A phenomenology study of transmedia museum storytelling and gamification through XR technologies

Abstract

This study investigates the integration of transmedia storytelling (TMS) within immersive extended reality (XR)-enhanced museum experiences, focusing on its potential to transform cultural engagement. Employing Heidegger's fourfold model as a theoretical foundation, along with the authors' conceptual framework illustrating the synergy of fourfold elements in XR-enhanced museums, the research explores how interactive narratives align with the dimensions of Earth, sky, mortals and gods to create richer, more participatory museum experiences. Drawing on semi-structured interviews with 27 experts from Asia, Europe, Canada and the United States, the study examines the challenges and opportunities of integrating TMS into museum practices. By focusing on the attunement of museums to the dimensions of the fourfold, the research highlights the transformative potential of storytelling and interactive narratives to shift museum experiences from passive observation to active participation. This phenomenological orientation towards dynamic storytelling offers implications for designing richer, more engaging cultural heritage experiences and invites further inquiry into the role of TMS in the digital age.

Keywords: Transmedia storytelling; XR technologies; Digital cultural heritage; Gamification; Edutainment; Audience engagement

1. Introduction and Research Aim

As cultural institutions, museums hold a wealth of cultural and historical knowledge. The intersection of digital media and museum practice has become a topic of growing interest, as museums adapt to the changing mediascape and evolving visitor expectations (Kidd, 2014). Introducing stories into heritage locations enables people to gain a deeper understanding of the space by connecting it to the historical events that occurred there (Guo, 2024; Liu, 2020; Svensson et al., 2017).

Transmedia storytelling (TMS) techniques, participatory culture, user-generated content (UGC) and the ethical considerations surrounding these new forms of digital engagement have emerged as key areas of focus in this field (Kidd, 2014). Henry Jenkins (2006) describes the emergent modes of cross-platform storytelling as "transmedia," arguing that some narratives are "so large" they "cannot be covered in a single medium" (Jenkins, 2006, p. 65). As Kidd (2014, p. 26) observes, "using multiple media platforms simultaneously, TMS thus allows for differing entry points for audiences; varying and contrasting perspectives on the action to be offered; and, crucially, opens up opportunities for play."

Therefore, TMS—known for creating interconnected narratives across various platforms—offers museums the opportunity to craft richer, more dynamic experiences.

In the context of museums and TMS, interactive digital narratives (IDNs) are becoming increasingly relevant (Lanszki, 2022). Several key UNESCO instruments inform digital heritage initiatives. The 2003 *Convention for the Safeguarding of Intangible Cultural Heritage* emphasises community participation and consent (UNESCO, 2003). The *Culture 2030 Indicators Framework* supports the measurement of culture's role in sustainable development, including through digital innovation (UNESCO, 2019).

Museums are adopting interactive storytelling techniques to enhance visitor experiences, allowing for multifaceted exploration and playful engagement with artefacts (Lanszki, 2022; Wang et al., 2024). This shift reflects the evolving role of the audience—from passive observers to active participants in interactive narratives.

Immersive technologies, including extended reality (XR) such as virtual reality (VR) and augmented reality (AR), further enrich these participatory experiences in museums for purposes of education, entertainment, guidance and accessibility (Chiara et al., 2023).

The potential of TMS and alternate reality games (ARGs) in museum contexts has also been explored, with successful implementations demonstrating their ability to enhance visitor experiences and engage new audiences (Schärer, 2015). However, it is essential that these experiences remain firmly grounded in the museum's mission and collection to avoid becoming disconnected forms of entertainment. TMS and ARGs can blur the boundaries between reality and fiction, offering new ways to interact with museum content and challenge visitors' perceptions (Schärer, 2015).

This research aims to investigate the integration of TMS within immersive XR-enhanced museum experiences, focusing on its potential to transform cultural engagement. A qualitative phenomenological approach was employed to explore how TMS influences visitor engagement in museums. Phenomenology, as Moustakas (1994) posits, is effective in revealing deeper meanings and emotional responses. It was particularly chosen for its ability to examine in depth the lived experiences of museum professionals and XR technology experts.

While the choice of a phenomenological approach allows for an in-depth exploration of participants' subjective experiences and perceptions—providing rich, detailed insights that quantitative methods might overlook (Creswell, 2013)—it is not without limitations. The interpretative nature of phenomenological research may introduce bias, and its findings, often context-specific, may not be applicable across all museum settings, thereby limiting generalisability. To address these limitations, we engaged in continuous reflection throughout the research process, examining and questioning our assumptions to ensure a more balanced and reliable interpretation of the data. Despite the context-specific nature of the results, they provide valuable contributions to the understanding and improvement of museum practices involving TMS. Therefore, phenomenology was deemed the most appropriate method for capturing the essence of participants' experiences across diverse settings.

2. Literature Review

2.1 Transmedia Storytelling in Museums

Museums serve as dynamic learning environments that foster engagement with narratives, collective memories, lived experiences, and open-ended inquiry. These elements are frequently utilized by art and history educators to enrich curriculum design, inform field research, and develop formal educational programs (Vallance, 2004; Andreassi, 2017; Paliokas et al., 2020). Central to this pedagogical role is storytelling, a method museums increasingly employ to advance their dual missions of cultural preservation and public education. By integrating personal and communal stories into exhibits, museums forge emotional connections that promote empathy and critical thinking. As Langer (2022, p.xi) notes, "Emotional connection, that feeling of resonance, is a hook that can lead to deeper and broader curiosity. And curiosity is the lifeblood of the museum in its current form." This focus on emotional engagement highlights museums' evolving role as catalysts for curiosity-driven learning.

Museums have long applied TMS techniques, utilising multiple platforms and media to convey cohesive narratives (Mateos-Rusillo & Gifreu-Castells, 2018). TMS has demonstrated potential in fostering culturally sustainable communities by engaging community members in the reinterpretation of history and cultural values (Song et al., 2023). This approach enables individuals with varying levels of media literacy to contribute to different stages of museum development, thereby increasing engagement in heritage preservation and exposing users to diverse cultural perspectives. Collaborations between museums, universities and communities using TMS may be crucial for creating sustainable cities and preserving cultural heritage in an engaging, adaptive manner (Song et al., 2023).

However, some key elements of TMS—such as encouraging UGC and fostering a fandom phenomenon—have often been absent in museum approaches (Mateos-Rusillo & Gifreu-Castells, 2018). Studying industries with greater experience in TMS could help museums refine their strategies. Selvadurai and Rosenstand's (2017) quantitative data-driven approach addresses a significant gap in transmedia exhibition research, where many studies remain conceptual rather than empirically validated. Their findings suggest that effective transmedia experiences rely not merely on deploying multiple platforms but on carefully calibrating the relationship between platform complexity and content complexity. This aligns with but extends Mateos-Rusillo and Gifreu-Castells' (2018) observation about museums' need to better encourage user-generated content, as Selvadurai and Rosenstand demonstrated that simplifying user participation requirements significantly increased visitor content generation and engagement.

To address this gap, Tuannoi and Rugwongwan (2020) proposed a *Transmedia Storytelling in Museum Model*, which suggests the use of multiple media channels to complete sub-stories within the museum, support curatorial services and allow visitors to access information easily across various platforms. This model is designed to enhance visitor engagement and storytelling capabilities, particularly in contexts with limited resources, and enables visitors to engage with museum content even if they cannot visit in person.

The potential of TMS in museum contexts is therefore evident, with its capacity to enhance visitor engagement, reach new audiences and create immersive, interactive experiences. Effective implementation requires a holistic approach—tailoring content to different platforms and audiences, and adapting practices from other industries (Panzner, 2017). Interdisciplinary collaboration, research and specialised training are essential, along with the need for museums to adapt their mindset and organisational culture to fully embrace transmedia approaches (Panzner, 2017).

2.2 Edutainment and Gamification as Tools for Participatory Museum Practice

To enhance visitor engagement, learning and retention, museums are increasingly integrating gamification into exhibitions as part of a broader shift towards immersive, experience-based strategies—commonly referred to as "edutainment" (Hainey, 2016; Huotari & Hamari, 2012). This integration reflects a growing emphasis on interactive participation and visitor-centred design within the evolving museum landscape. French (2016) identifies the market shift towards an "experience economy" as a key driver in shaping museum experience strategies.

Pine and Gilmore (2011) propose four realms of the experience economy: entertainment, education, aesthetic and escapist experience. The intersection of education and entertainment—which they refer to as "edutainment"—aligns with the core mission of museums and also influences how visitors evaluate the overall quality of their experience (Radder & Han, 2015, cited in French, 2016). The latter two realms, aesthetic and escapist experience, are defined by Pine and Gilmore (1999, p. 31) as "becoming physical or virtually a part of an experience itself", a characteristic that signifies immersion (Jung et al., 2016). In this context, immersive technologies such as VR demonstrate significant potential for advancing the experience economy within museums.

Moreover, gamification refers to the application of game elements—such as mechanics, narratives and user engagement strategies—to influence behaviour in non-game contexts (Deterding et al., 2011; Seaborn & Fels, 2015; Hamari, et al., 2023). In museum settings, gamification supports educational aims through interactive, narrative-driven experiences that enhance participation and visitor motivation (Ceccacci et al., 2021; Çetin & Erbay, 2021; Lampropoulos & Kinshuk, 2024). When thoughtfully implemented, it can balance enjoyment

with learning outcomes, offering personalised, layered access to cultural heritage based on user preferences and technological capacity (Ryan, 2022)

This potential is exemplified by *Never Alone* (E-Line Media & Upper One Games, 2014), a game co-created with the Iñupiat community to share Indigenous oral traditions interactively, and *Sculpted by ROM* (Royal Ontario Museum, 2021), an app enabling users to unlock artefacts and access community-informed multimedia narratives. Both cases illustrate how ethical, collaborative digital storytelling can foster innovative yet culturally grounded museum engagement.

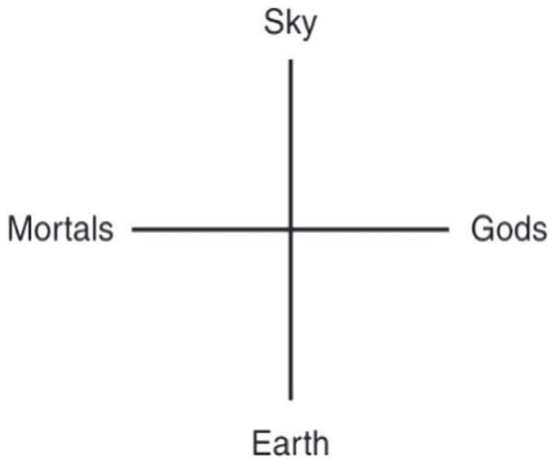
Building on the concept of edutainment within the experience economy, museums are increasingly experimenting with more interactive and participatory strategies to meet the evolving expectations of diverse audiences. As visitor satisfaction becomes more dependent on immersive and personalised encounters, gamification has emerged as a compelling approach to enhance engagement while preserving educational integrity.

2.3. A Fourfold Transmedia Museum Theoretical Framework

In *The Origin of the Work of Art*, Heidegger posits that artworks inherently possess a "thingly" character. Artefacts and artworks displayed in museums are objects imbued with cultural significance, their overall "thingness" rooted in the potential for artistic interpretation. Heidegger elaborates further, stating, "dwelling, as preserving, keeps the fourfold in which mortals stay in things" (Heidegger, 2008, p. 329). Central to this idea is the concrescence of the fourfold: Earth, sky, mortals and divinities (Heidegger, 2008, p. 321; see Figure 1). According to Heidegger, an object attains its true essence as a "thing" when it gathers and embodies the integral elements of the fourfold. Mitchell (2015, p. 7) expands on this concept, suggesting that the fourfold illustrates how things are structured, revealing the interrelationships between objects and the broader world.

Figure 1

Conceptual framework illustrating Heidegger's fourfold theory as applied to XR-enhanced museum exhibits (Authors, 2024).

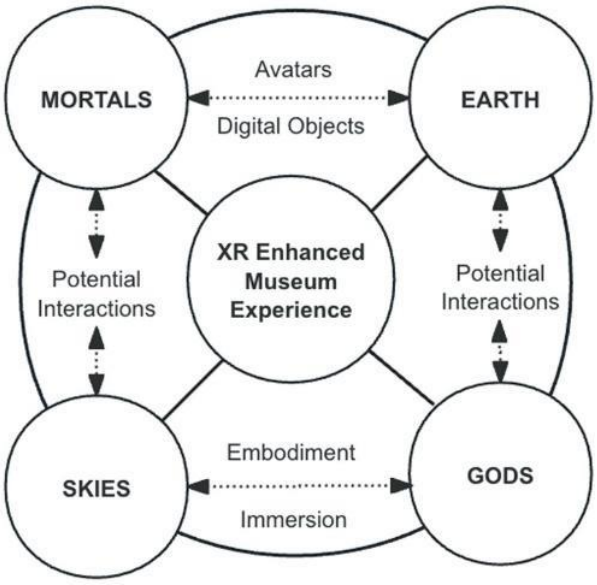


Within the realm of museum curatorial practices, Authors (2024) emphasise the critical importance of presenting the "thingness" of historical artefacts and artworks. They argue that such objects serve as focal points, drawing together four interconnected elements: mortals (museum visitors), Earth (the activities and actions undertaken by visitors), skies (the

possibilities and ideas inspired by the artefacts) and gods (the emotional and spiritual responses elicited during engagement with the exhibits).

Furthermore, Authors (2024) propose a conceptual framework (see Figure 2) that clarifies the interplay of these fourfold elements within the context of XR-enhanced museum experiences. In these virtual environments, users—referred to as mortals—adopt the roles of avatars, transitioning from passive observers to active participants. Through interactive engagement with digital artefacts, they embody the aspects of Earth and skies, representing both physical action and the possibilities or ideas inspired by the exhibits. This profound interaction fosters a sense of immersion that aligns with the gods aspect, evoking emotional and spiritual connections. As a result, the bond between visitors and artefacts is strengthened, creating a holistic and transformative XR museum experience (Authors, 2024).

Figure 2
Conceptual framework illustrating the synergy of fourfold elements in XR-enhanced museums (Authors, 2024).



This research adopts Authors' (2024) conceptual framework as a lens to explore the integration of TMS within XR-enhanced museum environments. By applying this theoretical approach, the study investigates how the interplay of Heidegger's fourfold elements—mortals, Earth, skies and gods—can deepen visitors' engagement, participation and emotional connection with cultural heritage. The framework provides a basis for analysing how TMS transforms museums from static exhibition spaces into dynamic, interactive environments.

3.Materials and Methods

3.1 Sampling

This research draws on phenomenological investigations conducted in 2020 and 2024, utilizing mixed methods such as face-to-face and Zoom interviews, and engaging 27 museum professionals and XR technology experts from China, Singapore, Europe, America, and Canada. Participants held critical roles such as curators, exhibit designers, digital strategy managers, XR developers, and researchers (see Table 1).

Participants were selected using purposive sampling, targeting individuals with specific expertise relevant to the study's focus. While this method enhances the relevance of the data collected, it may introduce selection bias and limit the generalizability of the findings (Palinkas et al., 2013). Efforts were made to include a diverse range of participants in terms of geography, institutional size, and professional roles to capture a broad spectrum of perspectives, thereby mitigating concerns regarding representativeness.

Table 1
Interview participants.

No.	Pseudonym	Region	Expert Area
1	Aaron	Europe	XR Development
2	Bella	Europe	Culture & Curation
3	Carl	Europe	Immersive Technology
4	Daniella	Europe	XR Development
5	Ethan	Europe	Museum Digital Program
6	Franco	Europe	VR Architecture
7	Gabriel	Europe	3D Digitalization
8	Holly	America	Storytelling
9	Israel	Canada	XR Design
10	Jack	Europe	VR Development
11	Kate	Asia	XR Design
12	Laura	Canada	UX Research
13	Mia	Europe	Culture & Curation
14	Noah	Europe	Culture & Curation
15	Owen	America	Storytelling
16	Penny	Europe	Culture & Curation
17	Quill	Europe	XR Design
18	Rose	Europe	Culture & Curation
19	Shawn	America	VR Development
20	Tiffany	Europe	Curation & Exhibition
21	Ulrica	Asia	Digital Curation
22	Victor	Europe	XR Development
23	Yun	Asia	Museum Curator
24	Yue	Asia	Museum Curator
25	Vivi	Asia	Museum Director
26	Zachary	Asia	Museum Educator
27	Lin	Asia	Museum Curator

3.2 Semi-Structured Interviews

Interviews were scheduled based on participant availability to ensure a comfortable setting for in-depth discussion. Each interview lasted between 45 and 90 minutes, allowing flexibility to explore emerging themes. Ethical approval was obtained from the university's ethics board prior to data collection. All interviews were audio-recorded with participant consent and transcribed verbatim to ensure accuracy.

A potential limitation of the procedure is the reliance on self-reported data, which may be influenced by social desirability bias or recall inaccuracies (Furnham, 1986). Participants

might present their practices in a more favorable light or be unable to accurately recall specific details. To address this, participants were assured of confidentiality and anonymity to encourage open and honest sharing.

Additionally, the use of multiple interviewers could introduce variability in data collection (King et al., 2018). To maintain consistency, a standardized interview guide was used, and all interviewers received training.

3.3 Thematic Analysis

The qualitative data from the interviews were analyzed using thematic analysis, following Braun and Clarke's (2006) six-phase framework:

- **Data Familiarization**: Transcripts were read multiple times to immerse researchers in the data.
- **Initial Coding**: Significant statements related to the research questions were coded using NVivo software to facilitate data organization and retrieval.
- **Theme Development**: Codes were grouped into potential themes reflecting patterns across the data, such as "Museum Transmedia Storytelling," "Gamification and Edutainment," and "Audience Engagement."
- **Reviewing Themes**: Themes were refined to ensure they accurately represented the data. Themes were merged or split as necessary for clarity.
- **Defining and Naming Themes**: Each theme was clearly defined, and representative quotes were selected to illustrate key points.
- **Producing the Report**: Themes were organized into a coherent narrative aligned with the study's objectives, as presented in the Results section.

Coding was collaboratively conducted by two researchers with advanced academic backgrounds in media and cultural studies, specializing in XR technologies and digital cultural heritage in museum contexts. This collaborative process ensured a diversity of perspectives and a balanced interpretation of the data.

Several strategies were employed to enhance the credibility of the analysis. Researchers engaged in reflexivity, involving self-reflection to acknowledge and mitigate potential biases that could influence interpretation (Finlay, 2002). Peer debriefing sessions were conducted, allowing researchers to collaboratively examine and challenge their interpretations, thereby reducing individual bias and enhancing reliability (Lincoln, Guba & Pilotta, 1985).

Additionally, member checking was conducted by sharing preliminary findings with selected participants to verify accuracy and ensure the interpretations resonated with their experiences, thereby enhancing the validity of the results (Birt et al., 2016).

While thematic analysis is flexible and well-suited to identifying patterns, it can also be subjective (Nowell et al., 2017). By employing the strategies above, this study aimed to ensure that themes were grounded in participants' narratives, thereby enhancing the overall trustworthiness of the findings.

4. Results and Discussions

Semi-structured interviews served as the primary data collection method, designed to explore the key themes of the study: *Museum Transmedia Storytelling*, *Gamification and Edutainment*, and *Audience Engagement and Participatory Culture*. The interview guide included open-ended questions that enabled participants—museum professionals and XR technology experts—to share detailed insights while maintaining consistency across interviews.

The semi-structured format supported in-depth exploration of the core themes and allowed flexibility to pursue emerging topics. This approach aligns with the phenomenological methodology, which centers on participants' lived experiences and perceptions. Thematic analysis of the interview data led to the identification of several key themes related to the integration of TMS in museums.

4.1 Transmedia Narratives for Immersive Visitor Experiences

Museums inherently possess a wealth of stories, and the use of storytelling techniques in curation and exhibition design is well established. TMS enhances the effectiveness of traditional storytelling by extending narratives across multiple platforms, creating immersive and engaging experiences for diverse audiences (see Table 2).

Table 2

Themes and representative quotes on museum transmedia storytelling.

Theme	Representative Quote	Interviewee
Educational Value	"Storytelling can be a way for people to be interested in museums and history. It brings people in to learn more, see something from a different perspective."	Laura (UX Researcher at a Museum)
	"Our museum is an educational platform, and through our exhibitions, visitors can gain a superficial understanding of the ethnic composition of our province and their culture."	Yun (Museum Curator)
Imagination and Immersion	"If you have a story behind it, it encourages the visitor to be drawn into that story."	Penny (Museum Curator)
	"We built some static scenes in the exhibition to depict the life of ethnic minorities, which can only stimulate their imagination. They have to go to the community if they want a more intuitive experience."	Lin (Museum Curator)
Recontextualizing Experience	"If you tell the right kind of story to a user, then you can alter the way that they walk down the street. You can alter and recontextualize what they see in the world around them."	Aaron (Co-founder and Creative Lead of an AR Company)
	"In our exhibitions, we contextualize ethnic minority festivals by showing short videos to help visitors understand the situations in which these displayed costumes would be used."	Yue (Museum Curator)
Interactive Narratives	"Interactive narratives try to tell stories which are comfortable with losing some of that authorial control."	Bella (Museum Curator)

Audience Participation	"We needed a natural fork in the location to tell the user, 'You have reached a decision point. Now we need you to go either left to trigger one storyline or right to trigger another.'"	Aaron
	"We curated an exhibition about the life of a Dong girl. We encouraged visitors to choose different period costumes for the girl, similar to a dress-up game. Our visitors not only understand what kind of costumes should be chosen for different occasions, but also the cultural interpretations."	Yun
Content Simplification	"You can't overload them with too much information; it needs to be pretty simple."	Laura
	"The majority of the museum's visitors are non-professionals, so as a curator, I want to provide content that is easy and smooth for the visitor to receive, as well as an enjoyable experience."	Yun
Maintaining Objectivity	"The problem with storytelling is that there is always an eye that will tell the story. So it will always come from a point of view."	Tiffany (Exhibition Assistant at a Gallery)
	"In our design process of XR storytelling, we are concerned about maintaining objectivity. We involve perspectives from ethnic minorities and include their voices. Because the museum is a platform for education, we must ensure that the cultural representation is respectful."	Lin
Control Over Experience	"Interactivity works for acquiring knowledge, but not so much for an artistic experience."	Noah (Museum Curator)

Interviewees highlighted the educational value of storytelling and its ability to spark imagination within museum contexts. Laura, a UX researcher at a museum, emphasized that storytelling serves as a gateway for people to become interested in museums and history. Yun, a museum curator, shared a similar view, stating that the museum functions as an educational platform, allowing visitors to understand artifacts and the cultures on which they are based. These sentiments underscore the role of storytelling in enhancing educational outcomes by engaging visitors on a deeper level.

AR and VR applications in museum settings allow museums to bridge the gap between physical and virtual storytelling. These tools not only enable deeper engagement with artifacts through interactive digital layers but also cater to diverse visitor needs by offering accessible off-site experiences. Penny, a museum curator, noted that adding narratives to exhibits enhances visitor immersion. Curators create static scenes depicting the lives of ethnic minorities, using storytelling to vividly bring those stories to life. They also suggest that visitors

explore ethnic minority communities for a more intuitive, immersive experience, highlighting the powerful role of storytelling in connecting visitors with artefacts.

Despite its potential, integrating XR technologies into storytelling presents several challenges. A key issue is maintaining objectivity. Tiffany, an exhibition assistant, pointed out that narratives inevitably reflect the storyteller's perspective, which can introduce biases and influence visitor perceptions. A practical response to this issue was observed at Penny's museum during the curation of exhibitions about ethnic minorities. The curators acknowledged this challenge and addressed it by incorporating diverse perspectives, particularly from the communities depicted, in an effort to balance the narrative and ensure that cultural representations are both inclusive and respectful.

Laura emphasized the necessity of keeping XR content simple in order to manage cognitive load and maintain visitor engagement. This involves striking a balance between providing sufficient information to educate without overwhelming visitors—an especially important consideration in the context of immersive technologies. Additionally, Noah raised concerns about the degree of interactivity in XR experiences. He argued that while interactivity can enhance learning, too much user control might compromise the artistic integrity of an experience. This tension between traditional curatorial methods and modern interactive approaches reflects the complex decisions that curators must navigate.

These challenges underscore the broader complexities of using XR technologies in museum settings. Curators must consider issues of objectivity, simplicity, and interactivity in order to create meaningful and engaging visitor experiences.

The incorporation of storytelling and XR technologies in museums marks a progressive shift toward more engaging and interactive forms of visitor experience. These strategies enhance educational value and deepen engagement, but they also introduce challenges that require careful curatorial balance. By addressing concerns related to objectivity, interactivity, and cognitive load, museums can effectively harness these tools to enrich visitor experiences while maintaining their educational missions.

Moreover, TMS allows museums to present artifacts and narratives from multiple angles, offering visitors varied perspectives and entry points into the story. For example, the use of ARGs and IDNs in museum settings enables visitors to explore different layers of meaning and context around the artifacts. This aligns with Kidd's (2014) argument that TMS opens up opportunities for play and imagination by using multiple platforms simultaneously. The findings suggest that the narrative complexity afforded by TMS enhances the interpretive potential of exhibits, allowing visitors to engage with cultural heritage in a more imaginative and dynamic way.

4.2 Gamification and Edutainment for Engaging Learning

The integration of gamification into museum experiences not only enhances visitor engagement but also makes learning interactive and enjoyable (see Table 3). Participation in these activities fosters deeper learning, as visitors actively engage with museum content—whether virtually or in physical spaces. These actions create new forms of interaction with exhibits, encouraging visitors to immerse themselves in cultural narratives while contributing their own insights. In doing so, they expand the Earth dimension by blending education with entertainment.

Table 3
Themes and representative quotes on gamification and edutainment.

Theme	Representative Quote	Interviewee
Cultural Integration	"Some people see games as a culture, and they use this kind of ideology in their immersive museum project design."	Rose (Museum Researcher)
	"We have realized that games are an indispensable part of contemporary culture. We have to consider this when curating an exhibition. The integration of games makes the exhibition more engaging."	Zachary (Museum Educator)
Interactive Engagement	"It was a child-focused AR app that created hidden, magical gameplay. Users were asked to seek out and tap hidden elements within paintings to find magical crystals from the movie."	Aaron
	"In order to show visitors why threads are colorful, a game was designed to introduce how different dyes are extracted from plants, how threads are dyed, and what colors can be obtained in the end."	Zachary
	"We have costume-changing AR systems that display various traditional costumes from different ethnic groups, allowing visitors to try them on virtually. Visitors can also share the images on popular Chinese social media platforms like TikTok and Xiaohongshu."	Vivi (Museum Director)
Intrinsic Motivation	"It is just sort of intrinsically motivating. It is interesting, fun, and engaging."	Carl (Director of Immersive Technologies)
Freedom and Exploration	"Play or democracy—just whatever you want, freedom. I will go wherever I want to go."	Quill (Game Developer)
	"VR technology is a developing trend, and our museum has considered making a VR open world so that visitors can freely explore minority communities, learn minority crafts, witness minority ceremonies, etc., in the virtual world."	Yun
Social Interaction	"They will look for things that are more social but with a game element."	Daniella (VR Developer)
	"We have costume-changing AR systems that display various traditional costumes from different ethnic groups, allowing visitors to try them on virtually. Visitors can also share the images on popular Chinese social media platforms like TikTok and Xiaohongshu."	Vivi
Entertainment Priority	"Entertainment was the top priority because we were getting the public to pay for the virtual reality tour and the	Bella

	augmented reality tablets. So it had to be fun."	
	"The majority of the museum's visitors are non-professionals, so as a curator, I want to provide content that is easy and smooth for the visitor to receive, as well as an enjoyable experience."	Yun
Edutainment Concept	"There is a big term called edutainment. It is education and entertainment; culture has a big role in entertaining but also educating people."	Kate (XR Artist)
	"The majority of visitors said that our plant-dyeing game not only made their visit fun, but also taught them about dyeing in ethnic minority costumes."	Zachary
Focus on Essential Experience	"I'm a little sceptical of games because they steer your attention towards things that are not essential, whereas what's essential is having an experience that stays with you."	Noah
Context of Gameplay	"You usually play games at home in your own intimate space, individually or with friends... It depends on the kind of museum and the approach they take."	Rose
Disempowerment	"Is it taking away from the educational aspects? Because of that idea of unification... especially for younger users, more distraction."	Mia (Culture & Curation)
	"The tool becomes a bodily extension... the boundary between objectivity and subjectivity becomes very blurred... do we lose some authenticity or authority of the audience?"	Ethan (Museum Digital Program)

Rose contends that gamification is not merely a tool but an integral part of contemporary culture that can enrich museum exhibitions. This viewpoint has gained widespread acceptance, contributing to a growing global consensus on gamification as an important component of modern exhibitions. Zachary, a museum educator, echoed this perspective by highlighting the indispensable role of games in contemporary culture, noting their effectiveness in attracting more visitors and enhancing learning through active participation.

Carl, the director of immersive technologies, emphasizes how games inherently motivate visitors by making learning interesting, fun, and engaging. Quill, a game developer, shared a similar view, pointing to the elements of freedom and exploration that games introduce—allowing visitors to choose their own paths and engage with content as they prefer. Together, these perspectives underscore how gamification can personalize and enrich the museum experience, making it more appealing and interactive for a wide range of audiences.

The concept of "edutainment" in museums merges education with entertainment, aiming to create engaging learning experiences that captivate broad audiences. Bella, discussing the use of VR tours and AR tablets, emphasized that making these experiences

enjoyable is crucial—especially when visitors are paying for them. This highlights the importance of entertainment value in ensuring visitor satisfaction. Kate, an XR artist, further elaborated on the dual role of culture in this context, noting its capacity to both entertain and educate. This approach enables museums to fulfill their cultural mission by making educational content more accessible and appealing. Feedback on specific applications, such as a plant-dyeing game, also suggests that visitors find these experiences both enjoyable and informative—reinforcing the successful integration of education and entertainment.

While gamification has clear benefits, some interviewees raised concerns about its potential drawbacks. Noah expressed skepticism, noting that although gamification can increase engagement, it may also risk distracting visitors from the core museum experience, which should remain memorable and meaningful. This underscores the need for gamification strategies that support, rather than overshadow, the museum's educational goals. Rose also discussed the context-dependent nature of gameplay, pointing out that games are traditionally played in personal or informal settings, either alone or with friends. This highlights the challenge of adapting game-based experiences for museum environments, where design must be carefully aligned with visitor expectations.

Despite its rising popularity, some professionals continue to express caution about the unintended consequences of gamification for learning and interpretation. Mia, from the museum's Culture & Curation team, voiced concern that immersive digital formats aimed at creating unified experiences may inadvertently reduce educational impact—especially for younger visitors, who might find such environments more distracting than engaging. From a more philosophical standpoint, Ethan, part of the Museum Digital Program, reflected on how gamified tools may blur the line between objective content delivery and subjective experience. As digital interfaces become more embodied, he suggested, the authenticity of the museum narrative and the interpretive authority of the audience may be called into question.

In summary, gamification has transformed museum experiences by making them more interactive and engaging. It aligns with contemporary cultural trends and responds to the evolving expectations of museum visitors. By incorporating game design mechanics such as achievements and challenges, museums aim to create more memorable experiences—especially for younger audiences (Anderson et al., 2002; Deterding et al., 2011). Through fostering curiosity and excitement, participants are encouraged to play, reflect, and learn through gameplay experiences such as touchscreen story-based quizzes, interactive art zones, and multi-user digital installations. As Madsen (2020) writes in her critical literature review of gamification in museum contexts: "the museum landscape is changing and museum users are looking for experiences that are interactive and engaging in comparison to passive experiences as observing objects in glass display with their hands on their backs" (p. 2). This shift—from museums as primarily informational institutions to experience-driven cultural spaces—has led to the exploration of new approaches, including gamification and TMS.

However, successful implementation requires a thoughtful balance between education and entertainment to ensure that core learning objectives are not overshadowed. As museums continue to evolve, maintaining this balance will be essential to leveraging gamification effectively while preserving the integrity of the museum experience.

4.3 Empowering Visitors Through Audience Engagement and Participatory Culture

The study of audience engagement is vital across both media industries and cultural institutions. The role and agency of participants in these experiences can vary, with individuals referred to as audience members, participants, interactants, visitors, consumers, players, guests, collaborators, or users (Gröppel-Wegener & Kidd, 2019).

In traditional museum contexts, people are typically described as a passive audience—able only to view displayed collections, with limited physical interaction. However, with the

advent of digital media, today's audiences can be described as active participants, able to interpret and engage with historical events in a range of interactive ways.

As participatory culture becomes a cornerstone of modern museum experiences, it is important to consider the ethical implications of inviting visitors to co-create narratives. Drawing on critical frameworks from media studies and gender representation in eSports (Taylor, 2018), it is clear that inclusive and equitable participation is not always guaranteed. Museums must thoughtfully navigate the risks of distorting historical or cultural narratives when UGC is incorporated into exhibitions.

Interviewees highlighted a shift in museum engagement, with visitors evolving from passive recipients to active participants. This shift reflects a growing expectation for both educational and entertainment value during museum visits, aligning with the broader objectives of participatory culture (see Table 4).

Table 4
Themes and representative quotes on audience and participatory culture.

Theme	Representative Quote	Interviewee
Educational and Entertainment Goals	"People go to museums to see interesting things or to be entertained to some degree or just to have something to think about."	Laura
	"The majority of visitors to Guizhou come to visit our museum, and through the exhibition, they can get a general overview of our province. Then, they take in-depth tours based on their interests."	Yun
Audience Diversity	"Museums have a very clear audience... general public, repeat visitors, members, donors."	Owen (Storyteller)
	"As an important cultural window, the Guizhou Provincial Museum receives millions of visitors every year, so we take into account the experience of every age group when curating the exhibition."	Yun
Engaging Communities	"You try to have a program throughout the year aimed at different groups... always community work."	Tiffany
	"Our Colorful Guizhou exhibition hall displays the costumes and artefacts of Guizhou's ethnic minorities, and in curating the exhibition, we consulted the perspectives of the minority communities to make our exhibition more authentic."	Yue
Attracting Younger Audiences	"We do not have a lot of young people interested... hopefully this is a new and different way to engage with history or culture."	Laura
	"According to our observation, our digital systems are used most by young people."	Zachary

Bridging Age Gaps	"We are trying to fill that gap between being a young student and being a professional."	Tiffany
	"We want older visitors to use our digital systems more, but they usually struggle to understand how to use them. We want the interfaces to be designed to be more age-friendly."	Lin
Benefits of XR for Audiences	"It could potentially bring in a new type of audience... a great way to engage with the current audience."	Owen
	"Based on the survey, our future digital innovations will focus on virtual reality technology, which is more capable of contextualizing exhibits and giving visitors a better experience."	Lin
Family Experiences with AR	"The AR screens were mainly for families... a family experience."	Bella
Age-Related Differences in Engaging with VR	"A lot of young people were immediately attracted to the VR experience because they're more used to this sort of thing."	Penny
	"We could encourage our more traditional visitors, perhaps older visitors, because it was a VR experience on a very traditional painting."	Penny
Remote Access and Inclusion	"XR can reach people in a different location... The immersive experience can put you in a spot where something is happening."	Laura
Technological Accessibility	"I hope that it will get easier, cheaper, and more inclusive in a lot of ways."	Gabriel (Cultural Heritage Lead at a 3D Company)
	"In terms of VR technology, our museum has considered it, but because this technology is not well known to most people, many encounter technical barriers. The cost of the equipment is also very high, so until now we have not included this technology in our exhibitions."	Zachary

Owen noted the importance of recognizing the diversity of museum audiences, which includes the general public, repeat visitors, members, and donors. Understanding these different segments is crucial for museums to design experiences that meet varied interests and expectations, thereby enhancing visitor satisfaction and engagement. Moreover, Tiffany discussed the role of community engagement in museums, emphasizing the development of

year-round programs targeted at different groups. This approach ensures that museums function as community hubs, fostering inclusivity and enhancing both cultural and educational impact.

XR technologies enhance museum experiences by attracting and engaging diverse audiences. Laura notes that XR can appeal to younger visitors who may find traditional approaches less engaging, offering a fresh connection to history and culture. Zachary observes high usage of digital systems among younger demographics, indicating their popularity and potential to attract new visitors. Penny highlights XR's appeal across age groups: younger visitors enjoy familiar interactive tech like VR, while older visitors benefit from VR's integration with traditional exhibits, bridging art and technology. Bella notes AR's popularity with families, fostering social interaction and shared experiences. XR also extends access to remote audiences, thereby broadening inclusivity.

Overall, XR technologies in museums have proven effective in attracting new audiences, enhancing engagement, and expanding access to cultural content. However, the long-term success of these experiences depends on inclusive design. To ensure accessibility for diverse user groups, age-appropriate and accessibility-oriented features must be integrated from the outset. Without such considerations, XR risks alienating key audiences—particularly older adults and very young children.

With regard to interactive narratives and audience participation, the rise of IDNs blurs the line between traditional storytelling and gameplay, transforming the audience from passive spectators into active participants. Bella, a museum curator, observes that these narratives introduce a form of storytelling that comfortably relinquishes some authorial control, empowering visitors to shape the narrative themselves. This transformation enables visitors to become co-creators of their own experiences.

Describing this shift, Aaron notes the integration of decision points within an AR setup, where visitors choose their own path, thereby determining the course of the story. This interactive element introduces a dynamic layer to the museum experience, allowing each choice to tailor the narrative to individual preferences. Similarly, Yun curates an exhibition where visitors engage in a dress-up game, selecting period costumes for a depiction of a Dong girl's life. This activity not only educates visitors about the appropriate costumes for different occasions but also immerses them in the cultural context behind these choices—further enhancing their participatory role in the storytelling process.

Lastly, challenges such as high costs and technical complexities persist, limiting XR's accessibility to all audiences. Gabriel, a cultural heritage lead at a 3D company, remains optimistic about overcoming these barriers, expressing hope that XR technologies will become easier, more affordable, and more inclusive in the future. Addressing these issues is crucial for the widespread adoption and effective integration of XR into museums.

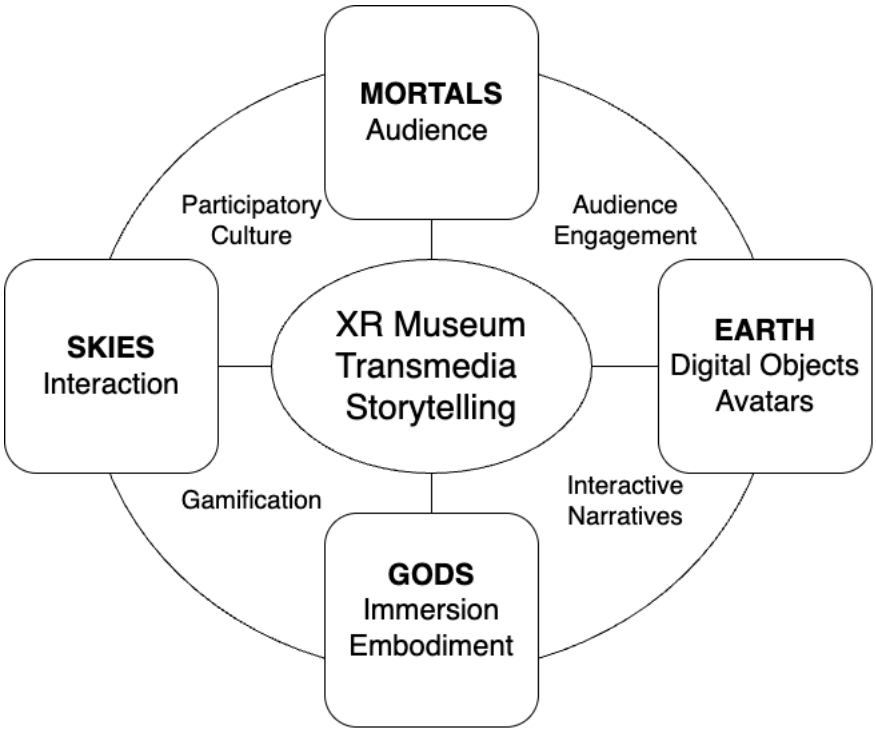
Museum engagement is shifting from passive to active participation, driven by evolving visitor expectations for experiences that are both educational and entertaining. XR technologies are supporting this shift by appealing to diverse audiences—including younger visitors and families—and by offering remote access to exhibits. However, challenges such as cost and accessibility remain, requiring continued efforts to ensure that these technologies are inclusive, sustainable, and effectively implemented.

5. Discussion

The thematic analysis of this study revealed that TMS, when integrated with XR technologies, serves as a powerful tool for museums to enhance visitor engagement and foster deeper connections with cultural heritage. The key findings underscore the transformative potential of TMS and XR technologies in redefining museum experiences, anchored in

Heidegger's fourfold model and the authors' conceptual framework. In the Mortals dimension, visitors shift from passive observers to active co-creators through interactive, choice-based narratives and UGC. The Earth dimension captures tactile, digital–physical experiences that localize and ground cultural meaning. Skies represents playful interaction design and narrative multiplicity, opening imaginative and interpretive spaces. Finally, Gods reflects the emotional depth and spiritual resonance evoked by immersive XR storytelling. Together, these quadrants map how museums—through embodied and affective transmedia design—can deepen engagement, support cultural continuity, and sustain intangible heritage (see Figure 3 below).

Figure 3
Transmedia-driven activation of Heidegger's fourfold in XR museum storytelling.



Key findings highlight the role of TMS in fostering a multi-platform approach to engagement, enabling museums to offer more immersive and inclusive cultural experiences. The shift from passive observation to active participation is a core finding, resonating with the Mortals dimension of the framework. Traditionally, visitors have been passive receivers of information. However, by integrating participatory culture and encouraging UGC, TMS empowers museumgoers to take on an active role in co-creating the museum narrative. Examples from the findings—such as the costume-changing AR system or interactive decision points in AR setups—illustrate how visitors now shape their own experiences by making choices that influence the story's progression. This participatory element enhances the Mortals dimension, aligning with contemporary trends in UGC and interactive storytelling. From a media studies perspective, TMS transforms traditional audience engagement by shifting the role of visitors from passive consumers to active participants (Jenkins, 2006). Drawing on insights from critical game studies, the notion of *play* within cultural spaces opens new avenues for engagement, where museum visitors can not only observe but also interpret and reshape narratives. The ability of visitors to interact with and contribute to the narrative through

transmedia platforms strengthens their personal connection to the exhibits, leading to a more immersive and fulfilling museum experience.

The findings also indicate that visitors form stronger emotional connections to museum exhibits through immersive storytelling techniques such as VR and AR. These technologies deepen emotional engagement by creating environments that resonate on both personal and cultural levels. Several interviewees mentioned that the emotional response to XR storytelling was more profound, as the digital environment allowed them to "step into" the narrative, feeling the weight of cultural histories in more intimate ways. This heightened emotional engagement aligns with the Gods dimension, as visitors experience cultural heritage not only as intellectual knowledge but also as an emotional and spiritual journey. It is evident that TMS can play a vital role in the preservation and dissemination of intangible cultural heritage (Giaccardi, 2012). However, to ensure long-term sustainability, museums must develop strategies that integrate these technologies into their broader cultural missions, ensuring they remain relevant and accessible for future generations.

Overall, museums are expanding their educational reach and entertainment value by using innovative XR applications that appeal to a wide spectrum of visitors across different age groups and interests. This analysis confirms that XR-enhanced TMS supports audience co-authorship and personalized engagement, aligning with Song, Gilardi, and Lam's (2023) emphasis on community-driven reinterpretation. Moreover, the emotional resonance reported by participants affirms Giaccardi's (2012) assertion that digital storytelling fosters affective engagement with intangible heritage. Building on these insights, Selvadurai and Rosenstand (2017) conducted an empirical case study at the North Sea Oceanarium in Denmark to investigate how visitors can be meaningfully involved in transmedia experiences that span pre-, during-, and post-visit phases. Their research revealed a critical heuristic for designing effective transmedia exhibitions: "The more platform complexity, the less content complexity" (Selvadurai & Rosenstand, 2017, p. S3677). This principle suggests that when designers increase the number of platforms or media types in an exhibition, they must correspondingly decrease the complexity of content for users, and vice versa. Their two-iteration experiment with Instagram integration demonstrated that reducing hashtag complexity while focusing platform usage resulted in significantly improved visitor engagement, with posts increasing 2.79 times, social media reach expanding 5.62 times, and engagement (likes and comments) growing 7.22 times per visitor. However, these advancements come with challenges, including maintaining narrative objectivity, managing technological complexities, and ensuring accessibility amidst high costs.

Our findings also reflect tensions observed in previous studies—for example, Xu et al. (2017) noted gamification's potential to distract from educational goals. The risk of disempowerment and loss of narrative clarity, particularly for younger users, echoes concerns raised by Madsen (2020) and French (2016) regarding the over-prioritization of entertainment in edutainment strategies. To optimize the benefits of XR and storytelling, museums must carefully balance these elements to uphold the integrity of their educational missions while adapting to evolving visitor expectations. By addressing these challenges, museums can continue to serve as pivotal cultural hubs—successfully blending education with technology-driven engagement.

6. Conclusions

Cultural heritage extends beyond archives; it is embedded in lived experiences, oral traditions, and evolving forms of storytelling. This study underscores the transformative potential of integrating TMS with XR technologies to shift museum experiences from passive observation to participatory engagement. The key findings emphasize the importance of ethical

storytelling, inclusive design, and culturally sensitive practices. XR should not be treated as spectacle, but rather as a means to empower diverse audiences—supporting co-creation and strengthening both emotional and intellectual connections.

Despite these opportunities, challenges persist. Maintaining narrative objectivity in participatory formats remains complex, and XR technologies often present barriers related to cost, accessibility, and usability—particularly for older audiences. To address these concerns, the study proposes six guidelines: (1) prioritize co-creation through participatory tools; (2) amplify emotional resonance through immersive storytelling; (3) design gamified experiences with pedagogical intent; (4) ensure inclusive, age-appropriate access; (5) collaborate ethically with communities to diversify perspectives; and (6) simplify content delivery to balance engagement with cognitive clarity. Collectively, these practices can help museums shape inclusive digital futures grounded in authenticity, agency, and cultural sustainability.

These guidelines position museums as adaptive cultural spaces where technology complements, rather than replaces, their core missions. Future research should investigate the long-term impact of TMS on engagement and learning, using longitudinal and mixed-method approaches. Further exploration of cross-cultural applications and participatory design strategies is also warranted to ensure meaningful integration without compromising cultural integrity. As museums continue to embrace interactive and distributed storytelling, curators, designers, and audiences must collaborate to craft narratives that are not only imaginative, but also culturally respectful and critically grounded.

Acknowledgements
This part is anonymous for peer-review.

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