Supporting Designers of Immersive Public Installations: Insights from a Multi-Role UX Perspective

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Abstract. Introduction*: Immersive experiences in public contexts hold significant educational and recreational potential. However, there remains a need for a deeper understanding of the factors that shape such experiences.* ***Objective****: This study aims to advance the understanding of immersive public experiences by identifying and analyzing the main components that influence the quality of user interactions, with the ultimate goal of enhancing user engagement and satisfaction.* ***Methodology****: A comprehensive literature review was conducted to identify the key components of user experience in immersive public contexts, including the roles assumed by participants, the journeys they undertake, the methods used to assess their experiences, and the tasks performed by the organizing team. Based on this review, two instruments were proposed: a user journey template and an activity planning guide. A workshop with specialists was then conducted to evaluate these instruments.* ***Results****: The instruments were refined in accordance with the feedback provided by the experts, resulting in enhanced versions designed to assist designers and operational teams in creating richer public immersive experiences.*
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1. Introduction

Virtual Reality (VR) aims to enable sensory, motor, and cognitive activities to be performed by individuals or groups while immersed in a digitally created environment, which can either be entirely fictional or a simulation of the real world. This provides users with the ability to interact, move through the space, and thereby experience an enhanced sense of presence [Peixoto et al. 2021, Rani et al. 2023, Whittaker 2025, Li et al. 2023]. VR has undergone significant technological evolution, contributing to the reduction of cybersickness, decreasing costs, and fostering the growth of interest in developing content based on this technology for the general public, with diverse applications [Greuter et al. 2022, Mai e Khamis 2018, Lin et al. 2019].

Given VR's unique characteristics, its use has demonstrated considerable benefits in fields such as education, particularly when aligned with the gamification trend, facilitating student engagement with the content [Peixoto et al. 2021, Hutson e Fulcher 2023, Kalogiannakis et al. 2021]. This technology allows for the simulation and exploration of scenarios that would otherwise be unfeasible or excessively dangerous [Kavanagh et al. 2017, Weech et al. 2020].

Furthermore, VR's ability to enable simple configurations compared to traditional expository methods and facilitate broader installations represents a significant advantage, especially in museums. It enhances visitors' comprehension and knowledge acquisition [Koebel et al. 2017, Margetis et al. 2020, Jangra et al. 2022]. This recognition is echoed by cultural heritage institutions and professionals, who highlight the transformation potential of immersive technologies in user experiences [Li et al. 2023].

On the other hand, a notable disadvantage associated with the use of immersive experiences with Head-Mounted Display (HMD) in public spaces lies in the fact that these devices are designed for individual use. In public settings, however, it is common for an audience to observe the interaction [Siess et al. 2019]. It is therefore important to consider that the audience's perceived presence, as well as users' prior experiences, significantly affect their cognitive, emotional, and behavioral responses in numerous ways [Rani et al. 2023, Chung et al. 2024]. This introduces unique challenges for the use of such technology in public spaces [Mai e Khamis 2018].

As VR systems incorporate various interaction types, and new forms of interaction continue to emerge, studies investigating user experiences remain essential [Min Kim et al. 2020]. Research indicates that understanding the factors shaping user experience is critical to designing better virtual environments, as users' perceptions within the environment determine the product's success [Chertoff et al. 2010, Xu et al. 2023]. However, despite growing numbers, there is still a limited body of research on how users experience spaces created with this technology [Skarbez et al. 2022, Gugenheimer et al. 2019].

Unlike private environments, in public contexts, interactions with VR systems are significantly influenced by social and environmental factors such as noise and long queues, given the inevitable presence of an audience observing the interaction. This aspect can cause embarrassment for some individuals, exacerbated by the fact that HMD users are unable to see their physical surroundings while their interactions remain easily observable to others [Mai e Khamis 2018, Siess et al. 2019]. Moreover, the mere presence of other people in the space can reduce participants' attention to the virtual environment due to potential interruptions [Auda et al. 2020]. Additionally, immersive experiences involving HMDs pose another challenge: unlike a screen, the device itself lacks an immediate, clear meaning for the user until it is worn and the immersion is experienced. Thus, it is essential to implement triggers that motivate users to take this initial step, fostering engagement with the system [Mai e Khamis 2018].Also, challenges such as space constraints and the need to ensure the proper functioning of technological equipment have been identified as potential factors that negatively influence user experience in public VR installations [Azevedo et al. 2025]. Considering the literature review, except for mentions of the prior selection of immersion based on the audience and review of the experience according to the feedback collected, all activities identified in the literature are exclusively related to the moment when the event takes place. Therefore, they do not provide guidance to the operational team on how to proceed before and after the event.

To support the planning and implementation of more inclusive and successful public VR experiences, we developed two instruments aimed at enhancing the quality of user experience: (i) a User Journey template, which helps map the different stages of

participant engagement, and (ii) an Activity Planning, which systematically outlines the tasks for the organizing team before, during, and after the event. These instruments were designed to help organize both indoor and itinerary events and provide an effective way of reflecting on the whole immersive experience. Even though, many mentioned challenges can be addressed by experienced designers, this work aims to offer instruments that not only support seasoned professionals but also empower designers with varying levels of experience to anticipate and respond to common User Experience (UX) challenges in immersive public events.

2. Literature review

The literature review conducted in this research serves as a foundation for theoretical and applied insights. It facilitated the synthesis of knowledge on the topic of interest and uncovered evidence on the evolution of user experience studies in immersive virtual reality applications within public spaces. It provided clear direction for future research efforts. The rapid review method was selected for its efficiency in quickly gathering reliable information. A single researcher can carry out this approach and apply stricter exclusion criteria to streamline the process [Cartaxo et al. 2020].

The review process was organized into four sequential stages, culminating in the thorough analysis of 45 selected articles. Section 2.1 provides a comprehensive explanation of the methodology used.

2.1. Methodology

Despite the increasing popularity of immersive installations in public spaces, there is a lack of structured guidance on how to design these experiences from a user-centered and operational perspective. The diversity of user roles, environmental constraints, and dynamics in public contexts introduces challenges that are often overlooked or unexplored in the literature. Therefore, this study aims to deepen the understanding of how immersive public installations are experienced and organized, especially through the lens of different stakeholders. To structure this investigation, we defined the following research questions using the PICO strategy [Kitchenham e Charters 2007]:

- **P**opulation: articles investigating user experience in immersive installations in public spaces;
- **I**ntervention: approaches, practices, and methods employed;
- **C**omparison: not applicable, as the purpose of this study is to describe the review;
- **O**utcomes: experience evaluation tools, roles, activities, and user journeys.

Thus, the main research question defined was: **How does the user experience occur in immersive installations in public spaces?**

In addition, to better define what user experience means in this context, the following research sub-questions were established:

- RQ1: What roles are played by the people involved in events featuring immersive installations in public spaces? In public immersive settings, interaction is not limited to the user wearing the HMD. Bystanders, spectators, mediators, and other roles critically influence the user experience through social presence, observation, and coordination. Identifying and understanding these roles is essential for planning, managing, and designing more inclusive and effective installations.

- RQ2: What are the user journeys during interactions with immersive installations in public spaces? While user journey mapping is common in UX design, it is less developed in the context of immersive public installations, where user pathways are shaped by physical space, social influence, and infrastructure limitations. This question aims to clarify how users engage from initial interest to full immersion (or withdrawal), informing designers about critical moments of engagement and friction.
- RQ3: What activities are performed at each stage of the interactions with immersive installations in public spaces? Understanding what tasks need to be done before, during, and after the experience, from setup to mediation and feedback, is key for supporting designers and operational teams, especially in itinerant or large-scale contexts where improvisation is risky.
- RQ4: How is the user experience assessed in immersive installations located in public spaces? Evaluation in immersive environments often relies on lab-based methods or personal devices, which are not always suitable or scalable for public installations. This question investigates how UX is currently assessed in public settings and identifies gaps or underused strategies, supporting more robust and context-sensitive evaluation practices.

The Scopus database[1] was selected for the search due to its extensive coverage, which encompasses content from a wide range of other databases. This broad scope reduces the need to consult multiple sources to achieve comprehensive literature coverage.

With the research questions defined as previously outlined, the next step was to formulate the search string. This process involved iterative adjustments, incorporating different terms and logical operators, until the final string was established, as described in Table 1.

Table 1. Search string used in the literature review.

Search String
(“ux" OR “user experience" OR “user behavior" OR (“design" AND “immersive" AND “experience")) AND (“VR" OR “virtual reality" OR “VR installation" OR “immersive installation") AND (“museum" OR “public space" OR “public context")

The following exclusion criteria were applied:

- EC1: Publications outside the 10-year range (2013–2023);
- EC2: Works that are not conference papers or journal articles;
- EC3: Works written in languages other than English or Portuguese;
- EC4: Works beyond the scope (i.e., not addressing the use of Virtual Reality in the context of public spaces);
- EC5: Works that are not fully accessible online.

The selection of works was carried out by the main author, who consulted a senior researcher whenever doubts arose regarding the inclusion or exclusion of a particular work, as well as for procedure review.

[1] https://www.scopus.com/

The first step involved executing the search *string* in the selected database. After generating the initial list, duplicate records were identified and removed, resulting in 256 works selected for preliminary analysis.

In the next step, the exclusion criteria were applied and the titles, abstracts, and keywords of each article were reviewed. Based on this analysis, 97 works were selected to proceed to the subsequent stage.

Following this, the Introduction and Conclusion sections of each study were read to assess their relevance to the predefined scope, resulting in 56 studies selected for the next stage.

Finally, before initiating an in-depth analysis, the full text of the selected articles was reviewed. At this stage, the articles were evaluated to determine whether they provided meaningful contributions to answering the research questions. As a result, 11 works were excluded, leaving 45 documents for detailed analysis.

A summary of the entire process is illustrated in Figure 1.

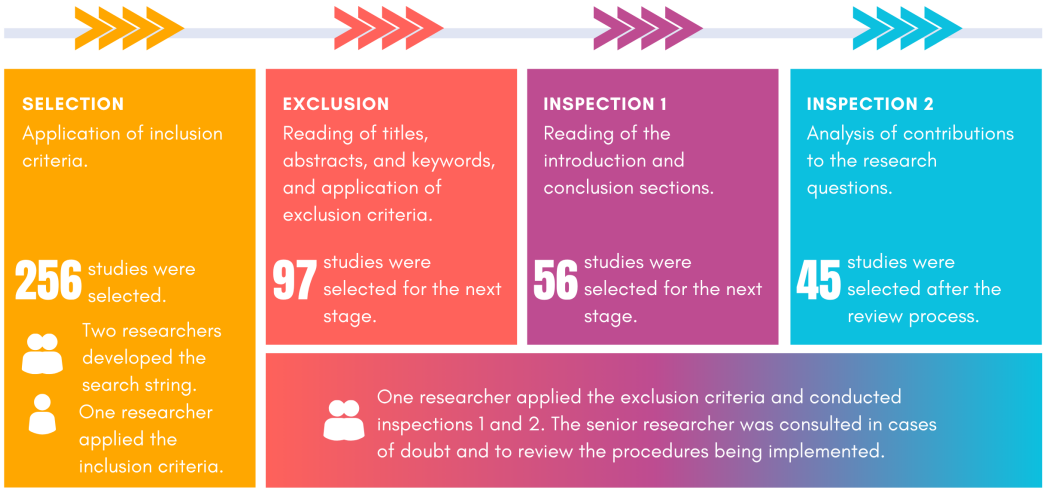

Figure 1. Flowchart depicting the stages of the conducted literature review, its scope, and the number of works resulting from each stage

2.2. Results

2.2.1. What roles are played by the people involved in events featuring immersive installations in public spaces? (RQ1)

Out of the 45 selected works, 12 mentioned the roles that individuals involved in these types of experiences assume.

The concept of co-presence in interactive virtual reality installations was investigated, highlighting the role of the partner [Guertin-Lahoud et al. 2023]. The partner, by being physically present in the real world, can influence the user's experience in various ways, reducing both their sense of presence in the virtual environment and their level of engagement. Another work referencing the role of the partner can be found in Mai et al. (2018) [Mai et al. 2018].

Another study [Greuter et al. 2022] identified 12 distinct roles in their public immersive experiences. To facilitate understanding, the authors proposed a spatial organization of the immersion area, divided into different frames based on varying levels of action power and interest among the roles. In the peripheral frame, which is further from the immersion point, four roles were mentioned. The first is the passerby, someone who moves through the space and may or may not be interested in the experience, a role also seen in the work of Mai and Khamis (2018). [Mai e Khamis 2018]. The second role is the bystander, who shows interest in the immersion but is not yet sufficiently engaged to approach or interact directly with the mediators. Next, there is the spectator, who is more likely to participate and, therefore, gets closer to the immersion, becoming more attentive. It is often the gathering of spectators that attracts the attention of passersby and other spectators, through the “Honey Pot" effect. The last role in this section is the reflector, who may have already visited the experience and is thinking about ways to improve their performance and experience before deciding to join the queue.

The audience frame consists of users who have decided to participate in the experience and are divided into two groups. The first group is made up of the anticipators, users at the front of the queue, about to engage in the immersion, usually with high levels of excitement and euphoria. The second group includes those further back in the queue, who are closer to the performance compared to the audience, and can influence others, either positively or negatively.

In the performance frame, there is the partaker, who has just started the immersion, still adapting to the virtual environment and understanding the mechanics and dynamics of the experience. Following them is the performer, an evolved version of the partaker, now familiar with the virtual environment and more comfortable with the idea of being observed by others. Lastly, there is the appreciator, someone deeply engaged and interested in the content of the immersion, to the point of seeking further information from the operational team.

In the orchestration frame, the operator, often the designer of the installation, possesses great knowledge of the content. There are also the actors, who are used to attract the attention of passersby and spectators, especially when the installation is newly opened. Lastly, there is the invigilator, responsible for assisting users, providing instructions, and supporting the transition between the real and virtual worlds.

In Eghbali et al., the term “user" refers to individuals wearing the HMD and participating in the immersion, while spectators are those who show interest in the user’s actions and try to understand what is happening [Eghbali et al. 2019].

The role of the bystander is also mentioned in Auda et al. (2020) when describing their interest in the experience the immersed user is having [Auda et al. 2020]. In the work of Keenan and coauthors (2020), passerby is also mentioned, in addition to the participants [Keenan et al. 2020]. Another work cites the term voyeur to refer to individuals observing the interaction of an immersed user with the system but who do not wish to actively participate [Siess et al. 2019].

Tennent et al. introduce a new member of the operational team, known as the technician. This person is described as someone who can benefit from the existence of monitoring panels to understand what is happening during the immersion

[Tennent et al. 2020].

Finally, Li and Chang (2017) use the term “surrounding people" to refer to all those who are not immersed [Li e Chang 2017].

To summarize the identified roles, Figure 2 was created, which spatially maps them as described earlier.

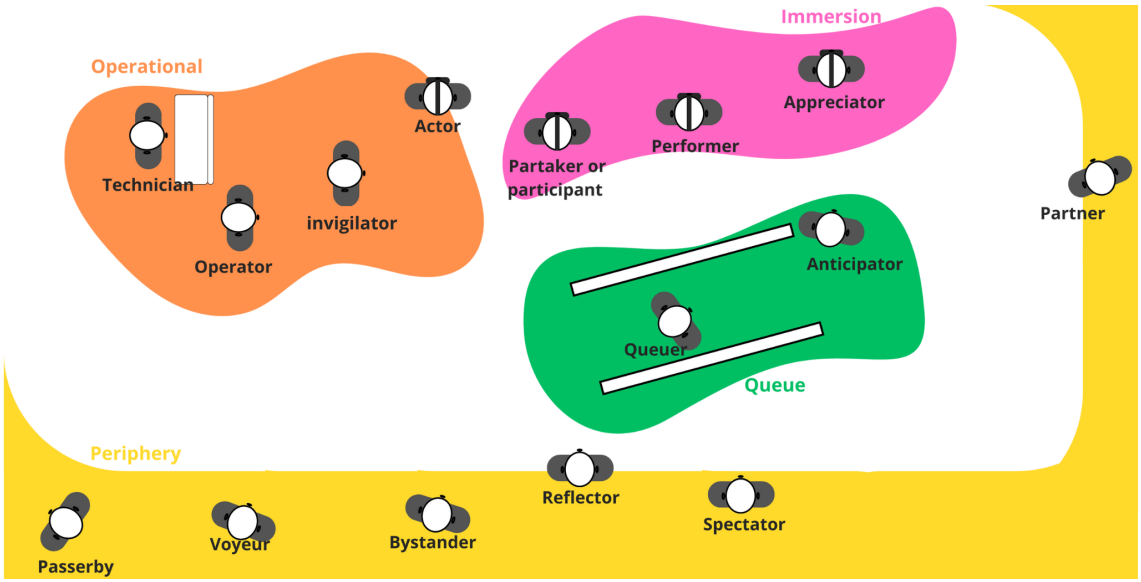

Figure 2. Spatial arrangement of roles identified in the literature, based on their proximity to the immersion area and other visitors

2.2.2. What are the user journeys during interactions with immersive installations in public spaces? (RQ2)

Considering immersive experiences with unsupervised HMDs, Mai and Khamis (2018) proposed an adaptation of the audience funnel model for these contexts. In this model, the user’s attention is initially captured, leading them to observe and react to the immersive experience. Subsequently, they are motivated to interact with the hardware (virtual reality setup), advancing to direct engagement once the device is donned. The user may then explore additional experiences before concluding their interaction, potentially moving on to subsequent actions such as influencing others to participate in the immersion [Mai e Khamis 2018].

The study by Tennent and coauthors (2020) emphasizes the importance of carefully planning both the starting and ending points of the user journey within an installation. This involves determining the number of these points, selecting the appropriate ones, and deciding whether a multidirectional flow should be permitted in the experience. A well-structured design of these moments can significantly enhance user engagement, thereby fostering new possibilities for the journey [Tennent et al. 2020].

In the context of museum spaces, it was observed that visitors often ignore traditional exhibition media in favor of VR-based exhibits. This insight underscores the importance of meticulously planning the visitor’s journey, not only to enrich the VR

experience itself but also to create strategies that encourage interaction with physical exhibits, thus promoting a more integrated experience between the digital and material worlds [Rushton e Schnabel 2020].

Another factor influencing the user journey is the presence of companions, as pre-existing social dynamics can directly affect the decision to participate in the immersive experience. As highlighted by Dahya and coauthors (2021), when a group of friends is involved, they tend to make collective decisions, either opting to participate together or choosing not to participate, particularly among younger individuals [Dahya et al. 2021].

From the perspective of the organizing team, the immersive journey must be designed to ensure that the invitation to the experience, the participation contract, and the return to the real world are appropriately managed [Whittaker 2025].

Finally, in the work of Greuter et al (2022), a passerby can decide to stop and observe the exhibition if their interest is sufficiently aroused. Similarly, a bystander, once captivated by the immersion, may transition into a spectator, who may then decide to join the queue to experience the immersion themselves [Greuter et al. 2022].

Reflective participants, having previously engaged with the experience, seek to improve their experience or explore content they have not yet discovered. On the other hand, participants may either evolve into the roles of performer or appreciator. This progression depends on their willingness to fully engage with the virtual environment, achieving complete immersion, and ultimately assuming the role of an appreciator. Alternatively, if they connect meaningfully with the audience, they may transition into the role of a performer, utilizing the space as a stage.

Figure 3 synthesizes the user journeys identified in the literature and relates the roles outlined in the Greutner et al. (2022)'s work [Greuter et al. 2022] to the stages of the audience funnel proposed by Mai and Khamis (2018) [Mai e Khamis 2018]. This synthesis describes a typical user journey; however, variations may occur as the journey may not necessarily follow a unidirectional flow. An individual may advance to subsequent roles or regress to previous ones, depending on their level of interest and willingness to engage with the immersive experience. In addition, withdrawal can occur at any stage, regardless of the role the individual assumes.

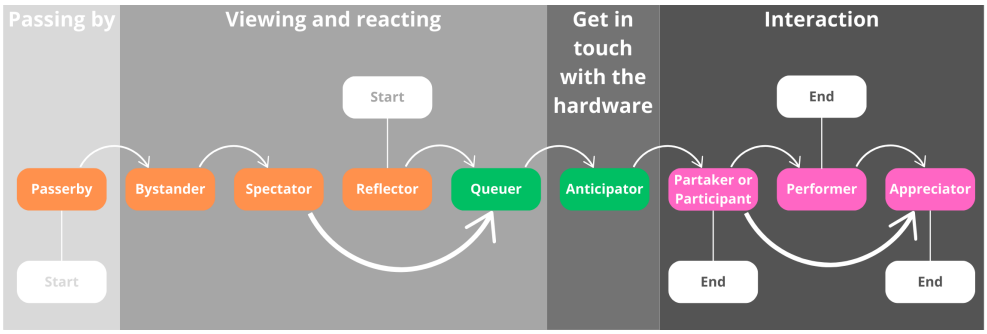

Figure 3. Flowchart synthesizing a typical user journey as identified in the literature.

2.2.3. What activities are performed at each stage of the interactions with immersive installations in public spaces? (RQ3)

The responsibility of providing adequate tutorials to visitors on how to use the immersive experience, covering the mechanics, dynamics, and concepts explored within the experience, as well as offering continuous support during the immersion, was highlighted as a task for the operational team in ten studies [Chung et al. 2024, Whittaker 2025, Bruno et al. 2020, Ogle et al. 2020, García et al. 2020, Keenan et al. 2020, Tennent et al. 2020, Eghbali et al. 2019, Siess et al. 2019, Koebel et al. 2017]. Additionally, three studies [Bruno et al. 2020, Ogle et al. 2020, Rzayev et al. 2020] also mentioned assisting users in wearing the HMD. Another three studies [García et al. 2020, Eghbali et al. 2019, Chung et al. 2024] emphasized the importance of obtaining consent for participant data collection and participation in the immersion. Other studies referred the selection of the immersive experience, considering the event's audience [Xu et al. 2023] and the review of the experience, using feedback data from the audience [Li et al. 2023, Morais et al. 2022, Duer et al. 2020, Keenan et al. 2020].

Ensuring the safety of both users and the audience during the immersion was emphasized by some works [Whittaker 2025, Tennent et al. 2020, Eghbali et al. 2019], while Whittaker (2023) [Whittaker 2025] also highlighted the importance of pre-planning the interaction space.

Finally, some works also ensure proper device and software functioning, in terms of performance and battery life [Whittaker 2025, Tennent et al. 2020].

Except for mentions of the prior selection of immersion based on the audience and review of the experience according to the feedback collected, all other activities identified in the selected studies are exclusively related to the moment when the event takes place. Therefore, they do not provide guidance to the operational team on how to proceed before and after the event.

2.2.4. How is the user experience assessed in immersive installations located in public spaces?(RQ4)

Of the 45 studies analyzed, 36 incorporated at least one method to evaluate the user experience. Among these, 23 employed multiple evaluation methods.

In terms of the tools utilized:

- 17 studies employed interviews with users or experts as part of their evaluation process;
- 11 studies utilized observation as an analysis tool, although 4 chose not to record the relevant material for subsequent evaluation;
- Only 4 studies did not include questionnaires in their evaluation, while 6 studies employed more than one type of questionnaire.

In addition to the types of questionnaires, observations, and interviews mentioned, 11 studies chose to use distinct evaluation tools, including memory tests, focus groups, movement and time graphs, co-creation sessions with experts, hedonic and pragmatic quality analysis, eye tracking, object tracking with which the user interacted, time

measurement to complete tasks, system logs, and feedback from facilitators. However, it is important to note that these tools were always used in conjunction with at least one of the items, such as questionnaires or interviews, which allowed the collection of subjective and objective data.

Table 2 summarizes the types of questionnaires adopted in the user experience evaluation.

Table 2. List of questionnaires adopted for evaluating user experience, along with related works in which they were used

Adopted questionnaires	Works
Presence Questionnaire (PQ)	[Chang et al. 2016, De Paolis et al. 2022]
User Experience Questionnaire (UEQ)	[Phichai et al. 2021]
Positive and Negative Affect Schedule (PANAS)	[Hürst et al. 2016, Mai et al. 2018]
Igroup Presence Questionnaire (IPQ)	[Mai et al. 2018, Rzayev et al. 2020, Chung et al. 2024]
Measurement, Effects, Conditions Spatial Presence questionnaire (MEC-SPQ)	[De Luca et al. 2023]
Simulator Sickness Questionnaire (SSQ)	[Weech et al. 2020, Chung et al. 2024]
Player Experience of Need Satisfaction (PENS)	[Weech et al. 2020]
Player Experience Inventory (PXI)	[Weech et al. 2020]
System Usability Scale (SUS)	[Othman et al. 2021]
Self-authored questionnaire	[Hürst et al. 2016, Fabola et al. 2017, Li e Chang 2017, Antlej et al. 2018, Kelling et al. 2018, Koebel et al. 2017, Eghbali et al. 2019, Lin et al. 2019, Rhee 2019, Tennent et al. 2020, Rzayev et al. 2020, Steier 2020, Dahya et al. 2021, Rudi 2021, Okanovic et al. 2022, Soccini et al. 2022, Guertin-Lahoud et al. 2023, Abrunhosa et al. 2023, Li et al. 2023, Tsita et al. 2023, Hutson e Fulcher 2023, Rizvic et al. 2019, Cartaxo et al. 2020, De Luca et al. 2023]

3. Proposed instruments for supporting immersive interaction in public spaces

The literature review covered a wide range of immersive public installations, including various types of devices such as CAVE systems, passive and active HMDs, as well as events of different nature, indoor and outdoor. Exhibitions held in spaces such as museums, libraries, galleries, and fairs were also considered. Despite this diversity, the development of activity and journey templates was initially designed for immersive public events of an itinerant nature, mainly utilizing HMD.

With the aim of assisting designers of immersive interactions in public spaces to enhance the user experience within their immersions, two instruments (see Figures 4 and 6) were proposed to help organize events and provide an effective means of reflecting on the whole immersive experience. The development of these instruments was guided by the User-Centered Design (UCD) framework, which consists of three core phases: research, design, and evaluation [Williams 2009]. The research phase was conducted through the literature review described in Section 2. Based on this, an initial version of the instruments was created. To evaluate the instruments and generate new insights for improvement, a workshop was then conducted with specialists involved in the development and mediation of public immersive installations.

The workshop involved three specialists in immersive events conducted in public spaces. The participants included director of Museu Casa da Descoberta[2], who has extensive experience organizing public and itinerant events featuring immersive installations (hereby named E1), a User Experience designer with 5 years of experience in VR (hereby named E2), and a developer of immersive installations with 8 years of experience (hereby named E3). The specialists were invited via email, which contained written materials detailing the proposed instruments along with their respective explanations.

The meeting took place on 30 October 2024 at Medialab[3], in the Computing Institute of the Federal Fluminense University, and lasted approximately two hours.

The workshop was divided into four stages:

1. Initially, contextual information was provided regarding the development of the instruments, along with a clarification that the purpose of the session was to evaluate these instruments;
2. Then, the participants signed the Informed Consent Form;
3. The first instrument presented was the operational team activities plan;
4. After explanations and discussions regarding the activities plan, the User Journey template was presented and debated.

For each instrument, the researcher presented the components step by step, followed by the observations of the participants. This format ensured that the explanation was still fresh in their minds, preventing the passage of time from compromising the comments by causing them to forget any details.

The audio of the workshop was recorded to ensure a complete record of all discussions raised. Subsequently, the Transkriptor[4] platform was used to transcribe the information. For data analysis, Qualitative Content Analysis [Elo e Kyngäs 2008] was employed, with the unit of analysis being the themes identified in the transcribed excerpts. An initial round of deductive coding was conducted to associate each excerpt with the specific instrument it referred to. In a second round of coding, the excerpts were categorized according to either an activity from the Activity Planning instrument or a section from the User Journey template.

[2]https://casadadescoberta.uff.br/
[3]http://medialab.ic.uff.br/
[4]https://transkriptor.com/

3.1. Activities planning instrument

First, the tasks identified in RQ3 were listed. The main researcher then categorized these tasks based on their execution timing (before, during, or after the events). The tasks were then grouped according to their scope, with additional tasks incorporated as needed for the pre and post-event phases. A detailed description was then developed for each item. The resulting workflow was reviewed by the senior researcher, who suggested a series of modifications, which were implemented in the instrument before it was presented at the workshop with the experts. The activities plan can be seen in Figure 4.

The following insights were derived from the workshop:

Regarding the training activity, it was suggested that it be adapted to include training for the technical team responsible for assembling and disassembling all equipment used. One of the experts commented:

> **E1:** *"The team that sets up the exhibition is a technical team, which is not necessarily the same as the one mediating the exhibition. This team must be capable of assembling the structure in any location."*

Still, regarding pre-event activities, it was suggested that transportation be included as one of the tasks to be carried out, given its direct influence on the structure available to the team for planning and organizing the immersion.

> **E2:** *"The organization needs to consider the size of the structure, as it must plan adequately for transportation."*

Another participant added:

> **E1:** *"It is also necessary to consider the disassembly and transportation after the event ends. After all, unless it is a fixed immersion, the structure will need to be moved to different locations."*

There was a consensus that, in events of medium to macro scale (defined as those involving more than 200 participants [de A. Menescal Campos 2000]), it would not be feasible to individually inform each person about data collection and obtain their consent. This is evident in the following quotes:

> **E1:** *"In events with large crowds, it becomes very difficult to collect consent through a written document, for instance, as this impacts the queue."*

> **E3:** *"What I see at events requiring consent is signage indicating that, by being in that area, individuals consent to data collection."*

In response, the activity description was updated to require interaction designers to develop more practical and scalable methods for communicating data collection procedures, while respecting privacy norms and existing legislation.

Additionally, it was discussed that during the introduction and demonstration, mediators should clearly inform participants about potential triggers the experience might cause, to minimize discomfort or unpleasant surprises.

> **E2:** *"At this stage, before the immersion begins, the characteristics of the experience that may negatively stimulate individuals should be highlighted."*

Regarding the preparation and initiation of the immersion, the following recommendation was made:

> **E1:** *"The [HMD] device should only be placed on the user after they are already in the correct location to begin the immersion."*

Thus, in the final version of the activities plan, the order of tasks was adjusted, switching the steps of positioning the participant at the starting point of the immersion and putting on the HMD.

Furthermore, the experts emphasized the importance of checking the specifications of the equipment to be used, as older VR devices require environments with controlled lighting to avoid damaging internal displays. One participant shared their experience:

> **E3:** *"I learned this the hard way when I burned my glasses after conducting a session in the university parking lot, which is an open and bright area. After that, we noticed a stain on the display."*

Following the implementation of the suggested adjustments, the activities plan was expanded to encompass 16 distinct activities, which are thoroughly detailed in the following list and visually represented in Figure 4. It is important to note that the activities plan was designed to be adaptable to different types of immersive experiences in public spaces. Therefore, the team should critically assess and select the activities relevant to their specific context.

- **A1. Operational Team Training:** Ensuring a seamless VR experience requires that mediators have a thorough understanding of the technology and the immersion being mediated. Such understanding will allow them to adapt their approach to the audience and provide support and guidance to users during the experience. Therefore, training must be comprehensive, covering the handling of VR equipment, the mechanics and dynamics of the immersion, as well as the experience theme, so that they are well-equipped to offer technical support, explain concepts, and answer visitors' questions. Furthermore, it is important to include professionals trained to assemble, disassemble, and transport the entire interaction setup, making it necessary for the training to also cover these logistical aspects;
- **A2. Technical Setup:** The proper functioning of software and hardware directly impacts the quality of the experience provided. The operational team must ensure that the software used in the immersion is updated, preferably to stable versions. Additionally, equipment should be clean, functioning properly, and fully charged. The team should also have spare devices available for replacement if necessary;
- **A3. Interaction Planning:** Interaction designers must plan the space by establishing clearly defined perimeters - one for the participants' queue to maintain order while they wait and another for the mediators' support area, allowing easy access to devices and support materials. Moreover, the immersion

area should be appropriately sized to ensure participants can move freely and safely without risk of collisions. Another important point is ensuring that participants can move through the interaction area without disrupting others, allowing any person to leave easily without causing interruptions. Collecting detailed information about the space and visitors—either by conducting a preliminary visit or contacting those responsible—helps ensure well-planned interaction. Structural requirements, transportation planning, and interaction setup must also be defined;

- **A4 and A13. Transportation:** Proper transportation of the setup is crucial to ensure all materials arrive intact and with sufficient lead time before the event. This allows the structure to be installed and reviewed without last-minute issues, ensuring that all elements are ready and functional when the event opens;
- **A5. Interaction Organization and Setup:** The interaction area must be properly organized and marked to facilitate visitor orientation. Signage should clearly indicate the queue location, immersion area, exit points, and support station for the mediation team. While organization should follow the plan, it is also important to be prepared for on-site adjustments. If the experience is itinerant, the team should also consider moving the structure for storage between events;
- **A6. Data Collection Notification:** If data collection occurs during the immersive experience—whether for research or improvement purposes—this must be clearly and objectively communicated to users before the immersion begins. Users must have the option to decline participation and, if so, have a discreet way to leave the immersion area. Communication should be scalable, clear, and compliant with current privacy regulations;
- **A7. Introduction and Demonstration:** Before the experience begins, mediators must establish contact with participants, providing clear instructions on what to expect from the activity. This includes explaining concepts, dynamics, and mechanics of the activity, as well as informing participants about potential triggers, such as fear of heights or darkness. In addition to verbal instructions, support materials such as explanatory cards, videos, or an early immersion in a virtual environment can be used to aid understanding;
- **A8. Immersion Preparation and Start:** In the moments before immersion, mediators should position participants in the appropriate location and, if the user is not yet equipped, assist them in donning the VR devices, starting the immersion only once the participant is ready;
- **A9. Immersion Transition and End:** After the immersion ends, mediators should reconnect with participants, assisting with the removal of equipment and ensuring a safe exit. This moment is ideal for gathering quick impressions from participants and inviting them to provide more detailed feedback if desired;
- **A10 and A14. Technical Maintenance:** The team must constantly monitor the need for cleaning, replacement, or recharging of devices to ensure the continuity of the experience. At the end of the event, maintenance should focus on cleaning and properly storing the equipment;
- **A11. Ensuring Participants' Physical Safety:** The team is responsible for ensuring the safety of participants during the immersion. This includes preventing falls, collisions with obstacles or other participants, and being prepared to intervene in case of imminent danger;

- **A12. Interaction Disassembly:** At the end of the event, if necessary, the team must disassemble the setup and ensure that the material is properly packed for transportation, thereby reducing the risk of damage during transit and facilitating storage until the next use;
- **A15. Feedback to the Development Team:** If the software used is under development or can be modified, it is important for mediators to meet with the developers after the event to share necessary improvements or fixes;
- **A16. Refining the User Journey:** The immersive experience can always be improved. Therefore, after the event, experience designers and mediators should discuss enhancements based on feedback and observations made during the event. To gather the inputs that will be used in this stage, some of the tools discussed in the Literature Review (Section 2.2.4) can be utilized;

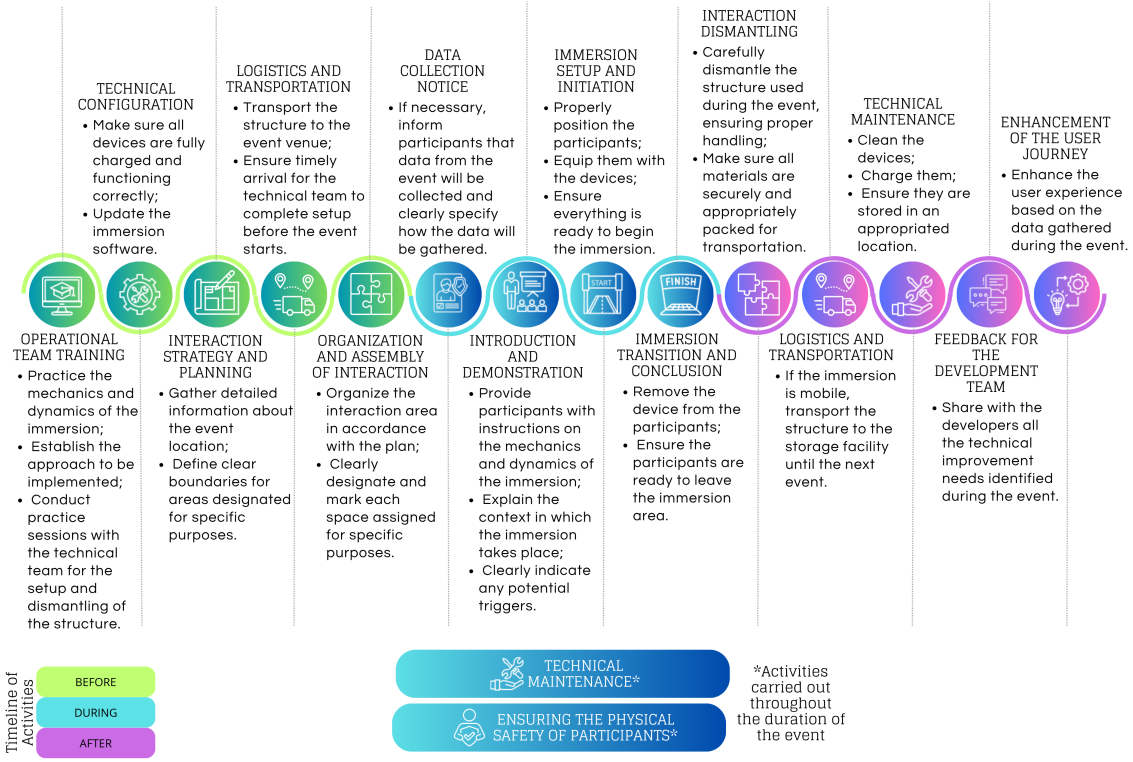

Figure 4. Planning of activities across immersive interaction phases in public spaces, with “before",“during", and “after" stages shown in green, blue, and pink, respectively.

3.2. User Journey template

To provide a means of observing, reflecting and planning the user experience, a User Journey template was proposed (see Figure 6). This template should be filled out based on the user experience, with the exception of the sections “Roles", “Actions", and “Interest". These sections describe a standard for experiences of this type, as the roles and their respective actions were defined based on the findings from RQ1 and RQ2 in the literature review, and “Interest" was defined as increasing as the user becomes more deeply engaged with the experience.

On the other hand, the sections “Touchpoints", “Thoughts", and “Experience" should be fully completed according to the experience being observed.

Initially, the template was empty and the experts were invited to complete the User Journey template based on their experience from one of the events they organized. The selected event took place at the Museum of Contemporary Art (MAC) in Niterói (RJ, Brazil) and featured three immersive experiences in its main hall. The chosen experience involved gameplay inspired by a windsurfing tour, in which participants navigated a designated circuit, visiting points of interest and collecting waste along the way. To enhance immersion, the virtual reality setup controls were integrated into a windsurf board, as shown in Figure 5 (A) and (C), enabling users to physically interact with the equipment, which was fully synchronized with the virtual environment being explored, see Figure 5 (B).

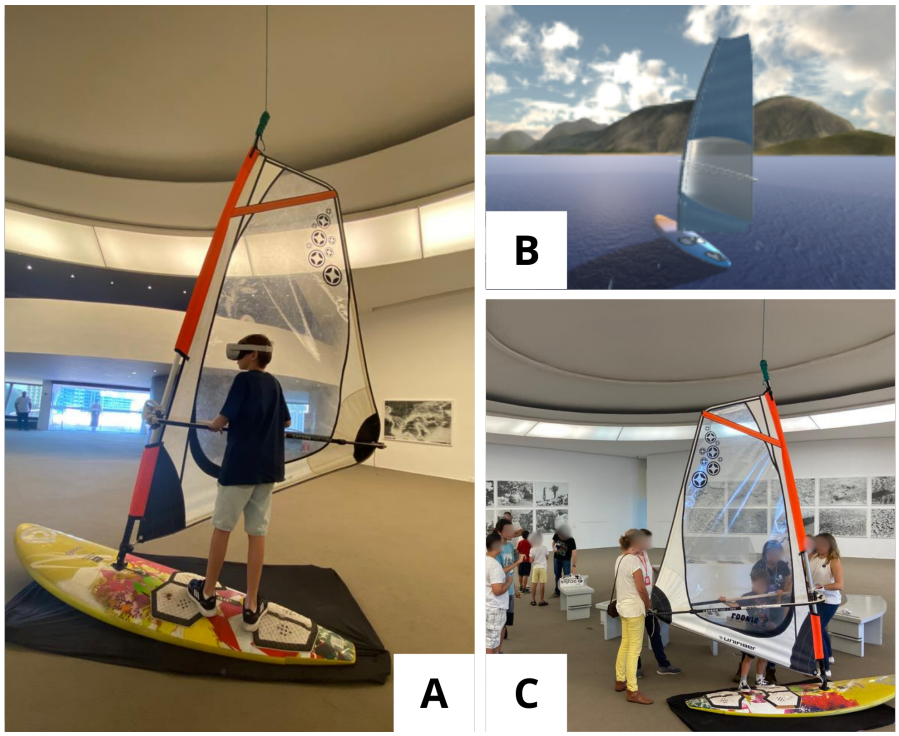

Figure 5. Composite image of three visual elements showcasing the WindyVR immersive installation: (A) A user interacting with the installation, wearing a HMD and engaging with a windsurf board setup that serves as a physical interface; (B) A screenshot of the virtual environment depicting the scenic setting of the experience; (C) The immersive installation set up in the main hall of the event venue

The workshop’s participants pointed out that interest is not necessarily a growing factor, and this is a characteristic that becomes evident in practice.

> **E1:** *“A person may choose a particular immersion because the line is shorter, or because they have already experienced the other immersions."*

> **E2:** *“I also thought about this, because we get many reports like this in practice. So, I believe that the ideal approach for interest is to be filled based on the evaluation being made."*

One participant also commented on the need to include a different type of sentiment.

> **E2:** *"I believe it's necessary to add a sentiment related to cybersickness."*

Later, the same person commented:

> **E2:** *"Since we are dealing with immersive experiences, frustration is a sentiment that makes more sense than sadness. Frustration, along with satisfaction, tends to appear frequently in this context."*

To accommodate the newly suggested emotions, the terms "disgust", "sadness", and "trust" were replaced with "discomfort", "frustration", and "satisfaction", respectively.

Regarding the engagement triggers, the experts noted that the surprise element created by the introduction of the windsurf board, and its impact on first-time users, was not intentional. Rather, it resulted from their effort to incorporate additional sensory experiences into the immersion—beyond just visual and auditory—by also including a tactile dimension.

Related to frustration and discomfort the experts mainly mentioned problems involving the "Queuer" and "Anticipator" roles. They observed that people expressed doubts, such as: "How long is the experience?", "How long should I stay in this line?" or"How should I use this equipment?". As a result, some people gave up waiting, while others stayed motivated after seeing previous participants leave the experience satisfied.

A participant also mentioned that it is important to provide users with sufficient information to prevent them from waiting in line and experiencing unnecessary negative feelings.

> **E2:** *"Sometimes, people feel uncomfortable waiting in line. Ideally, they should only enter the queue if they are able to participate in the immersive experience — whether due to physical limitations of the setup, such as height restrictions, or personal concerns, such as fear of the immersive environment."*

Furthermore, at this point in the journey, the experts observed the frustration and negative surprise of some users upon discovering that they could not participate due to the minimum height required for the experience.

Feelings of fear were observed both moments before embarking on the experience and during the initial stages of immersion.

Discomfort was mainly observed in the "Participant" role, particularly among users who attempted to engage with the immersion but were interrupted abruptly due to the effects of cybersickness. At the start of the immersion, participants may experience a range of emotions, depending on the number of people around them. These emotions can include discomfort from being observed, frustration from struggling with the controls, and, ultimately, surprise, satisfaction, and joy upon successfully engaging with the virtual environment.

There was also a discussion regarding the need to include two similar emotions, such as joy and euphoria. However, euphoria is characterized by a heightened sense

of excitement and enthusiasm, which is typical of users who are about to begin the experience. Therefore, both emotions were retained in the set, considering their distinct nuances and the unique role each one plays in the user experience.

At the end of the immersion, some users may feel frustrated, as mentioned by one of the experts.

> **E1:** *"Many users feel frustrated at the end, wishing to enjoy it for a longer period."*

Thus, the template, adjusted according to the contributions from the workshop with experts and properly instantiated for the previously mentioned immersive installation, is shown in Figure 6.

At the end, the workshop participants shared that this user journey template helps them better identify key areas for improvement in future installations.

3.3. Guidelines for applying the proposed instruments

First of all, we need to define the installation context and clarify whether the installation is educational, artistic, promotional, or experimental. Next, select and customize the instruments. At the Activities planning instrument adapt the list of tasks to the scale and type of the event (e.g., itinerant vs. fixed; indoor vs. outdoor). For the User Journey Template customize touchpoints, emotional markers, and context-specific phases (e.g., onboarding, immersion, offboarding). Afterwards, apply the following steps:

1. Apply the Activity Planning Instrument during pre-event phase;
2. Use the User Journey Template during observation or testing. At this point, methods for capturing de user experience can be tailored for each event;
3. Reflect and adjust the experience based on the insights collected. Use feedback, facilitator input, and journey maps to identify pain points, missed opportunities for engagement, as well as unexpected successes.
4. Conduct additional empirical tests to verify the effectiveness of the improvements and propose further refinements, following an iterative validation process.
5. Document and share findings by creating a report or summary highlighting what was learned from both tools.

These records can support internal training for future events, publications or case studies as well as further iterations of the instruments themselves.

Besides, this approach will enable the validation of the effectiveness of instruments and their continuous enhancement, maximizing their positive impact on the user experience. As such, the versions presented should be regarded as a starting point for an incremental development process, which may involve enhancements and expansions. In this context, new roles may be incorporated into the mapped user journeys, and new evaluation dimensions may be added to the proposed template.

4. Conclusion and future directions

In this study, we sought to compile information from the literature to provide a comprehensive understanding of how interaction occurs in immersive experiences in public spaces. Our primary objective is to understand the various roles involved, the

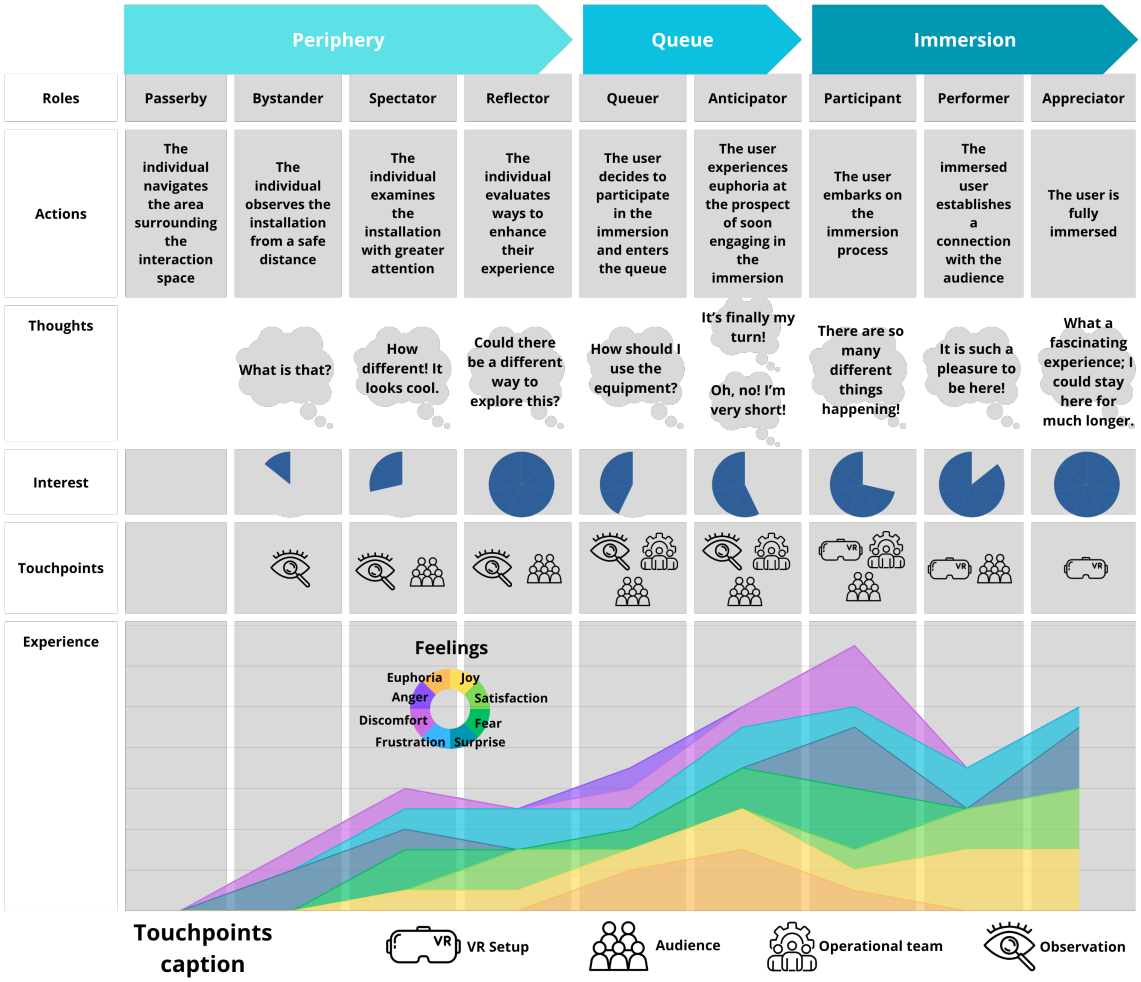

Figure 6. User Journey template based on insights from an expert-organized event. It outlines the transition between roles. As a bystander, the user observes the experience; as a spectator and reflector, they also engage with the audience through comments and gestures. In the queue area, contact begins with the operational team. Upon entering the immersive zone, the user dons the HMD, continues interacting with the team, and becomes visible to the audience. As a performer, interaction with the team ceases, but awareness of the audience remains. Finally, as an appreciator, the user becomes fully immersed, even disconnecting from the audience.

observed user journeys, the necessary tasks, and the evaluation methods employed in such installations.

At the conclusion of the study, in collaboration with experts in immersive installations for public spaces, we developed instruments designed to assist designers in the creation of these environments. These instruments aim to support operational teams in performing their tasks and implementing strategies to enhance the user experience. Additionally, they provide a framework for evaluating the experience and structuring the planning of user journeys.

While tools such as service blueprints [Pöyry et al. 2024] and VR journey maps [Mast et al. 2021, Yu et al. 2022] are valuable for structuring individual, collaborative

or service-oriented experiences, they often fall short in addressing the complexities of immersive public installations, which involve multiple user roles, operational constraints, and dynamic public environments. In contrast, the proposed instruments were specifically designed to support designers working in public and itinerant VR contexts, offering a structured method to plan logistics, anticipate challenges, and reflect on user engagement including non-immersed audiences and mediators. Unlike conventional journey maps, our tools integrate both design and operational perspectives, helping teams align user experience goals with real-world constraints.

As a final contribution the proposed instruments (Activity Planning and User Journey Template) can support not only practitioners, but also academic researchers and novice designers. For instance, researchers may use these tools as methodological guides for studying user experience in public immersive contexts, or adapt them to structure empirical studies. Moreover, while experienced designers can indeed solve some issues intuitively, our framework offers a structured way to anticipate edge cases, communicate between multidisciplinary teams, and document design rationale, which is valuable in collaborative or high-stakes environments.

Considering that it was not possible to perform tests and observations in real-world installations within the scope of this study due to time and logistical constraints, this limitation may impact the validation of the effectiveness of the proposed instruments. Therefore, as future work, it is recommended that empirical testing be carried out by a professional responsible for planning the user experience in immersive public installations. Furthermore, future research could explore adjustments to make immersive installations more accessible and inclusive, thus expanding the potential to create satisfying journeys for a broader audience. Another point to explore may be related to cultural differences and their impact on interaction in public spaces. Such instruments can undergo cultural adaptations to better serve these different behaviors, such as how to deal with long queues in lines, embarrassment in interacting in front of other people, and how to express their emotions in public spaces. In this direction, some studies have proposed strategies and design recommendations to overcome obstacles and enhance user experience in immersive public spaces [Azevedo et al. 2025, Greuter et al. 2022, Eghbali et al. 2019].

We also recommend investigating the impact of co-presence in immersive public installations, adjusting instruments to address this aspect. To evaluate the effectiveness of instruments, future studies could compare experiences in events where instruments were applied to those where they were not.

Finally, we highlight the importance of applying these instruments in immersive experiences that do not require the use of HMDs, exploring new possibilities for interaction and engagement.

5. Ethical Considerations

This study involved a design evaluation workshop with adult professionals (designers and event organizers) who participated voluntarily and provided feedback based on their expertise. No sensitive personal data was collected, and participants were not evaluated as research subjects. The workshop focused on assessing design instruments rather than studying participants' behaviors or characteristics. All participants received

detailed information about the purpose of the session and signed an informed consent form authorizing the use of their comments for research purposes. In accordance with our institution's guidelines and the ACM policy on research involving human participants [ACM Publications 2021], this type of activity is considered low risk and did not require submission to a formal ethics committee. Nonetheless, the study adhered to ethical research principles, including respect for privacy, voluntary participation, and anonymization of all data presented in this publication.

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