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Work-in-Progress—Visitor Onboarding for On-Site Mixed Reality Experiences in Museums: Learnings from Curators, Designers, Researchers and Artists

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Abstract. A growing body of research highlights the positive impact of Mixed Reality (MR) experiences in museum settings on visitor engagement. However, MR has not yet seen widespread adoption in museums, and user experience (UX) design of such experiences remains a crucial concern. Moreover, as a relatively new media form, most visitors need to become more familiar with MR and need onboarding assistance. Additionally, museum visitors have a low threshold for investing time in learning new interfaces to experience the narrative. While individual MR projects have tackled this issue, there is a lack of research incorporating professionals' perspectives in designing and planning MR exhibits in museums. This work-in-progress paper presents findings through thematic coding of semi-structured interviews of professionals who work with MR and identify as curators, designers, researchers, and artists. The results are divided into three parts. The first part looks at the need for onboarding flows in MR experiences in museums. The second part highlights common approaches to effective visitor onboarding for MR exhibits. The findings emphasise the need to create MR experiences that need minimal onboarding. The third part describes the types of MR experiences in museums that require minimal onboarding. The findings indicate a preference for designing experiences that respond to the spatial context, are well embedded in the museum's physical space, and employ familiar interaction design due to the ability of such experiences to quickly onboard novice visitors.

Keywords: Mixed Reality, Visitor Experience, Onboarding, Museums.

1 Introduction

Performing museums [1], in their quest for audience centricity [2] and immersion, have seen an increasing presence of digital interactive media in the past few decades. Mixed Reality (MR) [3] is a more recent form of such media being explored by museums due to its promise to enhance immersion [4], evoke a sense of empathy [5], aid interpretation [6], and improve enjoyability and memorability [7] of the experience. Some studies [8, 9] also indicate the positive association between MR experiences and visitors' intention to revisit the museum. However, despite the medium's potential, MR has not seen widescale adoption in museums compared to other visitor-facing digital technologies [10]. While this can be attributed to challenges of technology [11] and feasibility [12, 13], user experience (UX) design and onboarding for MR in museums also provide one such challenge [14]. A critical issue is introducing the medium to novice users [15, 16] to minimise the gap between the intended experience and the actual experience [17]. This process is referred to as user onboarding in the context of Human-Computer Interaction (HCI) and UX [18]. Onboarding also relates to the learnability of the interface [16]. Existing scholarship that provides insights into onboarding for MR experiences in museums focuses on individual cases and experiments [7, 19–21] or presents broad guidelines [22]. There is a lack of research that captures the know-how and perspectives of experienced MR practitioners (EMRPs) working as curators, media artists, designers, and researchers actively involved in such exhibitions' planning and design. While there have been studies focusing on insights from professionals [23, 24], there is a need for such studies that lie at the

intersection of MR and museums. This paper identifies the need for onboarding in MR exhibits and maps the approaches employed by EMRPs to onboard museum visitors and set them up for engaging experiences. It also aims to shed light on the nature of MR museum exhibits that require minimal onboarding. The research focuses on on-site MR experiences in physical museums.

1.1 Defining Mixed Reality in the Scope of the Study

As the term MR has been used in multiple ways [25], it is important to state our understanding of MR to avoid ambiguity. Milgram and Kishino's [3] reality-virtuality (RV) continuum is a widely cited source of definitions for MR. MR is also often understood in conjunction with 'Spatial Computing' [26], where the computation relies on spatial properties and physical objects. As this research is focused on site MR experiences, it is important to consider device-agnostic definitions of MR that account for the physical space of the experience. For this study, we align ourselves to the idea of MR in the RV continuum and anchor it in the museum's physical space. This understanding is similar to the properties of 'Strong AR' [25], where the physical environment is taken into account. Therefore, we understand MR as the super-class of digital media with a physical spatial 'substrate' [27] where the human, digital and the physical environment can interact.

1.2 Onboarding and Mixed Reality in Museums

Learnability of the interface for new users has been one of the primary concerns of HCI professionals for decades [28]. The term 'onboarding' comes from the business and organisational domains [29], where new hire ramps up to perform effectively. The term is now commonly used in the UX field to depict the experience of a new user learning to use software to achieve their desired task [18]. It is important to note that museum scholars [22] and UX practitioners [18] advocate using natural interactions that do not require complex onboarding flows. However, as museums adopt interactive media, onboarding experiences are becoming commonplace [22–30] in exhibits using digital technology. There are also possibilities to include such experiences as serious games to provide learning content engagingly [31, 32]. Concerning MR, there is a difference between the intended experience and the actual user experience in museums [17], as MR is novel and requires special hardware that (unlike smartphones) is not used in daily life [33]. Even though similar technologies seem to have an easier uptake amongst younger visitors [34], Museums are increasingly looking to engage newer and more diverse visitor demographic [35]. Therefore, implementing user onboarding for visitors becomes critical [16] to reduce the gap between the intended MR experience and the actual experience.

2 Research Design

A qualitative study was designed with semi-structured interviews as the data collection method, providing the flexibility to probe into individual experiences with open-ended questions and allowing interviewees to explain their thoughts and decisions. This interview method [36] has a mix of predetermined questions; the interviewer can change the wording, modify the order of the questions, include additional questions or omit them based on the conversation. A discussion guide [37, 38] was also created. The interview started by asking participants to describe their experience working with MR exhibits and recall the details of their recent MR project. The subsequent questions moved closer to onboarding-related themes. Questions like "What were the visitors supposed to do in the experience?", "How did they know what they were supposed to do?" and "How did you onboard visitors?" were asked, along with questions that probed the need for such experiences. Questions were progressively tailored according to the participant's response. The final section of the interviews was focused on their learnings from all their MR projects in general. They explored the reasons for choosing specific interactions over others and the choice of the narrative structure of the MR experience. The average length of interviews was 45 minutes.

2.1 Participant Recruitment

The participants were recruited using a mixed-method sampling strategy initiated with purposive sampling. Potential participants were identified based on their experience designing or conceptualising HMD-based MR experiences in museums or galleries. The general selection criteria were that they should have worked on the design phase of at least two such projects. A theoretical sampling process was followed as relatively few people work in this field [39]. Initial participants also recommended other potential participants, thereby integrating the

snowball strategy into the sampling method. The sample contained participants with a wide range of experience with MR, devices, roles, and institutions. Sixteen participants were recruited, and their core job profiles were equally distributed across as curators, artists, designers and researchers. Most participants had overlapping roles, for example, a designer who also was an artist or a researcher who also worked as a curator. They had a cumulative experience of 55 years working with MR in the context of museums in their core roles. All the participants had hands-on experience working with more than one MR exhibit. Of the sixteen participants, six were directly affiliated with a museum or gallery, while the others came from various backgrounds and affiliations, including university labs and large tech companies that consult or have partnerships with museums. At the time of the interview, the participants were located in South Africa, Canada, India, Israel, Estonia, Japan, the USA and the UK. Of the recent projects of the sixteen participants, six were based on HoloLens; four were based on HMDs where the physical environment was recreated and mapped on the physical world. Four were tablet-based AR experiences, and two employed projections and motion sensors. All the projects were deployed on-site and had thematic dependence on the physical artefacts or the physical space of the museum institution. The projects included interpreting heritage houses using MR, MR-based guided tours, and MR-based art installations. Two projects were deployed in gallery spaces designed to house the particular MR experience, and the rest were deployed in the museum's existing spaces.

2.2 Data Analysis

The interviews were audio recorded, manually transcribed and anonymised. The author analysed the interview transcripts using an iterative thematic coding process [40], where the initial codes were revised during the analysis. The interview and analysis were carried out by a single researcher. Therefore, care had to be taken to minimise bias. This was done by providing the thematic categories for respondent validation to corroborate the analysis [41]. The feedback was addressed and assimilated into the final themes to improve the accuracy of the findings. The themes were also triangulated against existing HCI and museum studies literature around user onboarding, immersive media, and visitor behaviour.

3 Findings

The results of the survey are divided into three parts. The first part describes the need for an onboarding experience. The second part describes common strategies employed to create effective onboarding. The final part describes the nature of experiences that required minimal onboarding, according to the participants.

3.1 The Need for Onboarding Flows for MR Experiences in Museums.

MR experiences, like other digital interactive experiences in museums, depend on the user's understanding of their agency [22]. Visitors are familiar with screen-based interactive systems like smartphones, which permeate other aspects of daily life. However, HMD-based MR experiences are not yet commonplace, and the interactions are not standardised. As a result, there are chances that visitors may completely miss some of the critical features of the MR experience. As Interviewee 3, who is a media artist, says:

> *"a lot of times people miss it. And then if your whole artwork is based on the interaction, then a lot of people miss the whole experience."*

On the other hand, there is also some hesitation about wearing a headset in a public space. Visitors perceive this as an additional effort. This could lead to even well-designed experiences being skipped by visitors. Interviewee 5 (a curator) says:

> *"It's a much bigger commitment for somebody, you'd get people who'd come in, and they're like, ah, you know, like I'm not gonna put a headset on."*

As a result, it is essential that the visitors can ease into the experience and get a sense of value over the cost of effort [42]. Multiple participants also suggested that effective onboarding was needed as it was important that visitors focus not on the medium itself but on the narrative and the exhibition's subject matter.

3.2 Common Approaches for Effective Onboarding in HMD-Based MR Experiences.

There were a few common themes among participants as their preferred approach to onboarding. These approaches are listed in the subsequent section.

Providing Opportunities to Observe Other Users to Learn and Prepare for Immersion. Interviewees 1, 3, 5, 8, 10, 13 and 14 mentioned making space in the exhibition design to cast the video feed from the HMD onto a larger screen to make it accessible to other visitors who were not wearing the headset. As Interviewee 5 puts it:

> *"even when we had a fairly sort of neutral space, it wasn't, we always had projections. So the headsets were almost always connected to a projector that was kind of the minimum that we would do."*

This had the effect of engaging non-users to help them imagine the experience. It is known that visitors are likely to learn faster by observing other people interact with the system [43]. In the case of MR, the non-user visitors saw 3D content, and the users interacting with it to get a feel for the experience. Interviewee 13 projected a 3rd person view for non-users on a screen. Interviewee 10 mentioned creating a physical window to the exhibit space where people waiting in the queue could watch the users wearing the headsets and interacting. Priming the visitor is also considered a way to help them immerse into the exhibit, as it was noted that the will to be immersed aids in inducing a state of immersion [44]. Interviewee 1(a designer) described this as:

> *"what we find really works is to see, you need to see a person, you need to see where they're standing in relation to the screen you need to see the full space. So that you can put yourself into that same situation."*

Expectation Setting and Multiple Instructional Touchpoints. Interviewees 1, 2, 3, 5, 6, 9,12,13,14,15 and 16 mentioned using more than one way of informing the instructions to visitors. These can be divided into three stages. The first is before the visitor enters the exhibition space. This also sets expectations amongst potential visitors and is usually done through marketing materials, website, and social media content. This includes information about the duration of the experience, device, spatial setting, language, key postures, gestures and 'pre-training' [45]. The second stage is on-site and non-immersive material once the visitor arrives in the exhibition space. For example, sometimes, the space contains carefully placed markers and stickers on the floor indicating where to stand or navigate. Apart from these, the visitor is provided with brochures and sometimes screens with animated instructions. The third stage is that once the visitor wears the headset, they are often presented with audio instructions or a short tutorial to help them onboard onto the experience. The interviewees used a combination of such instructional materials to ensure they could set expectations with the visitors and provide multiple touchpoints for them to engage with the instructional materials, which are readily available when needed [46].

Real Humans and Virtual Avatars as Guides and Trouble-Shooters. Current HMDs must fit correctly on the head and may also use eye calibration to provide a customised experience. This step often requires maximum human assistance. Interviewees 1,3,5,6,7,8,12,13,14, and 15 mentioned the need for a human present to help people wear the headsets and try the experience. For example, Interviewee 5 said visitors with curly hair needed careful assistance to put the HMD on. Interviewee 12 designed an experience where the humans present on the site were actors who dramatised the instructions. Interviewees 14, 15 and 16 also mentioned using human-like or anthropomorphised virtual holographic avatars to greet and guide the users in the experience. As current MR headsets have features like spatial anchors [47], the system always knows the user's relative position and state of the system. Virtual avatars can use this information to inform users about the next steps. This has also been observed by other scholars in the field [7].

Timely Nudges and Gradual Onboarding Interviewees 1, 8, 12, 14, and 15 mentioned approaches where all the instructional materials for user onboarding were not provided at the beginning of the experience but attempted to be provided at the right moment in the visitor journey through the experience. Interviewee 1 mentioned the need to reduce the "frontloading" of instructional materials. Interviewee 14 said they created their experience where the user initially performed simpler tasks, preparing them for more active participation as they progressed. A similar scaffolding approach is also followed by game designers [48], where the subsequent game levels are designed to ease the gamer into the experience and help them acquire the necessary skills gradually as they progress. Similar approaches are also found in the onboarding in UX design, where nudges [49] appear

appropriate, informing the users about their possible choices. This approach was popular amongst interviewees with MR experiences that were perceived to be complex and needed active participation from visitors.

3.3 HMD-Based MR Experiences That Required Minimal Onboarding.

It is generally prescribed in the field of HCI to avoid creating experiences with a steep learning curve and require elaborate onboarding flows [15, 18]. Interviewees also shared this belief, as most indicated their preference to create experiences that are easy to use and accessible to a diverse demographic. A few approaches to developing such experiences emerged that could be categorised based on their narrative structure and response to the physical space as follows:

Linear and Movie-Like On-Rails Experiences. On-rails experiences usually follow a linear narrative and are timed experiences that provide limited agency for visitors to interact with the subject matter. Much like chapters in a story, they are sequential. Interviewee 15 created an experience where each chapter plays out at a different spot in the gallery. The visitor wearing an MR headset must physically move from one spot to another. Interviewee 12 created a similar experience. However, in this case, the next chapter does not automatically start, and the visitor chooses to perform an air tap [50] gesture to invoke the next chapter at the designated spot. Interviewee 13 advocated providing a passive MR movie-like timed experience as they wanted to maximise the number of people who could view the experience; they said:

> *"There could be something more interactive that at the moment we hadn't felt the reason for it. We also think that it might also limit the public - like there might be some people that just to figure out how to interact with, might take them quite a while."*

Interviewee 2 also mentioned this approach by comparing it to a film-like experience to help immerse the visitor better:

> *"I would use something like film to may be aggressively immerse them more."*

Open-Ended and Performative Spatial Experiences. In contrast, there was a view amongst a few participants to create more open-ended and exploratory experiences. There is also existing scholarship that hints at the same [51]. This approach was amplified by Interviewee 4, who preferred their audience to have their interpretation and journey rather than dictating the terms of engagement:

> *"I don't want to guide the people into the experience. I wanted people to discover their own experience."*

Natural acts of walking around, gaze and human activity in space became the drivers of such experiences. Visitors do not need to learn new interactions but can rely on their existing spatial agency to interact with the exhibit. They do not have to learn any new UI and do not remember complex interactions; the experiences are designed for discovery and serendipity. Interviewee 2 mentioned this mode of interactivity as:

> *"Interactivity is the person walking from A to B. As less intrusive as possible to the flow."*

Experiences Grounded in Physical Spatial Elements. Due to current MR devices capabilities like Simultaneous Localisation and Mapping [52], experiences can appear perceptually grounded in physical space. Interviewees 2, 3, 5, 6, 7, 10, 12, 13 and 14 created such experiences where the key idea was to leverage the associations with the space for implicit interactions. For example, Interviewee 12 created an MR scene that can be viewed through a physical window. A visitor would instinctively know to move towards a window and perform the act of looking through it to engage with MR content. Interviewee 8 used a similar concept as they mapped a virtual portal on a physical door, inviting the visitor to cross the door's threshold to move into MR. Interviewee 13, who had built their MR installation around a physical table, encouraged the people to touch and hold the table and referred to this process as anchoring and grounding.

> *"you can lean on it and you can have a point of physical anchoring that sort of grounds you"*

These experiences were considered easier to onboard as they leverage the existing human faculty of spatial perception and the common understanding of architectural and physical elements.

4 Conclusion and Discussion.

Museum visitors have lower thresholds for learning new interactions [42]. Therefore, creating experiences that do not demand significant cognitive investment from the visitor to operate them is essential. MR is still novel and is presented through HMDs. As a result, an initial level of onboarding is required to help the visitor understand the value of the experience envisioned by EMRPs and create a willingness to participate. EMRPs must decide on the appropriate onboarding approach based on the context and the curatorial vision. The onboarding process could start even before the museum visit by providing relevant information regarding the exhibit. Once the visitor arrives at the museum, they may need assistance to wear the headset and find their bearing in the MR space. Due to the diversity of museum visitors, humans may need to assist the visitor initially. After wearing the HMD, depending on the context of the experience, there could be a choice of onboarding approaches. In case of more active experiences, this approach could be a voice, visual and avatar-guided instructional onboarding. Another approach could be making the onboarding process part of the exhibit's narrative. An essential aspect of this discussion is the nature of the experiences that require minimal onboarding effort. Linear and movie-like experiences are less demanding and do not require users to make choices by learning and performing gestures actively. Experiences grounded in physical spatial elements are natural extensions of a typical museum experience, where the visitor is spatially interacting with virtual objects anchored in physical space. This physical grounded-ness of MR exhibits requires further attention and research for truly immersive and engaging experiences. The future direction of the study is to frame recommendations for practitioners to create experiences that need minimal onboarding.

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