Curating wellness: Exploring healing experiences in digitally transformed museums

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Abstract

This study explores how digital technologies shape museums as spaces of healing, using a qualitative case study of the China Grand Canal Museum. We conducted semi-structured interviews with 27 visitors between July and August 2022 and identified five core dimensions of healing experiences: emotional engagement, sensory immersion, attention recovery, creative inspiration, and educational and cultural enlightenment. We further developed a conceptual framework that consists of four sequential stages that illustrate the digital transformation of museum space for healing experience: digital technology enablers, exhibition transformation, enriched visitor experience, and healing value realization. The findings contribute to understanding how digital technologies enhance museums' therapeutic potential while maintaining cultural authenticity, offering valuable insights for cultural institutions to manage digital transformation effectively.

Keywords: Digital transformation; Museum experience; Cultural heritage; Healing experience; Heritage tourism; Attention Restoration Theory

1. Introduction

Museums are undergoing a fundamental transformation through digital technology, evolving from traditional object-based exhibitions into dynamic, immersive spaces (Lunardo & Ponsignon, 2020). This transformation, driven by innovations such as augmented reality (AR), virtual reality (VR), and mixed reality (MR), has created unprecedented opportunities for visitor engagement and interaction (Guo et al., 2023; Yang & Lin, 2024). While museums have traditionally served as venues for education, leisure, and social interaction (Chan, 2009), the integration of digital technologies has redefined the museum experience, shifting focus toward hedonism and community-centered environments (Mirghadr et al., 2018). Leading institutions such as the China Grand Canal Museum have embraced digital technologies to create immersive exhibitions that blend cultural heritage with innovative presentation approaches (Guo et al., 2023). This transformation coincides with growing societal needs. Contemporary visitors frequently experience mental fatigue stemming from professional pressures, digital saturation, urban overcrowding, and social fragmentation. Museums possess distinctive qualities—cultural richness, aesthetic value, and meditative environments—that position them to alleviate these modern stressors. The recent global pandemic has further intensified public demand for restorative experiences, creating a post-pandemic context where healing is increasingly valued. Following periods of isolation and anxiety, visitors now seek psychological comfort alongside traditional educational outcomes from cultural institutions. As digital technologies transform museum experiences, understanding how these technological innovations might enhance museums' healing potential becomes increasingly important for both researchers and practitioners.

Extant research has focused on two separate aspects of museums. Digital transformation studies demonstrate how technologies enable novel forms of engagement through personalized learning, multi-sensory experiences, and participatory opportunities that enhance virtual presence and visitor satisfaction (Kamariotou et al., 2021; He et al., 2018). These innovations have redefined visitor interactions with cultural heritage through dynamic presentations and immersive technologies (Lunardo & Ponsignon, 2020; Hashim et al., 2014). Concurrently, research on museums as healing spaces has established their role in facilitating multidimensional healing experiences, including physical restoration, psychological renewal, and spiritual connection through heritage engagement (Kim et al., 2020). This therapeutic function emerges through guided, interpretive, and communicative activities that combine cultural education with anxiety reduction, enhanced self-esteem, and improved well-being

(Mangione, 2018; Fan & Luo, 2022). Despite these parallel research streams, two critical aspects remain unaddressed. First, there is an urgent social need in the post-pandemic era for accessible spaces promoting mental health and emotional healing. Museums, as public cultural institutions, have untapped potential to meet this growing demand through technological innovation. Second, while digital transformation is reshaping museums from static displays to dynamic experiences (Mirghadr et al., 2018), existing research rarely examines how these technological changes affect visitors' psychological well-being.

To address these gaps, our study explores how visitors experience healing within digitally mediated museum spaces through two interconnected questions. We aim to address the following two questions: a) What characterizes the healing experiences of visitors in digitally transformed museum spaces? b) How do digitally transformed museum spaces facilitate visitor healing? Drawing on Attention Restoration Theory (ART), which posits that restorative environments should provide a sense of being away, fascination, extent, and compatibility (Kaplan, 1995), we examine how digital technologies transform museums into healing spaces. This investigation focuses on the China Grand Canal Museum in Yangzhou, a site selected for its extensive integration of digital technology, cultural significance, and high levels of visitor engagement. The museum exemplifies the contemporary fusion of digital innovation with cultural heritage, featuring immersive exhibitions that seamlessly blend cutting-edge digital technology with traditional exhibits. This selection of this site helps reveal the broader healing potential of digital technology across various cultural spaces.

Using semi-structured interviews with 27 visitors conducted between July and August 2022, we analyzed how visitors experience and engage with digitally enhanced museum spaces. Our analysis identified five core dimensions of healing experiences: emotional engagement, sensory immersion, cathartic rejuvenation, creative inspiration, and educational and cultural enlightenment. Building on these findings, we developed a conceptual model to explain how digital technology enhances healing experiences in museum settings.

This study makes several important contributions to both theory and practice. First, we offer a novel healing perspective on museum experiences. Unlike existing research that primarily examines museums' educational, entertainment, or cultural heritage functions, our study is the first to systematically explore how digitally transformed museums specifically promote psychological and emotional healing through technological means. This focus on healing experiences as a core research object opens a new theoretical dimension for understanding museum functions in the digital age. Second, we identify and empirically validate a five-dimensional framework of healing experiences in digitally transformed museums: emotional engagement, sensory immersion, attention recovery, creative inspiration, and educational/cultural enlightenment. These interrelated dimensions provide a comprehensive analytical foundation for understanding how digital technologies holistically support different aspects of visitor well-being within museum spaces. Third, we reveal the specific transformative role of digital technology in facilitating healing by demonstrating how it reorganizes relationships between museum spaces, time, and visitors through three distinct processes: enchantment, fusion, and creation. This perspective moves beyond traditional museum research that typically offers functional descriptions of technology and instead sheds light on technology’s deeper impact on visitors’ emotional and psychological well-being. On the practical side, our findings provide museum managers and cultural institutions with concrete guidance for implementing digital technologies in ways that enhance visitor well-being while maintaining cultural authenticity.

2. Literature review

2.1. Attention restoration theory

Attention Restoration Theory (ART), originally developed by Kaplan and Kaplan (1989) and later refined by Kaplan (1995), provides a theoretical framework for understanding how certain environments can help individuals recover from mental fatigue and restore their psychological resources. The theory emerged from environmental psychology but has particular relevance for understanding how digitally enhanced museum spaces can facilitate psychological restoration and healing experiences. At its core, ART distinguishes between two fundamental types of attention: directed attention and involuntary attention (also called fascination). Directed attention requires conscious mental effort and is used for tasks that demand concentration, such as problem-solving or focused learning. This type of attention is finite and susceptible to fatigue, leading to decreased cognitive performance and increased stress when depleted. In contrast, involuntary attention occurs naturally when individuals encounter inherently interesting stimuli, requiring minimal mental effort and allowing directed attention resources to replenish (Kaplan, 1995; Ohly et al., 2016).

Recent research has expanded our understanding of how digital platforms can create restorative experiences through features like storytelling, personalization, and virtual connection (Wong et al., 2022). Studies demonstrate that restorative experiences engage multiple senses simultaneously, with both visual and auditory elements contributing to attention restoration and overall life quality (Qiu et al., 2021; Lin & Yang, 2024). Digital museum experiences facilitate restoration through environmental stimulation and mental adjustment (Fan et al., 2024), while carefully designed visitor engagement and multisensory experiences enhance their restorative potential (Zhou et al., 2023; Agapito et al., 2017).

Although ART was initially developed to explain restoration in natural environments, its application to built environments, particularly cultural spaces, remains theoretically underdeveloped. Traditional applications of ART focus on how natural spaces such as parks, gardens, and wilderness areas provide restorative experiences through their inherent qualities of soft fascination and removal from daily stressors (Ohly et al., 2016). The emergence of digital technologies in cultural spaces presents significant theoretical challenges for understanding restoration, particularly in the manifestation of ART's core components within digitally enhanced environments.

ART identifies four essential characteristics that make an environment restorative, each with specific implications for digital museum experiences. First, "being away" involves psychological distance from daily routines (Bagot, 2004), which digital installations can create through immersive technologies that transport visitors to novel environments. Second, "fascination" refers to features that effortlessly capture attention (Liu et al., 2017), which digital technologies achieve through dynamic displays and interactive elements that create what Kaplan calls "soft fascination" - gentle engagement that promotes restoration. Third, "extent" describes an environment's richness and coherence (Cole & Hall, 2010), which digital technologies enhance through virtual spaces and interconnected narratives that create cohesive, engaging experiences. Finally, "compatibility" represents an alignment between environmental features and visitor preferences (Hauru et al., 2012), which digital museum experiences support through personalized content and multiple pathways for exploration that match individual interests and goals.

The integration of digital technologies in museums challenges traditional applications of ART, revealing significant theoretical limitations. Digital technologies create unique forms of psychological distance and fascination, while the hybrid physical-digital environment introduces complex dynamics for extent and compatibility. In addition, the social dimension of digital museum experiences contrasts with ART's traditional focus on individual restoration processes.

2.2. Museums as healing hubs

Museums and cultural spaces in general have long been recognized for their capacity to facilitate healing experiences that extend beyond mere relaxation, with recent scholarship establishing healing as a multidimensional phenomenon encompassing physical restoration, psychological renewal, and spiritual connection (Liu et al., 2024). This understanding aligns with emerging research in environmental psychology and consumer well-being, which demonstrates how restorative environments contribute to positive emotions and life satisfaction while fostering visitor loyalty (Backman et al., 2023). The therapeutic potential of cultural spaces emerges from their distinctive ability to create environments that support psychological restoration while simultaneously engaging visitors with meaningful content (Rosenbaum et al., 2020).

In tourism and hospitality contexts, the concept of healing has been extended beyond traditional medical paradigms. Contemporary scholars define healing as an individual's holistic recovery from imbalances, incorporating physiological restoration and psychological subjective perceptions (Kim et al., 2012; Yang et al., 2015). They have explored the various important dimensions of healing experiences in cultural spaces: sensory healing, social healing, wellness and cultural healing, and natural healing (Liu et al., 2024). These dimensions manifest through what Kim et al. (2020) identify as three primary pathways: physical restoration through carefully designed environments, psychological renewal through engagement with meaningful content, and spiritual connection through encounters with shared heritage.

Museums, as unique repositories of cultural, historical, and artistic treasures, have a significance that extends beyond strengthening our familiar connection with the tangible world. They convey the beauty and provide a quiet yet potent force of creativity, passion, and belief that can shatter mundane and cliched perceptions, even altering our worldview (Schama, 2023). Museums increasingly embrace their role in healing through heritage, art, and culture by creating guided, interpretive, and communicative activities that incorporate education. They cater to the diverse needs of individuals, offering therapeutic benefits such as anxiety reduction, enhanced self-esteem and identity, inner peace, and improved mental and physical well-being (Mangione, 2018; Fan & Luo, 2022). Moreover, heritage in museums or heritage sites often functions as a storytelling medium, bridging the present with the past and fostering an emotional connection between individuals and the shared collective memory embedded in society or the deeply personal touch of individual experiences (Djabarouti, 2021). This emotional attachment stems from a sense of place, as visitors engage with the unique historical and cultural resources of a destination (Jewell & Crotts, 2002). Museums also play a significant role in healing individuals and groups affected by trauma, such as war veterans and those grappling with the aftermath of colonization (Simpson, 2009).

Today's museums emphasize the provision of immersive experiences through ethical and professional practices, community engagement, education, appreciation, reflection, and knowledge sharing (ICOM, 2022). This emphasis on experiential services underscores the transformative evolution of museums into multifaceted service institutions (Mangione, 2018). However, the current understanding of museums as healing spaces reveals several theoretical limitations. Although studies demonstrate museums' capacity for promoting well-being through cultural engagement (Fan & Luo, 2022; Mangione, 2018), they often lack theoretical grounding in how this healing occurs. Current research assumes passive restoration through mere presence in cultural spaces, without examining how specific museum elements drive healing experiences.

2.3. Digital transformation of museum experiences

Digital transformation encompasses the systematic integration of digital technologies across multiple domains: collection management, research activities, exhibition presentation, and knowledge dissemination. The primary goal extends beyond merely modernizing operations; it aims to create more engaging, accessible, and meaningful experiences that enhance the therapeutic and educational potential of museum spaces. The evolution of digital museum experiences aligns with broader trends in the tourism market, which increasingly demands technology-driven, entertainment-oriented, and personalized experiences (Lunardo & Ponsignon, 2020; Mirghadr et al., 2018). This alignment has challenged traditional perceptions of museums as static repositories of cultural artifacts. By seamlessly integrating physical and virtual realms, museums have created unique experiential landscapes that transcend conventional spatial and temporal limitations (Hoyer et al., 2020).

Digital transformation can enhance visitor experiences in several ways. First, digital technologies can break down traditional boundaries that have long limited how visitors experience museums, as the evolution from static displays to dynamic, interactive presentations opens new possibilities for engaging with cultural heritage (Hashim et al., 2014). By leveraging digital tools, museums can create exhibitions that extend beyond physical space constraints, offering novel ways for visitors to connect with artifacts and stories that were previously inaccessible (Guo et al., 2023). Second, digital technologies enable museums to create rich, multisensory environments where museums can engage visitors through multiple channels simultaneously - combining visual, auditory, and haptic experiences to create more immersive encounters. These multisensory experiences hold promise for therapeutic benefits, including stress reduction and emotional renewal (Kim et al., 2020). Third, technologies like AR, VR, and MR can transform museums from spaces of passive observation into environments for active participation, as these tools facilitate deeper “two-sided communication,” enabling visitors to become active participants rather than mere observers (Kamariotou et al., 2021). This shift toward active engagement holds promise for enhancing psychological restoration and social connection in cultural spaces (Backman et al., 2023), potentially strengthening museums' role as healing environments through the thoughtful integration of digital technologies that support both individual and collective well-being.

However, museums face significant challenges in this digital transformation journey, particularly in creating meaningful visitor experiences that balance traditional and innovative approaches. The integration of physical and digital environments - known as the “phy-gital” relationship - requires careful consideration of how digital technologies might enhance or impede therapeutic benefits. First, there is a risk of digital overwhelm, where excessive technological stimulation could counteract the restorative benefits traditionally associated with museum spaces, particularly relevant given ART’s emphasis on “soft fascination” that allows for mental restoration. Second, museums face the complex task of meeting visitors’ evolving expectations for personalized, interactive experiences while maintaining authentic cultural experiences and their educational role (Guo et al., 2023). The challenge lies in ensuring that technological additions complement rather than overshadow the intrinsic cultural and historical value of exhibits. Third, the effectiveness of digital interventions may vary significantly across visitor segments, with factors such as technological literacy, age, and cultural background influencing how visitors respond to digitally mediated healing experiences. While studies document the technological capabilities and increased visitor engagement in digital museum experiences (Lunardo & Ponsignon, 2020; Mirghadr et al., 2018), they predominantly focus on technology implementation and engagement metrics rather than understanding restoration processes. This technology-centric approach lacks theoretical grounding in how digital transformations affect psychological restoration, leaving a critical gap between technological innovation and theoretical understanding of restoration processes in these hybrid environments.

3. Research methods

3.1. Case selection

The China Grand Canal Museum was selected for three primary reasons: First, it serves as a landmark project in the construction of the Grand Canal National Cultural Park and specifically showcases the World Cultural Heritage value of the China Grand Canal. It stands as a significant embodiment and integration of Chinese culture, making it a highly representative and exemplary institution. Second, the China Grand Canal Museum boasts 14 specialized exhibition spaces, including Exhibition Hall No. 1 "Grand Canal—China's World Cultural Heritage," Exhibition Hall NO. 2 "Boats on the Canal," and Exhibition Hall No. 3 "Arrived at the Times: Grand Canal Street Shops." Exhibition Hall No. 8's "Impression" and "River Love" both utilize digital technology, seamlessly blending with ships, ancient buildings, and canal-side life scenes to deliver an immersive and captivating experience. Third, during summer vacation, the China Grand Canal Museum attracts over 10,000 visitors daily. This substantial visitor base provides ample opportunities to gather diverse sample data. These factors collectively aligned with the research objectives, making the China Grand Canal Museum the ideal setting for their investigations into the impact of digital technology on museum experiences.

Our fieldwork was conducted from July 24 to August 7 in Yangzhou, when the city was operating under China's "dynamic zero-COVID-19" approach. While some regions in China were experiencing lockdowns during this period, Yangzhou maintained relatively normal operations with preventive measures in place, including mandatory negative test results for public venue access, mask requirements, and capacity limitations. The China Grand Canal Museum implemented these protocols while successfully maintaining high visitation rates (over 10,000 daily visitors during our research period). These circumstances may have actually heightened visitors' need for healing experiences, as participants frequently mentioned seeking relief from pandemic-related stress and restrictions. The controlled environment of the museum, combined with its spacious layout and health safety measures, created conditions where visitors could safely engage with immersive experiences while temporarily escaping pandemic anxieties.

3.2. Study design

This study primarily focuses on the subjective perception and cognitive aspects of tourists' healing experiences, hence adopting a semi-structured interview approach. We followed a systematic process that incorporated multiple theoretical perspectives and expert validation. Drawing upon Kaplan's (1992) ART framework as our primary theoretical foundation, we crafted questions to explore the four essential characteristics of restorative environments while simultaneously capturing general museum experiences. For instance, to examine the "Being Away" component, we asked participants, "How did your thoughts change during your visit?" and "What were you thinking about while looking at the digital displays?" We further incorporated elements from Cho et al.'s (2016) and Guo et al.'s (2023) questionnaires, which specifically examine sensory experience, technology interaction, cultural engagement, and emotional response in digital museum settings. Questions such as "Tell me about surprising or captivating moments" and "What aspects made the cultural heritage meaningful?" helped us understand how digital presentations influenced visitors' engagement with cultural content. Moreover, restoration-focused questions such as "What physical sensations did you notice?" and "How did your attention change?" allowed us to identify specific instances of restorative experiences.

Before conducting the formal investigation, we sought validation from three cultural tourism experts, including two professors and an associate professor. Their feedback and

suggestions were instrumental in optimizing the interview outline and ensuring its effectiveness in distinguishing between general museum experiences and specific restorative outcomes. This expert review process helped refine our approach to investigating the "fascination" component of ART through questions such as "Which digital exhibits caught your attention?" and "Tell me about moments that particularly interested you." These questions helped us identify instances of effortless attention—a key indicator of restorative experiences. Similarly, questions about "Extent," such as "Tell me about how the digital stories unfolded during your visit?" allowed us to examine how digital narratives created coherent, engaging experiences that could support restoration.

We conducted our interviews on-site at the China Grand Canal Museum. Participants were randomly selected based on two key criteria: they must have completed a museum visit, particularly the digital exhibition hall, and be 16 years of age or older. This approach ensured that participants could provide immediate, fresh perspectives on their experiences while minimizing recall bias. Thirty semi-structured interviews were conducted, each lasting between 15 and 30 minutes. After reviewing the quality and completeness of the interviews, we eliminated three that were deemed too brief to provide meaningful insights. The remaining 27 participants generated over 45,000 words of rich, detailed information about participants' experiences. Table 1 shows their profile.

Table. 1
Participants' profile

Serial number	Sex	Age	Educational qualifications	Profession	Purpose of visit	Coding
1	Male	17	Junior high school	High school student	Relax	T1
2	Female	17	Junior high school	High school student	Relax	T2
3	Male	34	High school	Factory worker	Sightseeing and leisure	T3
4	Female	33	High school	Factory worker	Sightseeing and leisure	T4
5	Female	23	Undergraduate	Manager	Sightseeing and leisure	T5
6	Male	17	Junior high school	High school student	Experience museum activities	T6
7	Female	17	Junior high school	High school student	Experience museum activities	T7
8	Female	40	Undergraduate	Housewife	Take your children to experience museum activities	T8
9	Male	38	Master	Teleommunications employee	Experience technology	T9
10	Female	36	Master	Museum staff	Learn and understand technology applications	T10
11	Male	34	Technical secondary school	Self-employed	Take your children to learn about canal culture	T11
12	Female	36	College	Office worker	Sightseeing and leisure	T12
13	Male	26	College	Food service worker	Sightseeing and leisure	T13
14	Female	19	High school	Student	Sightseeing and leisure	T14
15	Male	64	junior High school	Retiree	Sightseeing and leisure	T15
16	Female	62	High school	Retiree	Sightseeing and leisure	T16
17	Male	20	High school	Student	Sightseeing and leisure	T17
18	Male	34	College	Automotive worker	Sightseeing and leisure	T18
19	Male	22	High school	Student	Sightseeing and leisure	T19
20	Female	25	Undergraduate	Manager	Sightseeing and leisure	T20
21	Female	26	Undergraduate	Graduate school prep instructor	Sightseeing and leisure	T21

22	Female	18	Junior high school	Student	Visit with parents	T22
23	Male	28	Undergraduate	Self-employed	Visit with friends	T23
24	Female	28	Master	Elementary school teacher	Visit with family and friends	T24
25	Male	18	Junior high school	High school student	Sightseeing and leisure, experience Yangzhou culture	T25
26	Male	32	Master	Internet company employee	Sightseeing and leisure	T26
27	Female	26	College	Dance instructor	Relax	T27

3.3. Data analysis

This study employs the systematic qualitative data analysis methodology developed by Gioia, Corley, and Hamilton (2013), which emphasizes rigorous concept development and theory building from qualitative data. Following their approach, the research team first organized all recorded materials into standardized electronic documents with sequential numbering. Throughout the analysis process, the team continuously engaged in comparative analysis between the textual data and established theories to identify analogous concepts and potential theoretical contributions.

The analysis proceeded through multiple systematic coding phases. In the initial phase, the team conducted first-order analysis using descriptive and pattern coding techniques, staying true to informant-provided terms and concepts while preserving the richness of the original data. This phase focused on thoroughly classifying and understanding the information contained within the raw data, maintaining informant-centric terminology and perspectives. The coding process began with a detailed analysis of 27 interview records, examining the data line by line and sentence by sentence until theoretical saturation was achieved - the point at which no new insights emerged from additional interviews. Given the extensive number of initial codes generated, the team then engaged in a systematic refinement process, consolidating repetitive concepts and streamlining related codes into meaningful theoretical categories while maintaining their grounding in the original data.

In the subsequent second-order analysis phase, the researchers identified higher-level themes by grouping first-order codes with similar attributes based on their theoretical relationships. This process involved three iterative rounds of refinement and modification, ultimately yielding 16 distinct second-order themes. The naming conventions for these theoretical categories drew partially from existing literature while remaining grounded in the original data, creating a bridge between informant experiences and theoretical constructs.

The final phase of analysis focused on theoretical development, with particular attention to emerging concepts that lacked sufficient theoretical support in existing literature. Through this process, the second-order themes were further aggregated into five overarching theoretical dimensions: emotional engagement, sensory immersion, cathartic rejuvenation, creative inspiration, and educational and cultural enlightenment. Each dimension represents a constellation of related themes sharing common theoretical attributes and relationships. Table 2 presents our data structure, showing the progression from raw data to theoretical concepts. This structure demonstrates how we moved from participant-centric terms to researcher-identified theoretical categories while maintaining the chain of evidence. Each dimension represents a constellation of related themes sharing common theoretical attributes and relationships. To ensure analytical rigor, when coding discrepancies arose among team members, the research team revisited the original materials and analytical memos to achieve consensus through careful comparative analysis.

Table 2.

Data structure

Aggregate Dimension	Second-order Theme	First-order Concept	Representative Quotes
Emotional Engagement	Multi-sensory Stimulation	Dynamic and shocking scenes	This is very real. The picture is beautiful, highlighting its dynamic beauty (T5) This museum is more of a dynamic presentation, more vivid, and more breathtaking. (T14)
		Audio-visual tactile impact	A lot of modern technology is used, such as naked-eye 3D effects, and there are also some special scene layouts. The viewing experience is quite good. It's a bit close to the look and feel of Universal Studios or Disney, and it's a perfect experience. (T20) Its scenes will show the changes of the four seasons. Different pictures are matched with different colors and sounds, and the emotions will also change accordingly. (T12)
	Scene Interaction	Interaction between people and space	You can take photos here, the results are very beautiful, I like it very much. (T19) The ancient streets here, coupled with the changes in the sky, are a bit like a time-travel drama. You can take photos and check in here. (T6)
		Human interaction	It feels very lively and cheerful. When the music reaches its climax, children run around, which is very appropriate for the occasion. Each museum is different. If you want to see history, you need to be quiet. This is an occasion that requires excitement. (T8) If there are too few people, it will be quite scary. It seems that the librarian is always staring at you, so it is good to have more people. Everyone on the virtual cruise feels like they are really experiencing life here. (T20)
		Game activity participation	We came here especially for the second time. There is a canal trail game activity here, and we wanted to try it out. (T7) When you're on the cruise ship, you feel like you're in a virtual world. It's like wearing a VR headset and playing games. It's quite fun. (T1)
	Emotional Mobilization	Bring novelty and surprise	I'm still quite interested in that scene. The scenes I saw last year were different from this year, so I will have a fresh feeling if I come here this time. (T21) This museum uses a lot of technical elements, so it's quite surprising. It's beyond my expectations and I feel quite excited. (T19)
		Feel excited	I haven't shown you this kind of realistic animation in other museums before, so my eyes lit up when I saw it. (T14) The feeling is very real and dreamy. I still sigh that the technology is relatively advanced, just like the scenes in the game. It is quite exciting. (T19)
Sensory Immersion	Interaction between Reality and Virtuality	Time travel experience	The technology here is quite good; it feels like traveling through time. When the technology isn't good, you don't get this feeling. (T21) Hall No. 1 uses naked-eye 3D technology to let you travel through 17 cities and experience the scenery along the canal. (T13)
		Blend of traditional and modern	While you're touring, you know you're in the present, but these ancient cultures "grab hold of you," making you feel that era's culture. (T16)
	Blurred Spatial Boundaries	Spatial immersion	They use a lot of technology to make you feel like you're really there, experiencing something completely different. (T12) There's a starry sky scene that feels especially atmospheric, like you're sitting on a mountaintop watching countless stars, and when a shooting star passes, you silently make a wish. (T7)

		Transitioning between spaces	It has many different exhibition halls with different design styles and themes, but they're not disconnected. You can move between different environments like ancient streets, historical trading scenes, and past life scenarios, which I find fascinating. (T10)
	Strong Sense of Presence	Hyper-realistic environment	That ancient street was stunning at first sight, with opera stages, seal carvers, stamp sellers, calligraphy sellers - the scene reproduction is very high quality. (T6) In Hall No. 2, they showed many canal boats, and the 'sand ferry boat' experience was incredibly realistic. (T14)
		Theatrical experience	There are great replica ancient buildings, shops, pavilions, bridges, and streams here. You can wear Tang Dynasty clothes, it's like being in a play. (T5) I've always loved watching historical dramas, and here you can see many ancient scenes reproduced through technology, very realistic, like being in a film set. (T17)
Attention Recovery	Aesthetic Appeal	Beautiful scenes	This 720-degree interactive panoramic space is so beautiful, I could stay here all day. (T22) When you're standing on the boat and it starts "snowing" on screen, it really feels like experiencing Yangzhou in winter. It shows that Yangzhou isn't just beautiful in spring, but in winter too. (T5)
		Expression of Chinese aesthetics	I really love Chinese culture, it's beautiful. Many cultural venues today don't do it justice, but this museum has put a lot of thought into incorporating classical aesthetic elements, which is really precious. (T27)
	The Sense of Time Fades	Lost track of time	Because it's all enclosed here and the scenes are so rich, you don't pay attention to time like you usually do. (T5) The whole morning passed so quickly, I hadn't finished seeing everything when suddenly it was noon. (T27)
		Present moment focus	I'm basically fully absorbed in looking, thinking, and wholeheartedly exploring what's inside and all the other details. (T21) I want to stay longer here (in the eighth exhibition hall), I feel very comfortable here, not thinking about anything else. (T9)
	Inspire Curiosity	Stimulate curiosity	This is great for children. Like that canal animation - she kept asking what it meant, really wanting to understand it. (T12)
		Help find points of interest	Technology helps me find points of interest or understand parts of the culture, though specific content still needs personal exploration. (T26) As a teacher myself, many things here interest me, like using technology simulation to explain knowledge points. (T24)
	Calm and Soothing	Finding inner quiet	By this riverside, watching the ever-changing sky, my mood becomes very peaceful. (T18) It's nice here, with changing seasonal scenes and soft music. You can just sit without doing anything, not looking at your phone, just quietly being present. (T20)
		Stress release	If you've been under pressure lately, coming here to look around makes you feel more open-minded and broadens your perspective - it's a form of relaxation. (T13) Being in high school third year is quite stressful, so coming here is a form of relaxation. The venue is well-designed with lots of technology and rich content, which helps escape from pressure. (T25)
Creative Inspiration	Situational Association	Historical scene connections	This matches the history we learned before - some scenes are more vivid with technology, making me think of content from our textbooks. (T7) Yangzhou is right by the canal. When I visited the end of Dongguan Street where the canal is, I wondered where Emperor Qianlong's southern inspection tour was painted, and what it looked like back then. (T14)
		Personal imagination	When on the boat, watching the screen and feeling the boat move forward, it's like being an ancient official inspecting the region. (T17) Next time, I want to bring someone special here. Those scenes of snowfall, rainy skies, and seasonal changes are particularly beautiful. (T19)

	Good Memories Trigger	Childhood memory activation	There's a lantern release scene (virtual scene) that reminded me of releasing lanterns with my parents when I was little, like suddenly returning to that time. (T25) We used to wash clothes and vegetables by the Grand Canal, just like what we saw on the boat. (T15)
		Sweet memory activation	The rainy sky and lantern release scenes are nice, reminding me of sweet moments from our past travels. (T21)
	Inspire Individuals	Technology should support, not overshadow	This museum has its characteristics - digitalization is a supporting exhibition technique that needs to harmonize with the overall space, safety facilities, and number of exhibits. This inspired me a lot, but we should avoid letting digital elements overshadow the main content. (T10) It depends on how you look at it (technology). It can't compete with Disney's technology, but it's very well done for a museum. More important is the content - even the most advanced technology is useless if it doesn't connect well. (T26)
		Extended technology applications	Since fireworks are banned now, seeing them here, even virtually, makes me happy. Cities should have more creative designs like this that are both environmentally friendly and relaxing, making cities warmer and welcoming. (T19)
Educational and Cultural Enlightenment	Sense of Gain from Learning	Lower learning barriers	In conventional museums, without an audio guide or professional guide, you might just skim past artifacts without really understanding them. The Canal Museum is more suitable for the general public – it's simpler and more straightforward, helping ordinary people understand canal culture. (T18) This museum turns historical content into game experiences, making it simple to understand and interesting. (T8)
		Valuable learning opportunity	We're from Henan, where we don't have this kind of technology - our hometown is economically behind, less developed than here. (T4) We brought our children here, and it's also a learning opportunity for ourselves - it's easier to understand than regular museums. (T11)
	Strengthened Cultural Identity	Enhanced patriotic feelings	I think Chinese people are remarkable. Look at Emperor Yang of Sui - even though his dynasty fell and people said digging the canal was too costly, this waterway was essential for people's livelihood and impacted hundreds or thousands of years of descendants. It's a vital part of Chinese history. (T3) Feeling proud that China has such a glorious history and has created so many miracles. It's different from what we felt through textbooks. (T17)
		Deepened historical understanding	Before, we only saw the Yangzhou Grand Canal through textbooks or TV dramas. But experiencing it here today through interactive experiences and animations, it feels different from TV - the understanding is deeper. (T2) I find myself reflecting, looking at the Yangzhou Grand Canal from different angles. On one hand, it brought suffering to people then, but historically, it strengthened economic and cultural exchange between North and South China. Especially standing on that simulated boat, it's like re-experiencing history. (T4)
	Self-reflection and Identity	Self-acceptance	I feel society's pressure is intense, and people easily feel lost. Coming here to see this history presented so realistically makes you think - many things might not be as important as they seem, you can take them more lightly. (T4) In this environment, you feel how small you are, you really get that feeling. (T21)
		Finding life motivation	When you're troubled and see that vast, universe-like scene, you realize you're just a drop in the ocean. Everything passes, no difficulty is insurmountable. No need to envy others' worlds, just focus on being yourself. (T3)

4. Findings

Our research has uncovered a transformative impact of digital technology on healing experiences within the museum setting. Five overarching themes emerge, each illuminating the remarkable capacity of digital exhibits to foster healing and well-being for visitors. These themes collectively paint a compelling picture of how digital technology is revolutionizing the healing potential of museums, transforming them into havens of emotional engagement, sensory immersion, attention recovery, creative inspiration, and educational and cultural enlightenment.

4.1. Emotional engagement

Emotional engagement refers to the way in which individuals emotionally connect with and respond to their environment or experiences, often influenced by sensory stimuli. Digital technologies transform traditional exhibits, evoking positive emotions and making the visitor experience more interactive and memorable. Our understanding of the world is primarily derived from sensory experiences, which involve an interplay between the individual and the environment. The introduction of digital technologies has significantly impacted our sensory experiences, particularly vision and hearing (Guo et al., 2023). In museums, digital simulations create dynamic and immersive environments that are visually and aurally captivating, appealing to modern audiences, and differentiating themselves from traditional museums. These immersive experiences generate a sense of novelty and excitement, effectively attracting visitors. "*Traditional museums simply display cultural artifacts, leaving visitors to simply observe them. This museum, however, is more dynamic and immersive, creating a breathtaking experience. (T5)*". During the visit, the virtual scene engages visitors in an interactive environment. "*It's not just about looking; there's also sound and light technology, a moving sand boat, and an ancient street roof that can rain. These are quite impressive (T4)*". Visitors can take photos, play games, and explore certain historical stories or knowledge points about canal management in different scenes, creating a gamified tour experience.

The scene changes brought about by digitalization have transformed the traditional perception of museums as serious, quiet, and fatigue-inducing spaces, making them more visitor-friendly and capable of evoking positive emotions. Research shows that tourists seek personalized, relaxing, entertaining, and interactive travel experiences (Bideci & Albayrak, 2018). Most tourists hold high expectations for lighthearted and enjoyable experiences (Sheng & Chen, 2012). As T9 remarked, "Cultural things may be a bit dull, but with the application of technology, they'll be better and have a sense of entertainment."

First, exhibition halls enhanced by digital technology allow visitors to quickly immerse themselves in a virtual and dreamlike space, providing a transitional moment for emotional adjustment and refocusing. For example, in Exhibit Hall 8, the combination of beautiful visuals and soft music creates a dual sensory stimulation of sight and sound, enabling visitors' emotions to flow and establishing a calming and therapeutic atmosphere.

Second, digital technology enables visitors to experience scenes that are typically inaccessible in real life. For instance, bustling street markets and moving boats along the canal vividly recreate the prosperity and vibrancy of historical Yangzhou. Visitors no longer passively learn about history through "cold" exhibits and textual descriptions; instead, they witness history "come alive before their eyes." This method of presenting information delivers a powerful emotional impact, fostering deeper engagement and emotional transformation.

Third, different museum halls employ various digital technologies to create diverse content. These include historical stories of the Grand Canal, theoretical explanations, interactive games, and virtual boating experiences. The rich and varied presentations evoke a range of emotional responses in visitors, such as joy, wonder, excitement, surprise, and delight, ultimately awakening positive emotions throughout the experience.

4.2. Sensory immersion

Sensory immersion refers to the deep involvement of individuals with their environment through a combination of sensory inputs, such as sight, sound, and touch. Historically limited by technology, immersive experiences were often fragmented. However, advancements in technologies such as artificial intelligence, augmented reality (AR), 5G, and other technologies, high-quality immersive experiences have become a widely sought-after consumption form. The digitization of museums has enabled the recombination and coding of various sensory symbols, creating a creative, virtual, and interactive combined experience. After adapting to the time and space context, visitors begin to integrate into the atmosphere of the scene. For example, T12 believes: "*It uses a lot of technology to allow you to actually be there and experience something completely different.*"

This immersive state is directly related to the space where tourists are located. First, the scene in which tourists participate in interaction forms a new space in itself. In Exhibition Hall 2 of the Grand Canal Museum, when many tourists stand on the "bow," it seems that all of them are residents living by the canal. The interaction between "people and objects," "people and scenery," and "people and people" strengthens the sense of presence, blurs the linear concept of time and space, and activates memory. The combination of external scenes and the inner world ultimately becomes the world of experience.

Secondly, the virtual space symbolizes the real world and presents a kind of aesthetic reality. Visitors immersed in it make unconscious reactions to changes in the content, such as making wishes following shooting stars, being surprised or sighing as the seasons change, stimulating the desire to continue watching. For example, T7 commented, "*There is a starry sky scene that feels particularly artistic, as if you are sitting on the top of a mountain and looking at the sky full of stars. At this time, shooting stars flash by, and then you silently make a wish in your heart*." The on-site atmosphere not only provides a shocking sensory experience but also creates and enhances the immersive experience of tourists.

4.3. Attention recovery

Attention recovery refers to the process through which individuals regain focus and alleviate mental fatigue, often by immersing themselves in environments that provide a break from their usual, attention-demanding activities. In digital museum exhibitions, attention recovery occurs when visitors detach from the stresses of daily life, reduce cognitive load, and restore their mental energy. To capture public attention, there must be what Kaplan refers to as the "fascination" effect, triggering tourists' "unconscious attention" (Cho et al., 2016). The digitization of museums precisely addresses this need. When immersed in digital experiences, tourists often shed distracting thoughts, lose track of time, and revel in beautiful moments, resulting in a noticeable reduction in stress.

Firstly, digitalization enhances tourists' concentration and curiosity. Virtual reality elevates the aesthetic appeal and immersion of the space, while light projection further encloses the environment. This immersive experience prompts visitors to temporarily detach from time-conscious activities on their mobile phones. As one participant described, "*I am basically immersed in looking at it, forgetting about time, and fully devoting myself to exploring the details*." Although existing research often overlooks the role of time, modern society's

dependence on structured time makes it challenging to “forget time.” The immersion and investment in technology might be fleeting, offering individuals a brief escape from their technology-saturated daily lives. Once tourists are immersed and resonate with the scene’s content, curiosity drives them to explore further. While conventional research views moments in non-usual environments as an “escape” from daily life, the effectiveness of such escapes depends on whether the new environment ignites positive emotions. Tourists satisfy their curiosity by delving into the unknown world, enhancing their sense of achievement and satisfaction, and alleviating attention fatigue resulting from prolonged concentration.

Secondly, tourists find an outlet to release accumulated daily stress. This release may not always manifest externally, but often results in inner peace and relaxation. Interviewees expressed this relief using indirect language such as “relax,” “it’s nice here,” “it’s calm,” and “it has a broad view.” For instance, T18 mentioned, “*If you are under a lot of pressure, come here and take a look; you’ll feel that your vision and mind broaden, providing a kind of relaxation.*” The degree of stress relief is influenced by factors like work pressure, immersion, personal preferences, and the exhibition hall’s design, theme, and content richness. While greater pressure and engagement can amplify the stress relief effect, individual preferences and the nature of the exhibition hall also play important roles. For example, exhibition halls demanding more attention and understanding may lead to fatigue, whereas entertainment-oriented exhibits offer a more obvious physical and mental relaxation effect.

4.4. Creative inspiration

Creative inspiration refers to the process by which individuals draw new ideas, concepts, or artistic impulses from external stimuli, particularly from immersive or imaginative experiences. In digital museum exhibitions, creative inspiration is triggered by the dynamic interplay between the visitor’s inner world and the digitally enhanced environment. These experiences stimulate the imagination, encouraging visitors to think creatively and integrate these inspirations into their own lives. The digitization of museums complements the physical world, providing a new way of telling stories and stimulating the imagination and creativity of tourists. The inner world of tourists and the real world constantly interact with each other, oscillating between imagination and memory. This is the essence of museum digitization, offering a unique experience that differentiates it from other travel encounters.

Firstly, the digital experience triggers situational associations. Immersed visitors become co-creators of the story, establishing new interactive emotional relationships with the digital pavilions and exhibits. One key aspect is the association with intellectual content. Modern individuals comprehend history and tradition through various media such as books, movies, and news. Digitization enables the visualization of the museum's display content, making presentations more realistic and vivid. This easily triggers specific memories in the hearts of tourists. For instance, the simulated cruise ship in Exhibition Hall 2 serves as a fragment that inspires visitors to contemplate the life scenes along the Grand Canal, Qianlong's southern tour, and the life encounters of historical celebrities. T24 mentioned, “*Yangzhou is always close to the canal. I have been to the end of Dongguan Street, which is along the canal. I would also reflect on where Qianlong's southern tour was depicted and what it was like at that time.*” It is evident that imagination has a spatial dimension. It can transport individuals to "another scene," a place that is not entirely unfamiliar. In the realm of imagination, storylines can unfold seamlessly, allowing for the blending of scenes and the transformation of space, thereby eliciting positive emotions effortlessly. The experience of being moved is akin to a beautifying filter in the world of animation, enhancing the depth of future memories.

Secondly, digital experiences evoke beautiful memories. In comparison to the association of intellectual content, memories of past scenes are more likely to stir the emotional resonance

of tourists and create a comforting sense of familiarity. For instance, T25 shared, "*There is a scene (virtual scene) where lights are placed, which reminds me of my parents when I was a child. I turned on the light by myself, and it felt like I was suddenly back in that time.*" Studies have indicated that memories with positive values can assist in alleviating negative emotions (Gillihan et al., 2007). Additionally, even groups from different regions can be moved by sharing common traditions. For example, T15 recounted, "*I saw many things when I was a child. I used those tools, like stone mills and carts. It was quite touching*." This empathy and connection with a sense of place can aid tourists in developing a deeper identity and attachment to the local culture, contributing to emotional recovery.

Thirdly, the digital experience stimulates creativity. The museum's digital exhibition is crafted with subjective consciousness. In creating a new virtual world for visitors, it opens up possibilities that may be challenging or impossible to achieve in the real world. Some visitors draw inspiration from these virtual environments, seamlessly connecting them with reality, work, and life, fostering a sense of inner satisfaction. T10 expressed, "*This museum has its own distinctive features. Digitalization serves as auxiliary exhibition technology, requiring alignment with the overall space, safety facilities, and the number of exhibits in the museum. This has been quite inspiring for me. However, it is critical to avoid issues arising from overreliance on digitalization.*"

The stimulation of tourists' creativity in the virtual world is also intertwined with the convenience of modern digital devices. As humans increasingly depend on electronic devices for thinking, memory, and judgment functions, the challenge lies in preventing a decline in deep thinking and creativity amidst complex information flows. The amalgamation of museum cultural heritage with digitally created scenes can pique the curiosity of tourists and spark their inspiration. T19 reflected on this, saying, "*It's not allowed to set off fireworks now, but you can see it here, albeit virtually. I am also very happy. There should be more creative designs like this in the city—environmentally friendly and capable of providing relaxation and enjoyment, making the city feel warmer.*"

4.5. Educational and cultural enlightenment

Educational and Cultural Enlightenment refers to the process through which digital technologies in museums facilitate deeper learning and cultural understanding. By transforming traditional exhibits into interactive, immersive experiences, they inspire visitors to explore, reflect, and connect with history and culture. This fosters intellectual growth and a sense of cultural pride, while encouraging creativity and a broader perspective on heritage. As a new spatial narrative method for museums, digital technology serves as both a contemporary expression of traditional culture and a crafted narrative content (Averbach & Monin, 2022), giving rise to innovative cultural experiences in performances and interactions. Modern tourists have evolved beyond being passive recipients and listeners; they now function as self-aware empiricists and meaning creators. Throughout their visits, they engage in active learning, fostering connections, interactions, imagination, and recollection. This active engagement prompts a profound understanding of life, history, and culture. The process of thinking and comprehending the world leads to the sublimation of cognitive and spiritual concepts, manifested in three key aspects.

The first point is that digitalization enhances the sense of learning gain. As a tool for facilitating learning, the role of digital technology is to activate historical scenes, consider and explore spatial functions, disrupt simple linear narrative rules, allow the intersection of time and space concepts, and render abstract content intuitive and accessible to modern individuals. By narrating in a more engaging manner, it not only heightens tourists' interest but also reduces the difficulty of learning in the museum, thereby increasing the internal sense of gain. T18

expressed, "*If traditional museums don't hire an interpreter or have professionals explain, you might just take a quick look at the cultural relics and not comprehend them. However, the Canal Museum is more suitable for the general public and is simpler and more straightforward, allowing ordinary people to understand canal culture.*"

Secondly, digital experiences enhance the pride and identity of national culture. Visitors actively or passively "graft" local cultural elements into their cultural system in unconventional environments. The museum's cold language is replaced with vivid content, and historical events are represented and interpreted using modern technology. The previously static cultural heritage dynamically completes the storytelling. Visitors gain a deeper appreciation for the wisdom of ancient people and the greatness of Chinese civilization. This process revises and deepens existing historical perceptions, strengthening the understanding of local culture and boosting national cultural identity and pride. "*I think the Chinese people are very great. You see, the Sui Dynasty's empire was ruined. People say that digging canals is too expensive. But this river is very important, related to people's livelihood, and related to future generations for hundreds of thousands of years. It is an essential part of Chinese history* (T3)." On the other hand, digital technology has overcome the authoritative discourse influence of cultural narratives and addressed the "high knowledge barriers" imposed by expert explanations. Tourists' resistance is diminished, providing them with more room for self-understanding and contemplation.

Thirdly, digital experiences stimulate creativity. Museum digital exhibitions, designed with intentional subjectivity, encourage deeper thinking by creating entirely new virtual worlds for visitors. In traditional museums, visitors often encounter static exhibits such as a ship model, an ancient building, or a beautiful landscape painting. Without specialized knowledge or expert interpretation, it can be difficult for them to grasp the underlying principles. Digital technology, however, excels by presenting three-dimensional models in immersive ways or deconstructing the artistic concepts of a painting within a digital space. This approach unveils the intricate structures and details of the exhibits, transforming seemingly complex ideas into sources of creative inspiration. Visitors can then share their thoughts on platforms like TikTok or Xiaohongshu, fostering broader discussions.

Furthermore, when exhibition content is overly specialized, audiences often struggle to express opinions or provide feedback. However, when historical knowledge, stories, or artifacts are reimagined through visual and interactive formats, audiences are empowered to "speak up" and "comment," sharing their perspectives. If these contributions are creative, they may even be realized in real-world applications. The ability to spark such creativity depends on aligning the museum's cultural heritage with digitally created scenarios that resonate with visitors and ignite their curiosity. T19 observed, "*We're not allowed to set off fireworks anymore, but here, I can see them virtually, and I feel very happy. Cities should incorporate more creative designs like this—environmentally friendly while also providing relaxation and enjoyment, making the city feel warmer*."

However, it is important to recognize that digitalization serves as a supportive exhibition tool and must be harmonized with the museum's overall spatial design, safety infrastructure, and the number of exhibits. Over-reliance or indiscriminate use of digital technology, simply to appear advanced, should be avoided. As humans increasingly depend on electronic devices for cognitive functions such as thinking, memory, and judgment, there is a risk that deep thinking and creativity could diminish amidst the overwhelming flow of information. Thoughtful integration of digital technology is essential to preserve and enhance the intellectual and emotional richness of the museum experience.

Summing up, the study shows that the digital transformation of museums creates immersive, interactive environments that facilitate profoundly restorative experiences for visitors on emotional, mental, and even spiritual levels. Features like dynamic exhibits, virtual reality, and multi-sensory effects tap into positive emotions like awe, joy, and imagination, providing temporary escape and relief from the stresses of daily technology-saturated lives. As visitors shed their inhibitions and lose themselves in these digitized cultural spaces, they undergo experiences of relaxation and rejuvenation as well as a stimulus for creativity, self-reflection, and deeper connections with cultural heritage. Associative empathy effects promote healing from dissatisfactions, allowing visitors to rediscover themselves and regain optimism. In these myriad ways, museum digitization promotes the well-being of visitors by crafting imaginative, emotive adventures that reveal new perspectives on life, history, and identity. The museums become vessels for cathartic sensations of healing and renewal.

4.6. Towards a conceptual framework

Based on both theoretical foundations and empirical observations at the China Grand Canal Museum, we propose a conceptual framework demonstrating how digital transformation facilitates psychological restoration and cultural connection. As illustrated in Figure 1, the conceptual framework shows that museum spaces are transformed through a progression of four interconnected stages that facilitate healing experiences through digital technology and exhibition innovation.

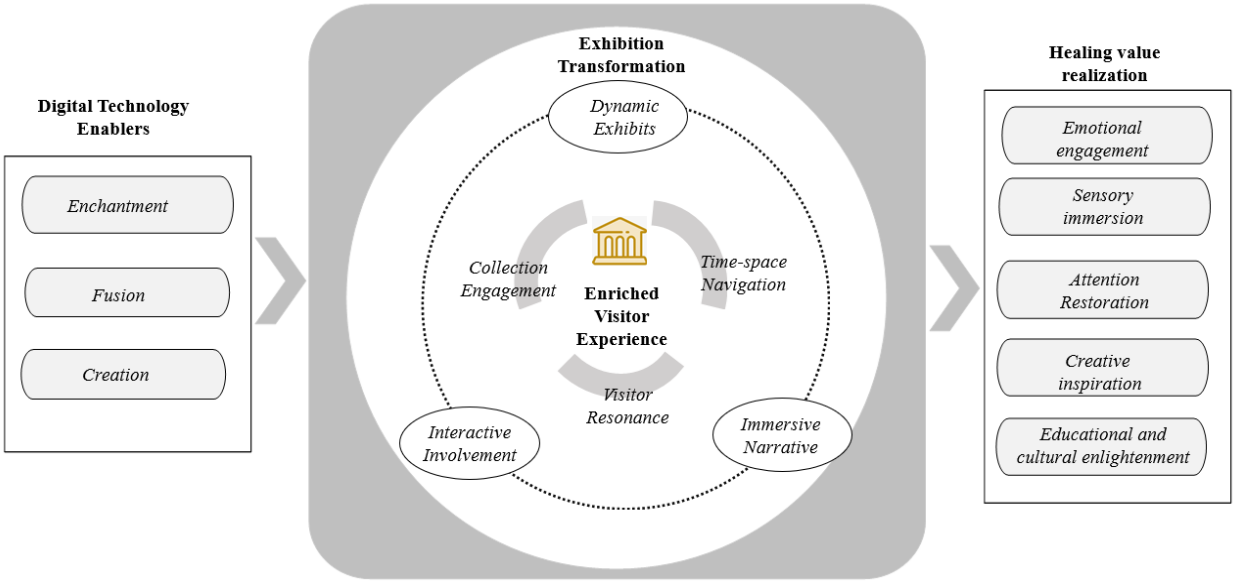

Figure 1. Proposed conceptual framework

Digital Technology Enablers facilitate transformative museum experiences through three core functions. The enchantment function creates an atmosphere of wonder through responsive environmental elements that appeal to multiple senses. At the Grand Canal Museum, this manifests through integrated lighting, soundscapes, and multimedia presentations that transport visitors across time and space. The fusion function achieves seamless integration of physical and virtual elements within the museum space, allowing museums to transcend traditional exhibition constraints. This fusion creates an unparalleled sense of immersion and authenticity, transforming the museum into a portal where visitors can experience historical narratives in previously unimaginable ways. The creation function generates innovative interactive experiences through digital technology, exemplified through responsive exhibits, immersive

virtual reality experiences, and adaptive multimedia presentations that respond to visitor behavior.

Exhibition Transformation reshapes how museums present and interpret cultural heritage through three interconnected approaches. Dynamic exhibits evolve museum presentations from static arrangements to responsive environments that adapt to different contexts and visitor needs. The Grand Canal Museum demonstrates this through virtual scenes and interactive installations that engage visitors on multiple sensory levels. Interactive involvement shifts the museum experience from passive observation to active participation through personalized systems and collaborative experiences. This approach enables visitors to form direct connections with cultural artifacts and narratives. Immersive narrative transforms conventional presentations into encompassing storytelling experiences that resonate emotionally with visitors, creating deeper understanding through multimedia presentations and virtual reality.

Enriched Visitor Experience emerges from the interaction between digital enablers and exhibition transformation, manifesting across three dimensions. Collection engagement evolves into rich, multi-layered interactions that allow visitors to examine artifacts from multiple perspectives and access deeper layers of meaning. Time-space navigation enables visitors to transcend physical and temporal boundaries, experiencing cultural heritage across different periods and contexts. Visitor resonance captures how individuals connect with and respond to museum experiences, acknowledging both personal and collective aspects of cultural engagement.

These stages culminate in the realization of healing value through five interconnected outcomes: emotional engagement, sensory immersion, attention restoration, creative inspiration, and educational and cultural enlightenment. The empirical evidence from the China Grand Canal Museum demonstrates how this progression enables museums to catalyze healing on emotional, mental, and social levels. Through immersive experiences that evoke wonder, escape, and connection, digitally transformed museums offer restorative retreats from modern life's stresses while deepening visitors' understanding of their cultural heritage. This framework conceptualizes how digital technology enhances museums' healing potential through experiences that connect people with their cultural lineage, ultimately transforming these institutions into timeless sanctuaries for restoration and rejuvenation.

5. Discussion and conclusion

This study explores how visitors at the China Grand Canal Museum experience digitally mediated spaces, focusing on their experiences of healing within these transformed museum spaces. Addressing our first question, "What characterizes the healing experiences of visitors in digitally transformed museum spaces?", we found through visitors' narratives that multiple dimensions of healing experiences emerged: emotional engagement through dynamic exhibits, sensory immersion in atmospheric settings, attention recovery from daily stresses, creative inspiration through interactive experiences, and educational enlightenment that deepens cultural understanding. These experiences unfold through various digitally enhanced elements, including innovative storytelling, interactive installations, atmospheric design, personalized experiences, and the integration of virtual and physical encounters. Together, these components offer visitors a sanctuary for restoration and personal growth, creating meaningful experiences that extend beyond their museum visit and contribute to lasting well-being. Addressing our second research question, "How do digitally transformed museum spaces facilitate visitor healing?", we propose a conceptual framework based on theoretical foundations and empirical observations at the China Grand Canal Museum, illustrating how digital transformation fosters healing experiences. The framework progresses through four interconnected stages: digital

technology enablers, exhibition transformation, enriched visitor experience, and healing value realization.

5.1. Theoretical implications

This study offers the first exploratory analysis of how digital technology shapes healing experiences in cultural venues, using a digitally transformed museum as a case study. While prior research has examined digital museums' entertainment and immersive qualities (Mirghadr et al., 2018; Li et al., 2023), we demonstrate that their value extends beyond sensory stimuli to foster deeper therapeutic benefits. Although digital tools are known to enhance memorable experiences (Yang & Zhang, 2022; Zou et al., 2022), their role in facilitating healing—particularly through emotional engagement, learning, and creativity (Guo et al., 2023)—remains underexplored. For instance, the China Grand Canal Museum's animated explanations of canal governance exemplify how digitalization can simultaneously educate, inspire, and entertain. These findings align with evidence linking immersion to emotional flow, especially among younger generations (Robaina-Calderín, 2023).

Our work expands Kim et al.'s (2020) three healing pathways (physical restoration, psychological renewal, spiritual connection) by identifying five interconnected dimensions of healing experiences. This reflects museums' evolving role as therapeutic service institutions (ICOM, 2022; Mangione, 2018) and advances ART in several key ways. Digital technologies create a distinct form of interactive fascination that merges active participation with restorative effects, challenging ART's natural-environment bias (Ohly et al., 2016). Through digital immersion, we see a redefinition of the "being away" concept via psychological rather than physical distance. Our findings show that attention restoration occurs through structured engagement with context-dependent interaction, not just passive surroundings (Kim et al., 2020). Digital technologies transform ART's extent component through dynamic coherence, creating rich experiences through temporal and narrative connections. Furthermore, digital museum experiences redefine compatibility through cultural-cognitive alignment, encompassing broader dimensions of meaning-making and cultural resonance (Hoyer et al., 2020; Mangione, 2018).

Furthermore, our research extends healing tourism research by shifting the focus from natural and medical settings (Qiu et al., 2021; Yang et al., 2015) to cultural spaces, framing digitally transformed museums as healing destinations. The five-dimensional framework we propose applies to diverse contexts, from historical sites to art festivals, expanding the conceptual boundaries of healing tourism research. Unlike prior work emphasizing functionality (Zeng et al., 2020), we introduce the concept of digital-cultural fusion, where technology enchants, fuses with, and reinterprets cultural content. This approach resolves tensions between authenticity and innovation (Lunardo & Ponsignon, 2020) by reorganizing visitors' relationships with space, time, and collections into cohesive healing narratives. While cognitive and sensory dimensions dominate existing tourism experience research (Agapito et al., 2017; Zhou et al., 2023), our findings highlight cathartic rejuvenation and creative inspiration as critical yet overlooked psychological outcomes. This perspective bridges psychology, cultural studies, and tourism to offer a holistic understanding of digitally mediated healing experiences.

Grounded in the China Grand Canal Museum case, our conceptual framework traces healing through four progressive stages: digital enablers (technology affordances), exhibition transformation (content adaptation), enriched visitor experience (emotional/psychological engagement), and healing value realization (well-being outcomes). This model challenges assumptions of passive restoration (Fan & Luo, 2022; Mangione, 2018) by emphasizing active, personalized processes (Bideci & Albayrak, 2018; Sheng & Chen, 2012) and repositions

museums as societal well-being catalysts in the digital age (Zhou et al., 2023). By integrating cultural tourism, digital innovation, and wellness, we provide a roadmap for designing spaces that harmonize learning, restoration, and emotional fulfillment—addressing post-pandemic demands for holistic experiences (Backman et al., 2023; Liu et al., 2024).

5.2. Practical implications

This study offers significant practical implications for museums and cultural institutions. The digital transformation of museums has become a growing trend, driven by both cultural preservation and tourism-related motivations. However, the introduction of digital technology often raises concerns, such as the risk of diluting cultural authenticity and an excessive focus on entertainment (Li et al., 2012). Our findings suggest that digital technologies can play a key role in enhancing the museum experience, but museums should prioritize the appropriateness of these technologies rather than investing vast sums in cutting-edge innovations.

Museum managers and decision-makers should prioritize the suitability of digital technologies in relation to the museum's content and cultural narrative. Rather than investing heavily in high-end technological equipment that might not align with the museum's themes, museums should focus on the strategic use of technologies that enhance the core message and cultural significance of the exhibits. For instance, our case study shows how carefully chosen technologies—rather than the latest and most expensive innovations—can create meaningful, enriching experiences for visitors. The integration of technologies at the Grand Canal Museum, such as lighting, soundscapes, multimedia presentations, and virtual reality, was tailored to support the museum's theme and deepen visitors' connection with its cultural history. This approach demonstrates that the careful selection of digital technologies that resonate with the venue's cultural context can enhance not only the aesthetic experience but also visitors' emotional engagement and educational enrichment.

Moreover, museums can benefit from exploring the integration of different technologies to both create new content and update existing exhibitions. For example, in exhibition halls with extensive content, digital technologies can be utlized to enhance storytelling and educational experience by combining historical stories with interactive, immersive, and multimedia elements. This integration can support exploration, entertainment, and educational objectives, ensuring that visitors leave with a deeper understanding of the museum's cultural offerings. Conversely, for exhibition halls with less content, digital technologies can help fill the gaps by creating additional virtual exhibits, interactive features, or participatory activities. For example, digital tools such as AR or VR can provide visitors with opportunities to interact with artifacts in ways that were previously impossible, offering a richer, more engaging experience.

In museums that focus on scientific or highly specialized content, digital tools such as animations, interactive videos, and virtual products can be particularly effective for communicating abstract information. For example, gamification techniques can be used to reduce the difficulty of understanding difficult subjects, allowing visitors to interact with and absorb information in an enjoyable and accessible manner. Furthermore, the integration of immersive storytelling and personalized visitor experiences should be central to any digital transformation strategy. Museums can leverage technologies to create environments where visitors are not passive recipients of information but active participants in the story. Interactive installations, virtual tours, and multimedia exhibits can allow visitors to explore different facets of an exhibit, tailoring the experience to their personal interests or preferences.

5.3. Limitations and future research

This study has several limitations that suggest directions for future research. The on-site interviews limited our ability to capture healing experiences in longer term, suggesting the need for longitudinal studies that track visitors' psychological states across multiple timepoints. While we identified healing experiences, our study lacks clear boundaries between general positive experiences and specific healing effects, indicating the need to develop validated measurement scales for digital museum healing experiences. Our focus on positive experiences overlooked potential negative psychological responses when museum content triggers trauma. Future studies should examine both restorative and disruptive aspects of digitally-mediated experiences. Moreover, as our findings are based on a single case study, future research should expand to different types of cultural venues to test the generalizability of our framework. Finally, our study did not systematically examine how different visitor segments experience digital healing differently; future studies should investigate how demographic factors and individual differences influence the effectiveness of digitally-mediated healing experiences in museums.

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