Between Curiosity and Clunkiness: Why Virtual Museums Still Fall Short

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Abstract

Virtual Museums have long promised accessible ways to experience culture online, yet many still struggle to engage visitors. Building on prior research that highlights issues of usability and interactivity, this study revisits the virtual museum experience through a comparative, user-centred lens which involved semi-structured interviews with twelve participants looking at 6 platforms; all ranging from virtual catalogue-based archives to immersive "Street View" environments. Thematic analysis identified 3 recurring factors shaping user experience: 1) Perceived quality and UX features strongly influenced the experience; 2) Users do not have strong preferences but have strong expectations when viewing different systems; and 3) Virtual Museums have the potential to complement physical museum visits. The findings further show how expectations now extend beyond issues of access to encompass design sophistication and sensory coherence. We discuss implications for rethinking virtual museums as intentionally designed experiences that complement rather than just replicate physical visits.

CCS Concepts

• **Human-centered computing** → Human computer interaction (HCI); HCI design and evaluation methods; User studies; • **Human-centered computing** → Human computer interaction (HCI); Interaction paradigms; Mixed / augmented reality.

Keywords

VMs, User Study, Qualitative Study

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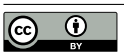
1 Introduction

Virtual museums (VMs) have grown significantly in prevalence and quality alongside advances in internet technologies [21]. Often described as "museums without walls" [6], they provide online access to digitised collections, enabling flexible and remote cultural engagement [20] [22]. Although VMs have existed for decades, their development was accelerated by the Covid-19 pandemic, as heritage institutions sought alternative ways to engage audiences amid physical closures [9]. This shift was further driven by sustainability goals such as equitable access and heritage stewardship [13]. Despite this growth, VMs continue to face challenges in delivering coherent and engaging user experiences. Prior research on VMs has investigated areas such as evaluating user and learning impact [11], analysis in terms of design and presence [20], contrasting audience behaviour in physical and VMs [22], as well as looking at the use of various technologies such as 360-degree immersive environments and the use of multimedia content [17]; often within the context of a single institution or design approach. While this research has generated valuable insights, it offers limited understanding of how users evaluate VMs in relation to one another. In reality, a user when looking up VMs on the internet comes across many different virtual museum platforms, and instead of interacting with a single system in isolation, they are likely to create expectations based on comparisons across encounters. Yet, little empirical work has explored how such comparative encounters shape the virtual museum visit, the visitor expectations, as well as the factors considered to be crucial to the experience.

To address this gap, we conducted a comparative, user-centred study involving semi-structured interviews with twelve participants who explored six virtual museum platforms, spanning a range of different design and technological approaches. Using thematic analysis, we examined how participants described and compared their experiences across platforms. Our findings highlight how perceived design quality, technological coherence, and curatorial framing shape user expectations of VMs, as well as how virtual experiences may influence interest complementing physical museum visits. We discuss implications for rethinking VMs as intentionally designed experiences that complement rather than just attempt to replicate physical museum visits.

2 Related work

Virtual Museums (VMs) provide online access to digitised artefacts and museum spaces, supporting cultural preservation, education, and public engagement beyond the limits of physical museums [21] [22]. Their development was accelerated by the Covid-19 pandemic, as museums increasingly turned to digital platforms to reach wider audiences. Over time, VMs have shifted from brochure- or catalogue-style websites toward more learning-focused experiences that emphasise context, interpretation, and visitor engagement [18]. Today, these platforms commonly offer digital replicas, virtual tours, and specialist content [1], prompting HCI research to move beyond



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questions of access and digitisation toward examining how design choices shape user experience.

Prior research has examined accessibility, usability, and engagement in VMs. Studies show that VM platforms often perform poorly in terms of digital accessibility compared to museum websites [17]. Evaluations of individual systems have identified interface and navigation issues, particularly for older users, as well as the importance of narrative, social interaction, and inclusive design in shaping visitor experience [7] [16]. Large-scale survey studies further suggest that factors such as education, entertainment, and accessibility influence engagement [8], and that VMs can motivate subsequent physical visits [13]. While this work highlights key experiential and design considerations, it largely focuses on single platforms or isolated features, offering limited insight into how users compare and experience different VM systems.

Existing comparative research in VMs has largely focused on contrasting platforms or systems along predefined technical, representational, or interactional dimensions. Prior work has examined VMs through large-scale document analysis, categorising platforms based on presentation styles, navigation, guiding mechanisms, and degrees of virtuality to assess design features and perceptions such as social presence [20]. Other studies have employed comparative usability evaluations across multiple platforms differentiated by visualisation technologies, such as panoramic imagery, database-driven interfaces, and 3D environments, under the assumption that distinct technological approaches serve different experiential aims [19]. Comparative methods have also been applied in more constrained contexts, for example by focusing on specific object types or heritage domains, such as tangible artefacts, to examine how alternative interface designs shape exploration and engagement [14]. Additionally, comparison has been used to isolate the effects of specific interaction modalities by holding system content constant while varying input devices or interaction techniques [2]. These studies together demonstrate the value of comparative approaches in virtual museum research, while also revealing a tendency to frame comparison around technological configurations, system features, or designer-defined categories.

Less attention has been given to the way users themselves experience and interpret the differences across various virtual museum platforms in-situ, especially when exploring multiple diverse systems. This gap in the literature is the motivation for this study, which used a user-centric, comparative design approach to examine how visitors evaluate VM experiences across VM platforms that vary in dimensions like navigation structure, curatorial focus and connection to physical museums.

3 Methodology

We adopted a qualitative, user-centred approach to examine experiences of different VMs. Using a comparative study design, each participant explored two platforms, enabling cross-platform comparisons of usability and engagement. Following ethical approval, twelve participants (N=12; ages 18–46, M=26) were recruited via university forums and word of mouth. This sample size ensured each platform was viewed four times and aligns with prior qualitative research on data saturation [10]. All participants were over 18, had access to a computer, and reported an interest in museums.

This research examines user experiences across diverse VM platforms. Rather than focusing on a single institution, we selected VMs that vary along three key design dimensions: navigational freedom, curatorial focus, and the relationship between digital and physical museum space. The sample selected includes fully explorable, partially navigable, and non-spatial interfaces (British Museum (BM), Louvre, Royal Museums Greenwich (RMG)), both physically grounded and fully virtual museums (including Virtual Museum of Modern Art (VOMA)), and object-centred, spatial, and concept-driven experiences (Anne Frank House (AFH); European Southern Observatory and Planetarium (ESO)). All platforms were accessible via desktop or laptop computers, reflecting the most common interaction setup for virtual museum experiences [2]. Participants answered some brief demographic questions before exploring two virtual museum platforms for 10 minutes each. This was followed by a 30-minute remote semi-structured interview. Data were analysed using inductive thematic analysis [3][4], with anonymised intelligent-verbatim transcripts [12]. Intelligent verbatim was used as this helped make transcripts more readable by removing unnecessary information such as speech fillers, false starts, and keeping all the other data exactly as is.

4 Results

4.1 Perceived Design Quality and Experiential Coherence

Across platforms, participants evaluated virtual museums primarily by perceived design quality and experiential coherence rather than content access alone. Navigation, visual and audio presentation, and overall style strongly shaped impressions. Navigation was a recurring issue, with several participants reporting difficulty orienting themselves due to missing maps, unclear transitions, and inconsistent controls (P4, P5, P6, P8, P11, P12).

> "And also in the La Silla tour, it's just like in any other VR experience too… it's a bit difficult to understand where I am, because it's like… I click on it, I go to someplace, but where am I exactly in the map? I don't know. I always want to know where I am." (P12)

These issues caused disorientation and frustration, particularly in immersive platforms such as the BM and VOMA, with some users noting physical discomfort during navigation (P8). Differences in technical and visual quality strongly affected usability, with smoothness and clarity seen as essential. Text-heavy platforms like RMG were perceived as sparse and less engaging due to limited multimedia. These distinctions were also seen when different types of media heavy platforms were compared with each other (P7).

> "But yeah, in the first one (AFH), I feel like the rooms in general were quite… you could see everything clearly, which was nice as opposed to the rooms in the second one (ESO) where you couldn't read anything that clearly… and also it wasn't really some sort of installation… I mean there maybe were little parts that you could interact with, but it was mostly just boards of information which from what I saw…" (P7)

More broadly, some participants noted that some virtual museum tours did not feel distinctive or intentionally designed, describing

them as similar to other websites rather than a curated cultural experience (P4). Another participant (P6) discussed how the ESO 360° tour of the astronomy museum and observatory area felt bland without the use of a VR headset. Participants often presented their thoughts in a comparative manner; contrasting systems that felt generic and bland to the ones with richer multimedia. In this case, the overall assessments of the visits were greatly influenced by design coherence, or how well navigation, presentation, and content interacted.

4.2 Contrasting interface logics

Participants frequently contrasted catalogue-based interfaces, such as RMG, with spatial modes of exploration like the BM or AFH. Catalogue-style access was described as rigid and archival but valued for potential access to rare or fragile objects (P11), particularly in research-oriented contexts. However, participant responses depended on expectation alignment: when platforms like RMG offered limited visual material or information, they were described as underwhelming and less effective as virtual museum experiences (P3, P6).

> "In that second one, I did kind of expect it to be more like the first thing, where it's kind of like a Google Earth situation, where you can actually walk around the place and look at them. The kind of archive layout of it was a little bit disappointing, because it did take away from the ability to be able to take a look at different angles of it, or you know, see different reflections, or see the exhibits accompanying it…" (P3)

In such cases, the absence of images or immersive elements led participants to compare this platform unfavourably with the other platform they used, even if they valued the idea of archival access in principle (P11).

> "…because it felt to me like… if you were really doing research and stuff like that… an opportunity to go and see all kinds of things that you wouldn't normally see in a museum. And so that stood out. I thought it was available. I got a bit excited about that" …. "it was disappointing in terms of… I found it quite hard to navigate and even when I did eventually get into the collection of the polar exhibits, I think they were definitely disappointing. They were disappointing because for example, you could see the sledge and maybe there was a description, I can't remember, but I didn't see any kind of description beside…or an explanation or that sort of stuff."

In contrast, spatially navigable and visually immersive platforms were often described as more engaging and memorable, despite the challenges noted in Theme 1. Participants valued the ability to move through spaces, orient themselves, and visually explore exhibits. However, preferences were not uniform; evaluations reflected expectation mismatch, with frustration arising when a platform's design logic conflicted with what participants anticipated. This suggests that responses were shaped less by immersive or catalogue features alone, and more by how clearly and intentionally these approaches were designed and communicated.

4.3 VMs as complementary experiences

Beyond the negatives and comparisons of design quality, participants described many ways in which the VMs were seen as valuable complements to physical museum visits, rather than replacements for them. These perspectives were often expressed when participants reflected on features that enabled access to content or experiences not readily available in physical settings. Many participants appreciated the ability to closely examine objects through digital interfaces, particularly features that allowed them to zoom in on fine details (P1, P5, P6, P9).

> "Well, I know in this one I kind of… I love statues. So, I'd probably…like in here, there's one in the glass casing, which is a small statue. I quite like that. I don't know what is that called… trying to zoom in now." (P9)

Participants viewed these features as providing access beyond what is possible in physical visits, where distance, crowds, or display conditions can limit inspection. They also valued virtual museums for enabling access to rarely displayed or inaccessible collections, including unseen exhibitions and archival materials. Some participants noted that VMs could be useful for previewing museums before an in-person visit and helping prioritise what to see (P5).

> "I think the virtual museum can be… a tool for visiting it before. If you're going to British museum tomorrow, today in the virtual museum you can have a look around and see where to go…and quickly know what to do etc. Sometimes… when you go to a museum, sometimes you don't like the things…. for example, an art museum may not be your area of expertise, so the virtual museum could provide kind of a pre-visit guidance I would say."

One participant also highlighted the potential of these platforms to present content that no longer exists in physical form, such as destroyed monuments (P12). Taken together, these comments frame the VM in a unique position to extend cultural access beyond the constraints of physical preservation, time and space. Overall, participants felt that the VM experience was most compelling when they offered distinct forms of access or perspective, rather than simply attempting to replicate the experience of physically being in a museum.

5 Discussion

This study takes a comparative, user-centred approach to understanding how people experience Virtual Museums (VMs). Across discussions of six platforms, participants evaluated experiences not in terms of individual features, but how well interaction, presentation, and curatorial intent worked together and met user expectations. In doing so, this work extends prior research that has largely examined VMs in isolation or focused on specific technologies or design elements [2] [20].

First, across all platforms, participants consistently emphasised design quality and experiential coherence when describing their virtual museum experiences. Comments focused not only on curatorial content, but also on navigation, visual and technical smoothness, and the perceived intentionality of the platform. This aligns

with prior work highlighting usability and design as central to VM engagement [1] [7] [14], and extends it by showing that these qualities become more noticeable when users compare multiple platforms. Importantly, participants did not view design issues as isolated usability problems; instead, they strongly shaped overall comfort and engagement. Even when content was seen as valuable, such as VOMA's affordance to display art and spaces that do not exist physically, poor execution led participants to describe the platform as unrefined or off-putting, including reports of physical discomfort. Together, these findings suggest that design quality acts as a gatekeeper in VMs: weak design can undermine otherwise compelling content, while coherent design can elevate more limited offerings.

Second, participants' experiences of VMs were shaped less by interface preference and more by expectation mismatch. This was most evident in responses to RMG, whose catalogue-style platform was initially valued as an archival resource offering access to rare or fragile objects. However, once framed as a "virtual museum," participants found its limited multimedia and interactivity disappointing compared to more immersive platforms. Similarly, spatially navigable museums were often described as engaging and memorable, but frustration arose when immersion was unsupported by clear navigation or meaningful interaction. Overall, dissatisfaction stemmed not solely from functional limitations but from platforms' failure to clearly communicate their purpose and mode of engagement. These findings highlight the importance of aligning interface design with clear expectation-setting and framing.

Third, we found that participants consistently framed VMs as complementary to physical museum visits, instead of being their direct replacements. Across all 6 platforms, participants felt that they were most compelling when these VMs allowed access that extended beyond the constraints of physical space; such as using zoom to closely inspect objects or being able to view objects that no longer exist. These features were viewed as uniquely digital affordances, rather than attempts to simply replicate a physical museum visit. This aligns with prior research [14][18], and also suggests how VMs can motivate on-site visits for their physical counterparts (if any) [13], and support cultural engagement across geography and time. Our study extends this perspective by showing how users themselves articulate their value of VMs as not just digital substitutes of physical museums, but as intentionally designed experiences that may provide alternative viewpoints or reflection; to activate communication circuits that might get lost in physical museum contexts [5]. Attempts to directly replicate physical museum visits, particularly when limited by technical or interactional constraints are viewed as weaker platforms compared to those that embrace digital affordances.

It is important to note that this does not mean that there are no positives to replicating physical museums and that all VMs must do something different to be useful to the visitors. As explained in the results, some participants actively recognised the importance of having a digital replica of the physical museum, not least for being able to view the exhibitions without needing to visit in person, but also as catalysts for being able to visit in advance to gain some familiarity and sense of navigation. We believe this to be of great value especially to neurodivergent populations such as people with autism, as this would allow them to explore the space at their own pace, an idea similar to empowering neurodiverse individuals by providing materials in advance of meetings [15]. Previous research has discussed VM could serve visitors before, during and after a physical visit [14], and therefore a replication could serve as a pre-visit affordance to those who would want it.

Take together, these findings suggest that VM design should move beyond a one-size-fits-all model. Designers and institutions may benefit from explicitly defining what they want a virtual museum to *be*, for example, a direct extension of a physical site, an archival resource, or a purpose-built digital experience; and ensuring that navigation, presentation, and curatorial choices consistently support that role. If VMs aim to closely replicate physical spaces, simply reproducing spatial layouts may be insufficient for the general audience. Incorporating digital-specific affordances such as video, audio tours, or exclusive podcasts may help create more interactive and engaging experiences. In contrast, VMs not intended as direct replicas may benefit from embracing the creative possibilities of the digital medium, for example by introducing more expressive spatial design, offering artefacts not available on site, or supporting interactive and personalised forms of storytelling [7]. Finally, as users evaluate VMs comparatively, design decisions should consider the broader ecosystem of digital cultural and commercial experiences that shape visitor expectations.

6 Conclusion and future work

This study used a comparative, user-centred approach to examine experiences across multiple virtual museum (VM) platforms, showing that user satisfaction depends less on specific interface types and more on how clearly a platform aligns its design, purpose, and interaction style with user expectations. Participants evaluated VMs in relation to other platforms and their broader digital experiences, highlighting the importance of coherent framing and expectation-setting.

Findings also show that VMs are largely understood as complementing, rather than replacing, physical museum visits. Participants valued platforms most when they extended beyond physical constraints by providing enhanced access, close inspection, or alternative perspectives on collections. Our insights suggest that a brighter future for online museums lies not in replicating physical spaces, but in purposefully designed digital experiences that embrace their unique affordances. Future research could explore how expectations evolve across audiences and over time, particularly as emerging technologies such as AI increasingly shape digital cultural engagement.

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