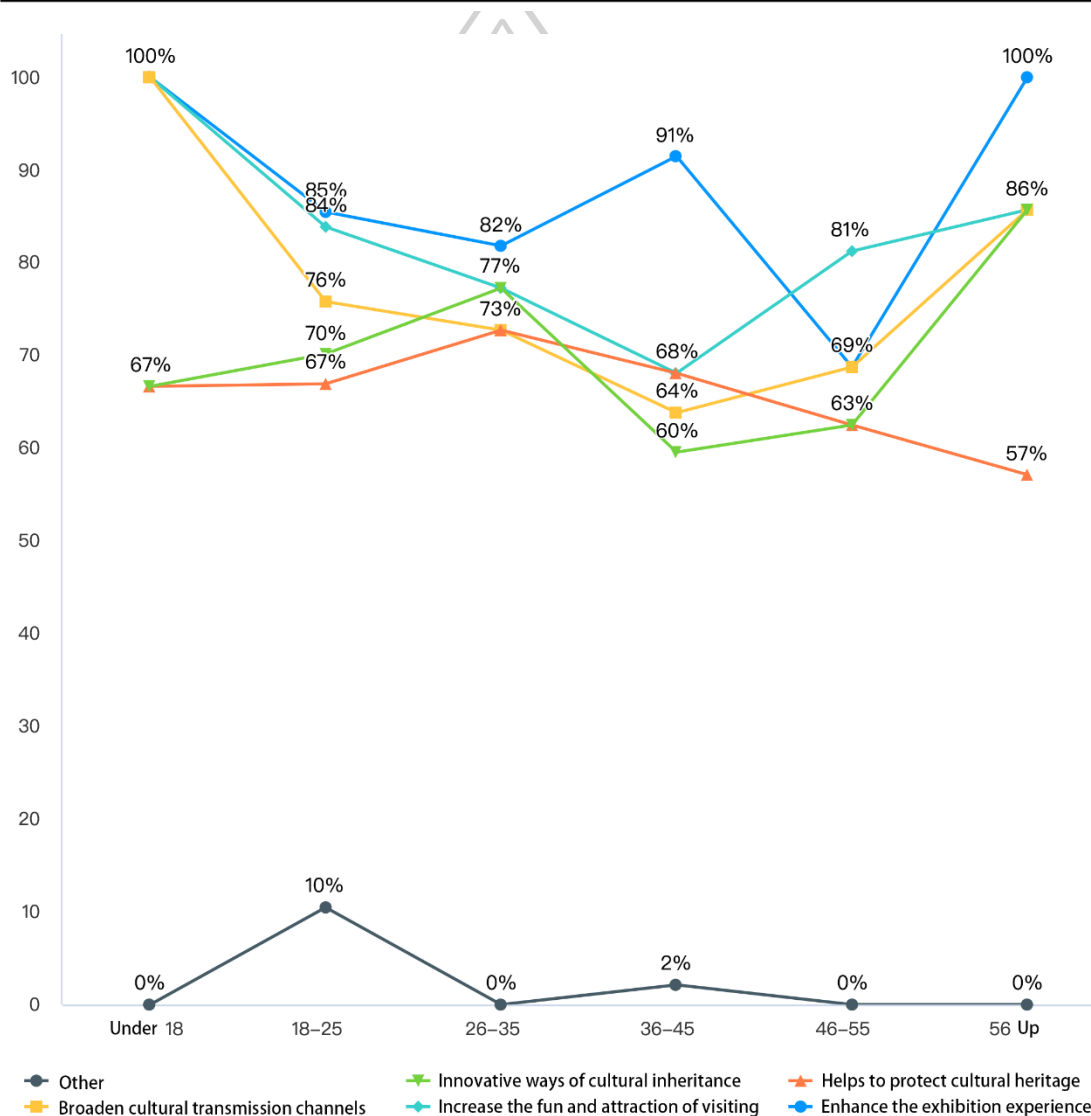


Diagram 69 Audience opinion of immersive digital media experience

Source: Drawn by Author, 2023.

Table 6 The Impact of Digital Media Technology on Audiences Experience

Source: Drawn by Author, 2023.

Ages \ Opinion	Enhanced interactivity and participation	Better understanding of cultural and historical	Increased efficiency and convenience	Exhibition promotion general	Total
Under 18	3(100%)	3(100%)	2(66.67%)	0(0.00%)	3
18-25	107(86.29%)	97(78.23%)	86(69.35%)	11(8.87%)	124
26-35	19(86.36%)	15(68.18%)	15(68.18%)	1(4.55%)	22
36-45	42(89.36%)	34(72.34%)	28(59.57%)	1(2.13%)	47
46-55	13(81.25%)	14(87.5%)	9(56.25%)	0(0.00%)	16
56 Up	7(100%)	6(85.71%)	6(85.71%)	0(0.00%)	7

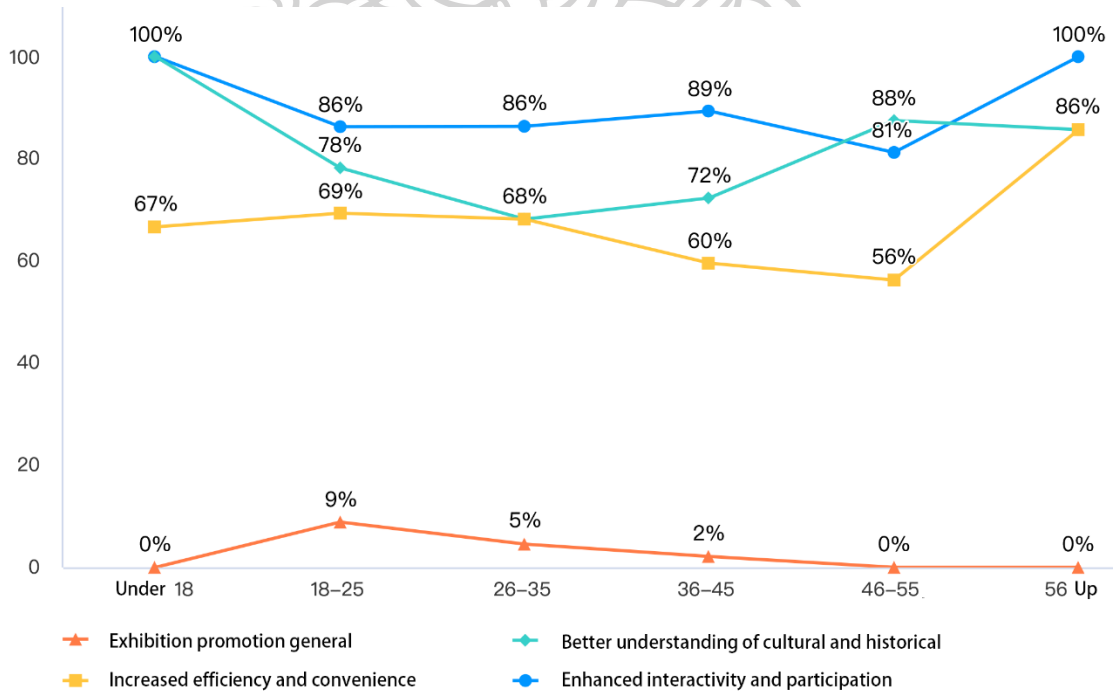


Diagram 70 The Impact of Digital Media Technology on Audiences Experience

Source: Drawn by Author, 2023.

However, respondents also raised concerns about security and privacy issues related to using NFC technology in museums. Therefore, museums must address these concerns and take appropriate measures. Additionally, respondents emphasized the importance of balancing digital and physical experiences in museums (Diagram 68).

Overall, the findings in Table 4 suggest that NFC technology can be an effective tool for enhancing museum experiences. However, it must be implemented carefully to address privacy and security concerns and to balance digital and physical experiences.

Table 5 displays survey results on various age groups' views towards immersive digital media experiences in museums (Table 5). Most respondents across all age groups agreed such experiences could enhance exhibition visits, increase visitors' enjoyment, and broaden cultural transmission channels. Respondents also recognized the potential of immersive digital media in protecting cultural heritage and providing innovative ways of cultural inheritance.

Nevertheless, significant differences in opinion were observed among the age groups. Specifically, respondents aged 18-25 demonstrated the most optimism towards immersive digital media experiences, with the highest agreement percentages for all opinions presented. In contrast, the age groups of 46-55 and 56 and up showed more moderate agreement levels overall, while respondents aged 36-45 expressed the highest agreement towards the importance of protecting cultural heritage (Diagram 69).

Table 6 shows survey results on the impact of digital media technology on museum audiences' experiences, categorized by age groups. Most respondents from all age groups agreed that digital media technology could enhance their interactivity and participation, promote a better understanding of cultural and historical exhibits, and increase efficiency and convenience. However, respondents showed a lower level of agreement regarding digital media's impact on exhibition promotion in general. The respondent's level of agreement varied by age group. Respondents aged 18-25 were the most optimistic about digital media technology's potential impact, with the highest percentages of the agreement for all opinions presented. Respondents aged 36-45 showed the highest agreement for enhancing interactivity and participation, while those aged 46-55 and 56 and up showed more moderate agreement overall. Overall,

these survey results suggest that digital media technology has the potential to enhance museum visitors' experiences in various ways, and different age groups may have different expectations and preferences for its use. These findings can inform the design and implementation of digital media in museums to better cater to visitors' needs and expectations (Source: Drawn by Author, 2023).

Table 6) (Diagram 70).

Table 7 Audience Satisfaction with Digital Media Intervening in the Overall Visiting Experience of the Tang Dynasty Tomb Mural Museum

Source: Drawn by Author, 2023.

Ages \ Opinion	Very Satisfied	Quite Satisfied	Satisfied	General	Dissatisfied	Total
Under 18	2(66.67%)	1(33.33%)	0(0.00%)	0(0.00%)	0(0.00%)	3
18-25	60(48.39%)	36(29.03%)	19(15.32%)	8(6.45%)	1(0.81%)	124
26-35	10(45.45%)	4(18.18%)	6(27.27%)	2(9.09%)	0(0.00%)	22
36-45	31(65.96%)	6(12.77%)	6(12.77%)	3(6.38%)	1(2.13%)	47
46-55	9(56.25%)	4(25%)	3(18.75%)	0(0.00%)	0(0.00%)	16
56 Up	7(100%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	7

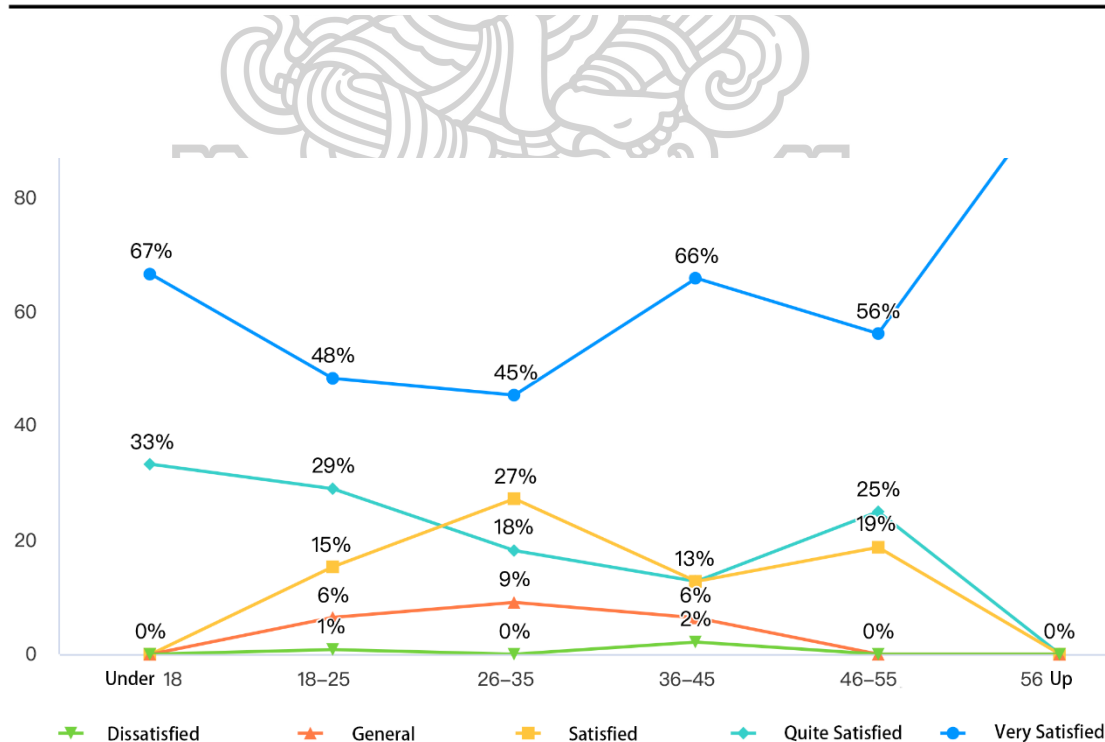


Diagram 71 Audience Satisfaction with Digital Media Intervening in the Overall Visiting Experience of the Tang Dynasty Tomb Mural Museum

Source: Drawn by Author, 2023.

Table 8 From the audience's point of view, what aspects still need to enhance the role of digital media

Source: Drawn by Author, 2023.

Ages \ Opinion	Provide more personalized experience	Richer exhibition information	More convenient social media attributes	Develop online educational resources	Introducing Digital Marketing Strategies	Total
Under 18	3(100%)	2(66.67%)	3(100%)	1(33.33%)	0(0.00%)	3
18-25	103(83.06%)	94(75.81%)	90(72.58%)	69(55.65%)	58(46.77%)	124
26-35	18(81.82%)	16(72.73%)	12(54.55%)	10(45.45%)	6(27.27%)	22
36-45	41(87.23%)	31(65.96%)	29(61.70%)	22(46.81%)	14(29.79%)	47
46-55	11(68.75%)	14(87.5%)	9(56.25%)	7(43.75%)	6(37.5%)	16
56 Up	5(71.43%)	4(57.14%)	6(85.71%)	4(57.14%)	3(42.86%)	7

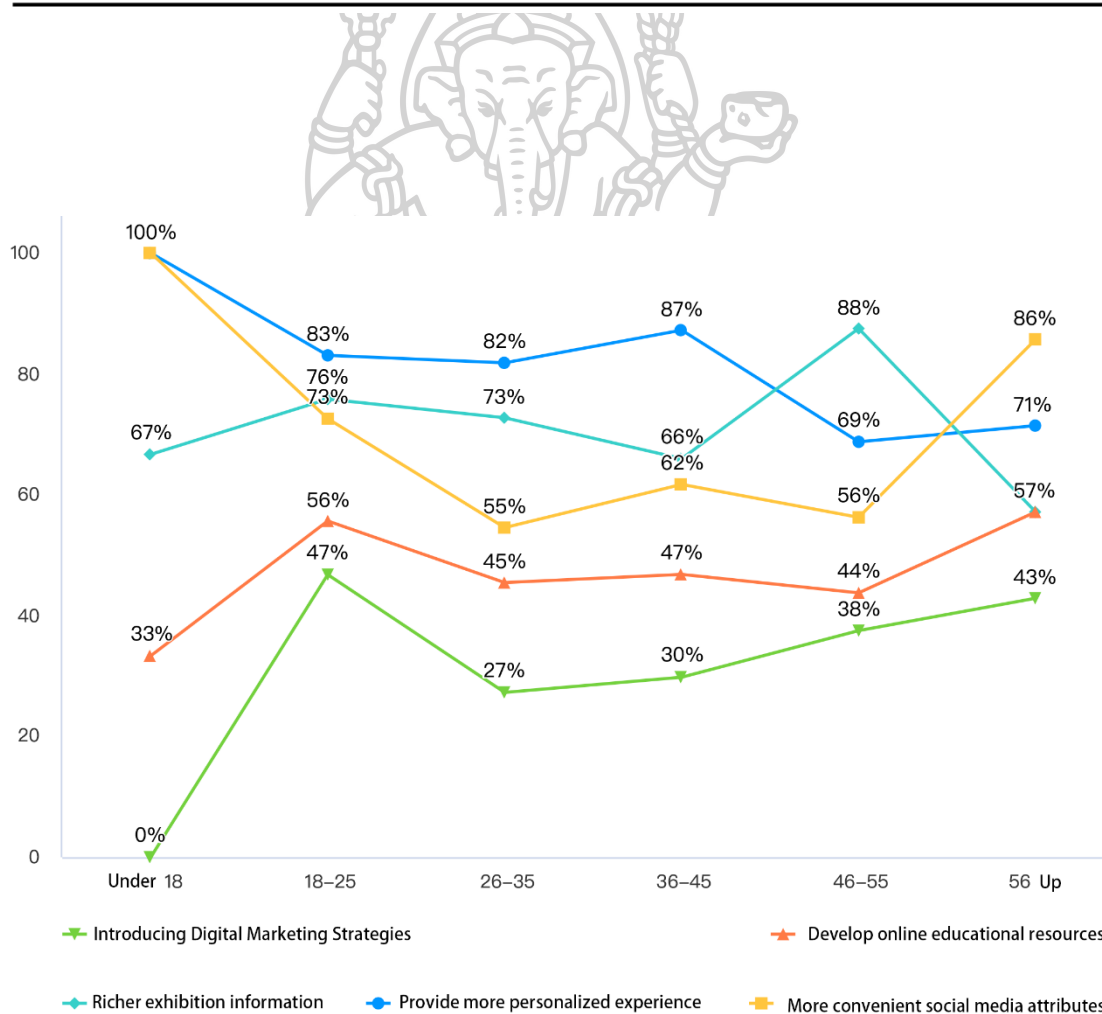


Diagram 72 From the audience's point of view, what aspects still need to enhance the role of digital media

Source: Drawn by Author, 2023.

Table 7 presents data that displays the satisfaction levels of museum visitors of various age groups regarding the use of digital media technology at the Tang Dynasty Tomb Mural Museum. The survey results show that most respondents across all age groups were satisfied with digital media's impact on their visiting experience. Younger respondents aged 18-25 were the most satisfied, while respondents aged 36-45 showed the highest level of agreement for enhancing interactivity and participation. Respondents aged 46-55 and 56 and up showed more moderate agreement overall (Table 7).

The data presented in Table 7 was clear and structured, displaying the satisfaction levels of visitors of different age groups in an organized manner. However, it could benefit from a more detailed explanation of the methodology used to collect the data and the survey questions. It would also be helpful to discuss the implications of the findings for the museum's digital media strategy and its potential to attract and retain visitors of different age groups. Additionally, the presentation of the data could be improved by providing a more descriptive title that accurately reflects the content of the table (Diagram 71).

Table 8 displays the outcomes of a survey that aimed to assess audience satisfaction with digital media interventions in the Tang Dynasty Tomb Mural Museum, focusing on different age groups. The results indicate that younger visitors, particularly those below 25, express higher satisfaction levels with the overall visiting experience and the role of digital media than older age groups. Furthermore, most respondents across all age groups prioritise providing more personalised experiences and richer exhibition information. Additionally, younger visitors are more interested in social media attributes, online educational resources, and digital marketing strategies (Table 8).

From an academic perspective, the survey findings provide valuable insights into the audience's perceptions and expectations of digital media interventions in museums. The results suggest that museums must consider diverse age groups' specific needs and preferences while designing and implementing digital media interventions.

Moreover, the results can inform the development of digital strategies to enhance the audience's experience and engagement in museums (Diagram 72).

The survey results indicate that the intervention of digital media positively impacted the audience's understanding of cultural relics, enhancing their cognition and reflecting the convenience of technology and the audience's participation. However, the effectiveness of the digital media intervention depends on the audience's needs and group characteristics. Therefore, exhibition planners must analyse the audience's visit behaviour, distinguish their different needs and group characteristics, and integrate digital media technology into the planning and design of the entire museum exhibition to create a better audience experience.

To improve the audience's cognition in the museum, exhibition planners should fully mobilise a range of exhibition factors, including space, media, audience, and exhibition, and achieve effective collaboration. The intervention of digital media should serve the needs of the audience and be integrated into the planning and design of the entire museum exhibition, with careful consideration given to the audience's needs and characteristics. By doing so, museum exhibitions can enhance the audience's understanding of cultural relics and provide an effective research method for cultural relic display.

5.5.2 Expert feedback

Researchers tried to ensure the reliability and validity of this study; five experts with extensive experience in design, art, and cultural relics were invited to provide feedback on the research and questionnaire report. These experts were selected based on their expertise and relevance to the study's subject matter. The experts who were consulted are as follows (Figure 115):

Prof. Zhan Qinchuan, Ph.D. Supervisor, Dean of the College of Design and Art, Shaanxi University of Science and Technology, China. Prof. Zhan specializes in digital design education and has published numerous articles.

2. Professor Mi Gaofeng, Ph.D. Supervisor, Deputy Dean of the College of Design and Art, Shaanxi University of Science and Technology, China. Prof. Mi is a multimedia design expert and has researched Digital Media and Cultural Communication.

3. Professor Chen Xia, Ph.D. Supervisor, Head of Department of Clothing, Xi'an Academy of Fine Arts, China. Prof. Chen's research focuses on applying Chinese traditional culture in art and design.

4. Professor Chen Zanwei, Ph.D. Supervisor; Director of the Department of Film and Television Animation, Guangzhou Academy of Fine Arts, China. Prof. Chen's research interests include digital animation and virtual reality technology.

5. Researcher Cai Changlin, Office of Cultural Relics, Archaeology and Protection, Shaanxi History Museum, China. Mr. Cai has extensive experience in cultural relics preservation and is familiar with the use of digital media in museum exhibitions.



Figure 115 Experts: Zhan Qinchuan, Mi Gaofeng, Chen Xia, Chen Zanwei, Cai Changlin

These experts were selected based on their expertise, experience, and relevance to the study's subject matter. They were chosen to provide valuable insights into the paper and questionnaire report and to ensure the study's reliability and validity.

During the interview, the experts were invited to participate in a semi-structured interview to ask three questions to gauge their views on using digital media technology in museum design:

(1). Can digital media technology provide new research perspectives and methods for museum situational design?

(2). Do the experts agree with the methods and results of this study using digital media technology to enhance audience perception?

(3). Can digital media technology become the new normal for the future technology and exhibition forms of Chinese museums?

Prof. Zhan Qingchuan's feedback. Prof. Zhan Qinchuan, a design educator with decades of professional experience, shared his views on the intervention of digital technology in museum situation design.

According to Prof. Zhan, the application of digital technology in Chinese museums is developing rapidly. However, there needs to be more practical cooperation between the technical characteristics of digital media and the design concept and form of museum exhibitions. Many museums prioritize novel digital media representations over the goals of the exhibitions, which weakens the exhibitions' impact. Furthermore, the traditional concept of cultural relics exhibition hinders digital media from intervening in museum situational design. There need to be forward-looking guiding theories proposed by the academic and design communities.

This research takes the audience as the core and focuses on enhancing participation and interaction while simplifying the way of information acquisition and sharing. The multi-dimensional information exchange enhances the visitors' cognition of the exhibition, breaks through the traditional linear exhibition mode, and explores future museums' multi-level and three-dimensional situational design methods. The design concept theory presented in this study provides a new research method and perspective for digital media technology to intervene in museum situation design, which has practical significance.

In addition, Prof. Zhan suggests that the development of museums in China should embrace the new dimension of digital technology by using new technologies such as virtual exhibitions and metaverse to build digital spaces. This approach can break through the lack of visiting experience caused by the scarcity of time, space, and resources and promote personalized experiences. This model theory is a valuable contribution to exploring future technologies for museum exhibitions.

Prof. Mi Gaofeng's feedback. Professor Mi Gaofeng has a dual educational background in philosophy and art and an academic experience in cultural heritage and digital media design. In this research, he interprets the significance of the conclusions of this study from the perspective of building digital cultural heritage.

The development of the concept of digital cultural heritage in developed countries in Europe, America, and Japan has influenced the early construction of

related ideas in China. Among them, the Japanese design concept has formed a unique style based on the absorption of European and American models, which provides a reference for Asian countries to learn and appreciate the development of their digital cultural heritage. At this stage, China has initially established the concept of localization to protect digital cultural heritage and is actively exploring new design paradigms suitable for the characteristics of the information age. It requires researchers to provide unique design options to explore theory and form. The descriptive indicators proposed in the design concept of this study are conducive to building a new digital cultural heritage protection paradigm in China.

Furthermore, the situational design of museums in the digital age should focus on the audience's experience, visiting behavior, interests, and hobbies, and carry out the intervention of digital technology. This study takes the audience as the core, pays attention to the participation and interaction of the audience, and simplifies the way of information acquisition and sharing. Multi-dimensional information exchange enhances the cognition of visiting. It breaks through traditional exhibitions' linear exhibition mode and explores future museums' multi-level and three-dimensional situational design methods. The design concept theory provides a new research method and perspective for digital media technology to intervene in museum situational design, which has practical significance for the field.

In conclusion, this study highlights the importance of digital cultural heritage and the role of digital technology in museum situational design. It provides a unique design concept that could contribute to developing a new digital cultural heritage protection paradigm in China. Future research can explore the implications of this concept in practice and further refine the design methodology.

Prof. Chen Xia's feedback. Professor Chen Xia is a respected China Artists Association Fashion Design Art Committee member and an academic fashion design leader. Her research and practice have focused on developing Chinese-style clothing design. In this research, she discusses the inheritance relationship between Chinese social etiquette systems and clothing design and offers insights into the combination of situational cultural attributes and digital technology.

As a scholar, Professor Chen has witnessed the significant changes in cultural communication brought about by digital media technology. While in the past, she only needed to learn relevant knowledge in the clothing field, she now must continuously pay attention to changes in social and cultural trends presented by social media, websites, markets, and other media.

Professor Chen emphasizes the importance of designers facing up to the community's spiritual needs for traditional Chinese culture in cultural communication. People today are eager to increase their confidence in Chinese culture, and it is vital to meet these needs. However, cultural communication is a complex issue, and telling China's "Story" requires careful consideration of the nature of cultural transmission and respect for cultural development. While digital media technology can bring new forms of display and interaction, more is needed to solve the core problem of spiritual needs in cultural communication.

The theoretical summary and practice of the study's visual cultural turn of traditional tomb murals provide a valuable case reference for relevant designers. By rethinking the nature of cultural transmission, designers can create sustainable development in the industry.

In summary, Professor Chen's research highlights the need for designers to respect cultural development while meeting the community's spiritual needs for traditional Chinese culture in cultural communication. This study's theoretical and practical insights can serve as a valuable reference for relevant designers.

Prof. Chen Zanwei's feedback. Professor Chen Zanwei is a distinguished member of the Animation and Digital Media Teaching Steering Committee of the Ministry of Education of China, a senior expert member of the China Digital Art Design Professional Committee, and the Secretary-General of the Guangdong Animation Artists Association. Professor Chen has been actively involved in the forefront of industry development, focusing on the parallel development of academia and industry.

Reflecting on his study and work experience, Professor Chen observed that the industry emphasizes the interaction between technology and art, and this has led to the law of industry development at the current stage: technology advances promote design development and provide new feasible means for the innovation and

performance of the plan. To achieve the design's purpose, the modern design must consider the technical exchanges between multiple disciplines, give full play to each professional's advantages, and achieve technical integration and collaboration among teams. Designers should have a broad cultural vision and always pay attention to the latest developments in digital technology, make full use of the effective allocation of resources, and focus on business efficiency.

According to Professor Chen, using digital technology in this research is reasonable and adequate. It makes full use of the integration of resources, gives full play to the technical characteristics of different professions, and promotes the realization of design goals. The research is experimental and has the value of promotion.

Researcher Cai Changlin's feedback. Cai Changlin is a senior researcher at the Shaanxi History Museum and is the deputy director of the Shaanxi Provincial Art Committee of UNESCO. His research focuses on the decorative patterns in cultural relics from the Sui and Tang Dynasties. In this interview, he shares his views on cultural inheritance and dissemination concerning his research.

He has argued that a chaotic phenomenon of pan-entertainment plagues Chinese social and cultural dissemination. According to him, pan-entertainment results from expanding consumerism and hedonism under the influence of capital in social development. On the one hand, it serves the interests of capital, and on the other hand, it caters to the low-level cultural consumption of the public. However, it is important to recognize that pan-entertainment cultural dissemination serves only some of the public demands of social and cultural development. Rather, its essence is to cater to the uncontrolled release of people's desires at the bottom. The mass media's pan-entertainment will decrease the cultural taste of the audience, weaken the social responsibility of citizens, and weaken the social responsibility of the media, which has evident social harm.

However, we should not adopt dualistic viewpoints and neglect the positive effects of pan-entertainment on cultural communication. The pan-entertainment of cultural transmission is the satisfaction of the audience's psychological needs. In contrast, the pan-entertainment of cultural communication is the product of market

competition and conforms to the law of market development. Therefore, we should adopt compatible measures and make full use of the market's integration and rational allocation of resources through the top-level design of the cultural management department. By doing so, we can guide the healthy development of social and cultural communication.

Cai shares his views on the importance of museums as treasure houses of human civilization, preservers, and recorders of history, uniquely promoting world cultural exchanges and mutual learning. He agrees with the visual turn theory of culture. He emphasizes that museum exhibition design should respect historical facts and the objective laws of development, with the primary aim of cultural dissemination.

He believes that in a society where pan-entertainment has become prevalent, museums should maintain academic and professional standards, aiming at educating people and using exhibition scenarios to enhance visitors' learning experience. Cai Changlin emphasizes the importance of using modern digital media technology to break through communication barriers and promote the audience's cognition without blindly catering to the audience's tastes. Instead, museums should actively guide visitors, stimulate their desire to explore through interesting visits, and cultivate their interest in learning.

Cai Changlin emphasizes that his design concept aligns with the development trend of the times, and his research method offers a reasonable solution to social phenomena. The research model's concept can stimulate the audience's interest and participation in interaction, promoting active thinking and practical learning. Ultimately, the design has research value in enhancing the audience's desire for knowledge acquisition.

The interview summarizes the feedback from five experts, namely Prof. Zhan Qingchuan, Prof. Mi Gaofeng, Prof. Chen Xia, and Prof. Chen Zanwei, Cai Changlin, on the intervention of digital technology in museum situational design in China. The experts opine that digital technology's application in Chinese museums is developing rapidly, but museums must prioritize the goals of exhibitions over novel digital media representations. The study emphasizes the need for forward-looking guiding theories to effectively allow digital media to intervene in museum situational design.

Additionally, the development of museums in China should embrace the new dimension of digital technology by using new technologies such as virtual exhibitions and metaverse to build digital spaces. The experts also focus on the audience's experience, visiting behavior, interests, and hobbies, suggesting that the situational design of museums in the digital age should incorporate digital technology to provide a personalized experience. Furthermore, the study provides a unique design concept that could contribute to developing a new digital cultural heritage protection paradigm in China. Lastly, the experts stress the importance of designers respecting cultural development while meeting the community's spiritual needs for traditional Chinese culture in cultural communication.

5.6 Chapter summary

Generally, Tang Dynasty tomb murals consist of two image systems: the images of scenes inside and outside the noble mansion representing the theme of the natural world, and the mysterious image system of the universe representing the theme of the spiritual world. The two systems are unified in tomb murals, reflecting the ancient Chinese spiritual concept of "harmony between man and nature."

Researchers conducted a questionnaire survey on the audience who visited the Shaanxi History Museum to focus on the audience's visit and related issues of the Tang Dynasty tomb murals. The analysis results show that the audience is satisfied with the exhibition of cultural relics but put forward improvement requirements for the museum's exhibition form, visiting situation, and atmosphere. Most of the audience thinks that the design of the mural museum is mainly to protect and store the murals. From the venue's design to the presentation of the exhibition content, it is impossible to stimulate the audience's enthusiasm, and the audience can quickly feel aesthetic fatigue during the visit. The audience expects to increase the fun and interactivity during the exhibition to deepen the memory and cognition of the museum visit. At the same time, the audience hopes that the form of the museum exhibition can relate to the audience's daily life habits and make full use of digital technology and information technology to enrich the audience's demand for knowledge acquisition and sharing.

The preliminary conclusion of the research shows that the situation design of museums in the digital media era should shift from focusing on "object" to "person." The audience is the core of the museum's situation design, and their visiting experience and cognitive improvement are essential for judging it. Design should take the audience as the core, space as the basis, media as the means, exhibition as the carrier, and the ultimate goal of improving the audience's cognition. Digital media intervention in museum situation design should pay attention to the cooperation between various elements of museum exhibitions, take audiences to acquire knowledge, experience the atmosphere, and gain a cultural identity as the purpose of museum situation design, and give full play to the technical characteristics of digital media technology interconnection in the information age.

The study also emphasizes the importance of cultural attributes in museum exhibition situations, as cultural concepts play a vital role in stimulating the audience's subconscious cultural identity. To this end, the study proposes the design concepts of virtual and real, loop-shaped corridors, square and circle, and movement and stillness. These concepts are figurative expressions of abstract cultural concepts found in traditional Chinese cultures, such as the yin and yang theory, the theory of reincarnation, the theory of the round sky and square Earth, and the theory of harmony between man and nature. Such figurative expressions should be integrated into the audience's visit process to stimulate their cultural identity subconsciously.

This article analyses potential digital visual design forms that could be applied to Tang Dynasty tomb murals. It explores the relationship between traditional artistic styles and modern visual design in the expression of these murals. The Authors emphasize the importance of tailoring the visual design to meet the information needs of the audience and the necessity of achieving a cohesive unity between the content of the murals and the exhibition space, media, and methods used to display them.

In particular, the Authors argue that by creating an organic combination of exhibition content and methods, the visiting experience of the audience can be enhanced, leading to a greater understanding and appreciation of the tomb murals. The article thus presents a new approach to the presentation of traditional art forms through the use of modern digital design.

Finally, the development of design solutions must consider the intersection of archaeology, history, philosophy, religion, and other disciplines. It is crucial to pay attention to the rational use of digital technology and to prioritize the audience's visiting experience and cognitive improvement (Stogner, 2009).



Chapter 6 Conclusions, Discussion, and Recommendations

6.1 Conclusion

The present research aims to

1. Analyze the challenges and opportunities of digital media technology in museum situational design,
2. Explore digital media situational design strategies and methods in the Tang Dynasty Murals exhibition context,
3. Evaluate the effectiveness of the digital media situational design in improving audience awareness and enhancing their visiting experience,
4. Provide theoretical and practical references for designing and promoting digital media situational design in Chinese museums.

Objective 1: Challenges and Opportunities of Digital Media Technology

The study illustrates the complex interrelationships between space, media, audience, and exhibition in museum contexts, with an emphasis on the central role of the audience. In this scenario, digital media technology emerges as a communication bridge that can augment cultural artifact displays and enhance visitor cognition. This role of digital media presents opportunities, such as broadening the array of information interaction methods and enriching multisensory experiences, and challenges, such as ensuring the consistency of exhibition technology, content, and spatial context while respecting the audience's daily usage habits and logical thinking patterns.

Objective 2: Digital Media Situational Design Strategies and Methods

This research proposes a prototype model for reconfiguring the spatial framework of museum situational design by analyzing the structural and artistic characteristics of mural tombs. The interactive capabilities of digital media are integrated into this situational design to offer an immersive experience, enriching visitor experiences and facilitating their interaction with the exhibits. The prototype model emphasizes the importance of prioritizing the audience and focuses on audience

sentiment, interaction, and the logic of applying interactive technology in the exhibition of cultural relics.

Objective 3: Evaluating the Effectiveness of Digital Media Situational Design

This study underscores the significance of prioritizing the audience in developing museum situational design during the digital era. Essential criteria for assessing the effectiveness of such designs encompass visitor experience, emotional engagement, satisfaction, and the enhancement of cognitive abilities throughout their museum visit. The study offers robust data support for evaluation and conclusions through scientific operation management and reasonable data collection. It concludes that digital media intervention can enhance visitors' cognition, augment their immersive experiences, and improve their cognitive comprehension.

Objective 4: Theoretical and Practical References for Future Design

The research provides a theoretical reference for China's digital museum development and practical insights for related industries. The conceptual model underscores the importance of audience emotional engagement with interactive technology and the rationale for its application in the exhibition of cultural relics. In light of recent advancements in communication and information interaction technologies such as 5G, digital media's potential to revolutionize museum experiences is highlighted. The model could serve as a guide for developing efficient digital interventions in museum contexts.

6.1.1 Conclusion Experimental prototype model

1. Conclusions Drawn from a prototype model.

This study investigates the interrelationships among key elements—space, media, audience, and exhibition—within the context of museums, with particular emphasis on the audience as the central component (Diagram 73). The interactive capabilities of digital media are integrated into the situational design of museums to enhance visitor cognition. By drawing upon interdisciplinary knowledge from fields such as history, exhibition design, digital media technology, audience psychology, and craftsmanship, this research generates innovative ideas for situational design in contemporary museums. The study underscores the significance of prioritizing the audience in developing museum situational design during the digital era. Essential

criteria for assessing the effectiveness of such designs encompass visitor experience, emotional engagement, satisfaction, and the enhancement of cognitive abilities throughout their museum visit.

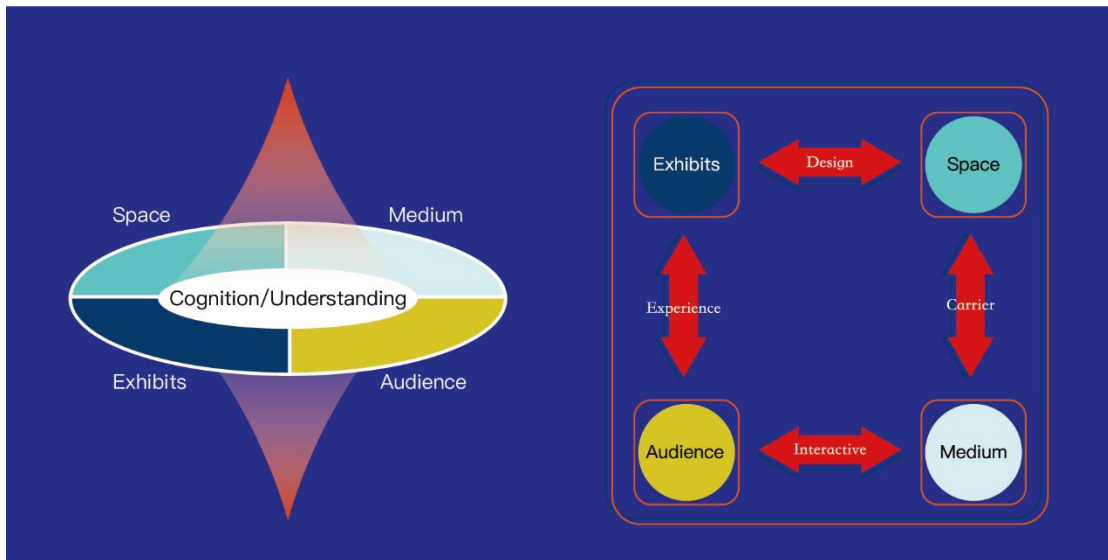


Diagram 73 The relationship between the four elements of museum situation design
Source: Produced by Author, 2021.

The construction and development of the conceptual model for this interdisciplinary knowledge system require collaboration from experts across various fields to ensure the harmonious operation and comprehensive management of different elements involved in museum situation design. This study offers robust data support for evaluation and conclusions through scientific operation management and reasonable data collection (Minoska-Pavlovskaja, 2019). The design of museum contexts in the digital media era should emphasize the relationship among museums, digital technology, and audiences, highlighting the interaction of the three as a unified system (Wang et al., 2009).

a. Museum exhibition design should prioritize audience participation and interaction, emphasizing the relevance of exhibition content and enhancing visitors' cognition during their visit (Roberts, 2013).

b. Digital media technology functions as a communication bridge, aiming to augment the display of cultural artifacts and audience cognition. The technology should ensure the consistency of exhibition technology, content, and spatial context, respect the audience's daily usage habits and logical thinking patterns, and prioritize audience participation and interaction (Chiu & Shih, 2020).

c. Design considerations should cater to various audience groups, analyze cognitive differences among visitors, and address the audience's diverse needs (Callanan, 2012). In the digital age, the audience has become the core component of museum context design. Visitor experience, satisfaction, and cognitive improvement are crucial for evaluating museum situational design.

In conclusion, incorporating digital media into museum situational design through a prototype model can effectively enhance visitors' cognition. The digital age provides audiences a broader array of information interaction methods, enriching their multisensory experiences. Technological applications have made information more accessible and practical for audiences, while digitization and multi-dimensional stimulation have improved visitors' immersive experiences and cognitive comprehension (Meenar & Kitson, 2020). Visitors actively explore their interests and engage in interactive experiences; their existing knowledge limits their cognitive enhancement. Design concepts should revolve around the cognitive differences of the audience and cater to the needs of various audience levels as much as possible. Relevant experts acknowledge this design concept and believe it is beneficial for bridging the cognitive gap between visitors and cultural artifacts, effectively increasing visitors' attention to cultural artifacts and enhancing their cognition during visits and interactions. The design concept should concentrate on coordinating and scientifically managing equipment and programs using digital technology, fostering effective audience collaboration, situational design, and cognitive enhancement (Varvin et al., 2014).

6.1.2 Conclusions theoretical

This study explores the influence of digital media intervention on museum situational design and its subsequent effect on visitor experiences. The research is grounded in analyzing mural tombs' structural and artistic characteristics, from which

the researchers propose reconfiguring the spatial framework of museum situational design. The conceptual model underscores the importance of audience emotional engagement with interactive technology and the rationale for its application in the exhibition of cultural relics. This investigation will contribute to the knowledge of museum design and visitor experience, providing insights into utilizing digital media to bolster audience engagement with cultural heritage. Based on this model, the study derives the following conclusions:

6.1.2.1 Employing digital media intervention in museum situational design can enhance visitor experiences by encouraging audience participation and interaction.

The integration of digital media effectively connects situational elements within museums, such as space, media, audience, and exhibition, thus creating a relaxed atmosphere for visitors. The narrative context, constructed through space, media, and exhibition, allows for an immersive experience. Dynamic video, audio, and near-field communication (NFC) technology facilitate multi-dimensional digital media interactions, stimulating visitors' visual, auditory, tactile, and other senses.

The researchers found that most audiences favoured digital media interaction to enrich their museum visits. The team reimagined the spatial framework of museum situational design by analyzing mural tombs' structural and artistic features. Their conceptual model emphasizes the importance of audience sentiment regarding interaction and the logic behind using interactive technology to showcase cultural relics.

6.1.2.2 Museum situational design under digital media intervention prioritizes visitor experiences, learning, and individual needs, aiming to guide and enhance cognition through situational experiences.

This conceptual model emphasizes an audience-centric, experience-driven approach to digital situational design, with visitor experience, quality, and satisfaction as crucial evaluation factors for museum exhibitions. Integrating digital media can heighten audience attention and foster better learning opportunities. However, cognitive improvement relies on various factors, including visitors' knowledge, experiences, interests, personality traits, social status, and income, which may influence their perception and understanding.

6.1.2.3 The proposed conceptual model offers a theoretical reference for China's digital museum development and practical insights for related industries.

In recent years, the importance of digital media in augmenting audience cognition in museum settings has garnered increasing recognition. It is particularly apparent in China, where rapid advancements in communication and information interaction technologies, such as 5G, have significantly altered daily life (Dong et al., 2011). As digital media continues to evolve, it increasingly blurs the boundaries between traditional museum exhibitions and cultural artefacts, enabling audiences to access information on cultural relics conveniently and effectively through digital interactions. The social aspect of digital media fosters a casual atmosphere that facilitates information sharing and deepens understanding via communication (Massi et al., 2020).

In a recent survey, audiences indicated that using digital media to enhance museum experiences piqued their interest, increasing their inclination to visit museums and improving their comprehension of history and cultural relics. It reveals the potential of digital media to revolutionize museum experiences and highlights the necessity for a theoretical framework guiding the development of efficient digital interventions in this context.

This research proposes a conceptual model that centres the audience on the museum experience, focusing on experience-driven digital situational design. The model emphasizes the significance of visitor experience, quality, and satisfaction as indicators of museum exhibition quality. By incorporating dynamic video, audio, and NFC near-field technology, multi-dimensional digital media interactions can stimulate visitors' senses and foster a relaxed atmosphere that enhances learning opportunities.

At the national level, the Chinese government actively advocates for the digital transformation of museums. This conceptual model can provide a theoretical reference for the digital development of China's museums and related industries. Future research should explore the practical implementation of this model in real-world museum contexts and examine its effectiveness in enhancing audience cognition and satisfaction.



Figure 116 The actual photo of the mural tomb in the Tang Dynasty, the murals on the walls are replicas

Source: Photographed by Author, 2023.

6.2 Discussion

6.2.1 Challenges and Solutions in Tomb Mural Replication and Exhibition

The "Law of the People's Republic of China on the Protection of Cultural Relics" imposes restrictions on personal activities, including academic research, within museum exhibition venues, prohibiting the unauthorized movement of cultural relics (Chai & Li, 2019). Furthermore, the original museum site could be more suitable for conducting digital design experiments. Consequently, researchers must identify alternative environments for executing their plans and collecting audience feedback while acknowledging the challenges in tomb mural preservation and exhibition limitations.

Researchers employed digital high-definition inkjet technology to address these issues to replicate the murals, merging traditional and digital methods to establish a novel museum exhibition environment (Figure 116). By relocating to a new venue, they overcame the original exhibition space constraints and optimized space planning and digital technology integration from the design's inception.

Researchers acknowledged the tomb murals' artistic value rooted in traditional Chinese spiritual beliefs (Dainian, 1985). They sought to create an immersive audience experience by simulating the tomb's physical space and restoring the reborn world. Careful consideration was given to audience interaction and participation, with the ultimate goal of enhancing their cognitive experience.

Using digital technology, researchers successfully overcame museum exhibition limitations and established a new environment balancing traditional Chinese culture and modern design. The audience's experience and interaction with the exhibit were prioritized throughout the planning process, offering a unique opportunity to appreciate better and understand the tomb murals' cultural significance.

6.2.2 Audience-Centered Museum Situational Design in the Digital Age

Based on surveys, interviews, and expert and audience consultations, researchers concluded that designing museum exhibitions in the digital age must prioritize visitors' experiences. Consequently, the situational method of museum design should evolve beyond traditional models focused on collecting and exhibiting cultural relics. Researchers found that while digital media technology supplemented traditional exhibition models, it needed to exploit digital interaction potential to meet audience expectations fully (Di Pietro et al., 2014).

Researchers attributed this phenomenon to museums' continued adherence to traditional design ideas, which failed to address audiences' needs in the digital age. They proposed an audience-centred museum situational design approach, subdividing audiences into different categories based on their experience needs and methods (e.g., potential, ordinary, loyal, and professional audiences).

By analyzing the different needs of these categories, researchers sought to understand better the relationship between audience needs and various elements of museum situational design (Diagram 74). Recognizing the importance of digital media in museum design intervention, researchers aimed to create personalized, interactive exploration opportunities catering to different audience groups' diverse needs. This approach would enhance audience cognition by promoting active museum experience participation.

In conclusion, researchers posited that audiences' visiting experiences must remain the core consideration in museum situational design in the digital age. An audience-centred approach informed by audience categorization should guide the museum design process. By embracing digital media technology, museums can create personalized, interactive experiences that promote audience participation and enhance audience cognition.

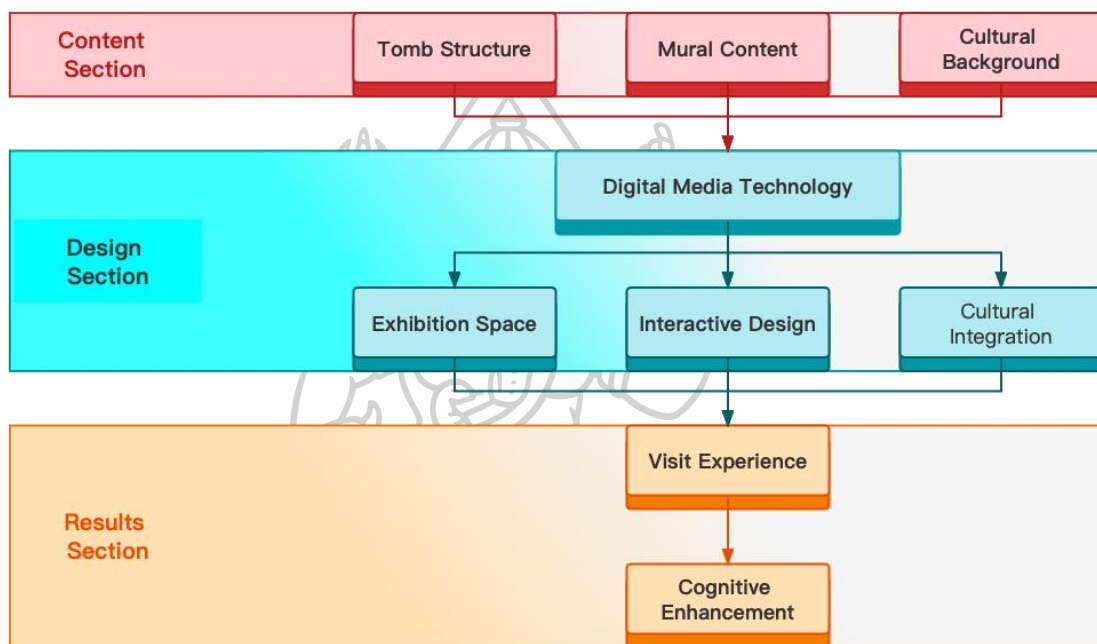


Diagram 74 Design process and relationship between elements

Source: Produced by Author, 2022.

6.2.3 Integrating Digital Media Technology and Cultural Relics for Immersive Experiences

Digital media technology should consider cultural relics' historical context, structural characteristics, and cultural significance to ensure rational digital design (Srinivasan et al., 2010b). Researchers have long acknowledged the potential of combining digital media technology and cultural relics for designing immersive visitor experiences. The design process typically comprises three stages:

A. Researchers derive inspiration from the cultural relics' structure and content to develop a design concept, including simulated walking tours, circular tomb passages, and dynamic image tombs, creating an immersive viewing experience for visitors.

B. During the visit, researchers emphasize the convenience and immersion of digital media interactions. Motion walking equipment, NFC near-field interaction technology, and interactive video and audio contribute to a multi-sensory experience tailored to visitors' personalized needs, encouraging active exploration. This approach facilitates a deeper understanding of the cultural relics for visitors.

C. Researchers incorporate traditional Chinese cultural concepts into the prototype model. The circular tomb design symbolizes the concept of reincarnation in traditional Chinese culture, while the dome and square room designs reflect traditional Chinese philosophy. Dynamic and static video displays convey traditional Chinese culture's yin and yang theory (JianJun et al., 2022). The seamless integration of these design concepts into the exhibition space planning, coupled with the application of digital technology, enables visitors to appreciate the cultural relics, comprehend the culture, and enhance their cognitive experience.

6.2.4 Further Integration of Museums and Digital Media Technology in China

6.2.4.1 Factors Affecting the Digital Development of Museums in China

Through literature surveys, field visits to museums, and interviews with audiences and experts, researchers have identified "people" and "technology" as critical factors influencing the development of digital museum design.

A. The Role of Audience Characteristics in Use of Digital Technologies

Human beings are at the core of all social activities, and individual experience needs form the relational basis of social interactions. To develop effective digital museum designs, it is crucial to consider visitors' experiences and cater to their cognitive needs. It is essential to recognize that people, as the core element of design, have individual differences in their bodies, identities, cultures, and hobbies. Therefore, digital museum designs must consider these individual differences and create unique experiences that satisfy the overall effect of the exhibition (Li et al., 2012).

At the physical level, visitors' differences in gender, age, and health affect their visiting experiences in terms of design scale, space planning, and interaction form.

Gender differences, for instance, can influence body shape and physique, and digital museum designs should consider these differences to create differentiated and personalized visiting experiences for different groups. Additionally, minors under 15 and older and visitors or people with physical disabilities require special consideration in the museum design.



Diagram 75 Number of Museums in China

Source: National Bureau of Statistics of China, 2021.

As a public place for cultural dissemination, museums should optimize design schemes by taking advantage of human body differences, enhancing the highlights of the museum's digital design, and meeting the needs of different groups.

B. Digital Media Technology and its Impact on Museum Situational Design

The museum industry in China has experienced rapid development in the 21st century, with the number of museums reaching 5,881 as of 2021 (Diagram 75). With

the increase in the number of museums, the quality of museum exhibition design has also continued to develop, playing an essential role in China's cultural and social development. According to statistics from the Ministry of Culture and Tourism of China, the number of visitors to Chinese museums is increasing yearly, reaching 1.3 billion in 2021, equivalent to China's population base.

Digital media technology has brought new vitality to museum design, gradually developing from the initial data collection and independent exhibition to a systematic and professional digital exhibition display system. With the support of cloud computing and big data technology, it is developing toward intelligent museums (Xu & Mi, 2021). Digital technology and digital media are increasingly integrated into museum exhibitions, becoming indispensable tools for museum design.

The construction of new museums has fully integrated digital media, bringing the audience an unprecedented visiting experience. In on-site exhibitions, the museum fully utilizes the interactive characteristics of digital media. It focuses on shaping the exhibition situation to set off the visiting atmosphere, mobilizing the audience's enthusiasm. The audience obtains multi-dimensional sensory stimulation in the enjoyable participation experience to enhance the audience's recognition purpose of knowing (Papaioannou, 2021).

Digital media technology breaks through the concept of time and space, using the network and intelligent devices to build an online museum, bringing the exhibition situation and audience experience into the virtual world. China's strong infrastructure construction capabilities ensure the integrity of China's network communication system. According to the 50th Statistical Report on China's Internet Development Status provided by the official website of the China Internet Network Information Center (CNNIC), as of June 2022, China's scale of netizens is 1.051 billion, and the Internet penetration rate is 74.4%. Therefore, citizens in remote mountains and frontiers can participate in museums' online exhibitions anytime and anywhere on the Internet (CNNIC, 2022).

C. Development of Design Concepts

The concept of museum design in the digital age has undergone significant changes. Traditional museum design centred on collecting and displaying cultural relics,

with the four elements of space, media, audience, and exhibition designed primarily around the display of artefacts. However, this passively educated museum situation design often fails to mobilize the subjective initiative of the audience. The advent of digital media has led to a new concept of museum design that prioritizes the audience experience, encouraging active participation and interaction with museum exhibits. This shift in focus from cultural relics to the visitor experience transforms the exhibition space into an experiential space, enabling the audience to engage with exhibits based on enjoyment and knowledge acquisition.

According to Jingbo (Jingbo, 2019c), this new museum design concept enhances audience understanding and promotes greater audience engagement by emphasizing interactive exhibits and visitor-centred design. The transformation of design concepts has brought about new developments in design forms, and digital technology provides powerful tools and means for museum design. For example :

1. According to Ding (Ding, 2017), the physical exhibition of cultural relics and virtual images can fully utilize the technical characteristics of digital media, such as sound, video, and interaction, and provide an augmented reality experience that combines reality and virtuality. This immersive experience can stimulate the audience's sensory feelings and further promote interaction between audiences and cultural relics, which includes moving, rotating, splitting, and combining virtual cultural relics. It can significantly enhance the audience's enthusiasm for visiting and exploring cultural relics. In contrast to the past's oppositional relationship between cultural relics and audiences, this new experience provides a more engaging and interactive way of learning about cultural heritage.

2. Harada (Harada et al., 2018) stated that digital media technology could engage the audience's physiological functions, such as hearing, touch, smell, and somatosensory, to create a multi-sensory integrated and immersive experience based on vision. To enhance the visiting experience, the museum's digital design should also consider fully mobilizing the audience's multi-sensory experience of coordination and interaction, which can enrich the exhibition with imagination and vitality and evoke inner emotional resonance.

3. Digital media has inherent technical advantages, enabling museums to transcend physical space constraints and offer virtual experiences to audiences. The virtual museum experience leverages computer technology to simulate natural exhibition scenes in the virtual world and establish online virtual museums via online communities and social media (Ikei et al., 2013). The virtual museum provides a range of exhibition experiences, including enhanced and immersive experiences, with no temporal or spatial limitations, fostering knowledge sharing and dissemination through the Internet.

4. Digital media technology offers museums the opportunity to provide a personalized experience to visitors, which is a departure from the centralized visiting experience of traditional museums. Interactive designs enable visitors to participate actively in their visit based on their interests and backgrounds. The decentralized nature of digital design emphasizes personalized attention to audiences with different experience backgrounds and hobbies. With the personalized experience, visitors can comprehend cultural relics from their perspective, accurately position themselves in their knowledge system, and develop a proper cognitive understanding. Such flexibility in visiting encourages active participation and meets the experience and cognitive needs of the audience in the digital age (Li et al., 2012).

6.2.4.2 Design Methods to Enhance Digital Experience in Chinese Museums

In the information age, rapid advancements in digital media technology have facilitated a dynamic upgrade in information transmission. Digital media art offers a multidimensional and enriching experience for museum visitors. It is crucial to prioritize the design methods employed in museum exhibitions, using digital technology to augment the visitor experience.

1. Audience-Centered Design Approach:

The design concept of museum exhibitions should cater to the audience's experience needs during a specific period. By harnessing digital media technology and focusing on the audience's experience needs, museums can effectively improve their digital exhibition designs.

2. Enhancing Cognitive Engagement through Situational design:

Situational designs incorporating digital media prioritize audience participation and exploration, offering active learning opportunities tailored to visitors' needs and leading to improved cognition (Vaz et al., 2018).

3. Multiple Narratives Connecting Situational Elements: (Diagram 76)

Digital exhibition design leverages the technical advantages of digital media to make corresponding adjustments based on the audience's age, gender, hobby, and educational background. Using multiple narratives in situational design can effectively unify various elements and create a more engaging and personalized museum experience for visitors (Srinivasan et al., 2010b).

4. Integration of Virtual and Reality Enhances Situational Experience:

Digital technology combines sound, video, and physical exhibitions, providing an unprecedented participatory experience blending virtual and reality. The seamless integration of exhibits and digital media immerses the audience in the exhibition situation, stimulating their memory and evoking their emotional connection (Danks et al., 2007) (Figure 117).

5. Encouraging Active Audience Participation through Digital Media Technology:

Integrating digital media technology into museum exhibitions enables audiences to explore exhibits actively. The interactive nature of digital media technology allows for differentiated solutions catering to audiences of varying ages, genders, educational backgrounds, and interests (Iwasaki, 2017) (Figure 118).

In conclusion, digital media technology has created opportunities for active audience participation in museum exhibitions. The effective use of digital media technology creates an interactive learning experience that enhances the cognitive abilities of the audience. By utilizing the design methods of multiple narratives, virtual integration, and encouragement, museums can better reflect the needs of the audience's visiting experience in the information age and provide visitors with a more enjoyable and educational experience.

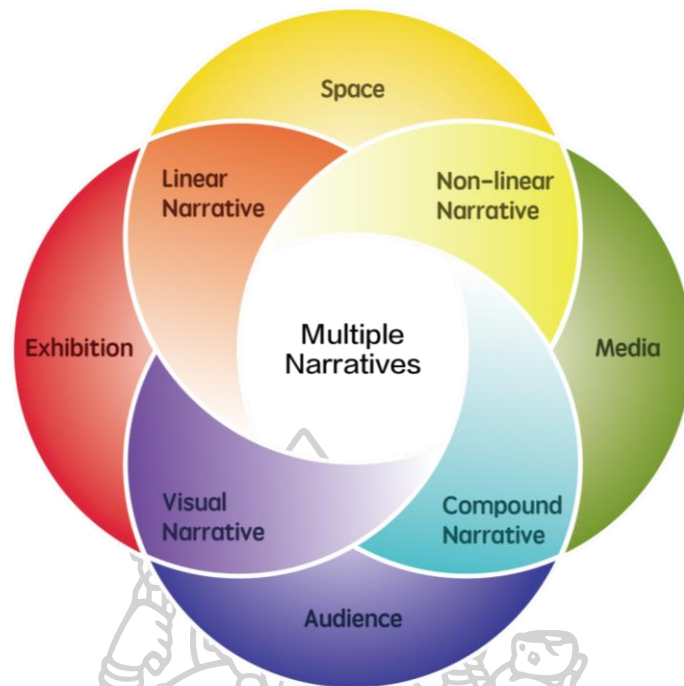


Diagram 76 Multiple narratives connect situational elements

Source: Produced by Author, 2023.



Figure 117 The Museum situation of Multiple Narratives



Figure 118 Situational experience of the museum's combination of virtual and reality

6.3 Recommendations for Digital Media Intervention in Museum Situation Design

To optimize the use of digital media in museum situation design, we suggest addressing four key aspects: purpose, standard, process, and cost.

1. Purpose of Digital Media Intervention:

The purpose of digital media intervention in museum situation design should focus on augmenting the audience's experience and deepening their understanding of displayed exhibits. It can be achieved through a variety of means, including interactive displays, augmented reality (AR), virtual reality (VR) applications, and, now more than ever, artificial intelligence (AI).

AI can analyze visitor data to understand their behavior and preferences better. This information can be used to create personalized tours and interactive experiences that adapt to each visitor's unique interests. For instance, an AI-driven recommendation system could suggest specific exhibits to visitors based on their past engagements and preferences. This element of personalization could significantly enhance the visitor's experience and connection with the museum's artifacts. Future research could further

explore this use of AI, investigating its potential to provide adaptive and dynamic museum experiences.

2. Setting Standards for Digital Media Intervention:

When implementing digital media interventions, museums should consider standards that maximize visitor engagement. The fusion of digital technology and cultural heritage should not merely aim to digitize artifacts but should strive to extend their cultural attributes and significance to visitors. It can be achieved by leveraging AI to generate information tailored to individual visitors' cognitive needs and preferences.

For instance, AI systems can analyze visitor interactions to generate and present information in a format that meets each visitor's learning style. It could involve visual enhancements for visual learners or narrative explanations for auditory learners. Establishing personalized information standards can provide visitors with a more enriching and engaging experience.

3. Process of Integrating Digital Media in Museum Situation Design:

Integrating digital media in museum situation design should encompass a seamless connection between the audience, space, media, and exhibition. The audience should be considered the core element of this process, with their needs, preferences, and understanding guiding the design decisions.

As we expand beyond the constraints of physical spaces, we must consider the potential of online and virtual exhibitions. Virtual reality, AR, and the emerging concept of the Metaverse provide opportunities for exhibits to exist beyond physical confines. These platforms enable immersive experiences accessed from anywhere worldwide, potentially increasing museum accessibility and engagement. Moreover, they can simulate interactions with artifacts that may not be feasible in a physical environment due to preservation concerns.

4. Managing Cost and Implementing Research Findings:

The cost of implementing digital media in museums should be thoughtfully managed, considering factors like equipment purchase, software development, maintenance, and potential updates. The presence of digital technicians in museum work is paramount to ensure the successful integration and maintenance of these technologies.

AI can lead to more efficient management practices in museums. For instance, AI-powered predictive maintenance can preemptively identify potential issues in exhibits or infrastructure, reducing downtime and maintenance costs. AI could also aid in optimizing visitor flow management, improving the overall visitor experience while ensuring adherence to safety regulations.

The findings from this research, including design principles and prototypes, will be incorporated into the dissertation and presented as an experimental model for similar interventions. This work is a stepping stone for ongoing innovation in digital media intervention in museum situation design, paving the way for further enhancements in user experience and cultural artifact preservation.

6.4 Chapter summary

This study investigated the impact of digital media technology on museum situation design and visitor cognition, ultimately highlighting its significance in revitalizing museum situation design and enhancing audience engagement and understanding. By employing digital media in situational design, museums can explore innovative concepts and methods, enhancing the visitor experience. By exploring the technical features of digital media, such as enhanced experience, immersion experience, virtual experience, and personalized experience, and using multiple narratives, virtual and reality combinations, and participatory design, digital media technology can positively influence the four elements of space, media, audience, and exhibition in the museum situation, creating an active visiting atmosphere.

The research analyzed digital media's technical features, such as enhanced, immersive, virtual, and personalized experiences. It demonstrated how employing multiple narratives, virtual and reality combinations, and participatory design can positively influence critical elements in museums, including space, media, audience, and exhibition. These aspects contribute to creating a vibrant and engaging visiting atmosphere.

In the information age, museum situation design must prioritize the audience's visiting experience. The effectiveness, satisfaction, and gains from experience should serve as crucial evaluation criteria. With the intervention of digital media technology,

museums transform from passive learning spaces with a binary opposition between cultural relics and audiences to dynamic environments promoting active exploration and learning.

The research aims to enhance the digital protection and exhibition of museum cultural relics in China. The study's findings provide a valuable foundation for other cases and contribute to the ongoing development of digital protection and the exhibition of cultural relics in Chinese museums.

In conclusion, the study emphasizes the importance of digital media technology in improving museum experiences and fostering an active visiting atmosphere.



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Appendix



A: Museum Visitor Experience Survey Questionnaire

Dear Respondent:

Hello!

This questionnaire is a survey of Silpakorn University's doctoral project "Research on the Cognitive Improvement of Tang Dynasty Mural Paintings Under the Intervention of Digital Art Media". In order to explore how to improve the museum visiting experience, I hope to collect some views and feelings of the audience on museum exhibitions, and your answers will become important data for this research. This survey is anonymous and we will absolutely respect your privacy. Thank you very much for taking time out of your busy schedule to fill out this questionnaire!

Survey time:

Survey location:

- Shaanxi History Museum
- Xi'an Museum
- Qianling Museum
- Princess Yongtai Tomb Museum
- Prince Yide Tomb Museum
- Prince Zhanghuai Tomb Museum

1. Your age:

- Under 18 years old 19~25 years old 26~35 years old
 36~45 years old 46~60 years old 61 years old and above

2. Your educational background:

- Below junior high school High school
 College and undergraduate Master and above

3. Your occupation:

- Enterprises and institutions Party and government agencies
 Foreign-funded enterprises Private enterprises Freelance
 Student Soldier Worker Farmer Retired Other

4. The number of times you visited various museums in a year:

- 1 time 2~5 times 6~10 times 10 times or more

5. How do you usually learn about museums and related exhibition information:

- Friend introduction Newspapers and magazines TV, radio
 Official website WeChat/Weibo/Moments Others

6. The main purpose of your visit to the museum:

- Hobbies and interests Educating children Leisure travel
 Study and research Social dating Others

7. Do you usually visit alone or with others:

- Alone Parent/Child Teacher Classmate/Friend Tour Group Others

8. The general length of stay in the museum:

- Within 1 hour 2~3 hours 3~4 hours Depending on the situation

9. Do you need an exhibition explanation, which method do you prefer:

- No need Manual explanation service Audio guide
Smart terminal (mobile phone, tablet computer)

10. Can you understand museum exhibition information well:

- Comprehensible to all Understandable to most
Cannot understand a few parts

11. What do you think of the application of multimedia technology in museum exhibitions:

- It is very necessary It has a certain effect It has little effect
It does not matter

12. Which aspect of the exhibition left the deepest impression on you:

- Exhibit itself Interactive participation Informative
Visual experience Exhibition space

13. Which presentation format do you prefer:

- Graphic exhibition board (informative introduction)
Physical display (no touching)
Simulation exhibits (accessible)
Smart terminal (mobile phone/tablet)
Online museum (virtual tour)
Virtual/augmented reality (VR, AR)

14. Do you want to share your museum visiting experience with your friends:

- I hope very much I don't want to I don't care

15. Do you think museums should:

Entertainment priority Knowledge education priority

16. What problems do you think exist in the current museum exhibitions

Single form Lack of interest Lack of appreciation

Lack of operation instructions High failure rate

Immature technology cannot understand

Insufficient interactivity Insufficient professionalism Others

17. In what areas do you think museum exhibitions need to be improved:

Number of exhibits Visual effects Interactivity Interesting

Participation Content navigation Easy to share Others ()

18. Do you know the tomb murals of the Tang Dynasty?

Don't know Have heard of it but never seen it

Visited and browsed Have specialized research

19. Are you interested in learning about the tomb murals of the Tang Dynasty?

Not interested Never mind Interested

Looking forward to in-depth understanding

20. From what angle do you want to understand the tomb murals of the Tang Dynasty?

Visual effects of murals Content history of murals

Excavation and protection of murals Knowledge related to murals

21. When you encounter confusion about the exhibits during the visit, do you prefer to use to solve the problem?

Do nothing Communicate with friends Look for a tour guide

Exhibition related audio, text, video Internet search

22. Your evaluation of the displays and exhibitions during this visit:

	Very satisfied	Satisfied	Fairly	Dissatisfied
Overall Evaluation				
Exhibition Content				
Exhibition Form				
Exhibition Environment				

23. The best museum you have ever visited is _____ ◦

24. What fascinates you most about the museum is _____ ◦

25. What suggestions and expectations do you have for museum exhibitions?



B: Questionnaire on Digital Media Art Intervening in Museum Situational Design

Dear expert:

Hello!

This questionnaire is a survey of Silpakorn University's doctoral project "Understanding Enhancement of Tang Dynasty Mural Painting Through Digital Art Media". In view of your professional influence in this field, I hope to know some of your views and feelings on digital media art intervention in museum situational design. Your answers will become important materials for this research.

Thank you very much for taking time out of your busy schedule to fill out this questionnaire.

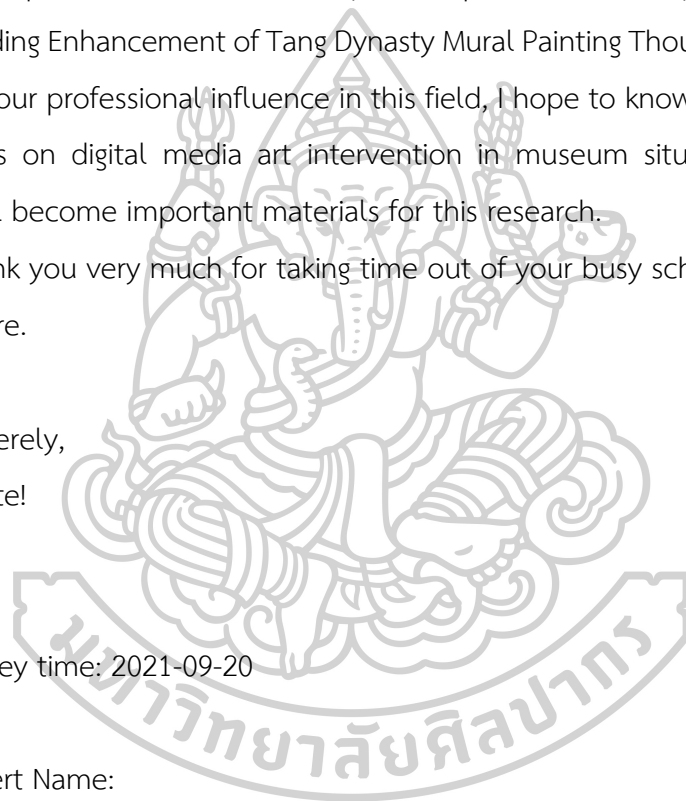
Sincerely,
salute!

Survey time: 2021-09-20

Expert Name:

employer:

Occupation/Position:



1. Your age:

20~30 years old 31~40 years old 41~50 years old

51~60 years old and over

2. What do you think the priority of museum exhibition functions is (please fill in 1, 2, 3, 4 in brackets):

- Preservation of cultural relics
- Scientific research
- Recreation and entertainment
- Educational dissemination (, , ,)

3. The weights of factors affecting museum display design are

Budget (%) Creativity (%) Technology (%) Concept (%)

4. Do you think museum display design should consider both knowledge and entertainment under the condition that:

- Entertainment and fun are given priority
knowledge and education are given priority

5. Do you think that the display design mediated by digital media technology will help enhance the audience's awareness of the exhibition and exhibits:

More harm than good Has some effect Little effect Great effect

6. What do you think are the outstanding problems in the digital media and new media display design: (multiple choices)

- Single form Lack of interest Lack of appreciation
Lack of interactivity High media failure rate Immature technology
Difficult to understand content Not professional enough
Lack of operating instructions Others

7. In your opinion, the best way to publicize museum exhibitions is: (multiple choices available)

- Media coverage Social network Activities
School cooperation Word-of-mouth marketing Other.

8. Which auxiliary guide method do you think is more effective in museum exhibitions:

- No manual Explanation service Audio guide
Smart terminal (mobile phone, tablet computer)

9. What do you think is the most important part of the museum display design: (multiple choice)

- Exhibit itself Interesting interactive Participation Knowledge
Visual experience Exhibition space

10. In which aspects do you think the current museum display design urgently needs to be improved: (multiple choices)

- Number of Exhibits Visual Effects Interactivity
Interesting Content Navigation Ease of Sharing Others

11. What do you think is the investment ratio of digital media technology in various types of museum exhibitions:

	Not suitable	Small amount	Moderate	As much as possible
Arts				
Technology				
Natural				
History				
Commemorative				
Ruins				
Miscellaneous				

12. Your evaluation of the display design of domestic museums:

	★	★★	★★★	★★★★	★★★★★
Overall Evaluation					
Exhibition Content					
Exhibition Form					
Exhibition Environment					
Creative Ability					
Technical Skills					

13. What do you think is the biggest gap between my country and foreign museum display design: _____.

14. What do you think will be the development trend of museum display design in the future?

15. In your opinion, which museum has better exhibition design at home and abroad?

The place that attracts you the most is _____.

C: Design Project User Questionnaire

Hello! We are conducting a user survey for the project design. The purpose of this survey is to find out the value of the project design from the users' perspective and to provide some reliable evaluation of the project design. We hope that you will answer the survey honestly, and we will keep your answers confidential. Please understand that it will take about five minutes to complete the survey. Thank you for being so supportive!

1. What is your age?

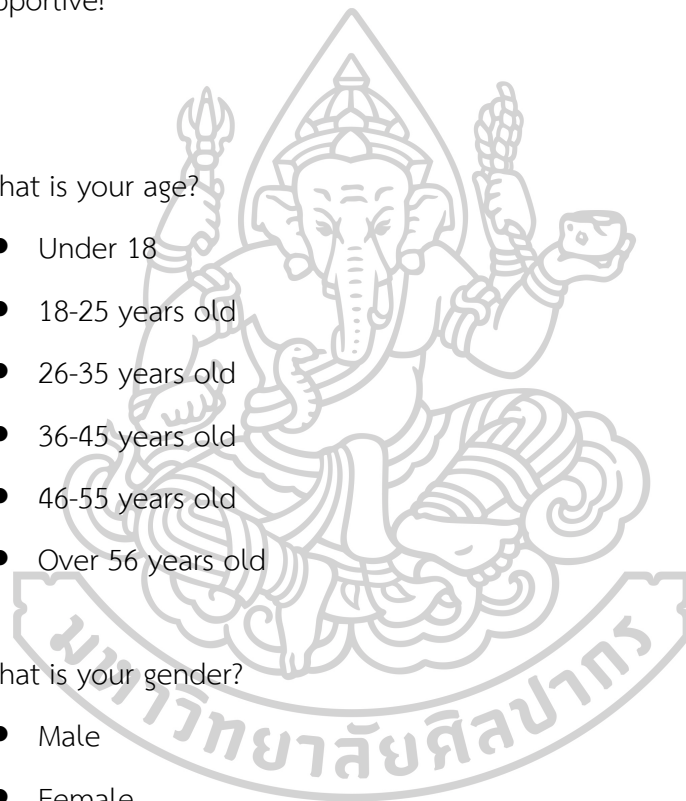
- Under 18
- 18-25 years old
- 26-35 years old
- 36-45 years old
- 46-55 years old
- Over 56 years old

2. What is your gender?

- Male
- Female

3. What is your education level?

- Primary school and below
- Junior high school
- High School/Technical Secondary School
- College/Undergraduate
- Postgraduate and above



4. Do you know about digital media technologies, such as virtual reality, augmented reality, mobile applications?

- Yes
- No

5. The following is the current situation of the preservation of murals in the tombs of the Tang Dynasty. Do you think it is necessary to intervene in the visit of the tomb murals of the Tang Dynasty through digital media technology?



- Very necessary
- Need
- Generally
- Almost no need
- Completely unnecessary

6. If you have used digital media technology for exhibition events, please select the type of technology you used.

- Virtual Reality
- Augmented Reality
- Mobile Applications
- Other (please specify _____)

7. What is your opinion on the use of digital media technologies such as NFC technology, virtual technology, and immersive experience in this study to intervene in the visit to the tomb murals of the Tang Dynasty?

- Very useful
- Somewhat useful
- So so
- Not very useful
- I'm not knowing how to answer.

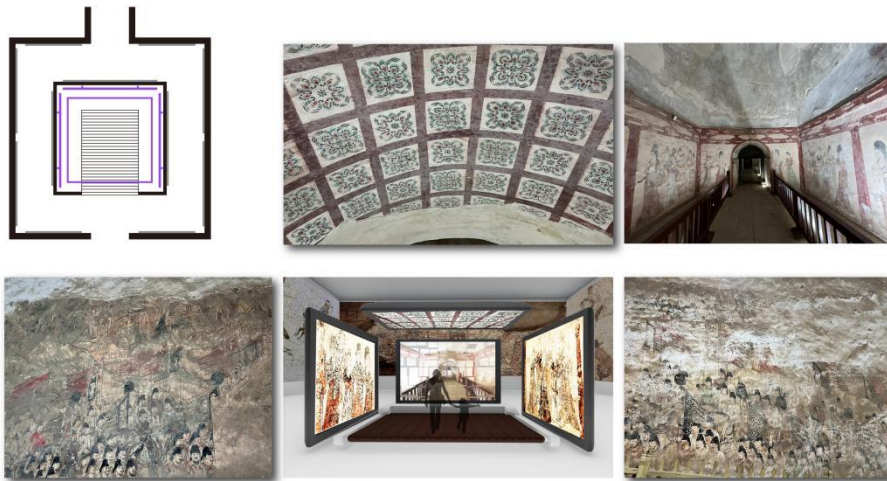
8. What is your opinion on using NFC technology to intervene in museum visits?



- Enriches the visitor experience through interactive participation.

- Information acquisition is more convenient and personalized.
- Improve the efficiency of museum management and visits.
- Security and privacy concerns need to be considered.
- Need to balance digital and physical experiences.
- I do not know how to answer.

9. What do you think about using digital technology to simulate visiting the tombs of the Tang Dynasty?



- Provide a more interactive and vivid visiting experience.
- Increase the fun and attractiveness of the visit.
- Broaden the channels of cultural transmission.
- Helps preserve cultural heritage.
- I do not know how to answer.

10. What is your opinion on using digital technology to intervene in the situational design of the tomb murals of the Tang Dynasty (immersive digital media experience)?

- Enhance the exhibition experience and expand the audience's visit dimension.
- Increase the fun and attractiveness of the visit.
- Broaden the channels of cultural transmission.
- Helps preserve cultural heritage.
- Innovating the way of cultural inheritance
- I do not know how to answer.



11. Do you feel that the digital media technology involved in designing Tang Dynasty tomb murals has improved your visiting experience and understanding of Tang Dynasty murals?

- Very useful
- Somewhat useful
- So so
- Not very useful
- Useless

12. What impact do you think using digital media technology can have on your visit experience?

- Enhanced interactivity and engagement
- Gain a better understanding of artifacts and historical context.
- Improve the efficiency and convenience of visiting.
- Other
- I do not know how to answer.

13. Do you like museum exhibitions where digital media technology intervenes?

- Yes
- No
- Uncertain

14. How satisfied are you with the overall visiting experience of the Tang Dynasty Tomb Mural Museum?

- Very dissatisfied,
- Not very satisfied,
- General,
- Satisfied,
- Very satisfied

15. From what angle do you think it is necessary to enhance the role of digital media in museum visits?

- Provide a more personalized experience.
- Enrich exhibit information.
- Leverage social media to facilitate interaction and sharing.
- Develop online educational resources.
- Introducing Digital Marketing Strategies

D: Publication

1. International academic journals: International Journal of Arts and Technology, Scopus Q1

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1

Design and development of an experimental prototype of Chinese Tang Dynasty tomb murals under the intervention of digital media technology

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Abstract: This paper describes the design and development process of a digital interactive installation for Tang Dynasty tomb murals. It aims to provide the audience with a better situational experience, promote the interaction between cultural relics, the environment, and the audience, and effectively improve their visiting cognition. The research is experimental, and the experimental results are part of the researcher's doctoral dissertation. Focusing on the structure of ancient tombs and murals' content, the researchers integrated traditional Chinese culture's philosophical thought of 'harmony between man and nature' into digital media technology and reshaped the digital situational design. Relevant experts and audiences who participated in the questionnaire have recognised the design concept. Research shows that digital media design in museums enhances the audience's attention to cultural relics and directly affects the audience's visiting and interactive behaviour. The study affirms the importance of digital media art in museum situation design.

Keywords: interactive technology; cultural heritage protection; digital situational design; Tang Dynasty tomb murals; cognitive enhancement.

Reference to this paper should be made as follows: Jie, G. and Chaetnalao, A. (xxxx) 'Design and development of an experimental prototype of Chinese Tang Dynasty tomb murals under the intervention of digital media technology', *Int. J. Arts and Technology*, Vol. 14, No. 3, pp.236–255.

Biographical notes: Guo Jie is a PhD candidate at the Faculty of Decorative Arts, Silpakorn University. He is an Associate Professor in the College of Design and Art, Shaanxi University of Science and Technology. His research interests include digital media art and cultural heritage protection.

2. International academic journals: International Journal of Arts and Technology, Scopus Q1

Application of motion capture technology in the digital recreation of Tang Dynasty mural art: a case study of Han Xiu's tomb

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Abstract: This study employed motion capture technology to digitally restore the murals of Han Xiu's Tomb from the Tang Dynasty. The aim was to enhance audience engagement and understanding of Tang Dynasty cultural traditions through a multi-dimensional digital media display. Using the knowledge framework of Tang Dynasty music, dance, and tomb murals, digital media art prototypes were developed. These prototypes were based on professional dancers' motion capture data, creating an immersive, interactive experience for audiences. Expert feedback was systematically analysed through evaluations and reviews to assess the impact of audience engagement and understanding of Tang music and dance traditions. The results indicate that this method effectively represents Tang Dynasty music and dance performances, thereby increasing audience interaction and cultural awareness. This study highlights the potential of motion capture technology in designing immersive digital media art experiences and suggests its broader implications for cultural heritage preservation and education.

Keywords: motion capture technology; digital media art; Tang Dynasty tomb murals; depictions of music and dance; digital restoration.

Reference to this paper should be made as follows: Jie, G. and Chaetnalao, A. (xxxx) 'Application of motion capture technology in the digital recreation of Tang Dynasty mural art: a case study of Han Xiu's tomb', *Int. J. Arts and Technology*, Vol. 14, No. 4, pp.216–235.

Biographical notes: Guo Jie is an Associate Professor at the College of Design and Art, Shaanxi University of Science and Technology. He holds a Bachelor's degree and a Master's degree from Xi'an Academy of Fine Arts and a PhD at the Faculty of Decorative Arts, Silpakorn University. His main research direction is digital media art and cultural heritage protection.

E: Exhibition

1. Experimental Exhibition - The Visual Cultural Turn of Tang Tomb Mural Paintings, Shanxi Jinzhong University Art Museum, July 1-15, 2022.



2. Design Prototype Exhibition - Exploring the Digital Innovation of Tang Tomb Mural Paintings, Shanxi Jinzhong University Art Museum, April 15-30, 2023.





VITA

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INSTITUTIONS ATTENDED	Faculty of Decorative Arts, Silpakorn University, Bangkok
PUBLICATION	<p>2022 Jie, G., & Chaetnalao, A. (2022). Design and development of an experimental prototype of Chinese Tang Dynasty tomb murals under the intervention of digital media technology. <i>International Journal of Arts and Technology</i>, 14(3), 236-255.</p> <p>2022 Jie, G., & Chaetnalao, A. (2022). Application of Motion Capture Technology in the Digital Recreation of Tang Dynasty Mural Art: A Case Study of Han Xiu's Tomb. <i>International Journal of Arts and Technology</i>, 14(4), 216-235.</p> <p>2023 Jie, G., & Chaetnalao, A. (2023). Information needs of local and non-local museum visitors: a study at the Museum of tomb murals of the Tang dynasty in China. <i>Humanities, Arts and Social Sciences Studies</i>, 24(3), 101-119.</p>
AWARD RECEIVED	2023 Received a scholarship for the Ph.D. program in Design, Faculty of Decorative Arts, Silpakorn University, Thailand.