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# Enhancing Authenticity in XR Heritage: Practitioner Insights and Preliminary Recommendations

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**Abstract**
Extended Reality (XR) applications are increasingly popular in heritage interpretation, leading to significant changes in the emergent digital heritage field. One major challenge is ensuring the objective, constructive, and subjective authenticity of XR experiences deployed in a variety of heritage settings. Through in-depth interviews with practitioners working directly on XR projects for cultural heritage, this paper discusses the theoretical and practical implications of authenticity in such projects. It proposes six preliminary recommendations to help practitioners design more authentic, meaningful XR experiences. Firstly, to enhance objective authenticity, the study suggests rigorous research and appropriate renderings based on historically accurate materials. Secondly, for constructive authenticity, the research emphasizes narrative design that incorporates diverse perspectives, including those of local communities and underrepresented voices, to reflect the social and historical significance of heritage sites more accurately. Thirdly, for subjective authenticity, the recommendations highlight the importance of interactive and immersive design that allows for personalized meaning-making. Finally, the recommendations reinforce the importance of ethics, inclusion, and sustainability across all authenticity concepts.

## 1. Introduction

Digital technologies, such as Extended Reality (XR) applications, are playing an increasingly important role in heritage spaces and generating new possibilities for enhancing visitor experiences. As such, the need for greater authenticity in these XR heritage experiences has become increasingly critical to deliver higher-quality experiences, increase engagement, and protect heritage from being simplified or misrepresented through commercialization. The definition of authenticity has long been a subject of debate within analogue heritage spaces, ranging from the objectivist perspective that centres on material authenticity to constructivists who prioritize the social value of heritage spaces and artifacts, to subjectivists who leave it to the individual to determine what is authentic and what is not (Wang, 1999). When translated into the digital context, XR experiences can enhance objective authenticity by informing the visitor of the value of the object or site, constructive authenticity by narrating their social value, and subjective authenticity by creating unique experiences for visitors (Vichnevetskaia et al., 2025). Existing research suggests that all three primary types of authenticity positively influence visitor experiences in heritage XR environments (Cardozo & Papadopoulos, 2021; Han et al., 2021; Jones et al., 2018; Nam et al., 2023; Pallud, 2017; Pescarin et al., 2023; Zhu et al., 2023). Despite this, a clear framework for achieving authenticity in digital heritage projects remains underdeveloped.

This research seeks to address the question: What strategies can enhance authenticity in XR heritage experiences? The objective is to offer preliminary recommendations for practitioners in the digital heritage space so they can create more authentic XR experiences. The paper explores how various definitions of authenticity can be applied in the design and delivery of digital heritage projects. The outcomes are based on an empirical study of 38 semi-structured interviews conducted with a diverse range of professionals working in the digital heritage space. These participants include developers, designers, heritage managers, tourism managers, funding bodies, academics, and storytellers who have been involved in a variety of XR heritage projects globally.

The recommendations focus on three key areas: technology selection and rendering quality, storytelling approaches, and visitor engagement strategies, as well as the transversal themes of ethics, inclusivity, and creative license. To enhance objective authenticity, the study suggests using the most rigorous possible research and appropriate rendering fidelity for 3D reconstructions while balancing realism with functionality. For constructive authenticity, the recommendations emphasize narrative design that incorporates diverse perspectives, including those of local communities and underrepresented voices, to reflect the social and historical significance of heritage sites more accurately. Lastly, to increase the visitors' experience of subjective authenticity, the recommendations highlight the importance of interactive and immersive design, such as allowing visitors to make choices that shape their experience or personalizing content.

This paper offers insights for practitioners looking to add meaning, depth, and credibility to their heritage XR experiences while protecting the digital heritage space from over-commercialization. The paper also contributes to the theoretical discourse by presenting an initial set of recommendations based on empirical research involving both academia and industry practitioners. Furthermore, it expands the understanding of the definitions and ways in which authenticity can be practically implemented within digital heritage experiences.

## 2. Digitalization and Authenticity in Cultural Heritage Spaces

### 2.1 Charters, Principles, and Guidelines for Digital Heritage Projects

Amid the rise of heritage digitalization, several charters and guidelines have been elaborated to inform digital heritage practices. One of the landmark documents in digital heritage is

the UNESCO Charter on the Preservation of Digital Heritage, which primarily advocates for the sustainability and maintenance of material heritage through digital continuity as well as the preservation of authenticity in terms of clear, authoritative sources (Charter on the Preservation of Digital Heritage, 2003). Next, followed the ICOMOS Charter on the Interpretation and Presentation of Cultural Heritage Sites, which suggests that visual reconstructions must be *"based upon detailed and systematic analysis of environmental, archaeological, architectural, and historical data*" (ICOMOS Charter on the Interpretation and Presentation of Cultural Heritage Sites, 2008) Meanwhile, the London Charter for the computer-based Visualisation of Cultural Heritage (2009), sets out seven visualization principles, including the promotion of rigour in research sources, contextualization of the methods used and how they have affected the outcome, the requirements necessary to verify that a 3D visualization is intellectually responsible and solid through the inclusion of data informing its source, and the maximization of access to the visualizations (Denard, 2012). A follow-up document, The International Principles of Virtual Archaeology, also known as the Seville Principles, discusses how the London Charter can be practically applied in the field of archaeology ('International Guidelines for Virtual Archaeology', 2013).

More recently, the focus has shifted toward using digital tools to empower communities and promote ethical heritage tourism. The ICOMOS International Charter for Cultural Heritage Tourism advocates the use of digital tools in heritage tourism to address conservation and community rights, promoting responsible tourism and heritage promotion (ICOMOS International Charter for Cultural Heritage Tourism, 2022). In the same vein, the ICOMOS International Charter and Guidance on Sites with Intangible Cultural Heritage (2024) emphasizes the deep relationship between communities and their heritage, including the importance of documentation, recording, and interpretation in ways that respect the values, meanings, and contexts attributed by communities themselves (Guidance on Sites with Intangible Cultural Heritage, 2024).

While these documents provide high-level guidance for digital heritage practice, they are still primarily focused on digital heritage conservation, the original object, data collection, and retention. In the rare cases that they discuss heritage interpretation through digital means, practical guidelines and actionable steps to protect and promote authenticity are largely absent, leaving an important gap in going from conceptualizing digital heritage projects to implementing them in real life.

### 2.2 Authenticity in the XR Heritage Space

There are three major ways in which the heritage sector defines authenticity: objective, constructive, and subjective. Objective authenticity emphasizes the significance of direct interaction between individuals and original objects, which serve as timeless representations of heritage (Bryce et al., 2015; Chhabra, 2012; Park et al., 2019; Wang, 1999). Constructivists, however, look beyond the original object. Instead, constructive authenticity is built through a variety of social and contextual perspectives (Bryce et al., 2015; Kolar & Zabkar, 2010). Subjective authenticity takes on yet another view, where the individual interacting with the heritage object or site determines whether it is authentic or not (Yi et al., 2018). In this framework, it is the visitor's personal engagement and emotional response that determines the authenticity of their experience (Wang, 1999). The discussion surrounding the authenticity of digital heritage in cultural heritage tourism reveals a multifaceted landscape. While traditional objective perspectives may view digital reproductions as inauthentic, constructive and subjective viewpoints highlight the potential for these technologies to provide meaningful, engaging experiences (Jones et al., 2018; Mudge et al., 2012; Steiner & Reisinger, 2006; Zhu et al., 2023). It is critical to understand that, while they may contrast, these definitions co-exist. A concept defined as "theoplacity" proposes an integrated approach to the various types of authenticity; each type of authenticity plays a role in shaping the visitor's experience, where place, belief, and action all impact how "authentic" the visit is from a range of perspectives (Belhassen et al., 2008).

Ultimately, the authenticity of XR heritage experience should be understood as a complex interplay of multiple definitions and experiences, reflecting the diverse ways in which visitors interact with and interpret cultural heritage from all three perspectives:

1. Objective: This authenticity is preserved through XR experiences that emphasize the historical and material integrity of the artifacts.
2. Constructive: XR technologies facilitate this perspective by providing dynamic narratives that reflect changing social perceptions and cultural contexts.
3. Subjective: XR technologies excel in creating unique interactions that resonate on a personal level, allowing visitors to craft their own authentic experiences (Vichnevetskaia et al., 2025).

Based on these definitions, this paper aims to inform the best practices and preliminary recommendations for creating more authentic XR heritage experiences.

### 2.3 Digitally Interpreting Heritage: Challenges and Opportunities to Authenticity

Digital interpretations abound in museums, cultural heritage sites, and in historic towns and cities. XR technologies, including Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR), are regularly used to tell the history of objects, spaces, and places (Rauschnabel et al., 2022). These powerful tools can provide deeper interaction and contextualization for artifacts and heritage sites, as well as enhance access to otherwise inaccessible heritage while protecting vulnerable items and sites (Cerquetti, 2018; Cranmer, 2019). Despite the popularity and ongoing advancement of these technologies, their selection and implementation come with significant challenges. Firstly, fidelity, or the ability of these technologies to resemble the original place or object, is one concern that can dilute some of the authenticity of the experience (Farrelly et al., 2019; Vital et al., 2023). Secondly, the funding, skills, and availability of technologies that would create the best experience do not always represent what is actually available to the museum or heritage site (Jeffrey et al., 2020; Leow & Ch'ng, 2021; Spadoni et al., 2023). Thirdly, issues such as loss of situational awareness, cognitive overload, and disrupted workflow can result in poor performance and increased human error (Cranmer, 2019).

Content is a crucial aspect of digital heritage interpretation, where effective storytelling plays a significant role. XR experiences have the power to enhance the original artifacts with information and digital reconstruction as well as enrich the visitor's understanding of cultural heritage (Cerquetti, 2018; Cranmer, 2019; Popoli & Derda, 2021; Shehade & Stylianou-Lambert, 2020a). Even so, these stories can be challenging to tell through XR. For one, documentation is often lacking to inform the content, while choices also need to be made to determine how and which stories to tell, bringing the authenticity into question (Farrelly et al., 2019; Vital et al., 2023). Secondly, there is a risk

that digital experiences may overshadow the original object or place (Cerquetti, 2018; Shehade & Stylianou-Lambert, 2020b). And finally, despite their potential for inclusivity, those with authority tend to determine which stories are told and what accuracy (or authenticity) means, frequently perpetuating exclusion in the heritage space (Jeffrey et al., 2020).

Today's XR experiences can educate, entertain, and serve as a visitor guide all at the same time (Hammady et al., 2020). They enable visitors to easily comprehend complex information and access parts of heritage sites that are otherwise inaccessible, thus broadening their appeal and potentially increasing both the time spent at the site and the likelihood of spending (Cranmer, 2019; Zatori et al., 2018). Furthermore, XR facilitates immersive storytelling, allowing visitors to co-create their cultural heritage experiences, which deepens their engagement with the narrative, creating a more subjectively authentic experience (Olesen et al., 2022; Popoli & Derda, 2021). New technologies also facilitate beautiful, interactive, and engaging experiences that increase visitor participation (Menegaki, 2022). However, challenges persist here too. First of all, many XR designs cater to individual users, which can lead to isolation, disconnecting the visitor from the surrounding environment and limiting social interaction (Menegaki, 2022; Shehade & Stylianou-Lambert, 2020a). The second issue is that curators are often concerned about the accessibility of new technologies for visitors with limited technological skills, particularly older individuals (Menegaki, 2022). Last but not least, the focus on technology risks breaking the connection between the visitor and the original.

These challenges and opportunities ultimately align with the various facets of authenticity in the digital heritage space (Table 1).

| Authenticity | Challenges | Opportunities |
|---|---|---|
| Objective | Fidelity, lack of funding and digital skills, overshadowing the original | Enhanced access, preservation, interactivity |
| Constructive | Content bias, lack of documentation, authority disputes | Inclusive storytelling, co-creation, enriched contextualization |
| Subjective | User isolation, cognitive overload, lack of connection to the original | Personalization, emotional engagement, fun |

Table 1 Challenges and opportunities in XR heritage in relation to authenticity based on literature review (Prepared by author)

This paper explores the intersection of digital heritage authenticity and the opportunities and limitations of XR experiences, aiming to address key challenges while enhancing the perceived authenticity of such experiences in cultural heritage settings.

## 3. Methodology

To understand how to enhance digital XR heritage experiences and make them more meaningful and authentic, this study interviewed 40 practitioners working in the field. The aim was to gain in-depth insights into the professional practices, decision-making processes, and contextual factors influencing XR integration in the cultural heritage sector.

The sampling strategy combined the criterion and snowball sampling methods. (Sharp, 2003). Criterion sampling was used initially to identify individuals who met the predefined eligibility conditions, often through their association with published case studies, project documentation, or institutional affiliations known for XR innovation. Snowball sampling was subsequently employed to expand the participant pool and access less visible yet equally relevant expertise. Existing professional networks, including academic and industry contacts, as well as interactions at conferences and digital heritage events, were leveraged to identify additional qualified participants. Finally, a total of 40 semi-structured interviews were conducted in English and Chinese (with the help of a volunteer for translation) using a standardized interview guide, developed to elicit insights into participants' experiences with XR projects in cultural heritage contexts. Of these, two interviews were excluded due to incomplete data or inconsistencies, resulting in 38 interviews being included in the final dataset for analysis. The sample size was not predetermined but was guided by the principle of thematic saturation, whereby data collection continued until no new themes or significant insights emerged during successive interviews (Ingelgom, 2020).

The data analysis process followed a structured yet flexible qualitative approach, beginning with the transcription of all interview recordings and the systematic organization of the data using NVivo software. Each interview case was classified according to both individual-level and organizational-level attributes to enable nuanced interpretation. The interview labels used here include the type of site or museum, the practitioner's professional background, and their geographic location. To arrive at the results, thematic coding was conducted in two main stages, combining deductive strategies, based on existing theories around authenticity, and inductive strategies, allowing new information to be extracted from the interviews, in line with qualitative content analysis best practices (Braun & Clarke, 2006, 2023).

## 4. Practitioner Perspectives

The interviews yielded a wealth of insights into the current practices surrounding heritage interpretation using XR technologies, particularly what's working and what needs to be addressed to improve projects in the future (Table 2).

### 4.1 Objective authenticity

As discussed in the literature, interviewees noted the awe that technologies can create around heritage artifacts and sites. Still, many projects struggled with balancing the ideal outcome with the technologies, funding, and time available to them. Practitioners emphasized the potential of XR to deepen contextualization by reconstructing entire spaces, visualizing different historical periods, and revealing patterns or overlooked values in artifacts (Figure 1). A curator for several AR projects at a key outdoor heritage site in Beijing explains:

> *Our objective with this restoration is not simply to showcase [the site] at a single point in time but to capture its various stages of transformation over the years, which sets this project apart from conventional site studies.* (P19, Outdoor Site AR, Academia, China)

This aligns with the literature, which highlights XR's capacity to enhance understanding of heritage objects and sites through space and time. However, both practitioners and scholars repeatedly underscore the issue of fidelity: digital reconstructions, even those based on rigorous sources, inevitably involve extrapolation by human authors or AI, raising questions about the

authenticity of what is presented (Vital et al., 2023). The designer behind an AR reconstruction of a heritage site in the UK maintains:

> *Although it's always an extrapolation to a certain degree. If you look at paintings of [the site], you'd think you could take all the paintings and say, the tower was this high, but it's not as easy as that.* (P25, Outdoor Site AR, Private, UK)

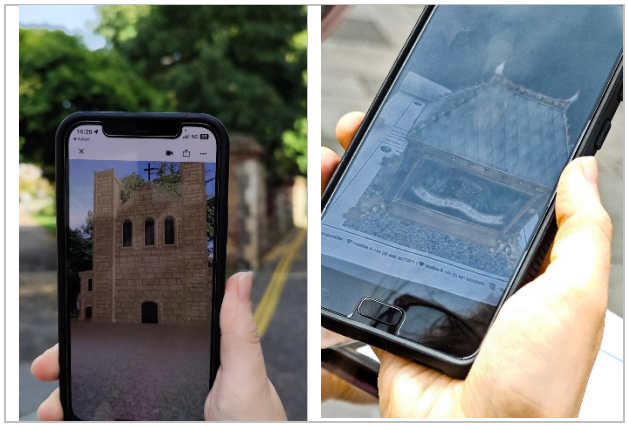

Figure 1 Left: 3D reconstruction from archival data of the Reading Abbey in Reading, UK; right: 3D scan of an ancient artifact, part of VARS.AT's AR scavenger hunt in Vienna, Austria (Photos by author)

The malleability of digital interpretation, while a strength (allowing updates as new findings emerge), also means that authenticity is continually negotiated rather than fixed. Practitioners noted the challenges of working with incomplete documentation and the need to balance imagination with research, reflecting concerns in the literature about how gaps in knowledge and technological constraints can dilute authenticity.

### 4.2 Constructive authenticity

Concepts related to constructive authenticity, which centres on the narratives built by society around heritage, were a recurring theme in practitioner interviews. Practitioners highlighted the tension between narrative goals, client needs, and commercialization — echoing the literature's observation that authority figures often determine which stories are told and how authenticity is defined (Smith, 2010). They acknowledged the interpretive nature of all records and the importance of transparency about what is fact, fiction, or legend. Practitioners also described the complexities of multi-stakeholder environments, where consensus is rare and the challenge is to tell stories meaningful to both communities and visitors (Waterton & Smith, 2010). An interviewee who oversaw the development of a large-scale urban heritage AR project notes:

> *You will find that 99% of these apps are funded through commercial stuff. The apps that I came across that were the most successful had the most authentic community-driven content. You can tell very easily when content is delivered in a very corporate communications kind of way. And that doesn't mean that it will last.* (P31, Outdoor Urban AR, Heritage Management, Ireland)

In the meantime, the interviewees spoke extensively about the opportunities to layer multiple narratives, record history in real time, and give authorship to communities to communicate their intangible histories through digital means, which aligns with calls in the literature for more inclusive and participatory approaches to heritage interpretation (Figure 2) (ICOMOS International Charter for Cultural Heritage Tourism, 2022; Jeffrey et al., 2020).

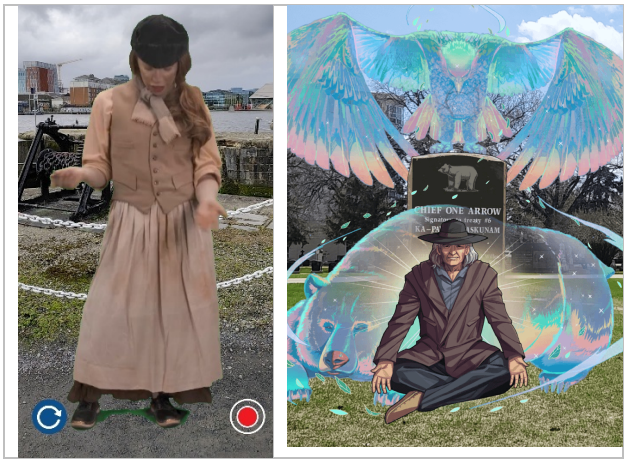

Figure 2 Left: A volumetric capture of a fictitious character built based on various historical figures, Dublin Docklands AR Trail, Ireland (Photo by Author); Right: A graphic representation of an indigenous elder and symbology, In Plain Site AR app, Winnipeg, Canada (Photo courtesy of ZenFri)

The CEO of a private firm working on an AR project with indigenous communities in Canada explains:

> *Before we completed development, we went back and shared our prototype work with the indigenous communities. We really wanted to make sure that they were an integral part of the process as development was happening. To say, yes, this is correct, no, that's not correct. Keep in mind that some of these stories have mythical creatures. When we're designing, and we're not indigenous, obviously, we don't really know what something should look like. That's why, as we modelled, we would always take it back and say, give us feedback. Did we get this right?* (P18, Indoor AR, Private, Canada)

Within this context, the designer's role shifts from sole author — which might be common in a game or art piece — to facilitator, empowering communities to share their own stories and revealing the deeper meanings behind artifacts and architecture.

### 4.3 Subjective authenticity

The visitor's personal, subjective experience — or what literature refers to as subjective authenticity — was another key focus. XR's immersive qualities, through visuals, sound, and interactivity, can foster a sense of awe and engagement that supports subjective authenticity. Interviewees noted that XR experiences facilitated meaning-making, learning, and heritage appreciation in novel ways. The project lead for an indoor XR experience in a Grade I listed building in the UK details:

> *What's important when we do this is that whatever we create leads to genuinely informative and meaningful new experiences so that people who go to the place will say, Wow, I didn't see that or have a different attitude towards the building or different attitudes in a particular part of the story.* (P24, Indoor XR, Academia, UK)

However, they also cautioned about the fine line between making experiences animated and fun versus trivializing serious topics, a concern mirrored in the literature regarding the risk of over-

commercialization (Figure 3) (Chhabra et al., 2003). A developer working on an indigenous project in Canada cautions:

> *There's a fine line between interaction and gamifying culture. And that's a really fine balance. You don't want to turn someone's 10,000 years of traditions and knowledge into a fun, cool game. But if you don't engage in some kind of interaction, then it's still static, right? (P09, Outdoor AR, Private, Canada)*

Accessibility remains a significant barrier: technological skills, socioeconomic factors, and device availability can exclude certain user groups, despite XR's potential to reconnect communities with their heritage and enable participation for those unable to visit sites physically. Practitioners stressed the need for simple, multi-lingual, and accessible design, as well as ongoing user assessment. Interviewees explained that there is a severe lack of post-launch user experience assessment in these types of projects due to time and budget constraints. As such, users' perception of the projects is often lacking. The risk of isolation in individual-focused XR experiences further challenges the social dimension of heritage engagement.

Figure 3 A screenshot of the Footprints Through Time Experience that tells the history of enslaved people in Louisville, USA (Screenshot courtesy of the project)

Finally, a recurring theme across all three concepts of authenticity is the tension between creativity and authenticity (Baudrillard, 1994). Practitioners recognize that designers bring their own voice and interpretation to heritage projects, shaping collective memory and the meaning of authenticity itself. As is often the case in physical projects, there is a need to balance factual accuracy with creative engagement, ensuring that experiences remain meaningful, honest, and commercially viable without sacrificing the integrity of the heritage (Champion, 2021). A professor and curator of a heritage VR experience in Shanghai highlights:

> *I think we always have to balance because we can never throw away facts. We're always trying to get a certain degree of authenticity. But you cannot be solely attracted to academic restoration because, for the public, it can be very boring. People will not buy it. And if you ask about authenticity, of course, there is no authenticity. Everyone could have their imagination. Everyone has their answer to what the building should look like. I think this is at least worth a try.* (P08, Indoor VR, Academia, China)

This reflection encapsulates a broader reality in digital heritage work: authenticity is not a fixed standard, but a negotiated space where historical fidelity, audience expectations, and interpretive creativity must continually coexist.

| Authenticity | Challenges | Opportunities |
|---|---|---|
| Objective | Fidelity and extrapolation, incomplete or problematic documentation, tech, budget, and time limits, overshadowing originals, optimization needs | Deepened contextualization, access to hidden or vulnerable heritage, updating interpretations, revealing overlooked value, preservation |
| Constructive | Content bias, selective storytelling, authority over narratives, stakeholder disagreement, balancing community and commercial goals, distinguishing fact/fiction | Inclusive, layered storytelling, co-creation with communities, real-time history recording, empowerment, integration of multiple perspectives |
| Subjective | User isolation, cognitive overload, weak connection to physical context, accessibility barriers (skills, devices, cost), risk of trivializing topics, lack of user feedback | Personalization, emotional and immersive engagement, interactive learning, rediscovery for communities, cross-cultural access, accessible, multi-lingual design |

Table 2 Challenges and opportunities in XR heritage in relation to authenticity expanded with practitioner insights (Prepared by author)

The findings from practitioner interviews reinforce and extend the literature's insights: XR technologies offer transformative potential for heritage interpretation but require careful negotiation of authenticity at every stage. Objective, constructive, and subjective authenticity each demand a nuanced, inclusive, and reflexive approach from designers, curators, and communities alike. Ultimately, meaningful digital heritage experiences emerge from a balance of rigorous research, creative storytelling, technological innovation, and a commitment to accessibility and participation for all.

## 5. Creating Authentic Digital Heritage Experiences – Preliminary Recommendations

By combining the above discussion and insights, this paper proposes a preliminary set of six crucial guidelines and actionable recommendations for future XR projects in the heritage space:

1. Refer to rigorous documentation and perform extensive research.
2. Use the right technology for the right task.
3. Contextualize the original in the current reality.
4. Tell meaningful stories grounded in representative voices.
5. Engage the user without over-gamification.
6. Reflect on ethics, inclusion, and sustainability.

**Recommendation 1: Refer to rigorous documentation and perform extensive research.**

The London Charter and Seville Principles clearly established that thorough documentation and research are foundational for XR heritage projects. Additionally, both literature and practitioner accounts emphasize the ongoing challenge of fidelity — how accurately digital experiences mirror original artifacts or sites. Drawing on the concept of objective authenticity, rigorous documentation anchors digital reconstructions in credible evidence, minimizing the degree of conjecture and extrapolation required (ICOMOS Charter on the Interpretation and Presentation of Cultural Heritage Sites, 2008; Wang, 1999). However, practitioners also acknowledge that gaps in the record are inevitable, and any digital interpretation is an act of constructive authenticity, requiring careful negotiation between what is known and what must be imaginatively reconstructed. Even so, the consensus in industry and academia is that without rigorous research, the integrity of both objective and constructive authenticity is fundamentally jeopardized.

To support both forms of authenticity, project teams should establish clear protocols for sourcing, cross-referencing, and transparently citing all documentary evidence underlying digital interpretations (Denard, 2012). Ideally, where documentation is incomplete, practitioners should adopt a self-reflexive approach, clearly marking elements of reconstruction or speculation within the XR environment, thus preserving transparency for users. Where possible, iterative updating protocols should be developed, allowing new findings or scholarly consensus to be integrated into the experience over time.

**Recommendation 2: Use the right technology for the right task.**

Technology selection is a recurrent concern in both literature and practitioner testimony, particularly as technological novelty can overshadow the specific needs of the heritage context. Inappropriate or technologically overburdened solutions risk disrupting user experience and can dilute the visitors' perception of subjective authenticity, as users become more aware of the digital medium than the heritage site itself (Leow & Ch'ng, 2021). Practitioners observe the practical limitations of funding, technical expertise, and device availability, underscoring the importance of contextually appropriate choices.

Prior to implementation, comprehensive needs assessments should be conducted with all stakeholders, including target audiences, to determine the most suitable technologies, even if these are less advanced than originally proposed. Efforts should focus on integrating technologies in a way that is seamless, accessible, and does not intrude upon or overshadow the heritage content. Continuous monitoring and post-implementation evaluation should inform refinements to ensure that the technology continues to serve its educational, experiential, and preservation objectives.

**Recommendation 3: Contextualize the original in the current reality.**

Contextualization emerges as a vital mechanism for connecting historic artifacts to contemporary lived realities, thus fostering both constructive and subjective authenticity. The literature and interviews alike reveal that effective XR experiences do not simply replicate the past but facilitate dialogue between past meanings and present identities (Cerquetti, 2018). Constructive authenticity is negotiated in this space as stakeholders address questions of relevance, inclusion, and evolving interpretation.

Designers should develop interpretive layers within XR experiences that explicitly link historical artifacts to modern issues, values, or memories. Where possible and relevant, it is important to collaborate with contemporary communities, either to draw living connections to the heritage in question or to reflect comprehensively on living heritage values (Jones et al., 2018). Periodic reinterpretation should be institutionalized, ensuring that contextualization remains responsive to both new scholarship and changing social realities.

**Recommendation 4: Tell meaningful stories grounded in representative voices.**

The co-construction of heritage narratives is core to both constructive and subjective authenticity. The literature and practitioner interviews highlight persistent challenges: those with institutional authority frequently control which stories are told, and whose voices are heard, risking the marginalization of alternative perspectives (Jeffrey et al., 2020). Meaningful narratives, rooted in representative voices, foster a richer engagement while democratizing authorship and enhancing the subjective resonance for a broader array of users (Popoli & Derda, 2021).

XR projects should prioritize participatory methods, inviting input and authorship from diverse community stakeholders, particularly those who have been historically underrepresented (ICOMOS International Charter for Cultural Heritage Tourism, 2022). Mechanisms for multi-vocal storytelling should be built into project governance, and digital platforms should be designed to accommodate the layering of multiple, sometimes conflicting, narratives. Transparent communication of what is fact, interpretation, or fiction should be maintained throughout the user experience. Last but not least, the visitors themselves should be given a voice, be it through customization, personalization, or feedback mechanisms that increase personal meaning-making.

**Recommendation 5: Engage the user without over-gamification.**

Both literature and practitioners warn of the risk that excessive gamification may trivialize serious topics or overshadow the heritage content itself. While interactivity can foster subjective authenticity through personal engagement and emotional resonance, there exists a fine balance between engagement and superficiality.

Interactive elements should be carefully calibrated to serve the interpretive goals of the project, enhancing rather than distracting from the core meaning of the heritage content. Regular user testing with a demographically diverse sample should be conducted to ascertain whether gamified elements support or detract from deeper understanding. Additionally, practitioners must draw on various voices to ensure that the gamification components they include are not in poor taste, particularly when dealing with complex social narratives or working with vulnerable groups.

**Recommendation 6: Reflect on ethics, inclusion, and sustainability**.

The imperative to address ethical, inclusive, and sustainable practices is strongly reflected where issues of accessibility, representation, and technological exclusion remain pressing

(Vital et al., 2023). Authenticity, in all its forms, is compromised when essential community voices are left out of the process or when short-term solutions undermine long-term heritage management.

Heritage XR projects must institute ethical review procedures, with explicit attention to the inclusion of marginalized voices, the accessibility of experiences for users of varying abilities and technological backgrounds, and long-term solution sustainability. Budgets should be built with longevity in mind, including cost items such as hosting, maintenance, evaluation, and updates. Regular stakeholder consultations should be institutionalized, and mechanisms for feedback, correction, and redress must be present throughout the project lifecycle.

## 6. Conclusion

This study has demonstrated that authenticity in XR heritage experiences is a multifaceted concept, encompassing objective, constructive, and subjective dimensions that together shape the quality and credibility of digital heritage encounters (Vichnevetskaia et al., 2025; Wang, 1999). Through empirical insights from a diverse group of practitioners, the research has identified actionable recommendations for enhancing authenticity, including rigorous technology selection, inclusive storytelling, and visitor-centred engagement. By integrating ethical considerations and promoting diverse perspectives, these recommendations provide a foundation for practitioners aiming to create XR experiences that are both meaningful and credible. Ultimately, this work advances the discourse on digital heritage by offering a set of empirically grounded guidelines that bridge theoretical definitions of authenticity with real-world application, supporting the ongoing evolution of immersive and responsible heritage interpretation.

## 7. Limitations and Future Research

Each XR heritage project is inherently unique, shaped by the nature of the site, its geographic location, and the motivations driving its development. As a result, some of the recommendations presented here may not be universally applicable, while others may have been overlooked. Moreover, the study's reliance on interview data from a select group of professionals means that perspectives from other key stakeholders—such as users, local communities, and non-participating institutions—are underrepresented. Practitioners from different regions or organizational contexts may also offer insights that fall outside the scope of this study. Future research should broaden the stakeholder base by including a wider range of practitioners, users, heritage site visitors, and community members. It would also be valuable to test these recommendations in varied geographic and cultural settings and to conduct case study analyses to better assess their practical application and effectiveness.

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