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Audience engagement in immersive installations

An exploration of key components through designing and evaluating immersive experiences

Master's thesis in Interaction Design and Technology

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Gothenburg, Sweden 2025

MASTER'S THESIS 2025

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Master's Thesis 2025
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Cover: Photo of the final immersive installation.

Typeset in L^AT_EX
Gothenburg, Sweden 2025

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Abstract

Immersive installations can be defined as real-world spaces where walls and floors are covered with moving projections, combined with surrounding sounds and light, to create an immersive and multi-sensory environment [1]. Visual Arena is a platform that brings together multiple stakeholders from the XR industry, and they have observed a growing interest in exploring immersive installations in Gothenburg. This thesis is a part of Visual Arena's feasibility study on audience engagement within such installations.

The project was guided by design thinking and followed an iterative design process proposed by Visual Arena, inspired by the well-known double diamond framework. It includes four phases: empathize, frame, experiment, and deliver. The approach resulted in the creation of a high-fidelity prototype in collaboration with Visual Arena's partner network to facilitate the development of an immersive installation.

Visitor feedback indicated that visuals, sound, and interactions contributed to a sense of engagement and immersion. While the onboarding areas helped visitors engage with the theme, they were less effective at preparing users for interactions within the immersive installation. Only a small subset of visitors identified a clear narrative, which may be a consequence of the less prominent storytelling due to technical challenges and time constraints. As a result, conclusions regarding the impact of narrative on user engagement remain ambiguous. Future work should further investigate the role of storytelling in immersive installations and evaluate the technical feasibility of implementing such installations.

Keywords: Immersive, installation, interaction design, storytelling, projection mapping, engagement, XR.

Acknowledgements

We want to express our immense gratitude to Martin Högenberg and the rest of the team at Visual Arena, for continuously inspiring us through their innovative minds and giving us the chance to join their explorative projects. We also want to thank the rest of the partner network at Visual Arena, whose joint efforts created an amazing opportunity for us to learn and participate in the creation of an immersive installation. Lastly, we want to thank Olof Torgersson for supervising and guiding us when needed.

Julia Böckert & Isabelle Ermeryd Tankred, Gothenburg, 2025-06-19

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1

Introduction

Immersive technologies usually refer to any technology that blends physical and virtual components, in order to give the user a sense of immersion [2]. Immersive technologies have become increasingly popular, and today we see many exhibitions claiming to be immersive. With the advancement of immersive technologies, such as virtual reality, augmented reality, and projection mapping, audiences are becoming more aware of their unique combination of interactivity and immersion.

Immersive technologies have opened up new art forms for artists and developers to express themselves [3]. Participants also become more active as they step into a multi-sensory and interactive environment, where their participation enhances their experience. These digital technologies create more opportunities for artists and users to explore a creative space together.

One type of immersive experience is immersive installations, which use projection mapping to display videos or images onto any surface to create an immersive space [3]. By blending physical and digital spaces, immersive installations can redefine how we experience music, art, and culture. The purpose of this thesis is to explore different aspects of immersive technologies and user experiences, to revolutionize the way physical immersive installations can be used to inspire, engage, and explore narratives.

1.1 Research Problem

Visual Arena is a neutral platform, meaning it does not represent a single organization's interests, that brings together actors from business, industry, universities and institutes, cities, regions, and authorities for collaboration and projects that lead to new ways of visualizing to help and strengthen work for a sustainable future [4]. Visual Arena has seen a growing demand from its network to explore the potential of immersive installations. Therefore, Visual Arena has become involved in a project that aims to position Gothenburg as a hub for cutting-edge immersive technologies, redefining how people engage with music, art, education, entertainment, and beyond. By blending physical and digital spaces, immersive installations open up unparalleled opportunities for engagement, creativity, and inclusion. During their project, Visual Arena has gathered several participants representing private businesses, public organizations, academia, and artists, each contributing unique perspectives to this initiative. The project will also be part of the XR Sweden feasibility study

[5], which is financed by Vinnova, Sweden's innovation agency. Their mission is to strengthen Sweden's innovative capacity and contribute to sustainable growth.

This thesis is part of the feasibility study, which aims to gain insights into immersive installations with the help of Visual Arena and its partners. Visual Arena provides a framework for innovation, a large network of experts, and inspiration when needed. While all projects within this feasibility study center on immersive installations, their technical approaches and thematic focus vary. This thesis specifically aims to explore which elements most significantly contribute to the user experience, with a particular emphasis on storytelling and narrative design in immersive installations.

1.2 Research Question

After discussions with Visual Arena and its partners, as well as research within academic literature and practical examples, the main research question was shaped to be:

What critical components are needed to enhance audience engagement in immersive installations?

1.3 Delimitations

Visual Arena does not produce finished products that are released to the market. Instead, they support other companies by facilitating exploration and innovation in ways that companies might not achieve on their own. This thesis aims to provide insights and recommendations for Visual Arena on how to proceed with immersive installations. As a result, this project will not involve the creation of production-ready prototypes of immersive installations, but rather experiments that serve as precedents to full-scale installations. The responsibility for developing complete immersive installations, including necessary technology and resources, lies with Visual Arena's partners. This thesis will serve as an exploratory phase, providing user insights that these partners can use for future development efforts.

2

Background

One of the earliest examples of what can be considered immersive art is the panorama [6]. Theatres use panorama paintings to guide the viewer from story to story, and place to place. Today, Virtual Reality (VR) and Augmented Reality (AR) are often considered as the main protagonists in immersive experiences [7]. VR places the user in an entirely virtual environment by using a headset, while AR blends virtual components with the user’s reality using a device, such as a mobile phone [8]. Extended reality (XR) is an umbrella term for immersive technologies [9], including VR, AR, and mixed reality (MR), as well as potential future technologies. XR solutions are described as “computer-generated immersive environments”, where audio plays a large part in the user experience. A unique element of XR is its ability to allow the user to explore an environment from a first-person perspective [10], which makes certain storytelling aspects more suitable for XR.

Although immersive installations are not dependent on personal devices, their use of projection mapping to transform physical spaces into immersive environments places them within the scope of XR technologies [11]. Therefore, this thesis draws on existing XR research, as immersive installations share goals with other XR technologies, such as creating immersive experiences and enhancing participant engagement.

To further define the concept of immersive installations, Sadia [1] describes an immersive installation as a real-world space with moving images or projections, surrounding sounds and lights, creating a fully multi-sensory space. VR and AR are device-based technologies, and provide users with a high degree of control and more defined content to explore [7]. However, projections on walls bring the user closer to the experience, as no headset or device stands between user and content. In the context of engagement, this means that participants in immersive installations can more easily share the experience with fellow users, compared to the more individual experience of VR and AR. The device-less and shared experience in immersive installations, together with users’ first-person perspective in the environment, makes them an interesting XR technology for exploring user engagement.

In addition to their engaging format, immersive installations are described as having “unique advantages over traditional galleries and museums, including accessibility, interactivity, and the ability to present works that transcend physical limitations” [12]. These characteristics align with Visual Arena’s vision of innovation and new formats for audience interaction.

Moreover, immersive installations are often designed to be visually striking and easily shared on social media. As de Souza [12] writes about one immersive installation: “The highly-instagrammable Infinity Rooms invite viewers to step into a world where the boundaries between the self and the surrounding cosmos blur, offering a unique experience that has exploded in popularity since the advent of social media”. For Visual Arena and their partners, this sharability adds another layer of value, as visitor-generated content can attract new audience and extend the reach of the installation far beyond its physical space.

2.1 Related Work

Multiple examples of immersive installations can be found around the world. Tokyo TeamLab Borderless [13] consists of projected, moving artworks that cover walls, floors, and ceilings, see Fig. 2.1. The artworks are influenced by each other and by the visitors to the installation and are not limited to specific spaces, hence the word borderless. TeamLab uses lamps, hanging lights, and non-flat surfaces to create mesmerizing experiences, while places like Atelier de Lumières in Paris [14] use existing artworks from famous artists such as Picasso, and animate them mostly using projections on flat surfaces. Fabrique de Lumières in Amsterdam [15] has similar installations, where a majority of artworks come from Dutch artists.



Figure 2.1: Image from Tokyo TeamLab Borderless [13]

Projection mapping is also being used in museums and exhibitions, where visuals can be projected onto displayed historical artefacts and create a more interactive venue for visitors to explore [16]. In Greece, a historical electric car was displayed through projections onto a wall, and using touch-points, users could interact with certain parts of the car in order to unveil the whole story of the car and its development. Another example is from Denmark, where researchers experimented with projecting visuals and text onto rune stones, in order to engage the audience and spark discussions. An exhibition more connected to criticizing society is “SOIL: The World at our Feet” [17], which uses projection mapping to show visuals of what is underneath and inside the soil on earth, and sounds recorded from microbial life, see Fig. 2.2. The exhibition is meant to increase sustainable behaviour with visitors

and show how humans affect the environment.



Figure 2.2: Image from SOIL: The World at our Feet [17]

More locally, Universeum [18] in Gothenburg has a dome called the “Wisdom”, where an audience can experience immersive sounds and videos in both 2D and 3D, see Fig. 2.3. For example, Gothenburg Film Studios [19] used the dome at Universeum to showcase a music concert they had filmed with a camera that spans 360 degrees, in order to create an immersive concert experience [20]. The dome is not considered an immersive installation like Tokyo TeamLab, but rather creates an immersive experience using a single dome-shaped screen. Both Universeum and Gothenburg Film Studios are partners with Visual Arena in this feasibility project.



Figure 2.3: The Wisdom at Universeum [18]

3

Theory

This chapter presents more background on the subject of immersive installations and relevant technologies and terms. It also presents elements that XR designs might use, such as storytelling and onboarding.

3.1 User Experience

User experience (UX) refers to how a person perceives and interacts with a product, service, or system, including how it looks and behaves [21]. UX designers consider the entire product design process, including user research, wireframes, and prototypes. It also involves aspects such as branding and function.

UX includes usability but they are not interchangeable [22]. Usability tests, for example, measure task completion rates, number of clicks, et cetera, but UX goes deeper than that. Measuring user experience means investigating how the user feels when using the system, and their level of satisfaction.

3.1.1 Interaction Design

Interaction design (IxD) is the design of interactive products [23]. In this process, the designer considers how users will interact with a product based on their needs and limitations. Interaction designers consider every way a user will interact with a product or service. IxD lies within the area of UX design but only covers user interaction, and not the broader scope of UX.

3.2 Immersive Installations

Immersive installations, also referred to as immersive installation art or interactive installation art, use projection mapping to create dynamic walls or surfaces of visuals and sound [24]. Installations can be viewed as three-dimensional artworks, and emerged in their first form during the 1960s and 1970s [25]. Immersive installations convey meaning and provide a sensory experience through projected imagery. The multi-sensory stimulus from visiting an immersive installation, such as experiencing visuals and sound, or physically interacting with projections, can evoke a multitude of emotions for users [24].

3.2.1 Immersion

Handa et al. [26] claims that immersion is a state where an individual is exposed to and surrounded by a captivating environment, usually artificial, and loses some or all awareness of their physical self. The state of immersion usually arises from intense focus and an expanded sense of space. Qi & Ziang [3] describe immersion as a critical component for immersive installations, and define it as a “comprehensive sense of participation” in the experience.

An environment’s capability of making users feel immersed, “immersiveness”, can depend on many factors. In physical installation art, users are not only immersed by what they see, but also what they feel and more importantly, hear [27]. A multi-sensory experience can amplify immersiveness and user engagement. Large installations can make the user feel small in comparison, increasing the feeling of being surrounded and a part of the artwork. Including interactive elements so that users can control the environment also increases the feeling of being one with the installation. Adding lights and shadows, such as warm yellow lights to represent the sun, was also shown to increase the authenticity of the experience, and therefore immersiveness.

3.2.2 Projection Mapping

Projection mapping is a technique that transforms physical objects into a dynamic display surface for video projection [28]. Unlike traditional projection, which is limited to flat screens, projection mapping allows visuals to be precisely aligned with complex, irregular, or three-dimensional surfaces. By using specialized software, the digital content can be adjusted to match the contours of buildings, stage sets, sculptures, or other physical structures, creating the illusion of movement, depth, and interactivity. Figure 3.1 illustrates projection mapping using a computer and a projector to project an image onto three cubes.

This technique has gained widespread use in fields such as entertainment, advertising, and interactive art. Large-scale projection mapping is commonly seen in concerts, museums, and public installations, where it enhances the visual impact of an event by immersing audiences in digital storytelling. In architecture, projection mapping is used for temporary facades or historical reconstructions, while in product design, it allows brands to showcase prototypes in engaging and interactive ways [28].

Projection mapping is achieved through several steps.

- **Hardware and Software Setup:** The fundamental components required for projection mapping include a projector, a computer, and projection mapping software.
- **Surface Analysis and Calibration:** The physical surfaces, on which the visuals will be projected, must be analyzed to account for their shape, texture, and environmental lighting conditions. In more complex installations, a 3D model of the surface may be created to facilitate precise alignment of the digital content. The projector’s position and focal length are then adjusted to

ensure accurate projection coverage.

- **Content Creation and Mapping:** The visual content, which could include animations, videos, and/or interactive elements, is designed to correspond to the physical features of the projection surface. The projection mapping software is used to map the digital content onto real-world objects, adjusting the visuals to align correctly with the shape, perspective, and depth of the object.
- **Testing and Refinement:** The final step involves iterative testing to fine-tune the alignment and contrast. Any misalignments are corrected to optimize the visual experience. In interactive installations, sensors or input mechanisms may be integrated to enhance audience engagement.

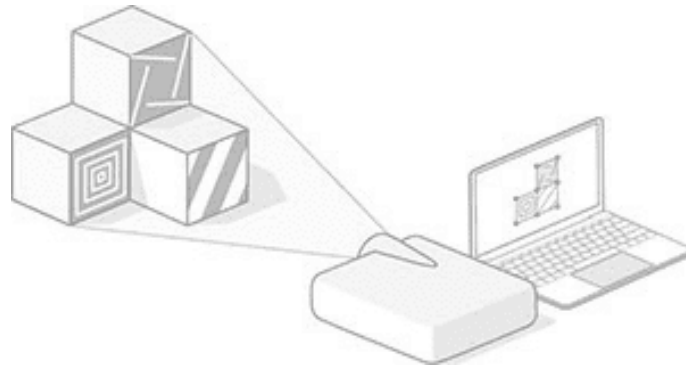


Figure 3.1: Illustration of projection mapping [28]

3.3 Onboarding in Immersive Experiences

Whittaker [29] believes onboarding in XR, especially in VR and immersive media, will give users the best possible experience. The author bases her beliefs on what is already being used successfully in immersive theatre, where guest participants or audiences are often slowly immersed through different sensory experiences. This includes meeting an actor in character, listening to audio, or viewing new settings that acclimate the user to the new environment they will enter. This is used to set the scene and expectations to facilitate the invitation to immersion.

Similarly, onboarding in immersive installations is a critical step in preparing users for interaction and helping them feel comfortable in unfamiliar settings. Mishra [30] emphasizes that onboarding in XR is especially important because the technology is still novel and often unfamiliar to visitors, who may be hesitant or unsure how to engage. Effective onboarding can take many forms, visual prompts, spatial cues, human guides or integrated narrative moments. The most successful approaches often minimize cognitive load and use familiar, intuitive interactions. In projection-based XR experiences, this might involve designing the space to naturally guide behaviour, allowing users to rely on instinct rather than explicit instructions.

3.4 User Engagement

User engagement is a concept that describes the depth and quality of a user’s interaction with a system. O’Brien & Toms [31] define engagement as “a quality of user experience characterized by attributes of challenge, positive affect, endurance, aesthetic and sensory appeal, attention, feedback, variety/novelty, interactivity, and perceived user control”. Their research highlights that user engagement is a process that consists of four stages: *point of engagement*, *period of sustained engagement*, *disengagement*, and *re-engagement*. *Point of engagement* is the initial moment when users are drawn into an experience, influenced by motivation, goals, aesthetics, and social factors. This phase could be followed by a *period of sustained engagement*, a phase in which attention and interaction are maintained from continuous feedback, a sense of perceived control, and a balance of challenges that keeps users invested. If a user stops the activity, either consciously or unconsciously, the phase of *disengagement* occurs. This can be caused by factors such as interruptions, usability issues, lack of motivation, or external distractions. However, it does not have to be the end of an experience, users can come back and enter the *re-engagement*. This phase is more likely to occur if a user is triggered by past positive interactions, curiosity, or external incentives. The User Engagement model, shown in Figure 3.2, illustrates relation between the four stages.

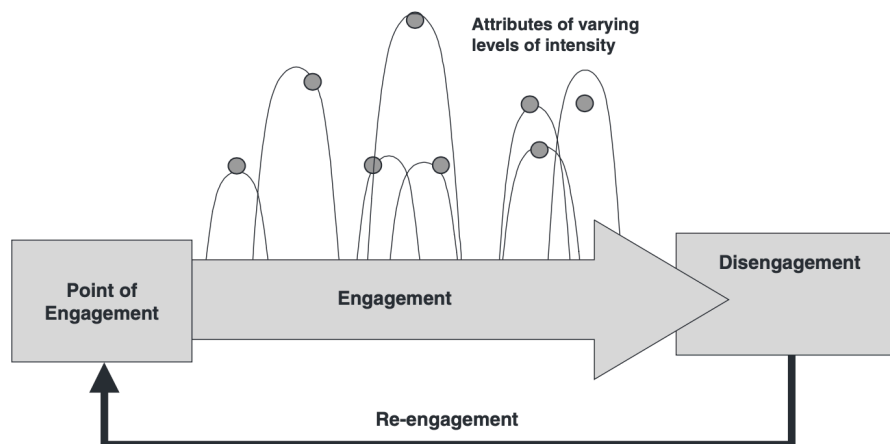


Figure 3.2: The User Engagement model [31]

Their study also connects engagement to previously established theories. Flow theory, where deep involvement leads to intrinsic motivation. Aesthetic theory, which highlights the importance of sensory appeal and visual appearance. Play theory, which describes engagement as an explorative and interactive process. Lastly, information interactive theory, which examines how information tells a story and how users interact to digital content.

These insights suggest that user engagement is not only about usability, but about creating compelling, interactive narratives that captivate users. Designers must consider how to sustain engagement and how to mitigate disengagement factors through

interactive experiences that offer user control and seamless narrative progression.

3.5 Storytelling

Oral storytelling is the traditional art form of telling stories that has been passed down from generation to generation, while the more modern *digital* storytelling involves technology, such as graphics, audio, and animations [32]. Storytelling can also be used in UX and service design to evoke emotional responses from a user or create understanding [33]. Storytelling in XR is unique, as it shifts the traditional third-person narrative to a first-person one [10]. The simplest structure of a story that is usually expected involves characters and environments driven by a conflict and ending in a resolution. Storytelling is also common to create compelling XR experiences, and using what Zhou [10] calls “spatial narrative”, the user instead becomes the main protagonist. The story is driven by the new and unexpected experience for the user and their attempt to understand the new environment. The resolution becomes the memory of the experience.

3.5.1 Narrative, Story and Storytelling

The two terms *narrative* and *story* are usually used to describe the same thing, but differ in their meaning. A story is simply the content, or a sequence of events [34]. Narrative is the traditional form for conveying or organizing experiences through stories [35]. By this definition, a lack of narrative can mean a lack of coherence or structure, or failing to convey the story. Storytelling, a third term, is how that narrative is communicated [34], and in the context of XR, narrative can be conveyed, for example, linearly or non-linearly. Although the terms may be defined differently across literature and industry, occasionally with overlapping or conflicting meanings, this thesis will use the definitions outlined above to maintain consistency.

3.5.2 Non-Linear Storytelling

Non-linear storytelling is described as stories that are broken down into fragments and are presented in different places or environments for the user to find [10], or any type of storytelling that does not follow a traditional linear timeline. Linear storytelling can be a problem in exhibitions and museums, as users cannot get the full experience unless they arrive at the beginning of the narrative and stay until the end. Non-linear storytelling can therefore be more suitable for some XR experiences.

3.5.3 Immersive Storytelling

Immersive storytelling can be defined as a “time-limited and location-based experience”, where the user’s action changes the experience and technologies such as VR are used to expand the narrative space, while engaging multiple senses [36]. Polydorou [36] has conducted multiple storytelling experiments, in one such example the immersive story was somewhat set, but through participant engagement, the artwork took its final shape. Ultimately, the purpose of the immersive storytelling was for

users to explore, rather than experience a set story with a traditional dramaturgical structure.

Another thing to account for in immersive storytelling used in XR environments, specifically in VR, is the memories of the user [37]. The spatial presence in a non-linear VR story had led users to experience numerous feelings, memories and thoughts. Bax [37] claims it is the strong capability of XR to trigger those memories that makes non-linear storytelling more suitable. Users immersed in an XR environment try to make sense of it by creating their own narrative, and therefore the events users experience in XR only become fragments to users' own stories.

3.5.4 Interactive Storytelling

Lebowitz & Krug describe the interactive storytelling spectrum, based on storytelling in games. The spectrum spans from completely authored stories without interaction from players, to a completely generative narrative, where a player can design a story almost entirely on their own [38].

Stories on the left-hand side of the spectrum can include some player choices, but the writers have a set of controlled scenes or choices that guide the user through a pre-planned story. An example of this is the game *Blood Omen*, which has two different endings. In the middle is “Branching Path Stories”, which has multiple endings in addition to multiple decision points within the storyline as well. On the right-hand side of the spectrum, there is much more freedom for players to explore the world and wander off, and less focus on the storyline. “Fully Player-Driven Stories” means the player is given multiple tools to craft a story, but the writers do not design any narrative whatsoever, as seen in games like *The Sims*. Some consider stories with interactive aspects to be non-linear stories.

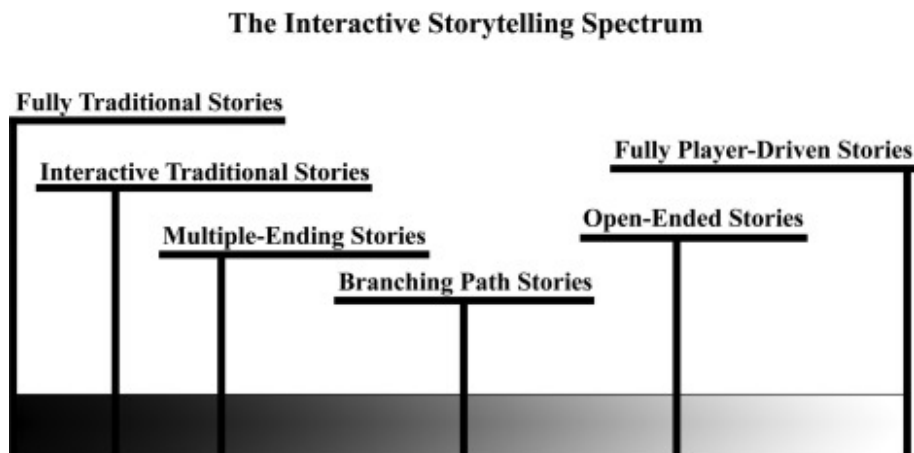


Figure 3.3: The Interactive Storytelling Spectrum [38]

3.6 Sound

Sound plays a crucial role in how people interact with their surroundings, often without them being consciously aware of it [39]. In everyday life, auditory cues provide information about both functionality and physical properties of an object. For instance, the changing sound of a boiling kettle can give an indication of how far along the process is, while the sound of an approaching vehicle can give a sense of its size and speed. Research has shown that people use sound to estimate not just the size and shape of an object but also their material and quality [39]. Although the research focuses on product experience, the findings can also be applied to immersive installations, where sounds play a critical role in enhancing the realism and user engagement within the immersive environment.

More than adding to the realism, sound can shape perception and guide attention in immersive installations. Salselas and Penha [40] highlight how sound can subtly guide user focus and narrative flow without breaking immersion. Their research demonstrates that auditory cues enhance spatial awareness, strengthen visual elements, and contribute to coherence in interactive storytelling. By maintaining consistency between auditory and visual elements, immersive installations can use sounds to deliver a seamless and intuitive storytelling experience.

4

Methodology

In this chapter, a number of relevant methods for the project are presented. Like many design projects, the methods include an iterative design process, and design thinking and its associated tools.

4.1 Research Through Design

Research through design (RtD), and design itself, aims to discover what might be rather than what is [41]. RtD is an iterative process, where new knowledge is generated by examining the current state of a situation and imagining a future state in the shape of a design [42]. Throughout the iterative process, reflections are made around the problem to understand and improve it.

Unlike traditional scientific research, RtD can be considered a generative approach and is not a suitable theory to be contradicted through falsifiability, as scientific theories usually are [41]. Design is more concerned with exploring possibilities through iterative experimentation and reflections, rather than verifying truths. Therefore, one can argue that RtD only needs to be successful sometimes, meaning that any number of unsuccessful attempts does not disprove the method.

4.2 Design Thinking

Design thinking (DT) is described as an approach to create new innovations and consists of multiple methods [43]. The methods associated with DT are ideation and prototyping methods [44], which are described in the subsections below. Innovation is enhanced when considering all three aspects of DT, which are: desirability from a user's perspective, viability from a business perspective, and feasibility from a technological point of view. Design thinking can also be used to solve more complex problems, also known as wicked problems.

4.2.1 Ideation

Ideation is a step in the design process where you generate ideas [45]. More specifically, ideation is often executed through methods like brainstorming, sketching, prototyping, brainwriting, and others alike. Ideation encourages wide thinking and

generation of innovative solutions, while ensuring the design remains focused on the needs of end users.

4.2.2 Point of View and How Might We

Two methods used in the preparation of ideation sessions are Point of View (POV) and How Might We (HMW) [45]. POV means filling out sentences based on insights gained during the first stages of research. The sentence to fill out is: (*user*) needs to (*user's need*) because (*insight*). These POV sentences narrow down a problem, capture the team's attention, and are insightful. Based on POV sentences, you can start to formulate HMW questions to break down the problem. HMW questions should not be too narrow or broad, but should structure the problem into tangible ideas. For example, if one POV states that young people in a city cannot afford to own a car, but sometimes need one, an HMW question could be "How might we design a car that is cheap and easy to share among people?". You can continue to break that question into sub-questions, around which you can base your ideation sessions.

4.2.3 Brainstorming

Brainstorming is a group ideation technique originally developed by Alex Osborn [46]. It is a well-known method designed to facilitate the rapid generation of ideas in creative problem-solving contexts. The method is based on four rules: (1) criticism is ruled out, (2) freewheeling is welcomed (the wilder the idea, the better), (3) quantity is wanted, and (4) combination and improvement are sought. To ensure a productive brainstorming session, the group must clearly understand the context and objective. All ideas, no matter how unconventional, should be documented using appropriate tools such as pen and paper or digital tools like Figma or Miro, see Section 4.10. The ideas should then be discussed and, if suitable, combined or built upon. The main purpose of brainstorming is to generate and document a large number of ideas, regardless of initial feasibility. This process promotes lateral thinking, sparks creativity, and enables teams to expand on each other's ideas [47].

4.2.4 Brainwriting

Brainwriting is a group ideation technique similar to brainstorming, but instead of verbally sharing ideas, each participant writes down their ideas. This approach minimizes verbal dominance, status hierarchies, and social pressure, thus fostering a more equitable and unbiased ideation process. Although brainwriting may lack social interactions that can be beneficial in some ideation contexts, it often compensates by generating a greater diversity of ideas and improving psychological safety among participants [46].

4.2.5 Crazy-8

Crazy-8 is a sketching exercise in which each participant has to sketch eight ideas in eight minutes [48]. The exercise encourages designers to push beyond their initial

ideas and explore more innovative solutions, which often emerge in later stages of the exercise.

4.2.6 Role-Playing

Role-playing is an experimental ideation technique in which participants act out scenarios related to a design problem [49]. During this method, participants are assigned various roles, such as users, professionals, or objects. They then act out situations that could occur in real-world contexts. Props, space, and movement can be utilized to make the experience more immersive. Role-playing can take different approaches, one common approach is *bodystorming*, where participants explore ideas by performing actions. Another approach is *informance*, in which participants present design concepts through short, improvised performances. Role-playing is a method designers can use to quickly experiment with different perspectives, find hidden challenges, and refine ideas through experience.

4.2.7 Personas

A persona in UX design is a fictional representation of what a typical user could be like [50]. Usually, this involves naming the persona, giving them goals, and describing their domain expertise, to name a few. Ideally, the personas are based on observations and research of users in the field. These personas can then be considered the project's end users, which the designer will keep in mind during the different stages of development.

4.2.8 User Journey Map

A journey map, also referred to user journey map or customer journey map, is a visualization of the steps an actor goes through when following and completing a process [51]. The journey map consists of five key elements:

1. Actor
2. Scenario + expectations
3. Journey phases
4. Actions, emotions, and mindset
5. Opportunities

The *actor* is usually the persona, see Section 4.2.7, essentially who the journey is about. *Scenarios* are based on the expectations or goals the actor has, describing a certain situation that consists of a series of events. *Journey phases* are the high-level steps that are involved in a scenario. For example, the journey phases of buying a product can be “discover, try buy, use, seek support”. Within the journey phases, the *actions*, *emotions*, and *mindset* of the user are defined. For the buying example, the *actions* would be what steps the user takes, the *emotions* are the highs and lows of the experience, and *mindset* is the thoughts and motivations of the user

through each step. Lastly, *opportunities* describe what insights are gained from the experience, and what a team can achieve with the knowledge from the journey map.

4.2.9 Empathy Maps

Empathy maps are a tool to empathize with users to create a product they need, which they are more likely to use or buy, in contrast to something they want [52]. An empathy map sums up insights gained from user research and divides them into four categories, namely “what the user said, did, thought, and felt”. The map is divided into four quadrants, which, apart from the mentioned categories, also include what the user hears and sees, see Fig. 4.1. Empathy maps are also a good tool to base one’s personas on.

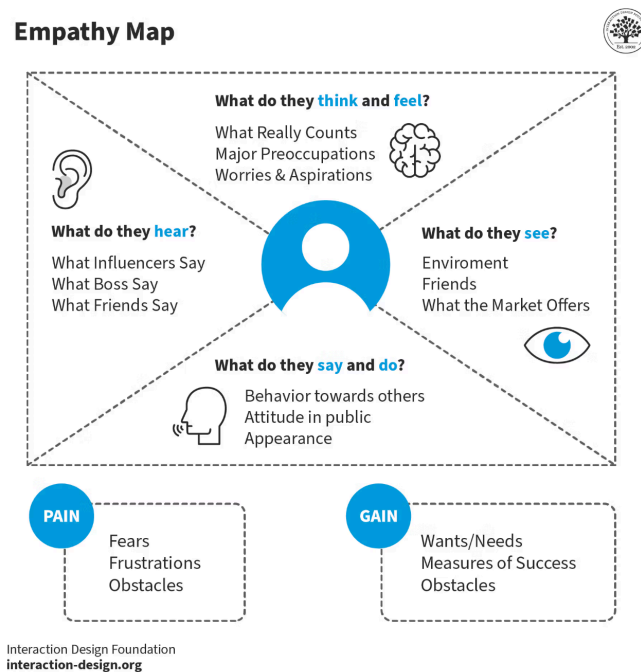


Figure 4.1: Interaction Design Foundation’s empathy map [52]

4.3 Iterative Design Process

Rogers et al. describe the process of interaction design in four stages [53]. The first step is to gather requirements and user needs, which are then translated into alternative designs. After that, you finalize a prototype, and finally, you evaluate the prototype and the process. These steps are meant to be repeated, and each step helps support the following one. Evaluation is a vital tool in interaction design, as it brings insight into what the user ultimately needs.

4.3.1 Double Diamond

Another method used by UX designers is the double diamond, which stems from the same ideas as the process mentioned above [54]. The double diamond also consists of four phases: discover, define, develop, and deliver. Discover and define are dedicated to researching and defining the problem, whereas develop and deliver are focused on designing. The two diamond shapes come from alternating divergent and convergent thinking, where discover and develop are diverging, and define and deliver are converging, see Fig. 4.2. The idea of an iterative process remains the same in many UX design methods.

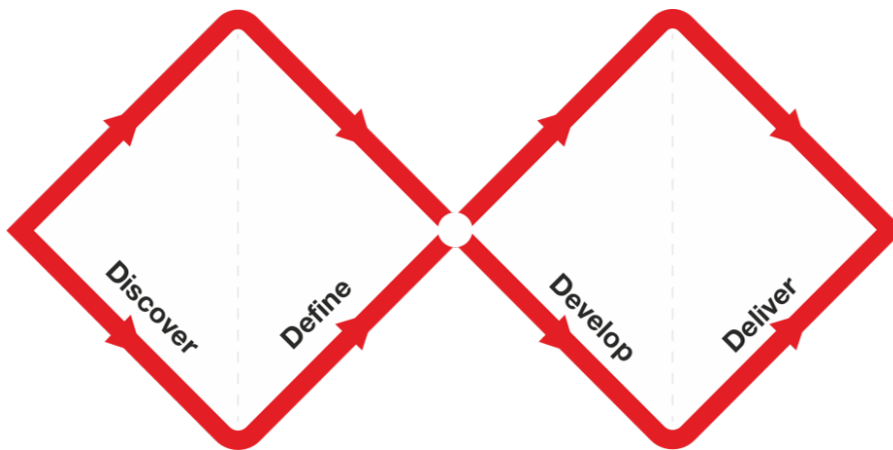


Figure 4.2: British Design Council’s Double Diamond [55]

4.3.2 The Innovation Framework

At Visual Arena, a similar approach has been developed, called the Innovation Framework, see Fig. 4.3. This framework draws inspiration from the double diamond and has a focus on innovation and exploring a topic. As Visual Arena does not put any products to market, the deliverables are usually considered the learnings resulting from each iteration. The Innovation Framework consists of:

- **Frame:** defining the scope, goals, and success criteria of the project.
- **Empathize:** building a deep understanding of users’ needs, behaviors, and challenges. Literature review, expert and user interviews are used to create personas, empathy maps and user journeys.
- **Experiment:** creativity, rapid prototyping, and user validation are included here. This is where the prototypes will be developed and tested in order to gain insight.
- **Deliver:** summarizing insights, reflecting on learnings, and creating actionable outputs for future implementation.

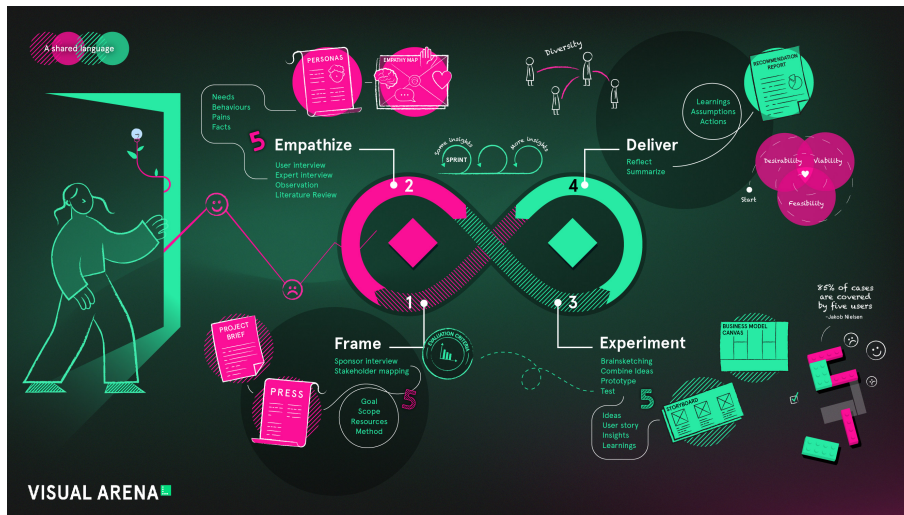


Figure 4.3: Visual Arena’s Innovation Framework

4.4 Prototyping

Prototyping is an aspect of design that provides a tangible representation of a system’s concept. It helps explore and evaluate design ideas while also facilitating communication between designers, clients, and users [56]. By creating prototypes, designers can identify potential flaws, gather feedback, and refine their concept before final implementation. Prototypes can be used at various stages of a design project. In the early phase, they help validate concepts and gather initial feedback. During design exploration, they allow for testing different design alternatives or features. Before final implementation, prototypes help to ensure that the design meets user needs and expectations while also allowing for adjustments based on gathered insights. There are different types of prototypes, each with a specific purpose. The two main kinds of prototypes are *Low-fidelity prototypes* (Lo-Fi) and *High-fidelity prototypes* (Hi-Fi).

4.4.1 Low-Fidelity Prototypes

Lo-Fi prototypes focus on broad design concepts such as content, form and structure, key functionality, and navigational structure [56]. They are designed to be produced quickly and thrown away as quickly, supporting early-stage idea generation and exploration. Lo-Fi prototypes are sometimes called paper prototypes since they are often made from paper. They often consist of a series of “screenshots” which users can walk through and interact with. Post-its and index cards can be used to showcase dynamic features. Lo-Fi prototypes can also be digital wireframes and interactive mock-ups, using tools like Figma or Miro, see Section 4.10. The key is to avoid spending too much time on details; if high precision is needed, a Hi-Fi prototype is more appropriate.

4.4.2 High-Fidelity Prototypes

Hi-Fi prototypes are more detailed and interactive, offering a closer look at the final product and allowing for in-depth usability testing [56]. They are valuable for evaluating key elements, such as visuals, interactivity, content, and functionality. Hi-Fi prototypes can be used to assess how easily users can learn and navigate a system. Additionally, they are often a crucial stage in client acceptance, before the final implementation.

4.4.3 Wizard of Oz

Wizard of Oz (WOz) is a prototyping method used in interaction design research, which is particularly useful in areas such as mixed reality [57]. It usually consists of an operator who simulates system intelligence as a crutch when testing prototypes, allowing users to react and interact with a system and its intended behavior before it is complete. As the prototypes advance, the WOz operator's role becomes less and less needed.

4.5 Interviews

Interviews in UX research are a common device, used for example when monitoring and gaining insights from usability studies [58]. Interviews are usually divided into three groups: structured, semi-structured, and unstructured.

4.5.1 Structured Interviews

Structured interviews follow a set script, meaning participants are to a high extent asked the same questions in the same order [59]. The questions can be closed- and open-ended, but most commonly, participants are asked to answer using a numerical scale or from a set of pre-written answers. Structured interviews are appropriate when wanting to gather information about a demographic (age, gender, et cetera) or wanting to compare similar data across different user groups.

4.5.2 Semi-Structured Interviews

Semi-structured interviews (SSI) are a qualitative research method, where questions are open-ended and explorative, and the interviewer loosely follows a script [60]. SSIs are best suited when researchers want to get an interviewee's unique perspective on a topic, rather than just general subject knowledge. They also have the advantage of being focused, while still allowing the interviewer to explore ideas that may come up during the interview.

4.5.3 Unstructured Interviews

Unstructured interviews are similar to a conversation with a participant, where some topics are set, but no specific questions are prepared [61]. This poses less constraint

on what the interview will contain, meaning both the participant and interviewer control what the interview will contain. Unstructured formats are best suited for exploring a new topic and gaining insights into what difficulties users or stakeholders face in a specific area. The format usually requires a skilled interviewer, as it can be difficult to avoid talking too much or dividing the time fairly across more or less relevant topics.

4.6 Surveys

Surveys are a popular method to collect data, used to gain information about a research topic or provide input or evaluation for designing a program [62]. One of the most popular forms of surveys is the questionnaire, where participants answer questions related to the goals of a project.

4.6.1 Visual Arena's Evaluation Survey

Visual Arena has developed a questionnaire for evaluation, in which users are asked to agree or disagree with statements on a six-point scale. The scale is meant to force the user in one direction, excluding the option of a neutral answer. The survey is used to gather data from users after evaluating prototypes.

4.7 Observations

Observation is an essential research skill that involves careful attention and organized documentation of phenomena. This includes studying people, objects, environments, behaviours, and interactions [63]. In design research, observational methods vary in formality depending on the intended use.

4.7.1 Participant Observation

Participant observation (PO) is a method used to understand situations or behaviours through participation in an activity, context, or culture [63]. The researcher aims to form a deep connection with participants, experiencing events from their perspective. During the observation it is crucial to document behaviours, interactions, and language, and the observation is often combined with interviews. The researcher can either observe from a distance while still participating in the activity or context, or they can fully participate and integrate into a group. Full participation is less common in design research due to ethical concerns. An important factor in PO is that the researchers maintain objectivity to avoid influencing participant behaviour.

4.7.2 Fly on the Wall

Fly-on-the-wall observation is an observation method where the researcher observes without interacting with participants, minimizing potential biases that could arise

from engagement [63]. The researcher deliberately keeps a distance to avoid influencing the behaviour being studied. This method is flexible, often without predetermined criteria, though guiding frameworks might be used. There are two types of fly-on-the-wall observation: secret outsider, where researchers remain distanced from participants, and recognized outsider, where the researcher’s role as observer is known but still unobtrusive. A recognized outsider could capture individual nuances of interaction and personal depth that a secret outsider might miss, however, it can lead to participants altering their behaviour knowing they are being observed.

4.8 Thematic Analysis

Thematic analysis (TA) is a qualitative research method used to systematically identify, analyse, and report patterns or themes within gathered data [64]. Thematic analysis is conducted in several iterative phases, beginning with familiarisation of the data through reading and note-taking. Initial codes are generated to capture significant features of the data, which are then organised into broader themes that reflect the underlying meanings and patterns. Each theme is carefully defined and named to ensure clarity and accuracy in conveying the essence of the data. In thematic analysis, it is important that researchers avoid bias and their own interpretations to ensure that the themes emerge organically from the data, which allows for a nuanced understanding of the participants’ perspective.

Two approaches are generally used in thematic analysis: inductive or “bottom up”, and deductive or “top down” [65]. Inductive TA means the themes are more grounded in the data, and are not developed by trying to fit the data into a specific frame; therefore, it is more data-driven. Deductive TA is more driven by a theoretical interest in the area, which leads to fewer rich descriptions of all data, and focuses instead on gathering the data into relevant themes connected to the researcher’s goals.

4.9 Immersive UX Evaluation Framework

The Immersive UX Evaluation Framework is a structured approach designed to evaluate UX in immersive environments [66]. The framework is based on the Expectation-Confirmation Theory (ECT) [67], which consists of five constructs: expectation, performance, confirmation, satisfaction, and repurchase intention. Since confirmation and repurchase intention are not applicable for assessment in immersive environments, the Immersive UX Evaluation Framework only uses the other three stages. During the first stage, the expectation stage, the participants complete a questionnaire to assess their initial expectations. In the next step, the performance stage, the participants interact with the immersive installation while observation methods are used to capture behaviours, interactions, and engagement indicators. For the final stage, the satisfaction Stage, participants fill out another questionnaire that measures how well the experience met their expectations, based on three factors: flow, presence, and engagement. The results are then presented in a radar

graph that visualizes the expected experience compared to the actual experience, again based on the three UX measures: flow, presence, and engagement.

4.10 Digital Tools

This section describes various digital tools that will be used during the project for design thinking and evaluation methods.

4.10.1 Figma

Figma is an online design tool that supports real-time collaboration. It is commonly used to explore ideas, gather feedback, build realistic prototypes, and streamline the product development process [68]. In this project, Figma can be used during the ideation phase for activities such as mind mapping and brainwriting. It can also serve as a space to document the results from How Might We (HMW), Point of View (POV), and Crazy-8. Throughout the design process, Figma can be used to develop mock-ups and sketches that contribute to the creation of prototypes.

4.10.2 Miro

Miro is another online design tool that supports real-time collaboration. It serves as a single platform for product teams to deliver customer value faster, through strategic planning to roadmapping, product briefs, and sprints **miro**. Miro is also the design tool of choice for Visual Arena. In this project, Miro acts as a collaborative space where students, Visual Arena, and its partners communicate and share ideas. It can also support joint brainstorming sessions and facilitate ideation of various concepts.

4.10.3 NEXT

NEXT is an artificial intelligence (AI)-powered platform designed to transform customer interaction into actionable insights [69]. It analyses a wide range of input, such as interviews, video recordings, reviews, and surveys, to help teams better understand customer needs, preferences, and behaviors. NEXT is provided by Visual Arena, and for this project, is particularly useful for analyzing and summarizing qualitative data from recorded interviews. Additionally, it serves as a collaborative space where members involved in this project can share, access, and engage with each other's recordings and interview material.

5

Process

The process was based on Visual Arena’s Innovation Framework, see Section 4.3.2, which is inspired by the Double Diamond design process. The framework consists of four phases that form a continuous, iterative loop. The process was also based on RtD (see Section 4.1), as many of the resulting designs are meant to help imagine what the future of immersive installations could look like.

The first half of the thesis went deep into phases *Frame* and *Empathize*, and resulted in a low-fidelity prototype in the third phase *Experiment*. The second prototype was built on the research and insights gained earlier, as well as extensive ideation sessions. Before the second prototype was created, it was decided together with Visual Arena and their partners within XR Sweden that a prototype could reach higher fidelity if all parties worked together on a single prototype. The prototype was then made to cover the general theme of this thesis, together with Visual Arena’s goals. Each party could then gain their own insights and perform tests on a larger target audience connected to their research, to fit their needs.

5.1 Planning

A time plan was created to align with the framework, allowing for at least two iterations of prototyping while also meeting the deadlines set by Chalmers and Visual Arena. Some phases overlap due to the simultaneous progression of multiple aspects. A Gantt chart, shown in Fig. 5.1, was used to structure and visualize the timeline for the thesis.

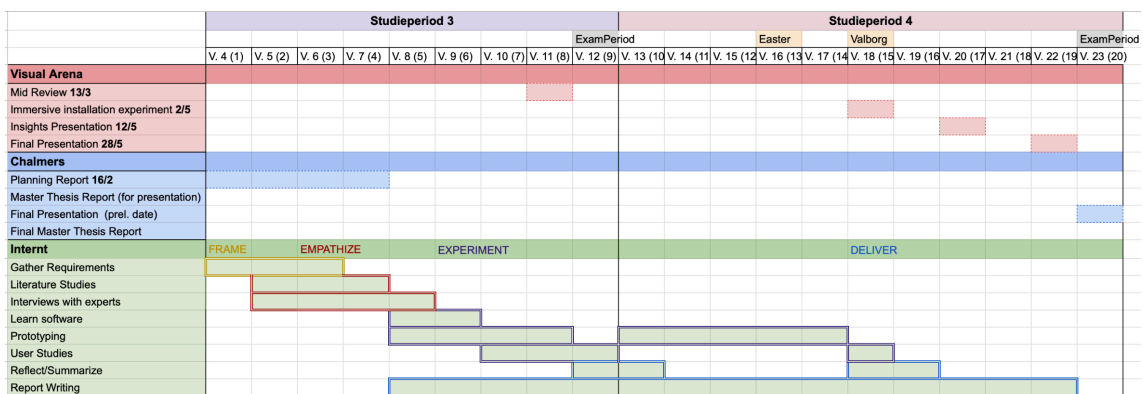


Figure 5.1: Gantt chart covering the thesis period

5.2 Frame

The *Frame* phase sets the foundation of the project by defying its scope, goals, and success criteria. This phase ensures that research is aligned with both academic and industry expectations.

5.2.1 Gather Requirements

During the first three weeks of the thesis, the focus was on collecting and organizing information essential for project success. A meeting was held at Visual Arena together with other students and partners of Visual Arena. The primary focus of the meeting was to get to know the partners, understand their work, and identify their expectations for this project. The partners also presented their areas of expertise and potential tools that could be used for prototyping and developing the project further on. In addition, goals and success criteria were discussed and a common vision for the project was explored. A meeting also took place with the supervisor from Chalmers to further define the research scope and align it with Visual Arena's Vision.

Meetings with Visual Arena were scheduled each week during this phase to also present more of their work, inspirational content and sources that could be useful. Visual Arena also arranged visits to Universeum to discuss their findings and what technology was being used in their Wisdome.

5.3 Empathize

The *Empathize* phase is dedicated to gaining a deeper understanding of the user needs and challenges related to immersive installations. Various research methods are conducted to collect qualitative and quantitative data that help to make informed decisions during the design process. During this phase, methods such as personas and user journey mapping are particularly useful.

5.3.1 Literature Studies

An extensive literature review was conducted to explore existing research on immersive storytelling, immersive technologies, and related design methods. This phase helped identify research gaps and provided theoretical ground for the thesis. Academic papers and case studies were analysed to extract key insights. The outcomes of this review are presented and discussed throughout Chapter 2 (Background), Chapter 3 (Theory) and Chapter 4 (Methodology), where relevant literature supports the understanding of the topic and justify the chosen methods.

5.3.2 Interviews with Experts

To complement the literature review, semi-structured interviews were conducted with experts in the field of immersive installations and storytelling, as well as with

other actors who have participated in projects using AR and VR.

An interview was held with Zenton, a multimedia agency specializing in crafting experiences and communication through sound design, interactivity, lightning, and multimedia. Their work includes museums, exhibitions, shopping malls, and public spaces, where they enhance storytelling through multisensory design. In the interview, they emphasized the importance of sound when creating a sense of immersion. They also discussed the potential of digital immersive installation to transform entire spaces but acknowledged the challenges in cost and technical requirements. They also provided insights into how many people are usually involved in a project, and what role they might have. Lastly, they highlighted the importance of stability and quality in technical implementations to ensure lasting impact.

Another interview was held with a PhD student from Stockholm University of Arts, who explores the dramaturgy of participatory experiences such as live-action role-playing and virtual reality. They highlighted the need for interaction and collaboration in storytelling and immersive installations. The researcher also believed that social relationships would become central in future XR scenarios, with experiences designed to be shared. Another point highlighted by the researcher was the need for a new narrative language in immersive storytelling, moving away from traditional conflict-driven plots. Lastly, unique, tailored experiences were mentioned as potentially not commercially viable on a large scale but could thrive in unexpected venues like festivals and art exhibitions.

Three additional interviews were held with two software engineering students who had developed an AR application, and one previous software engineering student who had developed a VR application. The students found that AR development tools were limited and hard to understand. Usually, an open-source tool would be used, but the lack of documentation was limiting the development. They also discussed that the existing tools were tough to learn and that a simpler tool was desired to become used to it quicker, but the advanced tools were still limited in what could be done. Students also highlighted how immersive technologies have a great amount of potential, and saw many future areas of application, but newcomers will have difficulties contributing to the field.

In the field of VR, inaccessibility was also highlighted, both because of resources, but also the cost and risk of being one of the first to develop VR on a big scale. Another difficulty with VR is that the experience can make people confused or motion sick, which brings people out of the immersion. In general, immersive installations were seen by the interviewee as a prominent feature of our future everyday lives, where mundane places or elevator rides would be combined with immersive technology.

These interviews provided real-world perspectives on challenges and best practices in the field. They also provided challenges that arose when beginners, such as students or previous students, tackled XR development. The biggest insights gained from these interviews were mostly what challenges this XR project could face and what experts see as important in terms of storytelling and immersion. These insights helped refine the problem statement and proved valuable during the Experiment phase.

5.3.3 User Survey

To gain a deeper understanding of user preferences for an immersive installation, an online survey was sent to various people living in or near Gothenburg. The survey was distributed through social media and word of mouth and gathered responses from 36 participants. The survey aimed to explore the interests, expectations and perceptions of the participants about immersive experiences. It included a mix of predefined and open-ended questions, allowing respondents to select from multiple-choice answers or provide their own. The questions are presented below along with a summary of the responses. All the answers can be found in A.3.

Q1: Would you be interested in visiting an Immersive Installation in Gothenburg?

- Yes: *35 respondents*
- No: *1 respondents*
- Not sure: *0 respondents*

Q2: If you could step into an immersive story, what kind of world would you want to explore? *Describe it in your own words or choose from the options below:*

- A fairytale: *17 respondents*
- Explore Gothenburg: *5 respondents*
- Explore Gothenburg's past or future: *22 respondents*
- A high-tech future: *23 respondents*
- Abstract art: *20 respondents*
- A game: *24 respondents*
- Outer space: *20 respondents*
- Customized answer: *0 respondents*

Note: It was possible to choose multiple answers

Q3: How interactive would you like the story/installation to be?

- I would like to simply observe the story, and not interact: *7 respondents*
- I would like a set story, but with some interactive elements: *14 respondents*
- I want my interactions to affect the story: *10 respondents*
- I would not like a linear story, but rather explore an installation without a beginning or end: *5 respondents*

Q4: How would you prefer to experience an immersive installation?

- By myself: *7 respondents*
- In a group of people I know, similar to visiting an escape room: *13 respondents*
- In public, similar to museums where anyone can come and go: *10 respondents*

- No preference: *6 respondents*

Q5: How would you prefer to experience an immersive installation?

- Excited: *23 respondents*
- Curious: *29 respondents*
- Relaxed: *11 respondents*
- Inspired: *22 respondents*
- Like an escape from reality: *18 respondents*
- Like I'm part of something bigger: *12 respondents*
- Customised answer: *0 respondents*

Note: It was possible to choose multiple answers

Q6: How would you like to interact with the installation? *Describe in your own words or choose from the options below:*

- Physical objects or obstacles that influence the installation: *21 respondents*
- Touching projected objects, interacting directly with the artwork: *27 respondents*
- Using bodily movements which affect the installation: *23 respondents*
- Interacting with other humans, the collaboration changes the installation: *9 respondents*
- Drawing or creating something that appears in the installation: *9 respondents*
- Customised answer: *0 respondents*

Note: It was possible to choose multiple answers

Q7: What elements do you think would help you feel immersed? *Choose as many as you like or and feel free to add your own ideas!*

- Wind: *25 respondents*
- Vibrations: *26 respondents*
- Weather effects: (feeling the sun or rain) *23 respondents*
- Large screens and projections that tower over you: *29 respondents*
- A big variation colors: *18 respondents*
- Animations: *25 respondents*
- Sounds: *31 respondents*
- A Black & white visual style: *3 respondents*
- Real movies or videos: *5 respondents*

- Animated/cartoon-like movies or videos: *6 respondents*
- Customised answer: *0 respondents*

Note: It was possible to choose multiple answers

Q8: In what way would you like these elements to be? *For example, should the wind feel like a storm or a gentle breeze? Should the sounds be loud or subtle? Where would vibrations be most exciting, in the floor, on the walls or somewhere else? Anything is possible!*

This was an optional question that allowed respondents to type their own answer. The question received 16 responses, and below are a few of them.

“If the point is for the experience to feel very interactive, I don’t think there should be any interactions that are so subtle they are missed. At the same time, if the background ambiance is overwhelming, you may miss the point of the installation. So I think it depends more on whether the focus is on an aesthetic experience, or if it has some kind of learning outcome. If the latter, more subdued cues would be appropriate. If the former, I think you are more permitted to push boundaries and put people out of their comfort zone.”

“I think it should be overpowering in a way that makes you no longer exist and fully emerge into the experience.”

“I should be able to feel it and but it should not too overstimulating, maybe also not too many elements at once or they should be balanced.”

“I don’t think it should be too much physical elements, since this could maybe be a bit scary and disorienting, so I think I would like it were a bit more gentle. But it should match the theme and vibe of the story, I think that would be the most important part.”

“Wind should be gentle, a constant background changing with the story. One of those sounds that you don’t really realize playing.”

Q9: What senses do you think are most important in making an experience immersive?

- Sight (visuals, projections, light): *34 respondents*
- Sound (music, environmental noise): *33 respondents*
- Touch (textures, vibrations, temperature): *15 respondents*
- Smell (scents that match the environment): *7 respondents*
- Motion (feeling movement, floating, tilting): *22 respondents*
- Customized answer *1 respondents*: all of them; immersion implies tricking all sensations to think that the artificial is real

Note: Possible to choose multiple answers

Q10: Now that you've learned a bit about immersive installation, if you had the power to create your own immersive world, what would it look like? *Do you have any ideas or inspiration that you think should be included in the installation? Think big or small!*

This question allowed respondents to type their own answer. Below are a few of the responses.

“personally my research interests are more about visualizing abstract "data" and making sense of them (preferably via user interactions); I'm less interested in a faithful virtual reproduction of something that exists in real life”

“I think feelings should be conveyed through the installation, or at least I would want to make the visitors feel something.”

“Probably something nature related and maybe more abstract, maybe similar to the Team lab museums in Japan. I also think fotografiska in Stockholm has had nice immersive exhibitions related to nature”

“it is very cool if you are able to follow a story and interact with your surrounding in some way (especially if your interactions have some visual effect since it makes you feel like you are a part of the installation), but i think triggering all the human senses is what brings an installation to life and makes it memorable.”

Q11: Finally, have you ever been in a space or experience that felt truly immersive? *What did you think about it? Was there anything that made it special?*

This was an optional question that allowed respondents to type their own answer. The questions received 19 responses and below are a few of them:

“I visited Teamlabs Forest in Japan (Fukuoka) (I think the pictures above are from there), and it was definitely a memorable experience, and would want to experience it again. The combination of the visual and sounds (music and/or sounds that complemented the visual) made it a memorable experience.”

“Not really, but I was once in a museum where there were really big sculptures made of yarn, where you could walk around and into them. I think that was really cool. I think what I liked most was how big they felt, and I felt small in comparison.”

“The closest thing was Van Gogh art projection showing that covered the whole museum room, it was really cool but it focused mainly on the visuals and only had background music. The cool thing was seeing the entire room covered in just art.”

The survey results showed that a majority of respondents were interested in visiting an immersive installation. Most respondents wanted to explore a world they wouldn't be able to explore in real life, such as an abstract world, the past and future, or outer space. While many desired interactive elements, most preferred not

to affect the storyline. The majority wanted to visit the immersive installation in a museum-like environment or in a group of familiar people, similar to an escape room.

The top preferred feelings were curiosity, excitement and inspiration. People mainly wished to interact with projected objects or by using bodily movements. There were no clear consensus on which elements would help them feel immersed. While many preferred subtle elements that would enhance the story without being overwhelming, some responses suggested the opposite with overpowering effects. The most important senses were visuals, sound, and touch, though a majority believed that a multisensory experience would be most effective.

5.4 Experiment

The Experiment phase focuses on creativity, prototyping, and validation of ideas. This phase is iterative, allowing for multiple refinements based on user feedback and technical feasibility assessments, ensuring that prototypes meet both user needs and technical requirements. The first iteration focused on the multi-sensory experience, while the second iteration was done in collaboration with Visual Arena's partners.

5.4.1 First Iteration

After collecting data from interviews, a survey, and literature research, the first phase of designing prototypes began. Below follows the process of creating a low-fidelity prototype.

First Ideation Session

From the user insights gathered in the *Empathize* phase, a few first ideation sessions were done. The collected insights were summarized into POVs (see Section 4.2.2) to define goals, user, and stakeholder needs. These were then converted into more tangible How Might We (HMW) statements, and three of them were used as a basis to perform Crazy-8s. The chosen statements were deemed the most relevant for the thesis and Visual Arena, and were broad enough not to create a narrow and solution-oriented mindset too early on in the process. The three statements used were:

1. HMW give users a multi-sensory experience?
2. HMW integrate storytelling into an immersive installation?
3. HMW integrate music into a storytelling installation?

The complete set of POVs and HMWs can be found in Appendix A.1.

The Crazy-8 ideation sessions resulted in a large variation of ideas across the different subjects. A common theme concerning music was to allow the user to affect the music in some way by interacting with both projections and physical objects on the walls and floor. Regarding creating a multi-sensory experience, the main ideas

concerned ways the body could be affected and affect objects, including wind and temperature changes, vibrations in the floor, and interaction with physical objects, obstacles, and other visitors. Lastly, ideas about integrating storytelling into the installation touched on having a cyclic, looping story, having the user control the story by choosing a certain room to enter, and following a character's footsteps, to name a few. The full ideation results can be found in Appendix A.2.

Low-Fidelity Prototyping

Based on the ideas and needs generated in the ideation sessions above, a lo-fi prototype was developed during the first iteration. This prototype was focused on the multi-sensory experience, and the aim was to understand what elements and visuals contributed to user engagement. The goal was also to further explore whether real exposure to different types of factors would change what users felt was important in an immersive installation, compared to what they stated in the survey.

Five people participated in the testing of the prototype. The test was carried out individually. The participant was asked to step into a dark room and stand on a wooden board slightly raised by pieces of foam underneath, see Fig. 5.4. From experimenting, it was found that a slightly raised platform allowed for stronger vibrations compared to laying it flat on the floor. The participant faced a white wall where a projection first played a video of a train closely passing by [70] (see Fig. 5.2), and then a second video of animated objects travelling through a dark, abstract space [71] (see Fig. 5.3).



Figure 5.2: Image from the train video [70]

Using Wizard of Oz, several elements were activated while a video was playing. During the train video, a heat lamp was activated in the beginning to mimic natural sunlight, it was then deactivated as the train passed the user, to mimic the shadow the train created in the video. A massage gun was pointed at the wooden board to simulate the vibrations from the train, and a fan was placed on the side, which was uncovered just as the train passed by to create a gust of wind. Two speakers

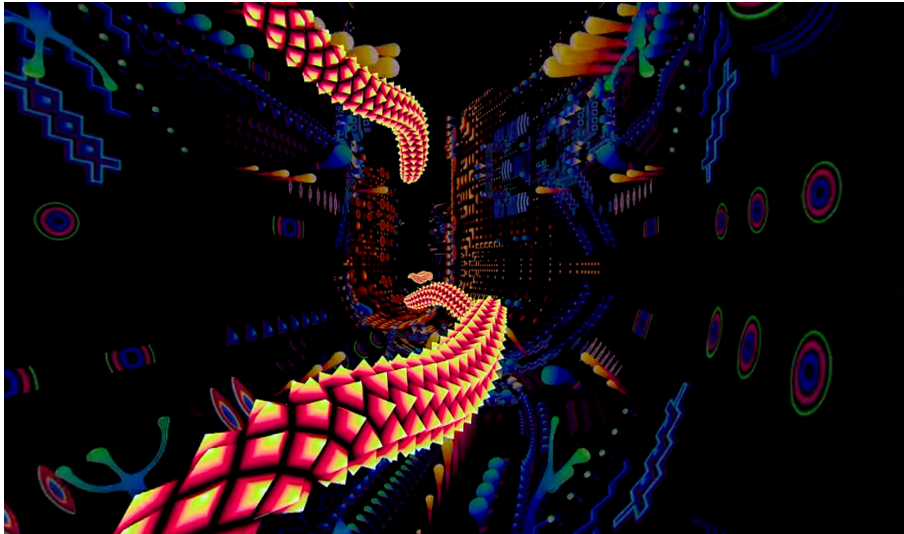


Figure 5.3: Image from the abstract video [71]

were used: one in front of the user, used for the sound of the train, and one behind the user, which played ambient sounds to mimic the background noise in the video. During the animated video, only the fan was activated to simulate the speed at which the user was “travelling”, and only the speaker in front was used. Finally, the room was draped in fabrics to create an immersive environment by covering the ceiling and air vents.

Evaluation of Low-Fidelity Prototype

To evaluate the user experience of the lo-fi prototype, each participant was interviewed using a semi-structured format. The questions asked were:

- What did you think of this experience?
- What elements or aspects worked better or worse?
- What did you feel was missing?
- How immersed did you feel on a scale of 1 to 5, where 1 is not immersed at all, and 5 is completely immersed?
- What contributed to your rating?
- If you could interact with the projection, what would you like to do?
- Did any element or aspect feel redundant or uncomfortable?
- Any other thoughts?

From the interviews, it was clear that a low-fidelity prototype was hard to feel immersed in, especially since the fan and heat lamp had to be manually controlled by a member of the team. This was also reflected in the scoring of “immersiveness” on a scale of one to five, which averaged a score of two. However, one user scored the first experience of the train as a two, but the second video as a four. This was



Figure 5.4: During the set-up of the low-fidelity prototype

brought up during other interviews as well, stating that it was easier to be immersed in the abstract. When asked about what in the projections they would have liked to interact with, all participants said they preferred to interact with the abstract video, as it felt more interesting, and that something unexpected could happen. The users felt familiar with a train, which made it less exciting. Some mentioned they were scared of the weight of the train, which is why they were hesitant to interact with it.

Vibrations in the floor were commented on as not being perfectly matched to the rhythm of the train, but were seen as positive since the users did not expect it. Overall, all factors like wind, heat, vibrations, and sound were deemed a positive contribution to the experience, but sound was said to be the most important one for immersion. One user commented on the low resolution of the videos, and mentioned that lower resolution probably is less forgiving in an abstract context, as the brain does not know how to “compensate for it”, compared to the real train video. When discussing the importance of sound, one user drew a parallel to games and said it would be fun if installations or games used songs to tell a story, or used sound and music as feedback to the user.

Two users also mentioned the abrupt transition into the testing, and wished for better continuity between arriving in the room and watching the videos. They

suggested a darker room at arrival, or other matching sensations to what they would experience.

Based on these interviews, it was concluded that a higher fidelity prototype had to be done for the users to focus more on their senses and the content, instead of being distracted by what happened around them. A better transition into the experience was wished for, which agrees with what Whittaker [29] states about onboarding in XR in Section 3.3 and will be explored further. Overall, the multi-sensory experience did contribute to the feeling of immersion, and the next prototype should focus more on the sound and the content, most likely more abstractly or less realistically. The comment about using music and stories together was notable and will be further explored in the next iteration.

5.4.2 Second Iteration

After the insights from the first iteration were presented for Visual Arena, some discussions took place with the team and its partners connected to the XR Sweden project. As the first iteration unveiled that a higher fidelity prototype could be necessary to gain better insights about immersive installations, it was decided that the second iteration would be a joint effort to create a prototype. The collaboration was thought to have a higher possibility of generating a high-fidelity prototype that could be presented to the public. This thesis would develop and provide the storytelling aspect of the installation, and provide insights from the previously done research.

Second Ideation Session

At this point, some different types of narratives were explored. Visual Arena had previously pitched the idea of having water, music, or nature as potential themes for a joint installation. From the first survey sent out to users, there was also a preference from users to explore abstract or futuristic realities. From these themes and insights, a few rough ideas of interactive storytelling were brainstormed. They were the following:

- An open, exploratory sea-world where visitors can interact with different creatures and objects in the water to unveil stories and memories.
- An installation with two diverging paths to take: one path will follow how Gothenburg becomes taken over by nature, and the other shows how Gothenburg turns into a futuristic and high-tech city. As a user chooses a new path or new room, a different story unfolds.
- The circle of life: The users can choose different rooms to see the life cycle of a living thing, for example, users can touch a projected seed and see it grow into a tree and eventually wither. Together, users would create a forest and see it in its different stages of life.

These ideas were only made quickly to start discussions with others in the team at Visual Arena, but the general idea was based on interactive storytelling, and having

users explore a world through interactions with projections.

The following ideation session was a role-playing session, where nine people were assigned one role each out of five: sound designer, visual designer, interaction designer, creative engineer, and experience director. The participants were Visual Arena and other thesis students participating in XR Sweden's research, and they were informed of the insights and goals gathered so far in this thesis. Groups of three then discussed and presented challenges and solutions while acting in their assigned roles, using the *informance* approach, see Section 4.2.6.

The role-playing had the goal of exploring the storytelling aspect connected to the gained insights from the low-fidelity prototype testing, such as users' preference toward abstract projections, interactions with the projections, and unexpected elements. The three groups each presented one or two ideas, which were:

1. Travelling to an unknown planet and exploring the new world, where you discover musical elements in unexpected ways.
2. Projecting familiar objects but having them behave in unexpected ways, so the next thing that happens will be hard to predict.
3. Use sound to guide the visitor through the unknown space.
4. A projected imaginary friend that you follow through the experience.

The ideas from the role-playing sessions and the brainstorming around interactive storytelling became less useful as the creative direction later changed for the project. Most ideas were therefore left unexplored, and instead, this thesis moved on to focus on ideation surrounding the laundry room. The ideas concerning life cycles, abstract visuals, and sound as a guide still resonated with the initial ideas from the first prototype, and was included when brainstorming later on.

Change in Creative Direction

A creative lead was brought in to coordinate the different actors toward the goal of a high-fidelity prototype, with experience in filmmaking, storytelling, and XR. The team now included the authors of this thesis, two students studying to become industrial technical artists, a musical artist with audio design experience, an XR developer, and a team from Gothenburg Film Studios, which is where the prototype was to be shown. An external company called Informationsteknik was responsible for providing and setting up projectors and Microsoft Kinect motion sensors. Göteborgs Stadsmission was later added as a collaborator to provide clothes.

The creative lead decided on a common theme to explore and create an immersive installation around: *the Swedish laundry room*. He had previously explored the laundry room in his own work and felt it was a suitable theme to explore in a new setting. As there was now a specific theme, it became easier to generate ideas and make decisions to develop a prototype in a shorter amount of time. The goal was to create a reflective experience for visitors to provoke emotions and memories. The previous ideas connected to interactive storytelling and nature were set aside as

the team agreed that the laundry room felt tangible and narrow enough to create something high-fidelity in the short amount of time there was left.

Approximately one month prior to the installation, the team began holding 30-minute meetings every other day. These meetings were intended to clarify the role and responsibilities of each member. However, this process proved to be somewhat challenging, as certain roles were initially ambiguous, with overlapping areas of responsibilities, particularly between the thesis role and the creative lead, both which were closely involved in shaping the narrative and interaction design. Over time, these challenges were mitigated through open communication and the development of mutual trust, which contributed to more effective collaboration. The working process also improved as team members developed a clearer understanding of each other's role and responsibilities.

Although there was no shortage of ideas within the team, a key limitation was the lack of resources to execute them, especially in terms of visuals and interaction design. As a result, some ideas developed within the scope of this thesis had to be set aside, both due to technical constraints and the creative lead having the final say in design decisions.

Third Ideation Session

To understand how users feel about the laundry room and narrow down what story to tell in the high-fidelity prototype, the team of eleven people of different backgrounds at Visual Arena was tasked to describe their experiences and feelings around the laundry room. These were written onto post-it notes in a Miro board, and were then used to create a thematic analysis, shown in Fig. 5.5.

Four clear themes emerged from the thematic analysis, and some insights were deemed too irrelevant or difficult to capture in a meaningful way and were put aside. For example, some of the set-aside post-its described how people wanted to avoid social contact in the laundry room. As there had been some discussions about the audience interacting with each other during the installation, it could become confusing to integrate a theme on avoiding social contact.

From the thematic analysis, another brainstorming session was carried out to investigate potential interactions, stories and visuals, see Fig. 5.6. This resulted in linear and non-linear alternatives to a narrative, different points of interaction connected to both detergent and laundry machines, and other elements that would be nice to visualize. These rough ideas were presented to the technical artists, and together, it was decided on what factors were feasible within the development scope.



Figure 5.5: Thematic analysis with four themes in bold

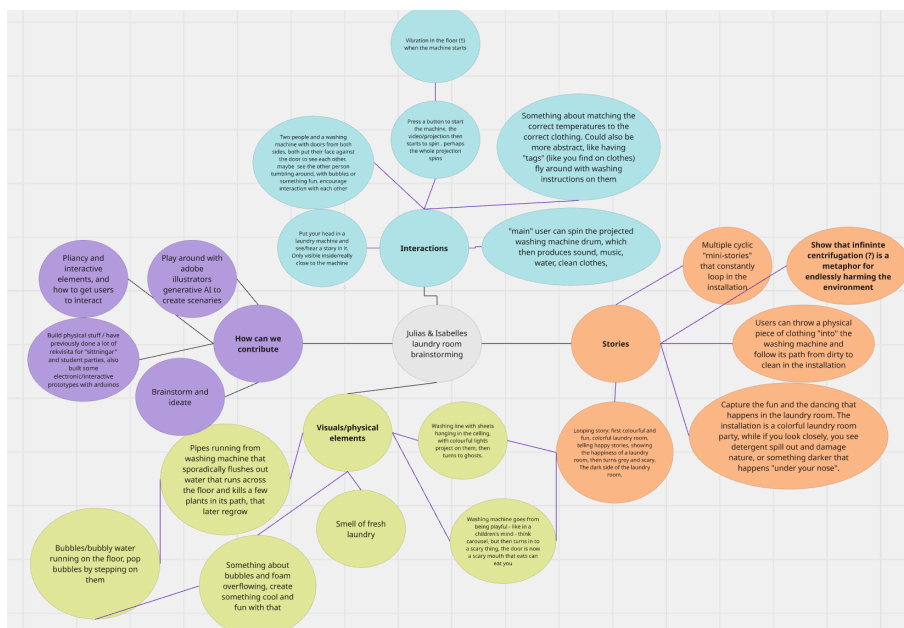


Figure 5.6: Mindmap from brainstorming around the installation

Developing a Narrative

As non-linear narrative structures seemed favorable in XR according to literature (see Section 3.5) and expert interviews (see Section 5.3.2), and inspired by its use of fragmental stories, a cyclic narrative with an atypical dramaturgical curve was designed. This was also generated earlier in the Crazy-8 sessions, see Section 5.4.1. The purpose of the cyclic structure was to represent the four themes that emerged from the thematic analysis in a continuous loop, and thereby illustrate fragmented stories through an abstract narrative that would bring the user through different emotions. An descriptive sketch of the cyclic structure is shown in Fig. 5.7. As mentioned in theory about immersive storytelling, see Section 3.5.3, it was known that users will inevitably try to find their own narrative in the laundry room, and think of their own memories associated with it. The story conveyed through a cyclic narrative structure would support that knowledge, as the four moods could help trigger different emotions in different users. Although fairly abstract and lacking a linear storyline, this was a way to keep the scope as simple as possible, as the technical artists had limited time and expertise. A more interactive storytelling was deemed too advanced, time-consuming, and difficult to achieve. The studio where the installation would take place also forbade users from touching the walls, which made interactions with projections impossible, even though it was a favorable element from earlier user insights.

Visuals were decided to be fairly abstract, as users had shown a preference for it in the first user tests. The initial idea was to represent falling clothing in different speeds, and use changes in colors, background, and effects to represent the different moods. The sound would go from somber to happy and upbeat, depending on the theme visualized, and include whispers of the team's testimonies, which would represent a sort of character in each fragment.

After the technical artists tried to implement the falling clothes, they realized it was a complex task and had to revert to simpler visuals. The technical artists were then given the insights from this thesis about inevitably triggered memories, along with the sketch of the cyclic story, and were tasked to create something reflective out of it in the little time that was left. As users liked interactions with physical objects, ideas around interacting with a laundry machine or clothing seemed more favorable with respect to interacting with a sensor.

Evoking Emotions and Memories

The reflective goal of the installation meant that it should evoke visitors' emotions and memories. The team discussed movements and senses that made them think about doing laundry, such as folding and shaking sheets with their grandma, ducking under hanging laundry, or smelling the detergent. This served as the inspiration when the technical artists developed interactions with the sensors, and when this thesis developed the surrounding spaces.



Figure 5.7: Sketch of four looping themes presented to the team in Miro

Onboarding Areas

One of the main things developed by this thesis, besides the narrative, was the areas surrounding the installation. Based on previous literature research in XR and interview results from the first user tests, it was decided to turn these areas into onboarding areas to acclimate visitors to the theme and help them start to reflect on what they associate with the laundry room, before entering the installation. The onboarding areas were shaped using brainstorming sessions based on the thematic analysis from the second ideation. The ideas also had to be narrowed down to fit what Gothenburg Film Studios and Göteborgs Stadsmission had access to. As a multi-sensory experience had previously been established to increase immersion, senses like touch, smell, hearing, and sight were all incorporated in the brainstorming sessions.

Creating the Installation

The installation was set up on site two days before it was opened to the public. Some of the physical elements for the onboarding areas were prepared in advance. The technical setup consisted of three projectors, a surround sound system, one stand-alone speaker, two Kinect sensors, and two computers. The projectors were mounted on a truss that was already installed at the location. Two projectors projected onto

the walls, while the third projected onto the floor, see Fig. 5.8. However, wall-facing projectors were partially obstructed by other equipment mounted on the truss, which could not be moved. As a result, parts of the visuals were disrupted by shadows and could not be resolved on site. Additionally, aligning the visuals where the walls and floor met was challenging due to the seamless curve of the cyclorama. The technical artists needed to calibrate for this, but the software used, TouchDesigner, did not support precise calibration for such a space. Therefore, a second software, MadMapper, was used to assist in calibration. This improved the visual alignment and overlap, although the mapping was not entirely accurate due to time constraints.



Figure 5.8: The team gathered to test the setup before the exhibition. Photo by Elena Perota

6

Results

The results aim to answer the research question “*What critical components are needed to enhance audience engagement in immersive installations?*”. The results focus on the jointly created immersive installation prototype based on the research process that this thesis has explored, together with the executive technical crew from Visual Arena’s partners. The installation took place on May 2, 2025, at Gothenburg Film Studios and had 140 visitors. This chapter describes the *Deliver* phase of Visual Arena’s Innovation Framework. It includes a description of the installations appearance, as well as insights gathered through multiple evaluation methods. The installation was assessed through semi-structured interviews conducted during the installation, a thematic analysis of the interview data, observation through video recordings, and a survey sent to all visitors after the installation.

6.1 The Swedish Laundry Room - An Immersive Art Experiment

The result of all brainstorming and planning with the other participants led to the development of an immersive installation called “The Swedish Laundry Room”. It consisted of two key areas: *the onboarding area* and *the installation room*. Together, they form a complete installation experience. Although they will be referred to separately for clarity, they are interconnected parts of a unified whole.

The installation was described as an immersive art experiment and was advertised through Visual Arena’s social media channels, as well as in an article published by Göteborgs-Posten. While the installation was free of charge, visitors needed to consent to being documented through photos, video, and interviews.



Figure 6.1: A visitor taking in the experience in the installation room

6.1.1 Onboarding Areas

The onboarding area was divided into several zones: *the outside area*, *the corridor*, *the square*, and *the interview area*. The outside area includes the entrance and adjacent parking lots. To help visitors find the entrance to Gothenburg Filmstudio, which can be difficult to locate, clotheslines were hung on the nearby fence as visual markers.

When entering the location, visitors were greeted by a host who ensured they were registered participants. The registration included a consent form granting permission to be recorded and interviewed. Unregistered visitors could still enter by signing a consent form on-site. The host then gave a brief overview of the experience and instructed the visitors to take a clothes pin from a board that resembled a laundry booking schedule, shown in Fig. 6.2. Each pin was labelled with a number, which helped identify participants during the interviews while still maintaining anonymity.

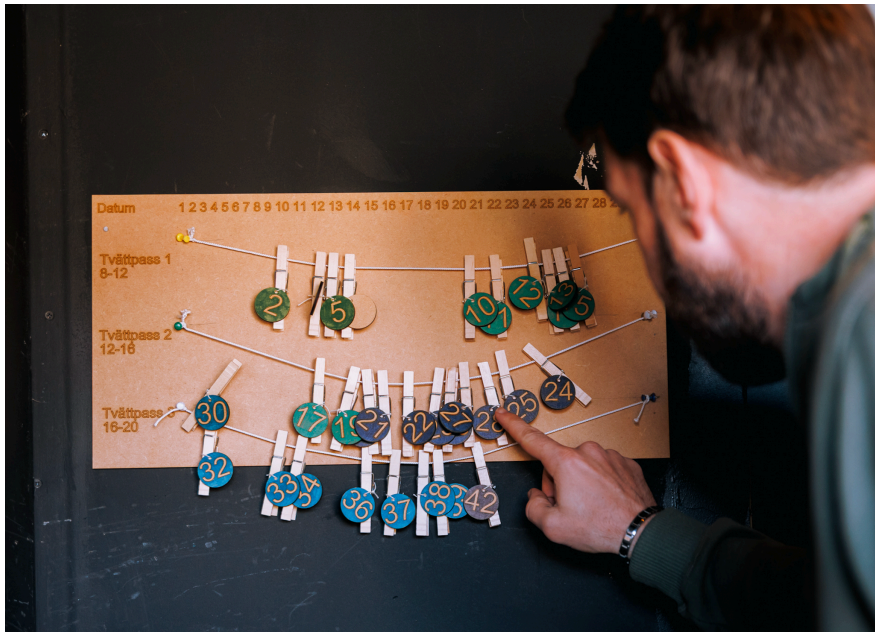


Figure 6.2: A visitor grabbing a clothes pin. Photo: Elena Perota

The entrance led directly into a long, partially dark *corridor*, where clothing lines with shirts hung across the walls, forcing visitors to duck or maneuver through the shirts at times, see Fig. 6.3. Tubs filled with clothes and laundry detergent were placed along the walls, along with a fan which added movement to the hanging shirts while spreading the scent of the detergent through the corridor.



Figure 6.3: The corridor leading into the square. Photo: Elena Perota

After passing through the corridor, visitors entered *the square*, a space designed for mingling and reflection. Here, they could read notes with other people's thoughts about the laundry room and write notes about their own experiences. These notes were placed with pins along the walls in the room, see Fig. 6.4. A washing machine,

6. Results

dryer, laundry baskets, and piles of clothing were placed in the room, setting the scene of a laundry room, along with notes one might typically find on a bulletin board in a shared laundry room, shown in Fig. 6.5. The square also served as a waiting zone for interviews. A smoke machine was placed close to the entrance of the installation room to somewhat imitate the damp and humid environment in a laundry room, but was deactivated after noticing the smoke affected the sensors in the installation. The entrance to the installation room was located next to the laundry machines, as shown in Fig. 6.6.



Figure 6.4: The walls with the notes and a table to write the notes

The interview area, located next to the square, was divided into four smaller sections using mobile room dividers. Each section was furnished with a couch, and the whole area allowed four interviews to be conducted simultaneously. From the ceiling, strings of small white and transparent balloons were suspended, resembling detergent foam clouds. These decorative elements were designed to add visual appeal and attract visitors towards the interview area, making the space feel more inviting and engaging.



Figure 6.5: A visitor reading the notes next to laundry machines and a laundry basket. Photo: Elena Perota



Figure 6.6: Entrance to the installation room from the square

6.1.2 The Installation Room

The installation consisted of projections on three surfaces: two walls and the floor. The walls and floor had rounded corners, also known as a cyclorama, which blurred the lines where the surfaces met. Due to permanent light fixtures on the truss where projectors were hung, an inevitable shadow was cast on one of the projected walls.

There were two zones where visitors could interact to trigger an event. The first zone triggered a sound when a visitor approached a pile of clothing on the floor. The sound consisted of AI-generated voices telling stories that were enhanced versions of the team’s testimonials, as intended in the sketch of the cyclic story. The other zone produced a more harmonious sound, based on the sound of a washing machine and running water. The sound was triggered when one or more visitors entered a specific area marked with circles on the floor. Here, visitors were encouraged to lift a sheet, and the sheet’s movement triggered both changing visuals and sound. The interaction is demonstrated in Fig. 6.7 and Fig. 6.8. On the two side walls, which did not have projections, lines with white sheets and clothing were hung as a neutral but thematic background. Throughout the floor and along the non-projected walls, stools were placed that allowed visitors to sit and observe the surrounding environment.



Figure 6.7: Sound and XR designers Alicia and Akshay demonstrating the interaction



Figure 6.8: Two students trying out the interaction

6.2 Interview Results

101 users out of 140 were interviewed, as some visitors were small children, under 18 years of age, or did not want to be interviewed. The interviews followed a semi-structured format, and the guiding questions can be found in Appendix A.4. When guests arrived, they were interviewed about their expectations and their previous experience with immersive installations and XR in general. They were then told to come back after they had visited the entire installation and felt ready to describe their experience. Then, a longer and more in-depth interview followed, focusing on what they experienced, what narrative they found, what feelings were generated, and what aspects contributed to those feelings. All interviews were recorded and uploaded into the tool NEXT, see Section 4.10.3, which transcribed the recordings using AI. The transcripts were then used to create a thematic analysis.

To perform the thematic analysis, a deductive approach was used. The first step in performing a thematic analysis is familiarization with the data. This step involved listening to the interviews and was combined with correcting the AI-generated script, which was not entirely accurate. Familiarization creates a general idea of what patterns can be found in the data, used for creating themes later on. Each quote from the interview scripts was then coded, meaning relevant parts were labelled with a so-called code. Similar codes are then grouped into subthemes, which are then grouped into larger themes. The coding process was done with the research question in mind, as this was a deductive thematic analysis. The questions posed to visitors often helped form themes. For example, only one question was related to storytelling, hence those answers were coded and grouped into different subthemes, such as “found no narrative”. These subthemes were then gathered into a larger theme called “finding a story or narrative”.

The thematic analysis resulted in four large themes, each with three to four subthemes. When finished, each theme and subtheme was reviewed, and any necessary renaming or moving of codes was done to accurately represent the data. The analysis was also reviewed to fit the research question, as the themes should aid in the discussion later on. Below follows a description of the four themes and their subthemes.

6.2.1 Theme 1: Immersion

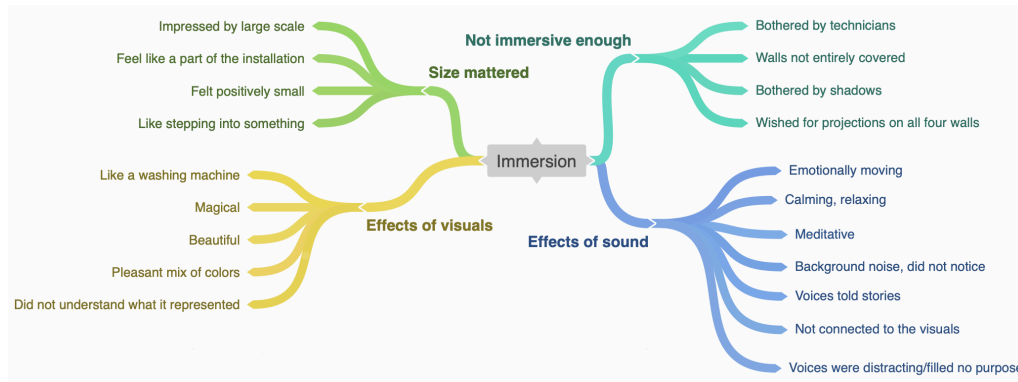


Figure 6.9: Mindmap of the theme *Immersion*

Immersion is one of the overarching themes, and consists of the four subthemes “Not immersive enough”, “Size mattered”, “Effects of visuals” and “Effects of sound”, as seen in Fig. 6.9. The name of the theme was chosen as it collected the subthemes describing what contributed to users experiencing immersion or not. The secondary branches to each subtheme are the phrases used to label the transcript in the coding process. The rest of the themes are visualized in the same way.

Subtheme 1.1: Not Immersive Enough

This theme covers the answers that were both brought up when asked about improvement areas, or when users were asked how visuals affected them. Of the four subthemes, it is the subtheme with the smallest number of data points. One participant said this when asked how the visuals made them feel:

“I would like to be more immersed in this. More wall coverage all around. If you turned your head, there was a shadow there, and on the other side too. So that would have been the finishing touch.”

Similar quotes were found a few more times, and these users seemed to express less emotional response to the installation than those who did not comment on the lack of all-around projections. One user said:

“If all walls were the same, so you became completely immersed in it, that would have been even cooler. Maybe then I would be more emotional.”

As this last quote states, a person will feel more immersed when the entire periphery is covered with the projections. This is not surprising for the results, but will still

briefly be discussed in the next chapter.

Subtheme 1.2: Size Mattered

The second subtheme highlights that a large installation makes the user feel small in comparison, and thereby more immersed. The users who pointed out the size of the room and projections have no overlap with the users who felt the installation was not immersive enough. A quote that summarizes this subtheme is:

“I felt like the size mattered. You felt positively small. It’s definitely necessary for it to feel impressive.”

Another interesting point that another user made, which comes up in theory section 3.2.1, is the comparison between VR and immersive installations.

“It was very interesting to come into something this big and immersive as opposed to using a VR-headset. It’s very interesting. More communal in a way.”

As discussed in the last sub-theme, these quotes only confirm what was already known from studying literature and are therefore not a surprising result.

Subtheme 1.3: Effects of Visuals

Users differed in their interpretations of the visuals, but most agreed that they were fascinating or pleasant to watch. Some tried to understand them, and some connected them to laundry and thought they represented clothing, like this quote:

“It was like a visualization of a laundry machine. Like the inside of the laundry machine, but in a more beautiful and conceptual way.”

A slight majority of visitors did not explicitly try to understand the visuals, but simply observed them and described them similarly to what one visitor said:

“Most captivating was the visuals. You sat there and just followed them. When you moved the cloth or stepped somewhere else, the visuals changed.”

Overall, visitors seemed pleased with the abstract visuals, and there were only a few comments wishing for other types of visuals. One reason for this could be connected to the lack of immersive installations in Sweden in general, and therefore, most visitors do not have a preference for certain immersive visuals yet.

Subtheme 1.4: Effects of Sound

This subtheme had the most datapoints in this theme, as one quote about the sound could have been coded with two different labels. Most users agreed on the calming and meditative effect the music had, but differed when it came to the voices. Some found them fun and enjoyed listening to stories, and some found them distracting. One visitor said the following about the voices:

“[The voices] felt like they did not fit in [...]. You sat there, dreaming away, and then the voices came... It felt all wrong.”

Only a few visitors noticed that the voices were triggered by standing in a specific spot in the room. One user who found the interaction point for the voices said the following:

“After you had been in there for a while, you noticed the voices only came sometimes. Then I figured it out, and sat on the stool to listen more.”

The music seemed to have the strongest effect on visitors, and one example that stood out was this visitor’s comment:

“The music was very calming, almost meditative. I don’t know, but I almost became a bit teary-eyed [...]. It was very pleasant.”

This aligns with user opinions from the first iteration, where sound was deemed the most important factor in an immersive installation.

6.2.2 Theme 2: Engagement

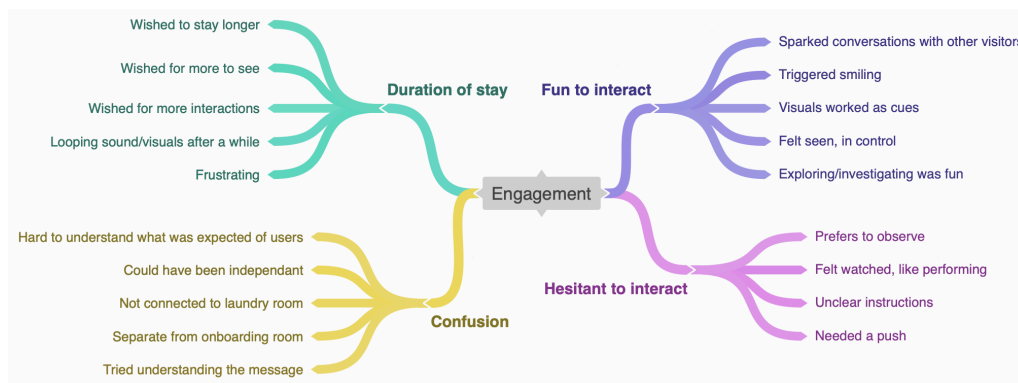


Figure 6.10: Mindmap of the theme *Engagement*

The name of this theme is derived from the four subthemes that describe different ways this thesis measures engagement, such as how visitors interacted with the installation and the duration that visitors stayed. It consists of the four subthemes “Duration of stay”, “Fun to interact”, “Hesitant to interact”, and “Confusion”, see Fig. 6.10.

Subtheme 2.1: Duration of Stay

The average time a user estimated how long they stayed in the installation was 15-20 minutes, and this subtheme gathered the answers that could explain what contributed to that average. Some users wanted to stay as long as they could, but some felt there was a lack of things to do or see after a while. Below follows a quote from one visitor.

“I would have wished for more interactivity points, like more easter eggs to find. You were finished with it pretty fast.”

This quote was one of many that wished for more things to explore. Another visitor commented on the visuals:

“I would’ve stayed longer if the visuals differed more, like one white load of laundry, one colored load of laundry.”

This user felt similar to others, who also felt that you eventually had seen and heard all that the sound and visuals had to offer, and at that point, they left. As it was quite a small installation, with little time to develop more advanced visuals, it is not surprising that a lack of things to see was affecting the duration of stay.

Subtheme 2.2: Fun to Interact

This subtheme describes the comments from users who interacted with the installation and reacted positively, which came from a majority of the visitors who tried the interactions. Most users in this subtheme described it simply as a fun experience, and some said that controlling the visuals and sound by themselves had a positive impact on their overall visit. One visitor sums up the general feeling below.

“It was exciting because I was the one affecting things.”

One user said it was fun to explore the room without clear instructions, saying:

“I went around and tried to find what triggered changes in the visuals, and what triggered the voices. And I found it. That was fun.”

Comments like these stood out as some users were confused without guidance during the interaction. This is discussed in the next subtheme.

Subtheme 2.3: Hesitant to Interact

This subtheme involves all the reasons visitors were hesitant to interact with the installation, and what made unsure visitors interact despite not planning to. Most visitors in this subtheme did interact, but found it difficult to understand how the interaction worked, needed guidance from a team member from Visual Arena, or was encouraged by a friend or other visitor who was more eager to interact, like this visitor mentions below.

“Maybe I’m too shy to interact. But I did it, with a push from a friend.”

The visitors who did not interact mentioned a preference for just observing others, or that since the interaction location was placed in the middle of the room, it felt like a performance to stand in the middle while other visitors watched from the sides. One visitor said:

“It seemed a bit scary to stand in the middle of the room with people all around.”

One visitor also mentioned that since the interaction with the sheet was meant for two people, he felt limited as he was there by himself, stating:

“But I’m here by myself, so I can’t really do it alone.”

This was also not a surprising quote, as having to socialize to be able to try the interaction can be a hindering factor for many visitors. Some might feel shy, and

others attended the installation when not many other visitors had arrived yet. This points out a flaw in having an interaction that requires collaboration.

Subtheme 2.4: Confusion

The last subtheme collected all aspects of the installation that seemed to spark confusion among visitors, and therefore created less engagement. Some mentioned the installation was not related to laundry, and that it seemed more like an independent installation. Users in this subtheme also mentioned how they tried to understand the message, or what they were expected to do, and wished for a better introduction. A visitor mentioned they were less amused because of their confusion in the quote below.

“It was a bit awkward. What am I supposed to do here? You felt forced to do something.”

Another pointed out the lack of instructions made them frustrated, stating:

“I think we just felt confused, because the interaction point was clearer on the left side, but not the right one. It was frustrating.”

More instructions for visitors were clearly needed for some, which might have been something to expect, as not many had attended a similar installation before.

6.2.3 Theme 3: Finding a Story or Narrative

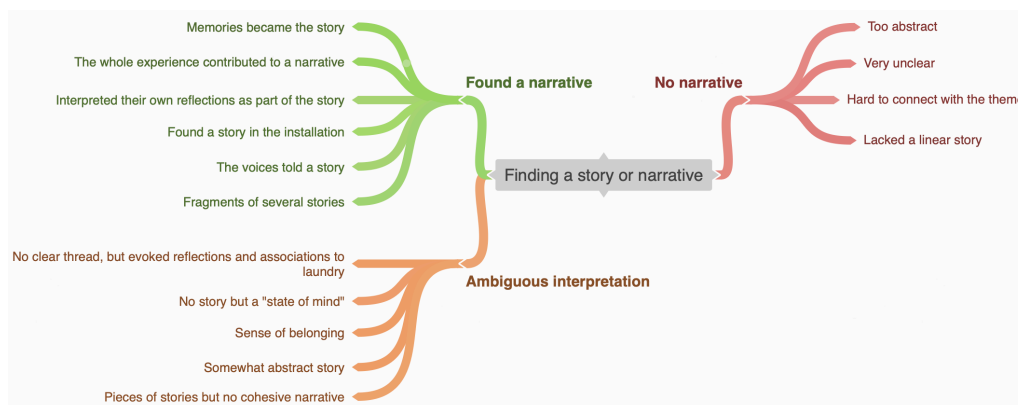


Figure 6.11: Mindmap of the theme *Finding a story or narrative*

This theme describes how visitors interpreted the storytelling in the installation. It consists of the three subthemes “Found a narrative”, “Ambiguous interpretation”, and “No narrative”, as shown in Fig. 6.11. These subthemes highlighted a noticeable split in how visitors perceived the narrative: while some visitors identified a distinct storyline, others struggled to find one at all.

Subtheme 3.1: Found a Narrative

Despite variations in how the story was described, a distinct group of visitors had nonetheless perceived and could clearly articulate a coherent story within the instal-

lation. Some discovered a story through the different voices that were played, while others gathered fragments from multiple stories in the installation and managed to piece together a complete story. For some, the reflections from the onboarding area turned into a story, and some described the whole experience as a unified story. One visitor described the storytelling as follows:

“My own memories of the laundry room became my story.”

Another visitor reflected on how the installation conveyed not only a story about environmental concern, but also about the social and personal dimensions of the laundry room:

“The story touched on nature, water, and environmental concerns through the voices. But also on people, how the laundry room can be a space for reflection and a pause from everything else. So, it became a mix of larger existential questions and the small, ordinary things”

Others described the story in more literal terms, a few simply described the story as *“Being inside a washing machine.”*

As the only existing storytelling element was the voices, it was still interesting to hear that visitors found a story of their own, even though it was not the intention of the team.

Subtheme 3.2: Ambiguous Interpretation

The most prominent subtheme within this theme concerned visitors who initially found it difficult to articulate a storyline when asked directly. However, upon reflecting on their experience, many began to describe experiences that implicitly contained some narrative elements, often without consciously recognizing them as such. In some cases, visitors did not identify a coherent story but instead recalled fragmented narrative elements or described an overall feeling as the narrative. One participant expressed this as:

“It was like impressions. Like short bubbles of sensations[...] I didnt really see a clear thread.”

Another visitor similarly noted the fragmented stories in the experience, saying:

“Several different stories, but difficult to understand the context or how they were connected.”

One participant reported a sense of connection or emotional resonance. For instance, one visitor described a subtle feeling of communal belonging:

“I think you feel this sense of togetherness, maybe. When you share a building with people. You live in separate apartments but are united by the laundry room.”

Another described their experience as dreamlike and immersive, where sounds and sensations evoked a strong, if unclear, story-like atmosphere:

“It made me feel like I was dreaming. Like I was inside a dream and you hear lots of voices, but you don’t really know what they’re saying. You hear them and you hear lots of things at once. Kind of like dreaming.”

Subtheme 3.3: No Narrative

The final subtheme within this theme includes visitors who either did not perceive a story or narrative at all, found it difficult to identify one, or felt frustrated with the abstract and interpretative character of the experience.

When asked whether they found a story in the installation, one visitor responded:

“No, well there is definitely a story but it’s not understandable at all, zero!”

Some people expressed a desire for a more concrete or accessible story:

“I felt it is a bit abstract at the moment, like to really understand what you are trying to do or tell.”

“A very open interpretation of what it is and what its about. And I think it would be nice to have it a bit more grounded. Like including something about what the laundry room has been historically, or what it means to the average person. Or perhaps an anecdote, something more concrete.”

In some cases, the perceived lack of storyline led to a sense of confusion:

“Well, I don’t know. I don’t reflect on it. It just felt more like[...] It was chaotic, you know.”

The question used to determine if people found a story in the installation was interpreted in many ways, and seemed to have sparked more confusion than intended. This will be discussed in the next chapter.

6.2.4 Theme 4: Effects of Onboarding Rooms

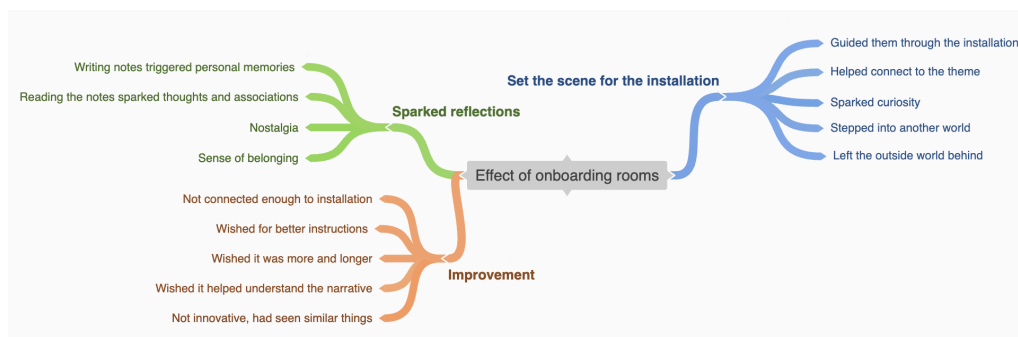


Figure 6.12: Mindmap of the theme *Effects of onboarding rooms*

The last theme is illustrated in Fig 6.12 and this theme has four subthemes: “Set the scene for the installation”, “Sparked reflections”, “Improvement”, and “Felt separate

from the installation”. The theme describes what role the onboarding rooms had according to the visitors, and the impact it had on the installation room.

Subtheme 4.1: Set the Scene for the Installation

This subtheme had the highest number of data points and highlights how the onboarding room helped set the scene for the installation. It created a sense of anticipation, supported visitors in understanding the narrative, and contributed to their sense of immersion. One visitor described how entering the felt like stepping into another world:

“I think the corridor was a really good first part. Its kind of like a portal into another world.”

Another visitor reflected how the smell and sight of laundry reminded them of the laundry room and sparked curiosity:

“It was kind of fun because there was the smell and the laundry, and you felt like, okay, now I’m on my way in. I mean, the smell really made you feel like you were in a laundry room. It created a sense of anticipation.”

Subtheme 4.2: Sparked Reflections

This subtheme had the second highest number of data points of the larger theme and describes how the onboarding triggered personal memories, a sense of nostalgia, and feelings of belonging. One visitor described this sense of belonging as follows:

“it was fun to be able to contribute with something in there. You could draw something or write something. And it created some sense of togetherness.”

Another visitor highlighted how each part of the exhibition contributed to the overall experience and how the onboarding reminded them of the laundry room and their own past experiences:

“I thought all steps were important in creating a complete experience. I think the booking board and bulletin board are important because that’s what it actually looks like in a laundry room. And it’s also interesting and fun to read others thought, it reminded me of my own experiences.”

It was interesting to hear that the design of the onboarding areas had the intended effect, but also that writing and reading notes sparked a feeling of belonging, something that was not expected.

Subtheme 4.3: Improvement

This subtheme captures aspects of the onboarding experience that visitors felt could be improved. While the majority of data points regarding the onboarding experience were positive, several visitors also identified areas with potential for enhancement. A few visitors suggested a longer and more immersive onboarding phase that builds

anticipation before reaching the main installation room. One visitor expressed it in the following way:

“I think it could have been a bit longer, not physically, but more like a process. Like a labyrinth, where you’re drawn in by the sound throughout the building, interacting with small things along the way. Then, after a while, you reach the main experience. I got there [The installation room] very quickly, which was cool, but in terms of impact, I think it could have built up more.”

One part of the onboarding experience included post-it notes that visitors could both read and write. While most visitors expressed interest in this element, a few felt that it was something they had seen many times before. One visitor responded bluntly:

“Post-its, that’s boring. I don’t even take time to read them because I think that it’s seen so many times and I just don’t care about what others are thinking.”

A similar suggestion was to use the onboarding to introduce how the installation room worked and how visitors could interact with it:

“[...] more description. It would be nice to know what to do in the installation room or like what can we interact with.”

The user refers to a more technical onboarding, which literature already states is important in XR. As the team wanted to see to what extent users need guidance in an immersive installation, it is still an important finding for future iterations.

6.2.5 Observation

To complement the interview data, a camera was placed in the installation room to record all visitors reactions and the duration of their stay in the room. The recording was six-hours long and did not pick up audio from visitors, but served as a tool analysing visitor behaviour after the installation closed. By significant increasing the playback speed of the video, it was possible to observe patterns in how the visitors interacted with the space.

Visitors who came alone tended to interact less with the installation. While a few appeared comfortable sitting on the stools, many remained standing along the walls, primarily observing rather than engaging. In contrast, visitors who arrived in groups were more likely to interact, particularly with the sheets. Although they often began by observing, they were more inclined to position themselves in the center of the room rather than along the sides.

It also appeared that the more people were already in the center, the more likely others were to join. The people who arrived at the beginning or end of the installation had the installation more or less to themselves, and gave the most positive interviews afterwards.

6.2.6 Survey

A survey was also sent out to visitors after the installation to collect quantitative data and more user comments on the experience. The exact questions and entire results can be found in the appendix, see Appendix A.5. The survey was developed in collaboration with Visual Arena, meaning that some questions, such as demographics, were more relevant to Visual Arena, and some questions related to, for example, immersiveness, concerned both parties. Users were asked to answer eleven questions, seven of which were questions about how visitors agreed to statements about the experience on a scale of one to six, where one was “Not at all” and six was “Very much”. In the last question, users could give a written answer with feedback, and the first three questions concerned demographic and previous experience with immersive experiences. Below follows the results of the questions relevant to answering the research question in this thesis.

Answers to Relevant Ordinal Questions

Five ordinal questions or statements were deemed relevant to answering the research question, and they were: “*To what extent are you familiar with immersive installations?*”, “*The immersive experience created a strong emotional reaction and captivates you*”, “*The immersive experience improved through the use of sound*”, “*The immersive experience improved through the use of visuals*”, and “*The immersive experience improved through the use of interactivity*”.

The most unanimous positive answers were about visuals, as a majority of visitors ranked the statement a five or six, see Fig. 6.16. A slightly smaller majority of visitors also said the experience was improved by the sound, see Fig. 6.15, albeit a few more answers was focused around three or four. Interactivity had a fairly spread out result, but with no visitors completely disagreeing with the statement, see Fig. 6.17. A majority ranked the installation’s ability to generate a strong emotional reaction around three to five in Fig. 6.14. Lastly, visitors were almost evenly spread out when asked about their familiarity with immersive installations, see Fig. 6.13.

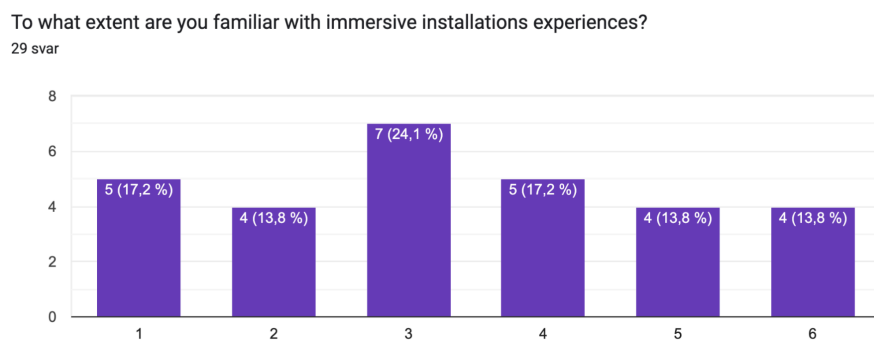


Figure 6.13: Bar chart of summarized answers to the question “*To what extent are you familiar with immersive installations?*”

6. Results

Wow factor The immersive experience created a strong emotional reaction and captivates you.
29 svar

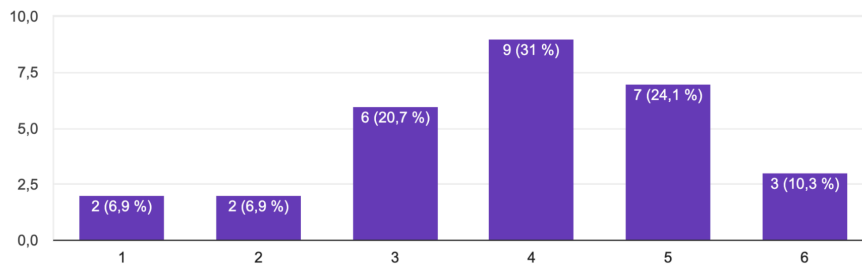


Figure 6.14: Bar chart of summarized answers to the statement “*The immersive experience created a strong emotional reaction and captivates you.*”

Immersive sound The immersive experience improved through the use of sound.
29 svar

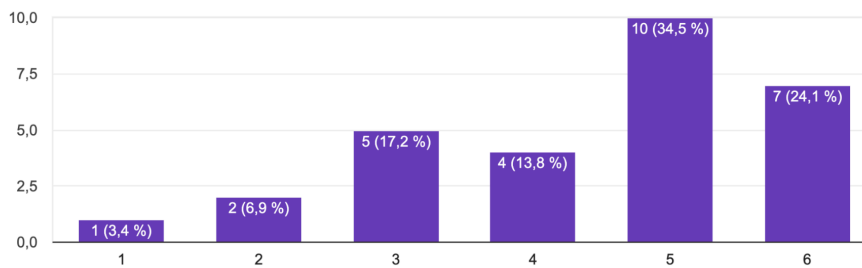


Figure 6.15: Bar chart of summarized answers to the question “*The immersive experience improved through the use of sound.*”

Immersive visuals The immersive experience improved through the use of visuals.
29 svar

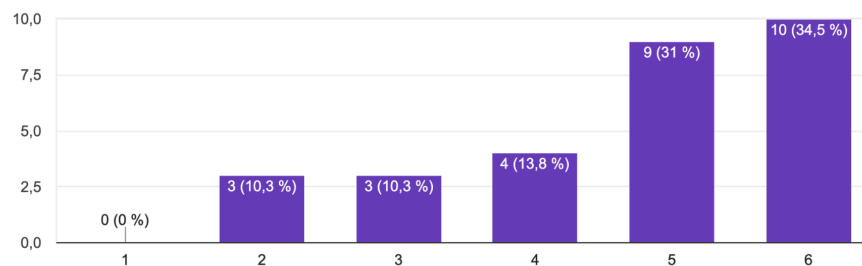


Figure 6.16: Bar chart of summarized answers to the question “*The immersive experience improved through the use of visuals.*”

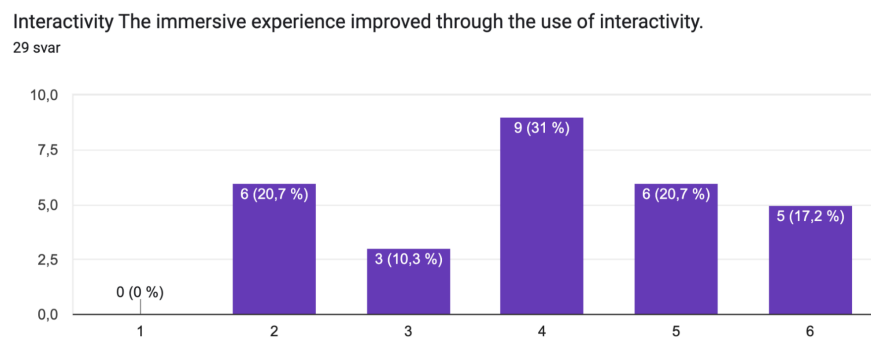


Figure 6.17: Bar chart of summarized answers to the question “*The immersive experience improved through the use of interactivity.*”

Open-Ended Feedback Question

Only eight people out of the 29 who answered the survey wrote an answer to the open-ended question “*Any kind of feedback that could help us develop in the area of immersive installations?*”. One person simply wrote “*I don’t know*”, and one person wrote “*Like to see less abstraction, more tactile..*”. Two of the respondents simply described their satisfaction with the installation and its calming, pleasant effect on them, and the other four had more feedback to give. A common theme for three out of the four was that the installation felt like a good start to something better, but they wished for more immersion, more obvious cues for interaction, and a better introduction before the installation. One participant had more feedback on the theme, saying the focus on the inherently Swedish laundry room is a less suitable theme for a multicultural city like Gothenburg.

7

Discussion

In this chapter, the aim is to discuss the final results, the factors contributing to audience engagement, and evaluate the process and choice of methods. Finally, recommendations for future work will be suggested.

7.1 Result Discussion

This section discusses the results from the thematic analysis of interviews, the observation, and the survey.

7.1.1 Immersion

Despite obvious flaws, such as projections that did not cover all the walls, a majority of users felt immersed in the visuals and sound, and many reported strong emotional responses while inside the installation. Some users also seemed to feel immersed simply by the size of the room and visuals, which confirms what we already know from theory on immersion, see Section 3.2.1. Even though the visuals did not stretch around the entire room, the visuals and sound had a calming and meditative effect on most users. Only a handful of users seemed bothered by the lack of all-around projections or shadows cast on the walls. This indicates that the feeling of immersion is still possible without projections in every part of the room for many users. However, it is difficult to determine whether visitors who mentioned the lack of complete immersion had the same emotional response as those who did not, since both groups gave similar responses regarding how the visuals and sound made them feel.

It was clear from the interviews that the visuals sparked the most engagement. Most visitors found them pleasant and enjoyable to watch. Many did not appear bothered by the abstract nature of the visuals, as some users even projected their own interpretation of them connected to the theme of laundry. This supports the findings from the first iteration, where users showed a preference for abstract visuals. However, a few users were confused and tried to understand what the abstraction visualized, which seemed to generate more dissatisfaction with the installation.

When it came to sound, responses differed more. Those who understood what triggered the voices seemed to enjoy listening to their stories. In contrast, those who did not make the connection between the interaction and the voices experienced

them as a distraction from the music. Some users did not mention hearing the voices at all, or did not point them out specifically, which could stem from the short malfunction of the sensors that happened in the middle of the experience. It could also be because the triggering area was placed too far to the left of the room for people to always pass it by.

Regarding the music, there was a strong consensus among users, who described it as meditative and calming, and it seemed to contribute to the emotional engagement experienced in the installation. Compared to the first iteration, where sound was considered a critical factor of the immersive experience, visitors in the final installation commented less frequently on its importance. This could be explained by the fact that the sound was often perceived as more of a background sound that they did not actively pay attention to, or that its mere presence, appropriate volume and sufficiently immersive quality led to a sense of satisfaction that did not prompt further remark from visitors. Nonetheless, since the music was mentioned to contribute to the emotional response in the installation, we maintain that sound remains a critical factor in immersive experience.

7.1.2 Narrative

Visitors who pointed out the lack of narrative sometimes referred to the lack of a linear story with a beginning, middle, and end. As we know from the theory of storytelling (see Section 3.5), the linear story is usually expected. The lack of perceived narrative could also stem from the fact that an experience in which visitors' memories and thoughts created the narrative was unexpected and perhaps too abstract in its execution. Even though the abstract visuals were positively met in both the first and second prototypes, they may have had a hindering effect on shaping the narrative. Integrating elements from a more conventional linear story, such as visuals that more accurately represented a tangible space and dramaturgical changes, might have helped the uncertain users in recognising themselves and their memories as the protagonists in the installation.

The voices, triggered by user movement, are intended to represent different characters based off the four themes in the original looping narrative. In the final installation, the voices received less attention than expected and might have diminished the feeling of a partly existing, albeit abstract narrative. Causes for their less protruding role may be due to a temporary malfunction of the activating sensor, and to users being more interested and affected by the visuals than the sound, as indicated by both the thematic analysis and the survey in Fig. 6.15 and Fig. 6.16. Even users who noticed the voices generally identified only one or two sentences, such as one about how detergent harms the environment, which did not seem to resonate with most of the users who noticed it. Still, some users recognized the voices as a narrative element, but not as part of the reflective narrative. Since we could not develop sound and visuals ourselves, we were limited to trusting the technical artists who tried to blend the vision of the thesis with their skills and time limits. This was also a cause for why the narrative and the installation itself became more abstract than we wished for, as any visually realistic object was much more difficult and

time-consuming to produce in the software used. Due to the abstract nature of the narrative, it was difficult to evaluate whether, and what types of, storytelling and narrative keep audiences engaged. Therefore, we leave a more thorough exploration of narratives in immersive installations as suggestions for future work.

We learned from the first survey (see Appendix A.3) that most users preferred a story with interactive elements that connect to the story itself. This was not entirely realized in the final installation due to difficulties in the technical realization, even though it was our initial idea, and it would be a possible future scenario to explore. However, it is worth noting that answers from the first survey came from users who were not entirely familiar with immersive installations. Their answers should be seen as a suggested preference among the choices given, instead of what they knew to be true. This is discussed in greater detail in the section methodology discussion (see Section 7.2).

The reflective nature of the installation appeared to enhance audience engagement, but it is unclear whether this was due to the theme of a well-known place or the design of the experience itself. This is an area that could be further explored using a subject or theme that is less familiar to users, in order to examine if reflective elements keep audiences engaged even when they have no prior experience with the topic.

7.1.3 Onboarding

Overall, the onboarding areas had a positive effect on users. A majority of users emphasized their role in building expectations and prompting reflection on the theme of the laundry room, both in the square and inside the installation room. Therefore, we believe the onboarding areas helped users feel more mentally prepared and, as a result, more engaged with the installation.

As a few people found the installation somewhat separate from the overarching theme, it highlights the value of having an introductory area to the theme, especially in cases where the immersive installation is fairly abstract. Still, some people were confused by the perceived disconnection between the onboarding areas and the installation room, but that could refer more to the installation's abstract interpretation of the theme than the design of the onboarding rooms.

One thing that was lacking in the onboarding process was introducing visitors to the actual technology in the installation. Many found it difficult to independently discover what possible interactions existed and how to explore them by themselves. The purpose from a designer's point of view was to investigate how much guidance was needed in a novel XR environment like this, and therefore, no instructions were given until the users demonstrated confusion and hesitated. However, as outlined in the onboarding theory, see Section 3.3, XR is a novel concept to many, and a lack of proper onboarding can cause users to be unsure about how to engage. Therefore, audience engagement in the installation might have been enhanced if visitors had been provided with some instructions.

7.1.4 Interaction

Although some visitors chose not to interact with the sheets, most still expressed high satisfaction with the overall experience. They reported feeling a variety of emotions and reflected on their own laundry experiences, suggesting that tactile interaction may not be essential in all immersive installations, as long as the installation manages to evoke feelings and reflections through other means. Such means could be visuals, sound, and other senses. Regardless, we found that the interactive elements generally kept the audience engaged for a longer time, as they were eager to try all possible things, and that more interactive elements would have prolonged their visit even more. Some users seemed to feel highly engaged by just watching other visitors trying the interaction. Only a few people specifically requested more interactive points, and a few mentioned the wish for “more things to do”, which does not necessarily refer to interactions. Therefore, it could be valuable to explore how an installation with, for example, multiple rooms compares to a single installation with multiple interaction points in terms of the length and engagement of a visit.

Engagement through interactions also appeared to depend on whether they felt obligated to interact, as well as on the number of people present in the room. For some visitors, trying to interact felt like an obligation, while for others, it was clearly something they wished to explore. The very position of the interaction with the sheets felt too much in focus for some users, and they disliked the fact that it put them at the center of attention. Therefore, audience engagement through interactions might benefit from placing the interaction points further away from the middle of the room, where people feel less watched. Extending the visuals to fully surround the room may also facilitate a more even distribution of visitors in the space, and thus redirect the focus away from the middle. In the final installation, stools were placed along the non-projected sides, which directed visitors’ attention toward the interaction point and the two projected walls, making visitors on the floor feel more at the center of attention.

7.2 Methodology Discussion

This section discusses and evaluates the process of the thesis and the methods used, focusing on the experience of working with an interdisciplinary team to create the installation.

7.2.1 Process

Joining forces with Visual Arena’s partner network enabled access to more advanced technical equipment and the opportunity to collaborate with more experienced people in sound, visuals, and XR development. This allowed for a more complex and refined immersive installation than would not otherwise have been possible. However, the involvement of multiple parties and ambitions also introduced challenges related to creative direction and control, particularly concerning the narrative direction, interaction design, and visuals. Although the long process of brainstorming concepts and directions was still strongly driven by this thesis, the realization of

those ideas was shaped by others' interpretations, technical limitations, and time constraints. This resulted in split visions and limited our ability to fully shape the storytelling experience.

The decision to use the Swedish laundry room as a set theme offered a clearer direction and facilitated proceeding. It allowed us to focus our effort on how to express the theme rather than spending time defining what the story should be. From our perspective, the specific theme or narrative content was less critical than the way the story was conveyed. We were more interested in exploring how interaction and immersion could be used to communicate it. Although it would have been exciting to further explore some of the ideas we had before the laundry room theme was decided, having a defined theme helped align the project and enabled progress, albeit at expense of some degree of creative control.

In addition, the complexity of the tools and systems used (e.g., TouchDesigner, MadMapper, Unreal Engine, Kinect sensor and the projector setup) created a gap between the conceptual design and hands-on implementation. Although the advanced technology enhanced the immersion in the final installation, it also restricted our ability to contribute to the development of visuals and interaction. It was these technical areas we initially wanted to be more involved in, but instead, we were required to adapt our design concepts and also rely on the collaborating developers to implement our ideas.

Since both storytelling and immersive installations were new areas to us and Visual Arena, we initially intended to explore which storytelling device was most suitable for immersive installations before settling on one. However, that process became slightly interrupted when we decided to pursue the jointly created prototype with Visual Arena's partners. Therefore, the storytelling research we had done had not yet been tested on a smaller scale, which could have affected our confidence when developing a narrative for a large installation. Consequently, we lacked definitive insights into which aspect of narrative development most strongly influences its prominence in immersive installations. We believe that multiple smaller iterations, focusing more on storytelling, could have helped gain better insights into developing a narrative.

The first iteration, using only one projector and one screen, also generated valuable insights that became crucial elements of the final installation. This iteration allowed us to explore the area independently before cooperating with the partners to create a prototype on a larger scale, even though this thesis was not single-handedly responsible for its creation. However, it resulted in us never having the opportunity to explore storytelling in smaller iterations, as mentioned above, which could have led to a clearer narrative in the final installation. It could also have led to better insights into interactive, collaborative, or immersive storytelling, which were all researched in the beginning.

Nevertheless, the process provided valuable lessons in interdisciplinary collaboration, communication, and the realities of designing immersive installations in more professional settings. Without access to a large studio and expensive equipment like sensors and projectors, the thesis alone would not be able to realize such a complex

installation. Therefore, the cooperation with partners was inevitable to answer this research question in the best way possible.

At the same, this cooperation brought limitations, especially in terms of control over the narrative, which was ultimately a large part of what the thesis aimed to explore. We still found insights about user preference in regards to narrative that could be extracted, just not enough to draw any definite conclusions. The process also gained meaningful insights into audience engagement and the practical challenges of integrating narrative into immersive installations.

7.2.2 Evaluation

There is an established framework for measuring user experiences in immersive environments, see Section 4.9. However, the framework focuses solely on factors that contribute to successful experiences. Visual Arena had a vision centred on fostering innovation rather than merely achieving success. As a result, it was equally important to explore what did not work and to embrace the possibility of failure.

Therefore, the framework was not used directly to evaluate the installation. Nonetheless, it served as a valuable source of inspiration during the evaluation process. Similarly to the framework, the experiment began by interviewing the visitors on their expectations and previous XR experience in order to better understand the user group and their prerequisites. Observations were conducted throughout the experiment to capture behaviours, interactions, and engagement.

While the original framework relies solely on questionnaires to assess user experiences, this project aimed to gain a deeper understanding of the users feelings and opinions. To achieve this, semi-structured interviews were conducted both before and after the installations. These interviews provided valuable insights into the users' perceptions that would not have been captured through the questionnaire alone.

Using the framework's standardized questionnaire might have allowed a more direct comparison between users' expectations and with actual outcome. However, this was weighed against the potential burden on participants of completing both a questionnaire and a lengthy interview in the same visit. In this context, it was deemed more valuable to prioritise semi-structured interviews, as they enabled richer insights and encouraged self-reflection among visitors.

7.3 Answer to Research Question

After discussions of the result, we address the research question “*What critical components are needed to enhance audience engagement in immersive installations?*” here. Our findings suggest that several elements play a significant role in shaping the user experience. Most obviously, carefully designed *soundscapes* and *visuals* are essential for creating a sense of immersion. This was consistently confirmed by observations from both prototypes, expert interviews, and literature. *Interactive elements* were also shown to be crucial to sustain engagement over time. Finally, a

strategically designed *onboarding* process proved important for helping users orient themselves within the XR environment and for establishing a sense of immersion early on.

It was not possible to draw a clear conclusion about whether a specific type of storytelling is a critical component. We observed that some visitors became confused or lost focus and immersion while trying to understand what the exhibition was about. However, it remains unclear whether this interpretation was influenced by the fact that we specifically asked questions about storytelling and narrative. We also do not exclude the option that the interview questions were ill-structured for evaluating the user experience of storytelling specifically. Lastly, to ensure that visitors can more easily navigate the experience and find it meaningful, we recommend including some form of narrative framework, as we believe it is a critical component for understanding and engagement.

7.4 Contributions

This thesis has provided an academic approach to evaluating immersive installations, an area we found to be underrepresented in existing literature. Since many immersive installations are situated in art forums or entertainment contexts, it was challenging to find research connected to the development and implementation process of such installations. Therefore, this thesis aims to provide other researchers with deeper insights into the creation of immersive installations. For a thorough evaluation of the technical process, we refer to Visual Arena and their partners.

This report also reveals some technical and social challenges faced by students when creating a high-fidelity installation together with a professional team in the XR area. It highlights the known fact that prototypes of a higher fidelity might help gain better insights on how a complete product would perform, but reaching beyond your own capacities may put you, as a designer, in a place where you have less control and insight into your own work. Therefore, low-fidelity prototypes where the designer retains full control over each element may be more suitable when conducting research in a new field.

7.5 Future Work

One possible next step, as previously mentioned, is to try to create an immersive installation independently and learn tools like Touch Designer and projection mapping to explore the technical process. This will open up possibilities to evaluate existing technology, establish guidelines for other new developers in the field, or explore the feasibility of creating immersive installations on a smaller and cheaper scale.

Another suggestion is to explore different storytelling devices in immersive installations to determine what preference users may have. As known from the interviews, users usually expect the linear narrative to which they are familiar, but if presented with other options, they might change their preference. From the first survey, see

Appendix A.3, users also seem to like the idea of a story with interactive elements. This opens up opportunities to also explore more types of interactions with the installation, which could, for example, affect the narrative and lead to interactive storytelling.

As suggested in the discussion about narrative, it could also be beneficial to explore the reflective design of the installation on another subject that is lesser-known to the public, to see how well that sparks engagement. The final installation used many elements to remind visitors of familiar elements in the laundry room, such as ducking under sheets, and the smell of detergent, which could have been contributing factors to user engagement. It would be interesting to explore if users find the same amount of nostalgia and thoughts in an environment where nothing is previously known, but with a theme that still encourages reflection.

7.6 Ethics

Since this thesis is part of XR Sweden feasibility study [5], all results will be shared and included in their research. Transparency has been a priority throughout the project, ensuring that participants were informed about how their data was collected, how it may be used in the future, and that their anonymity would be kept. Participants were also made aware of their right to withdraw at any time, and participants was informed about this before participating in any user study.

As the focus of this thesis has been to conduct a feasibility study, resources and time have not been allocated to universal design, as it falls outside the scope. If Visual Arena's partners choose to realize concepts from this thesis, it will be their responsibility to create a universally accessible installation.

Prototypes developed during this thesis were intentionally designed to be colorful, bright, loud, and generate emotions. All users participating in prototype testing received a disclaimer beforehand and were informed of their right to withdraw from the session at any time. However, during the interviews, some participants expressed that they felt overwhelmed by the various sounds playing or by the volume of the sounds. Most of these participants also mentioned having some form of neuropsychiatric diagnosis (NPF). These insights highlight the importance of considering sensory sensitivity and accessibility in future development stages, particularly if the installation is intended for a broad and diverse audience.

8

Conclusion

The purpose of this thesis was to explore audience engagement in immersive installations. The final installation about the Swedish laundry room, created together with Visual Arena's partners, showed that the prototype did spark engagement, which seemed to be enhanced by the reflective design, abstract visuals, and slow and pleasant music. Most users felt immersed by the installation despite projections only covering two walls, which was expressed either through strong emotional engagement or fascination with the size of the visuals. Onboarding areas also helped visitors become introduced to the theme and sparked reflections that continued throughout the installation. However, some users wished for clearer instructions on what the installation would entail, which highlights the importance of onboarding in XR environments.

The narrative developed became an abstract, reflective narrative, where visitors' memories became the central storytelling element. Some visitors found coherent narrative elements in the installation, while others found the narrative unclear, which could have affected their engagement inside the installation. A more obvious and structured narrative would have helped to further investigate its effect on audience engagement. Due to time limits and a dependency on technical expertise from Visual Arena, the narrative elements became a secondary design choice in the final installation. More comprehensive insights might have been gained through additional testing of different storytelling devices separately, albeit the technical expertise from Visual Arena's partners would still be needed to realize a large-scale installation.

Interactive elements encouraged engagement, but some visitors felt hesitant to interact due to a lack of instructions or the central placement of the interaction points. Some users wished for more interaction points or more things to discover to stay engaged longer. However, users who noticed the impact of their interactions on the installation expressed similar satisfaction to those who simply observed the interaction. Therefore, interactions are considered a critical component to enhance audience engagement, but visitors do not necessarily have to interact themselves to feel engaged and satisfied with the installation.

Future work includes exploring the different types of storytelling in immersive installations, as this thesis did not thoroughly test what types of narrative users prefer in immersive experiences. As the equipment to create a large-scale installation was only possible through Visual Arena's network, it would be interesting to explore the

8. Conclusion

feasibility of creating an immersive installation with cheaper and more accessible equipment. Exploring the technical process of creating an immersive installation also provides opportunities to evaluate and propose suggestions to novice XR designers entering the field.

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A

Appendix

A.1 POVs and HMWs

A.1.1 POVs

- Habitants of Gothenburg needs to be introduced to II because II are new and maybe foreign.
- Habitants of Gothenburg needs to desire experiencing IIs because it could benefit Gothenburg economically
- Habitants of Gothenburg needs to experience II because it can create strong bonds with others experiencing the same
- Habitants of Gothenburg needs to experience IIs because it can awaken a new interest
- Habitants of Gothenburg needs to have a multi-sensory experience because it enhances the feeling of immersiveness
- Habitants of Gothenburg needs to understand how to interact with a story because its easier to be a bystander if interacting is hard and/or generative.
- Habitants of Gothenburg needs to experience music/concerts in a new way/with II because it can elevate the experience
- Habitants of Gothenburg needs to be given tools to use because that helps users create/choose a storyline
- Habitants of Gothenburg needs to be surrounded by a large installation because that enhances the feeling of being small, therefore immersed
- Habitants of Gothenburg needs to hear sounds because it can guide user focus and narrative flow
- Habitants of Gothenburg needs to experience music/art in a new way because it can attract a new audience
- Habitants of Gothenburg needs to be informed about what type of interactive storytelling they engage with because that helps users understand what they can/cannot do.

- Habitants of Gothenburg needs to interact with a story rather than collaboratively generate a story because collaborative storytelling can be a difficult task.

A.1.2 HMWs

- How might we (HMW) give users tools to help users actively interact with a story?
- HMW surround users with sounds that guide them through the narrative flow of the installation?
- HMW inform users about how to interact with the installation?
- HMW give users a multi-sensory experience?
- HMW create an II that users want to visit/experience?
- HMW create an II connected to music or concerts that helps elevate how users experience music?
- HMW create an installation that users feel immersed by?
- HMW create an installation that sparks a new interest for the users?
- HMW give users a memorable experience?
- HMW design a storytelling installation?
- HMW integrate storytelling into an immersive installation?
- HMW integrate music into a storytelling installation?

A.2 Crazy-8 sessions results

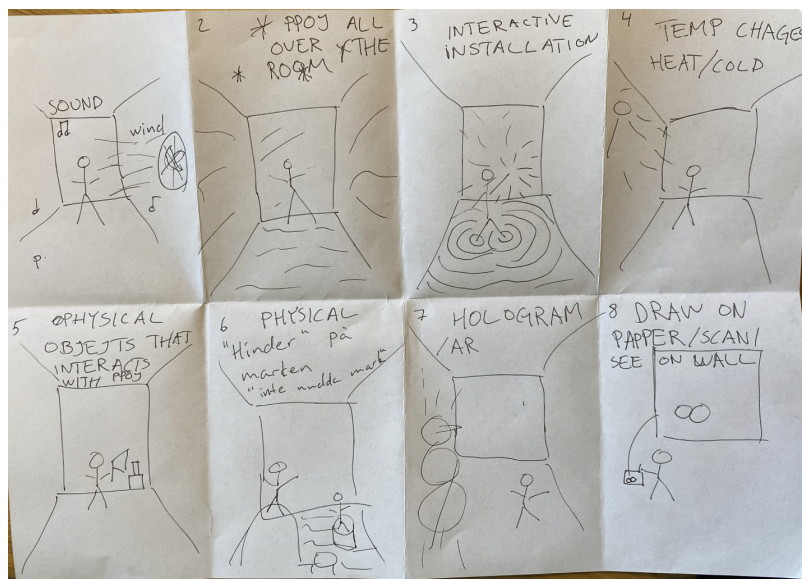


Figure A.1: Isabelle's Crazy 8 results to the question "HMW give users a multisensory experience?"

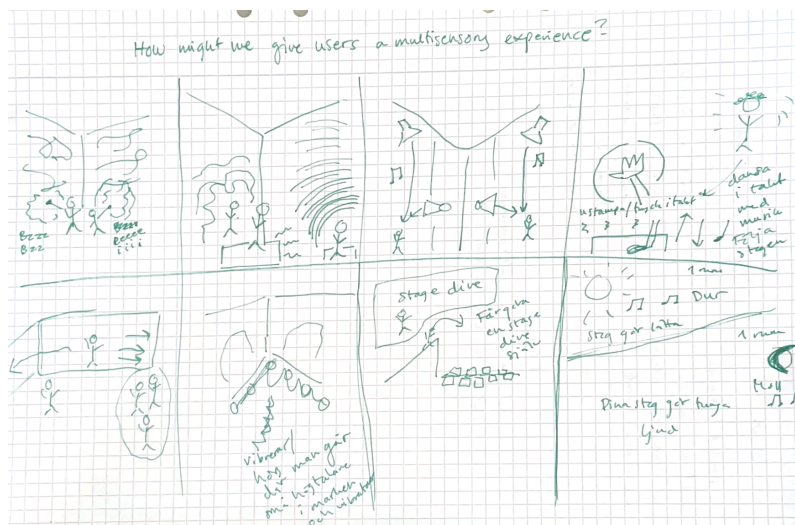


Figure A.2: Julius's Crazy 8 results to the question "HMW give users a multisensory experience?"

A. Appendix

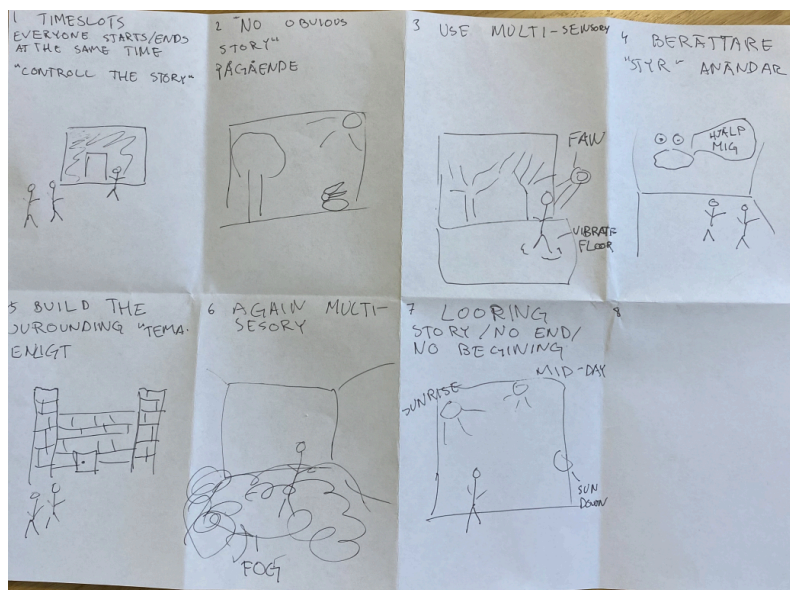


Figure A.3: Isabelle's Crazy 8 results to the question "HMW integrate storytelling into an immersive installation?"

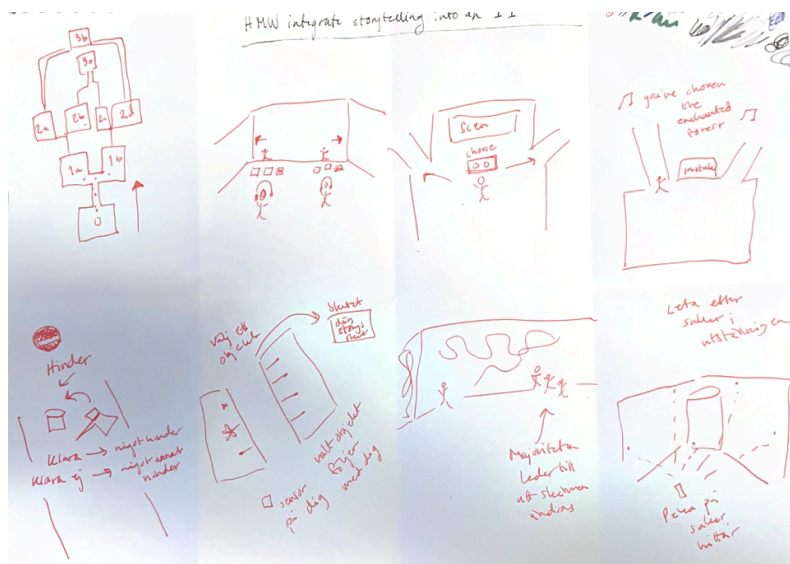


Figure A.4: Julius's Crazy 8 results to the question "HMW integrate storytelling into an immersive installation?"

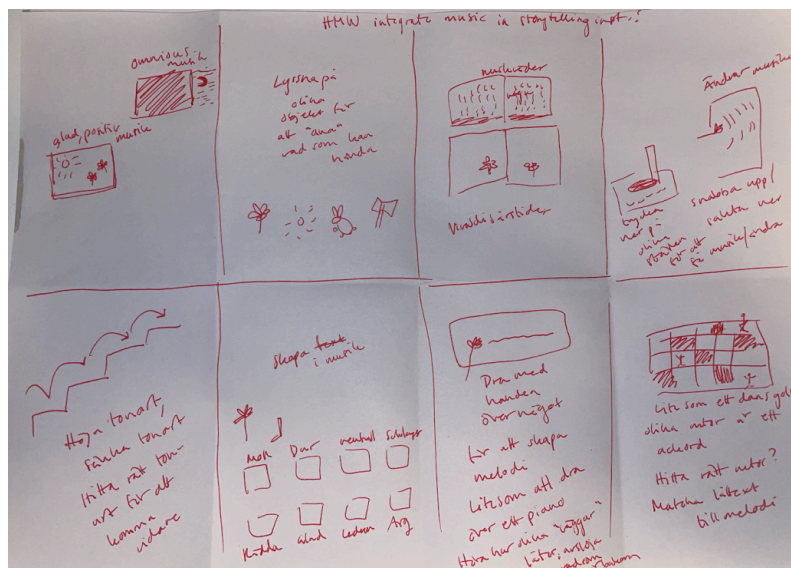


Figure A.5: Julius's Crazy 8 results to the question "HMW integrate music into a storytelling installation?"

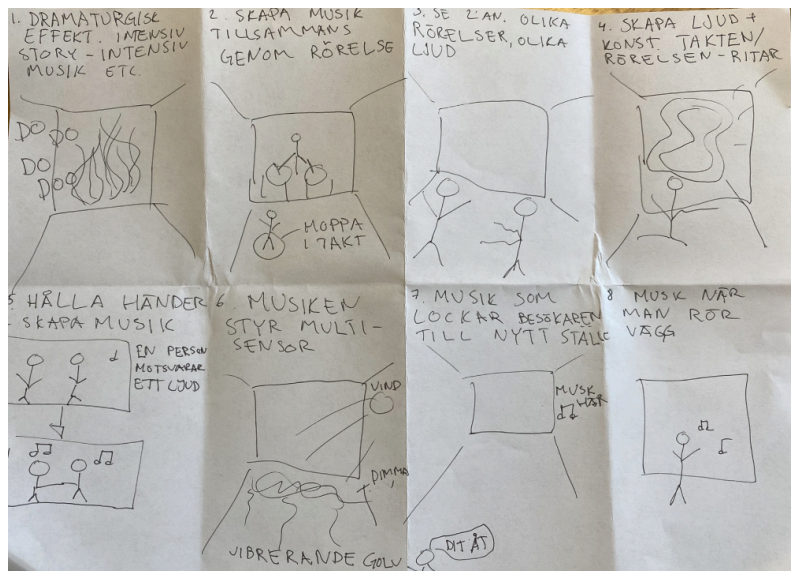


Figure A.6: Isabelle's Crazy 8 results to the question "HMW integrate music into a storytelling installation?"

A.3 User Survey - Expectations on Immersive Installations



Figure A.7: Question 1-4, including answers

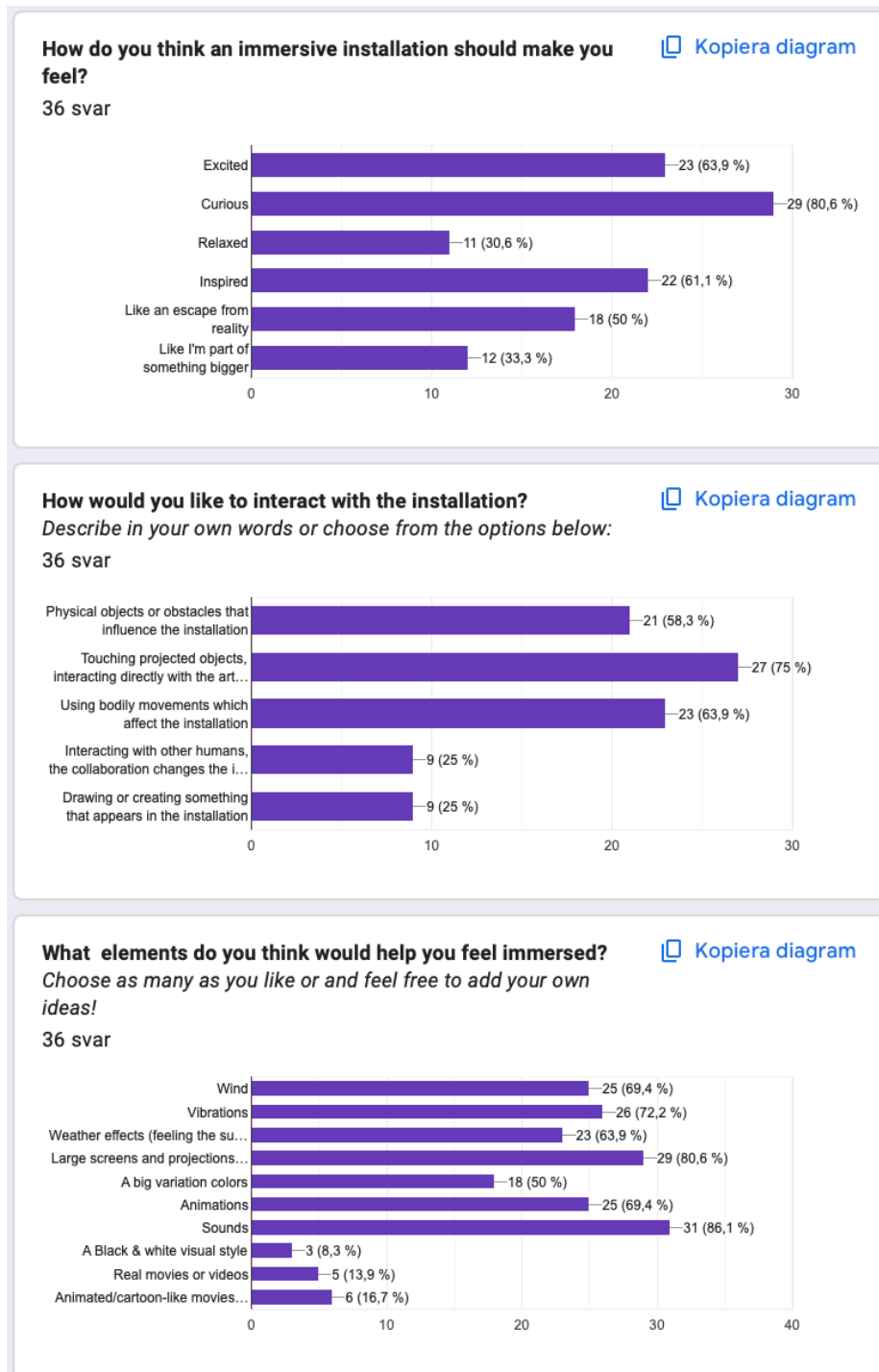


Figure A.8: Question 5-7, including answers

A. Appendix

In what way would you like these elements to be?
For example, should the wind feel like a storm or a gentle breeze? Should the sounds be loud or subtle? Where would vibrations be most exciting, in the floor, on the walls or somewhere else? Anything is possible!

Subtle effects

I really would depend on the artwork, if the element is important to the installation/artwork then it should be amplified accordingly etc. Like if the installation was about the history of Gothenburg in a sense of what the city looked like before etc then I would count the wind as "ambience" if you understand what I mean. Like a gentle breeze would be immersive if the wind is not the "important" aspect or the "take-away" of the artwork etc but would immerse you in the city, e.g. how it would feel like if you were in the city in that specific time-frame.

Loud sounds, vibrations

I think vibrations would feel most in the floor, you wouldn't really notice the walls vibrate unless you touched them.

I don't think it should be too much physical elements, since this could maybe be a bit scary and disorienting, so I think I would like it were a bit more gentle. But it should match the theme and vibe of the story, I think that would be the most important part.

Vibrations on the floor, wind depends on what the storyline is, I think both storm and gentle breeze sound fun with the right timing!

probably a gentle breeze and a variation of sounds, so both subtle and loud sometimes if the installation is depicting a story that also varies.

Gentle breeze, the ground shaking, defined colors

Obviously this depends on the setting, however, say you want to try and show how it is to be in the vast emptiness of space. In this case you would want there to be as little sound as possible. But if you're in a rainforest while it's raining then you'd want to be able to feel the rain hit your body, the somewhat strong gusts push and rustle both your clothes and the vegetation around you. You would need to be able to hear the sound of the rain in the trees and maybe even the cries of animals around you.

Floor is good for vibrations. A light breeze could be enough.

if you want to 'say a story' obviously every element should support your storytelling and not stand out; having a story emerge and evolve based on preferences is a vastly more complicated problem

if the point is for the experience to feel very interactive, I don't think there should be any interactions that are so subtle they are missed. At the same time, if the background ambience is overwhelming, you may miss the "point" of the installation. So I think it depends more on whether the focus is on an aesthetic experience, or if it has some kind of learning outcome. If the latter, more subdued cues would be appropriate. If the former, I think you are more permitted to push boundaries and put people out of their comfort zone.

Röster, samtal

Wind should be gentle, a constant background changing with the story. One of those sounds that you don't really realize playing.

I should be able to feel it and but it should not too overstimulating, maybe also not too many elements at once or they should be balanced

I think it should be overpowering in a way that makes you no longer exist and fully emerge into the experience

Figure A.9: Question 8, including answers

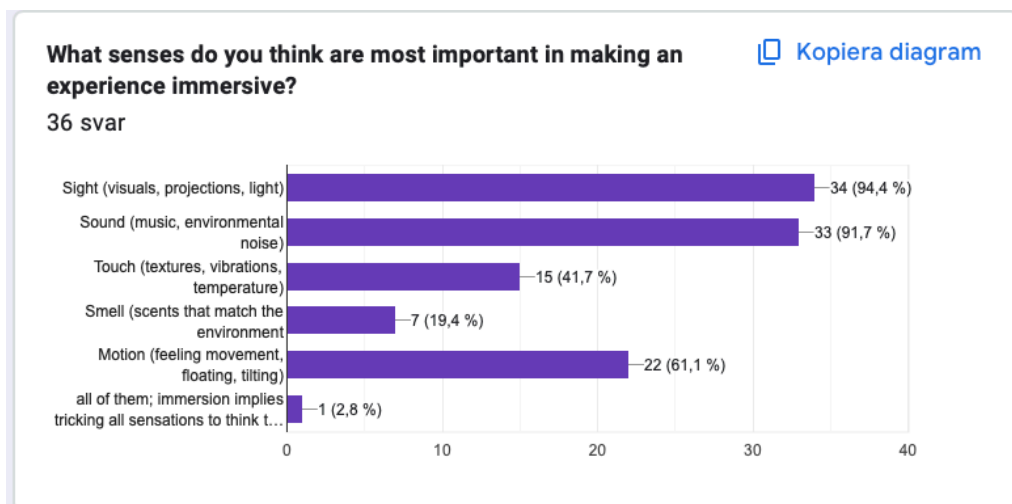


Figure A.10: Question 9, including answers

| Now that you've learned a bit about immersive installation, if you had the power to create your own immersive world, what would it look like? Do you have any ideas or inspiration that you think should be included in the installation? Think big or small! | Finally have you ever been in a space or experience that felt truly immersive? What did you think about it? Was there anything that made it special? |
|---|---|
| Experiencing different times or places that are no longer available. For example, getting to experience an approximation of how the Jurassic was to live in | I have not |
| Måcket abstraktion, interaktion med omvärlden (alltså mer än bara syn och hörsel), ta den faktiva världen in i verkligheten, så inte bara skärmar utan fysiska föremål och projektioner. Musik/soundscape mycket viktig. | Gemensamma nämnare får sina upplevelser är nog att bli helt omsluten, så installationen syns var man än vänder eller tittar, samt att det är väl genomtänkt med ljusdesign och hur ljudet kopplas till de fysiska installationen. |
| SciFi future or something like that | |
| I would like to see an installation that teaches you of Gothenburg's history, i.e. how the city developed over time and it would be cool if the entire room would show that. For example, the floor would look like the street, the walls would project the buildings/nature that existed at that time and possibly the smell could be like it smelled at that time. TLDR: just an immersive experience on how it would feel and look like if you were in Gothenburg in 1621. | The one that pops up in my mind is the FlyOver Iceland in Reykjavik which places you in a rollercoaster-like chair and has a wraparound panoramic screen in front of you that shows you the nature of Iceland and how it would look like and feel if you flew over Iceland "as a bird" is what I would describe it as (not in a vehicle or confined space, like just flying as a bird is). And the ride had elements such as wind and sometimes water if you flew next to a waterfall etc. Was a very cool experience even though I'm from Iceland and have seen most of the nature it. |
| - | |
| I'm not sure, but a space theme sounds very cool and I feel like have some really good potential. | I visited Teamlabs Forest in Japan(Fukuoka)I think the pictures above are from there), and it was definitely a memorable experience, and would want to experience it again. |
| Not sure | No |
| A more interactive experience of something like IMAX interstellar. Something grand and amazing | The combination of the visual and sounds (music and/or sounds that complemented the visual) made it a memorable experience. |
| I want to experience someone's vision of the future, or an alternative present or past. I would want to wish that it were 'real'. How would it feel to be in four dimensions or to be somewhere surreal like in deep ocean or space. | |
| I love outer space and stars, so that would be cool. | |
| I don't know, maybe something with nature as I like being in the nature a lot, or some other beautiful environment that you might not get to see that often. | I think being in a room with screens or projections all around you would make you feel more immersed |
| I think it would be fun to explore another world, like a fictional world, and you feel like you walked right into it. | Not really but I was once in a museum where there were really big sculptures made of yarn, where you could walk around and into them. I think that was really cool. I think what I liked most was how big they felt, and I felt small in comparison. |
| | |
| I think anything with a space theme would be a lot of fun, like maybe making a zero gravity room that is turned on when you step out of the spaceship would be really cool. | The closest thing was Van Gogh art projection showing that covered the whole museum room, it was really cool but it focused mainly on the visuals and only had background music. The cool thing was seeing the entire room covered in just art. |
| It is very cool if you are able to follow a story and interact with your surrounding in some way (especially if your interactions have some visual effect since it makes you feel like you are a part of the installation), but I think triggering all the human senses is what brings an installation to life and makes it memorable | |
| Traveling through the cosmos. Or maybe something like doctor strange when he's sent around | I have not but I would love too |
| The texture of the floor one walks on would be important to get right. If you want to simulate us walking up a sloped gravel road, then make each step feel and sound as if we are on said road, make us actually walk up a ramp. | |
| I don't know | |
| Rymden låt coolt. Typ att kunna landa på olika planeter och känna lite typiska grejer för dem. Varmt, blåsig, blött? | Tyvärr inte |
| Something trippy or far from reality. Maybe space | I've been in an installation with mirrors and hanging lights, that was cool |
| personally my research interests are more about visualizing abstract 'data' and making sense of them (preferably via user interactions); im less interested in a faithful visual reproduction of something that exists in real life | my own experiences are more specific to VR (wearing headsets etc), which I feel is not quite what your study's focus seems to be |
| Colorful | World of Games in Gothenburg |
| See how Gothenburg could look in the future. How a buildings that's not built yet could look | Not really |
| I think feelings should be conveyed through the installation, or at least I would want to make the visitors feel something. | |
| An immersive planet installation surrounds visitors with alien landscapes and dynamic lighting. Interactive elements respond to movement and touch. Sound and sensory effects enhance the experience. | No |
| I think it would have to be used very carefully with limited player impact, as having too much of player impact could make people, especially young people, too invested into that world. And that would lead to even more social problems with young people not knowing how to communicate with real people and form friendships nor relationships. It could very well lead to the end of the human race, so be careful. | |
| Personally I'd like a more abstract immersive installation, where there are elements that are responsive but don't exist in reality. I'm a bit adverse to touching a lot of things if others are also touching it too, because of germs, so I would want a more visual experience with some tactile elements being delivered indirectly. For example, vibration coming from the floor, or the entire exhibit tilting if it were suspended. | Yes, there was a VR experience I went to in a salt mine. The scale felt really impressive, and also, at the time I was the only person in the exhibit, so it felt very intimate as well. |
| None right now | |
| Kunna ställa frågor till personer i the universe o få svar | No not yet |
| Not sure | |
| I would have something food inspired, like trying to remember your grandmas old recipes with scents and other type of interactions | |
| Jag vet inte :(| |
| Probably something nature related and maybe more abstract, maybe similar to the Team lab museums in Japan. I also think fotografiska in Stockholm has had nice immersive exhibitions related to nature | Team labs since they had installations that were very unique to me and not something I had experienced before, many different areas so it was very engaging |
| Grand space or fantasy that makes you feel like a ghost observing a story in a dream | All kinds of cinema, especially 3D and 4D. Cosmonova is a great example |

Figure A.11: Question 10-11, including answers

A.4 Final installation interview questions

Interview questions before installation:

- **What are you expecting from this?** What kind of experience are you hoping for?
- **Are you familiar with immersive experiences?** Have you visited any before, what kind?
- **Do you know what XR is?** Any personal experience? (VR, AR, MR etc)
- **When did you last feel truly immersed?** Can you describe that moment?
- **What do you associate with a "tvättstuga"?** Any thoughts or feelings about the Swedish laundry room?

Interview questions after installation:

- **Describe your experience.** Any specific moments or places? How did it feel?
- **What story do you take with you?** What is *your* story? Can you describe it?
- **What made you experience that story?** E.g. visuals, sounds, interaction senses.
- **What role did your own memories play?** Did anything personal come to mind?
- **Did you interact with the installation?** If yes, how? If no, why?
- **What was most captivating? Why?** A moment, element, emotion?
- **How did sound and visuals affect you?** Any lasting impressions?
- **Other senses - positive or negative?** Smell, touch, movement etc.
- **What about the surrounding spaces?** Did the physical environment add anything?
- **What could make this better?** Anything missing or unclear?
- **Was this memorable?** Why, why not?
- **What will you take away from this?** Thoughts, feelings, images?

A.5 Final installation, additional survey questions

What is your gender identity?
29 svar

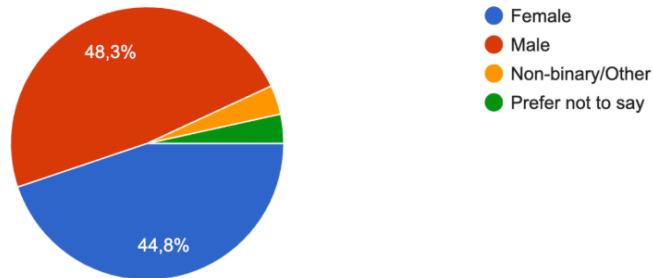


Figure A.12: Summarized answer to the question “What is your gender identify?”

Name of the city where you currently live, or the city nearest?
29 svar

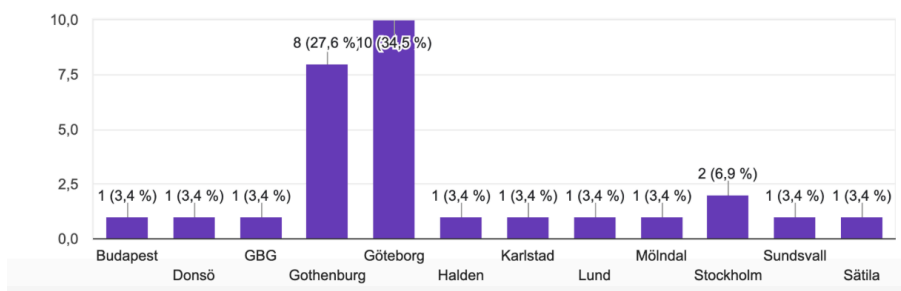


Figure A.13: Summarized answer to the question “Name of the city you live, or the city nearest?”

Social interaction The immersive experience enables a shared experience and collaboration among you and your fellow visitors.
29 svar

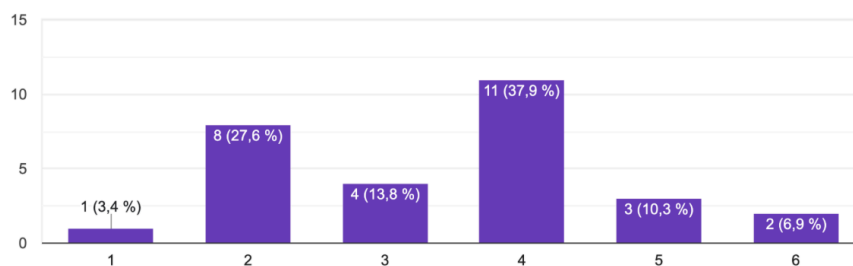


Figure A.14: Summarized answer to the statement “The immersive experience enables a shared experience and collaboration among you and your fellow visitors.”

Shareability The immersive experience inspires you to share your experience in person or on social media.
29 svar

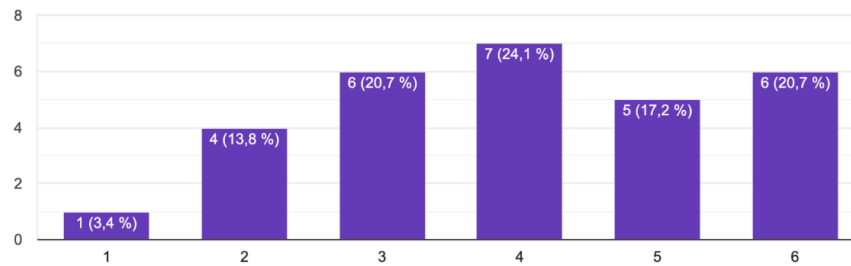


Figure A.15: Summarized answer to the statement “*The immersive experience inspires you to share your experience in person or on social media.*”

Accessibility The immersive experience is open and inclusive to diverse voices.
29 svar

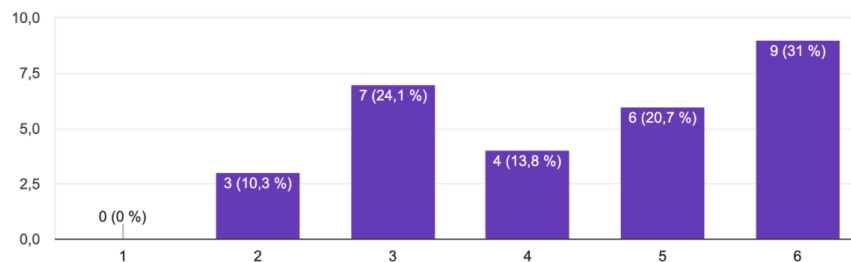


Figure A.16: Summarized answer to the statement “*The immersive experience is open and inclusive to diverse voices.*”