Preferences For Cultural Relic Preservation Method In Chinese Traditional Museums

Liu Jun*
Universiti Putra Malaysia,
Serdang, Selangor,
Malaysia
Corresponding author
Email: gs64132@student.upm.edu.my

Maszura Abdul Ghafar*
Department of Architecture,
Faculty of Design and Architecture
Universiti Putra Malaysia,
Serdang, Selangor,
Malaysia
Email: maszu@upm.edu.my

Adlina Ab Halim*
Faculty of Human Ecology,
Universiti Putra Malaysia,
Serdang, Selangor,
Malaysia
Email: adlina@upm.edu.my

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**These authors contributed equally to this study*

ABSTRACT

Static exhibits in Chinese traditional museums pose challenges in maintaining connections between the public and museum artwork. There is a need for a better exhibition method to stimulate visitors' monotonous experience of cultural relics and visitors' sense in Chinese museums. The aim of this study is to identify the best preferences for cultural relic preservation methods in Chinese traditional museums. This systematic literature review paper discusses the systematic inferences of cultural relic preservation strategies in Chinese museums, heritage preservation techniques, and the human-exhibition interaction (HEI) concept that could aid the sustainability of cultural heritage interest while conveying cultural heritage-related knowledge in China. This study found that mixed realities (XR) and Human-Exhibition-Interaction (HEI) could facilitate diverse cultural heritage restoration, accuracy and sustainability when adhering to museum exhibitions. The proposed preferences for the cultural relic preservation exhibition method could aid in better visitors' experience and sense of cultural relics in Chinese museums.

Keywords: *Digital technology, Museum's exhibition, Mixed reality, Cultural heritage preservation*

INTRODUCTION

Cultural heritage serves as a vital manifestation of human society's cultural and economic activities (Yike, 2020). It is not only a testament to a nation's historical development and cultural heritage (Jia, 2020) but is also crucial for preserving historical and traditional information as well as the values of national culture (Sun, 2019). Formed during specific historical periods, they carry the historical and cultural values of different eras, protecting and passing on these historical relics is our historical mission. Currently, museums face two issues in the preservation and restoration of cultural relics, one is the natural damage that occurs when the relics are unearthed, and the other is the secondary, irreversible damage that is caused by human factors during the traditional restoration process (Sun, 2019; Zhao et al., 2018), which severely affects the presentation and transmission of cultural values.

Museums, as the most concentrated venues for historical and cultural heritage, have evolved from a simple preservation approach to emphasizing the comprehensive protection and development of cultural relics (Zou et al., 2022). They have gradually become the main institutions for cultural relic protection, focusing on the relationship between the safety of cultural relics and the environment (Yike, 2020). The implementation of wireless monitoring systems and preventive conservation measures (Lei, 2021), along with the introduction of risk management concepts and virtual restoration technology (Boboc et al., 2022), will enhance the protection capabilities and levels of Chinese traditional museums. This will improve the level of cultural heritage management, and ensure the safety of museum relics while meeting the needs of different cultures (Skublewska-Paszkowska et al., 2022), as well as contribute to the promotion of sustainable cultural development (Wang & Xia, 2019).

China has recognized the importance of preventive conservation in the work of cultural relic protection. Although all exhibits have been accounted for, visitors do not always have access to them (Lischke, 2014). Static exhibits in Chinese traditional museums pose challenges in maintaining connections between the public and museum artwork. Therefore, there is a need for a better exhibition method to stimulate visitors' monotonous experience of cultural relics and visitors' sense in Chinese museums.

LITERATURE REVIEW

The purpose of this study is to explore the current preference of traditional Chinese museums for cultural relics protection. In this study, the relevant Systematic Literature Review (SLR) database was used to identify the literature on the application of digital technology in museums. First, it summarizes the cultural relics protection strategies of Chinese museums. Secondly, the application of science and technology in the field of heritage conservation and the concept of sustainable human interaction (HEI) are reviewed. Finally, the key starting point (POD) of this paper is summarized.

Cultural Relic Preservation Strategies in China Museums

Historical and cultural heritage received a special status in China (Perez-Alvaro & Forrest, 2018). The Chinese government is adjusting policies to protect cultural relics to adapt to the development of society and the needs of the economy (Bollo & Zhang, 2017). According to the official Chinese definition of "cultural heritage", it is divided into two broad categories: archaeological sites and artifacts (Huijun & Doyon, 2021). These artifacts reshaped the concepts of national identity domestically and globally in China, altering the socio-economic and cultural life of the Chinese nation (Evans & Rowlands, 2014).

Effective mechanisms are necessary to protect these cultural relics. In 1909, the Chinese government introduced measures such as "Interim Measures for the Protection of Cultural Relics, 1916" (Li, 2015). With the support of government measures and laws, there are three different modes of cultural relic protection and display: museums, archaeological site museums, and archaeological site parks (Huijun & Doyon, 2021). The emergence of site museums and site parks represents efforts to overcome the limitations of museums. Fortunately, the rise of the latter has remained the exact value of the existence of museums.

Table 1. The promulgation time and content of China's cultural heritage protection policy

Policy Name	Enactment Year	Brief Content
Regulations for the Preservation and Promotion of Ancient Sites	1909	The first cultural relics protection law enacted by the Qing government's Ministry of Civil Affairs, which standardized the survey and preservation of ancient sites, including steles, stone pillars, stone chimes, statues and stone carvings, ancient paintings, and cliff inscriptions.
Interim Measures for the Preservation of Antiquities	1916	Enacted during the Beiyang Government period, aimed at surveying and protecting antiquities, including ancient cultural sites, tombs, and buildings, and is one of the important regulations for cultural relics protection in China.
Regulations for the Preservation of Scenic Spots and Historical Relics	1928	Announced by the Ministry of Interior of the Nationalist Government in Nanjing, it was the first to use the concept of "scenic spots and historical relics," specifying the types, scope, and methods of protection for these relics.
Antiquities Preservation Law	1930	Formulated and promulgated by the Nationalist Government, it is the first cultural relics protection law in Chinese history, covering the scope, preservation, registration, excavation, and circulation of antiquities.
Detailed Rules for the Implementation of the Antiquities Preservation Law	1931	Announced by the Executive Yuan of the Nationalist Government, it provided detailed explanations for the implementation of the Antiquities Preservation Law, including the registration, restoration, and excavation of antiquities.
Interim Regulations on the Management of Cultural Relics Protection	1961	Promulgated by the State Council, it is the first legal document in China specifically the protection of cultural relics, covering aspects such as the scope of cultural relics, ownership, grading, and management.
Cultural Relics Protection Law of the People's Republic of China	1982	Adopted by the Standing Committee of the National People's Congress, it stipulates the legal system for the protection, management, and utilization of cultural relics and is the fundamental law for cultural relics protection in China.
Intangible Cultural Heritage Law of the People's Republic of China	2011	Adopted by the Standing Committee of the National People's Congress, it aims to inherit and promote the excellent traditional culture of the Chinese nation and strengthen the protection and preservation of intangible cultural heritage.

In addition to the cultural relics protection policies mentioned in Table 1, the Chinese government also emphasized the importance of immersive exhibitions and the construction of digital museums in the "Opinions on Promoting the High-quality Development of the Digital Culture Industry" (Dang et al., 2023), reflecting high regard for the digitalization of cultural heritage. The "14th Five-Year Plan" further encourages high-definition data collection and the presentation of cultural heritage (GOSC, 2021), which champions the meticulous capture and portrayal of cultural relics in high definition, a natural progression from Yan et al.'s (2010) advocacy for digital conservation. The combination of traditional and digital conservation methods is essential for the effective conservation of Chinese museum artifacts. Traditional approaches prioritize on-site protection while digital approaches focus on creating digital copies and virtual environments for virtual recovery and sharing. This study is consistent with the views of scholars such as Feng (2017), Geng (2023), and Wang (2023) that when cultural relics have sufficient photographic information, digital 3D images, and detailed cultural relic attributes, these elements can be combined to retrieve and protect the authenticity of cultural relics. The implementation of this strategy ensures a balanced approach, leveraging the strengths of both approaches to enhance visitor interaction and education, ensuring a balanced and sustainable development of cultural heritage conservation.

The concept of preventive conservation policy, as introduced by Yang (2020), was proposed to prevent damage to cultural relics due to improper preservation and restoration practices. This policy has become the standard approach for museums in China when managing cultural relics, focusing on the proactive management of the conservation environment and preventive measures to avoid damage. In the early years of preservation, measures for cultural relics involved taking pictures and transferring the information to electronic databases, as described by Feng (2017). This method was a significant step toward the digitization of cultural heritage. As preservation methods evolved, 3D imaging was used to model cultural relics, as noted by Zhao et al. (2023).

Heritage Preservation Techniques

Museums, as the embodiment of cultural heritage (Anton et al., 2018), have transcended their traditional roles, becoming integral to public life and the vanguard of cultural development (Feng, 2017). With the advent of digitalization, museums have transformed from information providers to creators of rich digital content (Winesmith & Anderson, 2020). Advanced 3D scanning and photogrammetry (Liang et al., 2019; Yin & Antonio, 2020) have revolutionized the documentation and exhibition of cultural relics, enabling virtual exhibitions that vividly bring heritage to life, as seen in Kyoto National Museum's virtual displays (Daassi & Debbabi, 2021) and the digital reconstructions of China's Mogao Caves (Fu et al., 2020).

Alfahal and Alaabar (2023) emphasize the role of photogrammetry in creating realistic 3D models. Photogrammetry, combined with other imaging techniques, allows for the creation of detailed digital models that can be studied, preserved, and shared with a wide audience. However, Jia et al. (2022) pointed out that 3D detailed data alone can be insufficient, potentially resulting in underutilized cultural relic protection processes. However, the three-dimensional presentation of technology has significantly improved visual engagement (Feng, 2017; Geng, 2023). Therefore, 3D laser scanning, praised for its precision by Yin and Antonio (2020), is the cornerstone of capturing the physical attributes of cultural relics. These scans provide accurate measurements and a comprehensive record of the relics' features, which is essential for restoration and preservation efforts. Advanced imaging techniques such as X-ray CT and MRI, as noted by Vanhoof et al. (2021) and Wagner et al. (2023), enable non-destructive analysis, enhancing the understanding of ancient artifacts without causing harm. These technologies can reveal hidden details and internal structures, providing invaluable insights into the construction and materials of cultural relics.

Despite significant advancements in digital technology for cultural heritage preservation, Chinese museums still lag in embracing innovative facilities. Traditional exhibition techniques such as large screens and multi-touch displays fail to harness the potential of digital technology (Lu, 2022; Xu, 2023); apparently, digital guides and QR code explanations are ineffective in enhancing exhibit presentations or disseminating knowledge (Zhang, 2015). Thus, stringent environmental control for the preservation process (Xue, 2024) as well as diverse conservation and sustainable mechanisms (Yu, 2024) are needed for conservation strategies. Notably, 3D scanning and printing for precise replication of cultural relics (Challenor & Ma, 2019), digital intelligent restoration technologies (Zhao et al., 2023), and 3D dynamic interaction space (Pietroni & Ferdani, 2021) could provide alternative methods for the restoration and protection of cultural heritage (Bekele et al., 2018; Boboc et al., 2022).

Dang et al. (2023) stated that the application of sensor detection in early large-scale archaeological sites in China was only initiated in 2010. The extensive adoption of this technology did not unfold until the establishment of the China National Platform for World Heritage Monitoring (CACH, 2021) in 2015. Over the past decade, graphical and spatial data has been integrated into advanced databases such as Heritage Building Information Modelling (HBIM) and Geographic Information System (GIS), marking a decade of progress in digital documentation and conservation. Moreover, the widespread application of immersive technologies in China has been a notable development within the last five years. Despite the variance in scale and complexity in the application of digital technologies for restoration and conservation, the strategic emphasis by the Chinese government on digital cultural heritage within policies and plans, along with the innovative applications of these technologies in museums, evinces a profound commitment to enhancing the preservation and presentation of cultural relics. The advent of photographic technology, 3D laser scanning, digital twin technology, and the development of immersive technologies, particularly the deployment of head-mounted devices and data monitoring platforms as noted by Dang et al. (2023), not only enrich visitors' experiences but also fortify the competitiveness of museums. These efforts not only improve the visitor's experiences but also strengthen the competitiveness of museums by leveraging cutting-edge digital solutions for cultural heritage protection.

China's unique restoration philosophy, "restore the old as the old" (Lu, 2012; Yu, 2024), ensures meticulous attention to historical authenticity in the restoration process. The Digital Twin technology (Dang et al., 2023), creates a virtual replica of physical artifacts, allowing for detailed analysis and monitoring without the risk of damaging the original. X-ray, CT Scans, and MRI enable non-destructive analysis without harming the cultural relics (Vanhoof et al., 2021; Wagner et al., 2023). Therefore, virtual technology could optimize the restoration process of cultural heritage while providing immersive experiences for the public to interact with cultural relics in new ways. Preservation approaches such as high-resolution imaging and scanning help in preserving the cultural relics, fostering a greater public appreciation for cultural heritage.

Digital models allow the participants to understand artworks without spatial limitations (Scopigno et al., 2011); digital technology could increase the visitors' spatial multi-dimensional exhibition exploration to enhance interactivity in modern museums (Scopigno et al., 2011). This could enhance visitors' pull toward cultural relics in museums, enhancing museums' competitiveness (Chen et al., 2024; Han et al., 2019; Xu et al., 2024). Here, this study foresaw that when the Chinese traditional museums support sustainable interactivity and education of the cultural relics, they could promote the conservation of Chinese museum cultural artifacts.

This study agrees with scholars (Feng, 2017; Geng, 2023; Wang; 2023) that when cultural relics have sufficient photographic information, digital 3D images, and detailed cultural relic attributes, these elements can be combined to retrieve and protect the authenticity of cultural relics. The implementation of this strategy ensures a balanced approach, leveraging the strengths of both approaches to enhance visitor

interaction and education, ensuring a balanced and sustainable development of cultural heritage conservation.

Human-Exhibition Interaction (HEI) Concept for Cultural Relic Sustainability

HEI is a comprehensive concept that involves Exhibition Design Factors (EDFs), Audience Experience Factors (AEFs), and Behavior Data (BD) (Wang & Xia, 2019). It emphasizes that the core of exhibition design should be the communication between the exhibition and the audience. Virtual technologies are one part of enhancing immersiveness. Various styles and content in the digital virtual platform could facilitate visitors' comprehension of cultural relic concepts, experience, and education (Wu et al., 2022; Dang et al., 2023). Through immersive information interaction, a significant sensory experience could be enhanced (Serravalle et al., 2019) and reshaped the interaction between reality and virtuality. Scholars (Bitgood, 2006; Roppola, 2013) emphasized that when considering visitors' feelings in exhibition design there is a need to advocate an empathetic approach to relic curation. For example Augmented Reality (AR), could give users satisfaction and behavioral intentions toward cultural relics (Chung, 2018; Jung, 2015); when using Mixed Reality (XR) devices in museums, it could demonstrate the integration of virtual technologies into traditional experiences (Chung et al., 2018; Jung et al., 2015; Trunfio et al., 2022). Hence, addressing HEI through virtual technologies could emphasize the sustainability preservation of the cultural relics and ensure optimal interaction between visitors and relics over time.

Wang and Xia (2019) proposed that the narration power of media storytelling could be enhanced through cultural heritage educational impact. Through story engagement, visitors could develop heritage narration consciousness that appreciates the depth and breadth of cultural narratives. Vis-a-vis virtual digital applications could give lasting emotional narratives for visitors as compared to the traditional method (Kolay, 2016); the multidimensional influences of HEI improve communication between cultural relics and visitors (Piehl, 2020), and is an effective information delivery method (Yoo et al., 2023). The HEI concept, with its focus on the sustainability of cultural heritage, ensures that the integration of digital technology not only enriches the visitor experience but also fosters a deeper understanding and appreciation of cultural relics in a sustainable and enduring manner. By leveraging the power of narrative and interactivity, museums can create exhibitions that resonate with visitors on a cognitive and emotional level, leaving a lasting impact and contributing to the preservation of cultural heritage for future generations. In essence, the HEI through its user-centered design and application could offer a comprehensive framework for museums to innovate in cultural relic exhibition design. This supports cultural relics preservation and presentation, ensuring the sustainability of cultural artifacts.

The integration of head-mounted displays (HMDs), image rendering, and AR, could significantly expand the possibilities for cultural relic preservation development (Cranmer et al., 2023; Trunfio et al., 2022). The XR platform technologies could offer new immersive cultural relic experiences. XR technologies such as XR-OLED (Lai, 2022) and computational sensing architecture (Xu et al., 2024) are among the approaches that China Traditional Museum could take to display its cultural relics. These technologies applications could increase visitors' multidimensional exploration (Scopigno et al., 2011), bring a better reputation and more visitors to the museum (Chen et al., 2024; Han et al., 2019; Xu et al., 2024; Yan et al., 2010). This paper concurs that XR and HEI could facilitate diverse cultural relic restoration, accuracy, and cultural relic sustainability when adhering to museum exhibitions. Therefore, HEI that emphasizes audience engagement, virtual technology integration, and immersive cultural experience in the museum’s cultural relic could sustain the preservation and present historical heritage narrative and emotion using XR reconstruction.

Point of Departure (POD)

As shown in Table 2, through Cultural Relic Preservation Strategies in China's museums, the Heritage Preservation Techniques and Human-Exhibition Interaction (HEI) Concept for Cultural Relic Sustainability and other related topics have been systematically reviewed, and the key results are summarized as a starting point of departure (POD).

Table2. Point of Departure (POD)

POD	Construct Description	POD Results
POD1	Cultural Relic Preservation Strategies in China Museums	Integrating traditional and digital conservation in China protects cultural heritage, balancing on-site preservation with digital replication for sustainable development.
POD2	Heritage Preservation Techniques	Digital advancements revolutionize China's cultural heritage preservation, enhancing authenticity and public engagement.
POD3	Human-Exhibition Interaction (HEI) Concept for Cultural Relic Sustainability	HEI integrates virtual technologies to enhance visitor engagement and sustainable cultural heritage preservation.

RESEARCH METHODOLOGY

This study seeks to investigate the current preferences for cultural relic preservation methods in Chinese traditional museums (CTM). This study employs a systematic literature review (SLR) of relevant databases to identify literature on the application of digital technology to museums. The search terms "AR or VR or MR," "museum," and "digital technology" were selected as the most appropriate terms to capture the relevant literature. In addition, the search term "cultural heritage preservation" was included to ensure that all relevant literature was identified. The Web of Science and Scopus databases were used to search for literature published between 2019 and 2024. Among the themes discussed are the current cultural relic preservation strategies in Chinese museums, the limitations of heritage preservation techniques, and the human-exhibition interaction (HEI) concept that could be used to aid the sustainability of cultural heritage interest while conveying cultural heritage-related knowledge in China. From the inferences, this study will propose the best preference for cultural relic preservation methods in Chinese traditional museums.

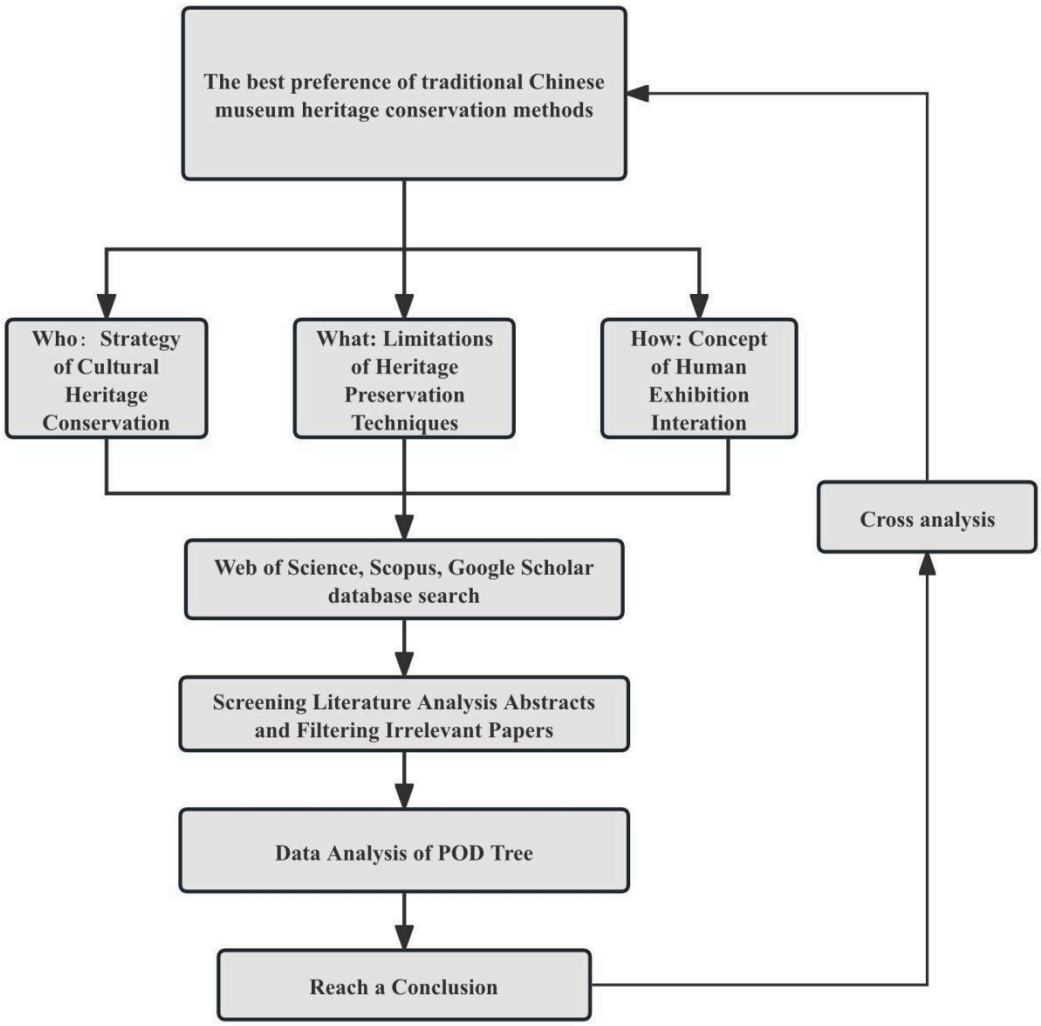

Figure 1. Workflow of Systematic Literature Review
(Source: Author's illustration)

By applying the Systematic Research Questions (RQ) the structural classification as proposed by Rahinah (2011) to construct and refine research questions, the research questions are targeted and operable. During the research process, three core components of research questions are identified: "who", "what", and "how". While "who" represents the group or individual affected by the research, "what" refers to the core and subject matter that is needed to solve the problem. The "how" refers to the expected outcome or goal of the study. Figure 1 shows the flow of the methodology.

FINDINGS

The review findings led to several conclusions across the three POD sub-topics. The conclusions encompass the current strategies for relic preservation, the constraints faced by heritage conservation, and the concept of human-exhibition interaction (HEI). The initial task is to provide a synthesis of the three

primary points of discussion (POD1, POD2, and POD3) from the review. The synthesis of POD4 is derived from an intersectional analysis of POD1 and POD2. An intersectional analysis of POD2 and POD3 yields the insights for POD5. POD6 encapsulates the findings from the intersectional analysis of the current relic preservation strategy and POD3. Further intersectional analysis between POD4 and POD5 results in the formulation of POD7. The insights for POD8 are gleaned by intersecting POD5 and POD6. Ultimately, POD7 and POD8 are synthesized to arrive at the final theoretical proposition, POD9. This final theoretical proposition, POD9, represents the most comprehensive theoretical assertion, which is the outcome of a series of intersectional analyses: China's heritage protection focuses on authenticity, minimal intervention, tech integration, and mixed reality for global digital cultural sustainability.

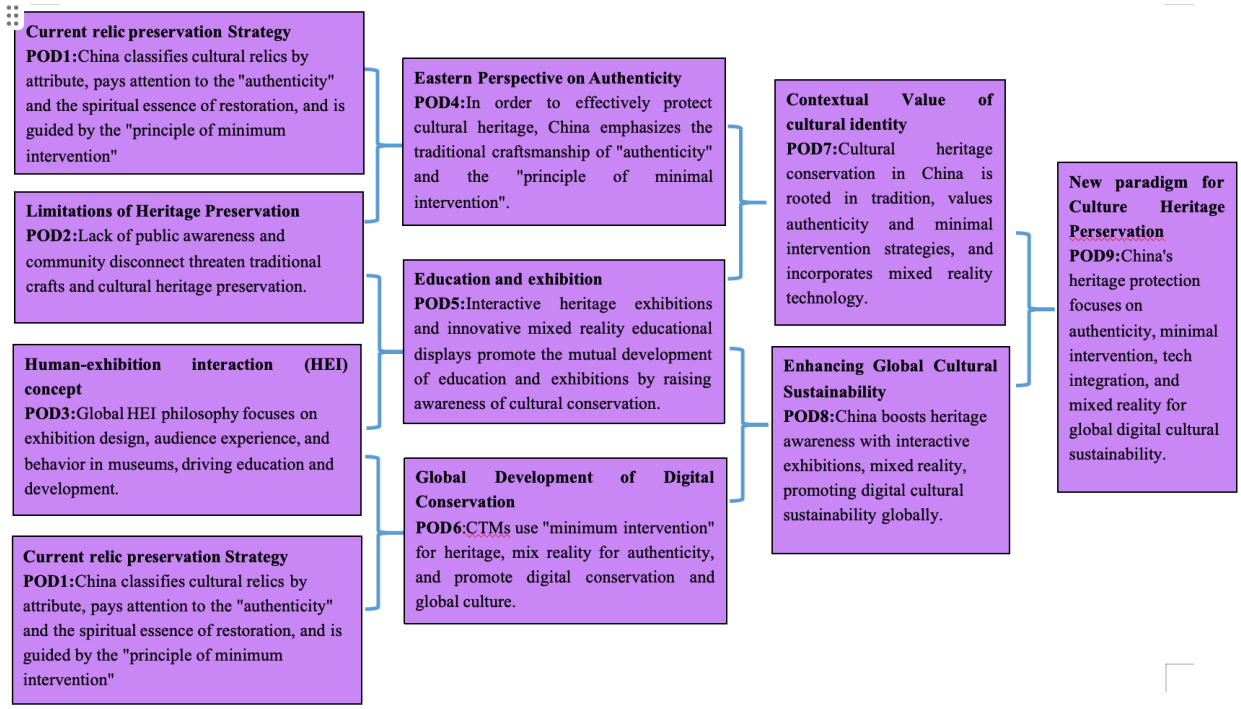

Figure 2. CTM's Preference for Heritage Conservation
(Source: Author's illustration)

Cultural Identity and Digital Heritage

Cultural identity, as a contextual construct, is the cornerstone of a nation's heritage and a pivotal element in the global tapestry of cultural diversity. It is the intangible framework that binds communities, defines their history, and shapes their societal evolution. The value of cultural identity lies in its ability to provide a sense of continuity and belonging, serving as a conduit for the transmission of collective memory and shared values across generations. In the context of global cultural sustainability, the preservation of cultural identity is not just an academic pursuit but a vital component of a broader sustainable development agenda. It is through the lens of cultural identity that we can appreciate the depth of cultural heritage and understand the imperative to sustain it for future generations. The United Nations' Sustainable Development Goals (SDGs) underscore the importance of cultural heritage in fostering social inclusion, economic growth, and environmental protection. The paradigm of cultural relics protection has evolved from a focus on the physical preservation of artifacts to a more holistic approach that encompasses the digital realm. This new paradigm recognizes the potential of technology to enhance the

conservation of cultural relics, enabling wider access and deeper engagement with cultural narratives. Digital technologies such as 3D scanning, virtual reality, and AR are not merely tools for replication and visualization; they are platforms for storytelling that can bring cultural heritage to life in immersive and interactive ways.

Contextual value of cultural identity

Galleries, libraries, archives, and museums are increasingly adopting digital methods to disseminate information about cultural relics, reflecting a broader academic and societal enhancement in extending the experiences in museums toward cultural relics. This could acknowledge the contextual "aura" of the cultural relics (Petrelli et al., 2013). Digital platforms could cover a wider audience, for an inclusive environment that encourages a sense of belonging to a shared cultural group.

Enhancing global cultural sustainability

Digital technology has been widely used globally, especially in cultural sustainability, and is reflected in the reconstruction of cultural relics in the virtual environment. Virtual restoration revives its ancient appearance or disseminates contexts and cultures from the previous period in real time to deepen knowledge and understanding of history and culture. Through this multidimensional XR approach, visitors can trace the historical trajectory of lost artifacts and gain a deeper understanding of the connections between these artifacts and their original owners, providing new perspectives and pathways for the digital preservation and education of cultural heritage.

CONCLUSION

This comprehensive study has delved into the intricate relationship between digital technology and the preservation of cultural heritage, particularly within the context of Chinese museums. The integration of AR and VR in XR has emerged as a pivotal platform in revolutionizing cultural relic information presented, explored, and interacted with by the public. The immersive experiences of cultural relics are paramount for global cultural sustainability. It is through the lens of cultural identity that one can appreciate the depth and breadth of cultural relics, and therefore sustain them for future generations. The United Nations' Sustainable Development Goals (SDGs) highlight the significance of cultural heritage in fostering social inclusion, economic growth, and environmental protection. The paradigm of cultural heritage protection has evolved to embrace a holistic approach that includes the digital realm, recognizing the potential of technology to enhance conservation efforts, enabling wider access, and deeper engagement with cultural narratives. XR technologies offer personalized experiences that cater to the diverse needs and interests of visitors, fostering a deeper understanding and appreciation of cultural heritage. Moreover, the application of digital technologies in cultural heritage conservation aligns with the principles of sustainable development. The Human-Exhibition Interaction (HEI) concept is central to this new paradigm, emphasizing the importance of creating meaningful connections between visitors and cultural artifacts through engaging and interactive exhibition spaces. In conclusion, these new paradigms, leverage the strengths of both physical and virtual realms to shape the future of cultural heritage conservation, education, and appreciation. These could contribute to a sustainable and inclusive global cultural ecosystem. The proposed preferences for the cultural relic preservation exhibition method can aid in better visitors' experiences and sense of cultural relics in Chinese museums.

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