



UNIVERSITY OF TWENTE.

An Interactive Installation for the MuseumFabriek in Enschede

Rosa S. Amptmeijer
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Supervisors:

dr. ir. R. Klaassen
dr. ir. D. Reidsma
dr. A.M. Schaafstal

Human Media Interaction Group
Faculty of Electrical Engineering,
Mathematics and Computer Science
University of Twente
P.O. Box 217
7500 AE Enschede
The Netherlands

Summary

This report discusses the findings and conclusions derived from the research conducted to design an interactive installation that keeps visitors engaged for the Museum-Fabriek. The study addresses various sub-questions related to contributing design aspects, suitable installation design, the content, recommendation system design, the impact of the recommendation system on visitor experience, and a revised iteration of the design. The research emphasizes the importance of understanding the target audience, consisting of explorers, facilitators, and affinity seekers. It highlights the importance of enabling visitors to explore freely, a collaborative multi-user design, ensuring user-friendly and comprehensible interactions, scalability, affordability, added value, and the use of text at the level of B1 level language proficiency. The content analysis of 22 interviews resulted in the identification of four categories that are of relevance for the topic of the installation (the fireworks disaster in the area of Roombeek in Twente): housing, businesses, stories, and help. These categories, along with a timeline, will be used in the installation to present the content in a cohesive manner. Additionally, a nonpersonalized recommender system was implemented to enhance content connectivity. However, due to limited data the impact of the recommendation system on visitor experience could not be conclusively determined. Based on the testing results and literature, a revised iteration of the installation is proposed. Improvements are made to the attention-grabbing aspects, the videos, especially their length, as well as enhancing glanceability to increase user engagement.

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Introduction

In our society museums have always played an important role, providing a space for both leisure and learning. With technology increasingly embedded in our daily lives, museums are incorporating technology to lose their traditional image. One such museum that focuses on creating interactive exhibitions is The MuseumFabriek in Enschede. They're moving away from passive observation to active participation. In this report, the goal is to further enhance the experience of visiting the MuseumFabriek by making it more engaging and enjoyable. This report is the second report about this challenge. The first one focused on making a framework for designing an interactive installation for the MuseumFabriek, text from that report is partly added in Chapter 2, background [8].

1.1 Research goals

The goal of the MuseumFabriek is to make a visit a fun and engaging experience for children, while also offering in-depth information for adults. The museum's main target audiences are families and individuals interested in learning about the Twente region. A more in-depth analysis of the MuseumFabriek and the underlying motives of the visitors will be explained in Section 2.3 "Frameworks for museums and The MuseumFabriek specifically", and in Section 2.1.1, "Identity Lens". The museum houses multiple exhibitions about the Twente region, including a dedicated section that showcases the history of the Enschede's textile factory. There are several other sections dedicated to specific themes. One of those sections is dedicated to the firework disaster that struck Enschede in May 2000. This section is filled with information but lacks interaction. The goal of this project is to make this area interactive, either by adding or changing parts of the exhibition.

1.2 Research questions

To achieve the goal of making a visit to the MuseumFabriek a fun and engaging experience, the scope and the underlying research questions need to be defined. In this report, it is not the goal to design the entire experience anew. The goal is to make one installation that will add to a fun and engaging experience. The main research question is how to design such an engaging experience with an installation.

- **How to design an interactive installation for the Museumfabriek to keep the visitor engaged?**

The focus of this question is on the design, this entails different aspects that are needed to be able to come to a well-founded design. This includes but is not limited to making a framework, brainstorming, doing interviews, building and testing an installation, and coming up with recommendations. To answer this question based on research more questions need to be answered. The first one that needs to be answered will be discussed in Chapter 2, "Background".

- **What aspects can be derived from the literature that might contribute to a great design for an interactive installation for The MuseumFabriek?**

This question was already answered in the research topics done on this topic [8]. Thus the section about this question is a slightly modified version of that report to accommodate this question and the main research question better. The focus will be on frameworks, both already existing frameworks and a framework that is made based on existing work. The next research question will be discussed in Chapter 3, "From ideation to final concept", and is focused on ideation and the opinion of the museum.

- **What kind of installation is suited for the Museumfabriek?**

To be specifically designing something for the Museumfabriek it is necessary to both brainstorm general ideas and to know what kind of installation the museum wants and therefore what direction this project should take. The museum prefers a simple design with the content focused on the firework disaster of 2000. There is a lot of information about this disaster so the next research question is focused on the content and is discussed in Chapter 4, "The System".

- **What content should be included in an interactive installation for the Museumfabriek?**

The answer to this question tells us how the content is analyzed and made presentable. With the installation's content sorted, it becomes clear that many parts are connected. So the next question focuses on how a connection between content can be made in the form of a recommendation system. This system will recommend multiple videos to the user once they finished watching a video. The intention is to make people want to know more and continue using the installation. This question will be answered in Chapter 4, "The System".

- **How can a recommendation system be implemented in an interactive installation to make a connection between content?**

With this recommendation system implemented, the next question will be focused on the evaluation of the recommendation system. It will be done by doing a field study in the museum. And testing two different conditions of the installation, one which contains a recommendation system and one that does not. This study will be done with a mixed methodology consisting of gathering log data, making participants fill out a questionnaire, doing interviews, and making observations. More on the method of this test will be discussed in Chapter 5. The results and thus the answer to the question will be discussed Chapter 6, "Results".

- **Does a recommendation system change the experience of visitors that interact with an interactive installation in the MuseumFabriek?**

After this testing period of the interactive installation, there will be clear aspects that can be improved on. To finish this project a new iteration of the installation is made. This iteration has both the results of the test and aspects from the literature incorporated. This question is discussed in Chapter 7, "Revised Iteration of the Design".

- **What can be changed in a revised iteration of an interactive installation in the MuseumFabriek based on the testing results and literature?**

1.3 Additional chapters

Once all the above-mentioned questions have been addressed, two additional chapters will follow. These chapters are "Discussion", where all the answers to the research questions are thoroughly examined and discussed. This is followed by "Conclusion and Further Research", where the main research question is answered. Furthermore, this chapter explores potential avenues for future research, highlighting what needs to be done to further investigate the topic, and specifically emphasizes the critical information that needs to be taken into account in order to reach a better and new conclusion.

Background

In order to construct an installation, it is crucial to understand previous efforts and existing frameworks developed for interactive installations in museums. This chapter aims to answer the research question: **”What aspects can be derived from the literature that might contribute to a great design for an interactive installation for the MuseumFabriek?”**. In order to answer this question, various frameworks covering different aspects are examined. The initial step involves reviewing existing frameworks concerning interactive installations in museums. The second step involves exploring the frameworks utilized by the MuseumFabriek itself and investigating the broader influences of the museums’ choices. The final step covers incorporating the insights gained from related work to develop a framework that defines the important aspects to consider when designing an interactive installation specifically for the MuseumFabriek.

2.1 Existing frameworks

2.1.1 Identity Lens of Museum visitors

The first framework is the “Identity lens of Museum Visitors” made by Falk [21]. It examines the reasons why people visit museums. Understanding these motivations is important for an effective design. When designing an installation for a specific museum, it becomes essential to analyze and understand the motivations that bring people to visit. This knowledge enables designers to create installations that live up to visitors’ expectations. According to Falk [21], there are five primary motivations behind museum visits.

- **Explorers** are curiosity-driven with a general interest in the content of the museum.

- **Facilitators** are socially motivated, their focus is primarily focused on enabling somebody to go to the museum.
- **Professionals/Hobbyists** feel a close tie between the museum content and their professional or hobbyist passions.
- **Experience seekers** are motivated to visit because they perceive the museum as an important destination. Their satisfaction primarily derives from the mere fact of having been there and done that.
- **Rechargers** are primarily seeking a contemplative, spiritual, and/or restorative experience. They see the museum as a refuge from the work-a-day world.

Two motives are added to this list, since more museum focus on a specific region or group. These two additional ones have not been fully researched yet but they fill a gap that cannot be filled by the other five [21].

- **Respectful pilgrims** are driven by their sense to honor the memory of those represented by the institution and/or exhibition.
- **Affinity Seekers'** main motivation to visit a museum is because it speaks to their sense of heritage.

Falk states that besides knowing what type of visitors come to a museum there are a lot of other aspects to take into consideration when designing (part of) an exhibition. Most visitors will read some information labels but barely any visitors will read everything. It is important to know the surroundings of the installations and to know how busy it is. For example: if there is an overload of information the visitor will not engage and will continue to a part of the exhibition that is calmer [21].

Both of Falk's frameworks serve as valuable guidance to be utilized in addition to other frameworks. They offer a concentrated and specialized focus on one aspect of designing an interactive installation.

2.1.2 Framework for categorizing installations

The next framework is made by Szandra Iván [30], it is made to categorize interactive installations in museums. Her framework is based on two other frameworks and related work. First, these two frameworks are explained, followed by the framework of Iván. The first framework is made by Grammenos, Dimitris, et al., during a project for the Archaeological Museum of Thessaloniki. They divided existing interactive exhibits in museums into the following categories [24].

- **Hybrid exhibits:** an addition to an existing museum artifact by using graphics or audio commentaries.

- **Side exhibits:** small additional exhibits that are adjacent to a real exhibit. It provides indirect exploration or interaction with the real exhibit.
- **Isolated, but linked exhibits:** these are related to a real exhibit but are installed in their own space.
- **Stand-alone exhibits:** have a link to the museum or an exhibit but are not directly linked. This form is often used to explain and demonstrate scientific principles or other abstract concepts.

This framework is not suited for this project. The main focus of the framework is on entire exhibitions. This is useful when designing an entire exhibit, however, in this project, a stand-alone installation will be added to an existing exhibit. And thus there will not be a further explanation of this framework, only in relation to the framework made by Iván [30].

The next framework is made by Andrea Witcomb, it is the other framework that is incorporated into Iván's framework. This specific framework is a didactic framework consisting of four pedagogical models that are used during active experiences in museums [52].

- **Didactic Expository model**, the museum positioned itself as an authoritative source of knowledge. In interactive experiences, this is commonly used on information displays where there is no invitation to think critically and analytically.
- **Stimulus response model** has a focus on transmitting knowledge by repetition and rewarding the correct answers.
- **Discovery model**, people are invited to make their own discoveries, from which to learn by discovering and experiencing, making use of the users' backgrounds and prior knowledge. This is the most used model in interactive experiences in museums.
- **Constructivism and Interactivity model** looks at a visitor's background and is using open-ended narratives. This framework is solely focused on learning experiences and this can be an important part of an interactive installation in a museum.

And lastly, in this section the framework made by Iván is discussed [30], this framework includes both of the above-mentioned frameworks and combines it with categories found by looking at existing installations. There are twelve different categories as shown in Table 2.1. The framework is used by Iván to rate currently existing installations on all these categories and to determine which categories are important for the installations. A scale from - - to + + is used, where - - is a low score and + + is a high score. The following are the categories used in the framework:

- **Collaborative:** Measures the extent to which the installation provides a collaborative experience.
- **Solitary:** Determines the degree to which users engage in solitary experiences, even with a group they have to take turns.
- **In-Bubble:** Assess how much the installation offers a one-sensory experience such as an audio guide.
- **Heads-Up:** Evaluates the immersive nature of the installation, where users are fully engaged with their surroundings.
- **Person-Centric:** Measures the significance of user input as a vital part of the installation.
- **Exhibition-Centric:** Considers whether the installation serves as a tool for the rest of the exhibition
- **Vision-Based:** A technical category that means the installation is well adjustable in terms of constraints, adaptability, and modularity of the system.
- **Sensor-Based** is a technical category that means the installation needs certain conditions available in terms of constraints, adaptability, and modularity of the system.
- **Follow Path:** Determines whether the installation follows a predefined structure that users must follow.
- **Own Path:** Assesses whether the installation allows users to explore freely and create their own paths.
- **User Generated Content:** Explores the extent to which the installation relies on user input for its content or functionality.
- **Social Engagement:** Evaluates the installation's ability to evoke a sense of social context and encourage social behavior.

In this framework, it is not clear what the criteria are based on, how the pluses and minuses are scored, and how the installations score in relation to each other. Thus some improvements should be made in order to consider this a framework that can be used in this project.

Location	Allard Pierson Museum, Keys to Rome	
System	Pointing History	General Exhibition Space
Source	Personal Experience	
Technology	LEAP discovery beam	RFID tag identification - >storyline = 3D replicas
Collaborative	-	-
Solitary	++	+
In-Bubble	-	-
Heads-Up	++	+
Person-Centric	-	-
Exhibit-Centric	++	++
Vision-Based	++	-
Sensor-Based	-	++
Follow Path	++	+
Own Path	-	+
User Generated Content	-	-
Social Engagement	+	+
Learning Theory	Didactic	Stimulus

Table 2.1: One of the Keys2Rome exhibitions, discussed in Section 2.2.4, placed in the framework of Iván [30].

2.2 Existing work

Since the framework made by Iván is not perfect it is important to try and make a new framework, based on existing interactive installations, that will be suited for this project. Thus in this section previously made interactive installations and different contributing aspects from each of them are considered and discussed.

2.2.1 EMDialog

The EMDialog is a **free exploration** installation, placed in the Glenbow Museum, Calgary [26], see Figure 2.1. The function of the museum is to allow visitors to delve deeper into the life of Emily Carr. It was placed in the Glenbow Museum, Calgary [26]. The focus of the installation is to attract and involve the broad audience of the museum. It was made as a result of an interdisciplinary collaboration between Holly Schmidt, an artist, Uta Hinrichs, an engineer in computational visualistics, and a PhD student at the University of Calgary. There is no clear task and visitors are free to go further and explore everything or walk away after looking at the installation for a short while. The installation consists of a large interactive display showing two visualizations that present commentary and imagery about Emily Carr's life and works. These visualizations can be explored by touching the screen. One of the re-

requirements of the designers was to make the interaction as lightweight and intuitive as possible and based on the “**walk-up-and-use**” principle. This is because museum visitors are likely to use trial and error techniques to try the installation, if they can not figure it out they will walk on. Visitors of every age would interact, although adults would be more hesitant compared to children and young adults. Mostly elderly people complained about the **lack of clear instructions** and could be seen walking from the display to the projection trying to find instructions. This is a design choice to leave out the instructions because clear instructions can also obstruct free exploration and discourage people when they see a lot of text [27].

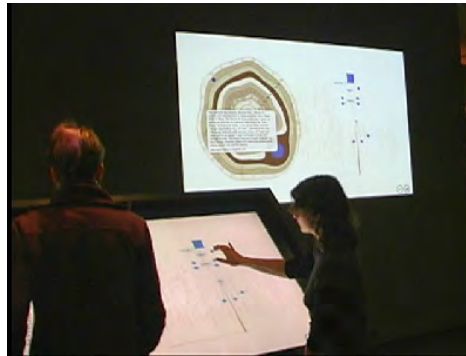


Figure 2.1: The touch screen and the display screen of the EMDialog

A different important aspect of this installation is that the display is cloned on a larger projection screen, so it is visible to a larger audience. This has some advantages and some disadvantages. The **observers** genuinely liked watching other people interact and one person even stated that it was the most intriguing part of the installation. This was for observers an accessible way to watch the installation. But for the person that was interacting with the installation, it could feel as having their performance **judged** which makes it more difficult to explore the installation freely. So a recommendation would be to use lightweight interaction techniques and clear visual feedback might make people feel more comfortable and less vulnerable about making interaction “mistakes” in public [27].

2.2.2 Atlantic Wall

To make the ‘The Hague and the Atlantic Wall: War in the City of Peace’ exhibition more engaging and give **different perspectives** the Museum, the Hague made an installation using **tangible objects** [34]. The exhibition made use of 6 different tangible objects that triggered a specific perspective in a certain language when used. Thus, every object could be used to experience the exhibition differently. For example, one object represented a civilian who spoke in Dutch. While a different object represented a German soldier, whose story is presented in English. The objects

can be seen in see Figure 2.2 and were available at the start of the exhibition and throughout the exhibition. There were boxes the object could be placed on. When the box was activated, a story was told from the perspective of the object. From this research, some noticeable observations were made. On the days that staff was present, and **staff encourages** people to use the tangibles more people would use them. From the overall data that was analyzed the conclusion was that around 40 percent of the visitors made use of the objects to some extent. A second important observation is that most people visited the museum with a group and if one person of a group is enthusiastic about the installation, they will explain it to the rest and make them also more enthusiastic [34].



Figure 2.2: The object that can be carried around the exhibition to activate different stories

2.2.3 Reminisce

To create a new experience at Bunratty Folk Park the design of Reminisce was tested. In the park, there are different locations and huts providing information on various aspects of the exhibition. Every location has a small token that could unlock a digital layer on the open-air experience [15], see Figure 2.3a. In every hut that was visited, visitors could collect a small object they could use at the end of the exhibition and that they could take home afterward. All the small objects were related to the hut they were taken from. At the end of the walk, an object could be placed on a desk and digital content about the house the token was taken from was displayed. The tokens represented some sort of **key to unlock the digital content** by placing the tokens on a desk, see Figure 2.3b. The main lesson learned by the creators of this project was that it is important that both the physical, as well as the digital content in such an installation, should **fit the main story** [14].



(a) Some tokens that can be found around the exhibition
 (b) The interactive desk where the tokens can be put on

2.2.4 Keys to Rome

To **connect multiple locations** in one exhibition the Keys to Rome exhibition was created. The four locations were Rome, Sarajevo, Amsterdam, and Alexandria [2]. Each of these locations held a place in the Roman empire and culture. At each of the locations, the exhibition consisted of objects unique to that location. The objects from the other places were replicated and could be used as an interface to control a 3D rendered image on a screen that could be rotated and explored [13]. The unique aspect of this exhibition is the connection of four separate locations and using a **3D printed object as a controller**.

2.2.5 Austrian Technical Museum

At the Austrian Technical Museum in Vienna, there are multiple interesting installations inside the exhibition. There is an abacus that guides visitors through calculations, see Figure 2.3a, a Morse ticker, a telegraph, see Figure 2.3b, and some more screen-based installations [28]. These installations are designed to give the visitor a more **hands-on experience** in the museum. This way people can experience the feeling of how it was to actually use these machines. They can learn more about Morse code by doing it. These are mostly installations with a clear goal like solving a sequence of calculations with the help of an abacus or recording your own news in a TV newsroom, see Figure 2.3c. From their observations, the conclusion was made that both the set-up and the interface as well as the content and the appeal of the installation itself are important. It is also recommended to **layer the installation** so visitors can explore on their own, and go as deep as they want. Going deeper is not necessary and early success can be achieved. This way people will feel satisfied when they stop using the installation and feel like they had an engaging experience [28].



(a) An Abacus where visitors are asked to solve calculations



(b) A telegraph with predefined task



(c) The newsroom where visitors can record their own news

Figure 2.3: Interactive installation at the Austrian Technical Museum

2.2.6 Interactive Art Work

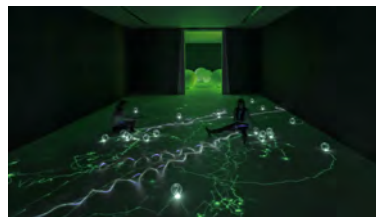
There are a lot of interactive artworks that are not directly relevant to this project. They often only offer an experience and do not help to enhance the information the museum brings. The interesting part about art installations is the way they want to capture and keep the attention of the visitors. They often offer a new way to experience art. This way of thinking can be helpful while building an educational experience and can help to offer a new experience. Daan Roosegaarde and Random International both have installations that make use of light to capture the attention of the visitor, see Figure 2.4a, 2.4b, and 2.4c. Light is used to make a trail, this is very temporary; it does not damage the existing surface, but it is visible to the visitor and after a few minutes the installation will go back to its original state [41].



(a) Temporary Graffiti



(b) You are able to make prints on the wall by making use of the light



(c) Balls make their own tracks on the ground

Figure 2.4: Installations focused on using light as a way to interact

A different material that can be used in interactive art installations is water [29]. Similar to light, water has the attribute to get back to its original state after someone has manipulated it. Water also has a reflective surface and when touched people get wet, which most people don't like. All of these attributes can be used in interactive installations to make people come to new insights. The rain room by Random International uses the fear people have of getting wet, see Figure 2.5. The water makes way for the people without them getting wet but of course, no one just walks up to a place where water is streaming down while visiting a museum. Although water might not be the ideal material to use while building an educational interactive installation, it is an interesting concept to think about using more than the standard materials.



Figure 2.5: The Rain Room makes use of water

2.2.7 Conclusion & Discussion

In this section, a lot of existing interactive installations were discussed and it can be concluded that three main design choices can be found in the majority of the installations. These main design choices will be explained in-depth and placed in a framework based on similar aspects seen in these installations. The first design choice is the form of an installation. Installations can differ on a scale from screen-based to embodied. A screen-based installation is solely based on a screen where some sort of interaction takes place, this can be done by using a tabletop or multiple screens as the EMDialog from Section 2.2.1. A different approach is having an embodied installation, this can vary from using only tangible objects like the Atlantic wall from Section 2.2.2 or even an interactive space as the artwork from Daan Roosegaarde from Section 2.2.6 where the entire room is the installation. These examples are the extremes on the scale, but a lot of the installations can be found somewhere in between, for example, a screen with a sound system that fills the entire room. Or that the use of a tangible object can make something happen on a screen as was done in Reminisce in Section 2.2.3.

The second design choice that can be seen in every installation is the function of a storyline as part of the installation. This ranges from complete free exploration with no nudging to set tasks that the visitor has to perform. With informative interactive installations, it is rare to see something with complete free exploration, there is always a goal in mind to inform the user, and the user is nudged toward that. The EMDialog from Section 2.2.1 is the informative installation that has the freest exploration. The goal is still to find information but in what order a user achieves this goal or how much information is found is not determined for them and is not important for their interaction. There is no clear beginning or end. On the other side of this spectrum, the installations from the Austrian Technical Museum can be found, see Section 2.2.5. These installations have a clear start and a clear end with a set path in between them. With the abacus, your goal is to solve mathematical problems with increasing difficulty. Between these two extremes on the scale, there are installations where there is not a completely free exploration, or installations with some nudges to guide you to what you are supposed to do. But there is less of a clear start and end compared to the abacus.

The last aspect is the nature of the interaction. If an installation is meant to be used by a single person or by multiple users. This is also a grey area because a lot of installations are controlled by one input at a time and can be enjoyed by multiple persons at the same time. Most screen-based installations use screens that are able to process only one input at a time but make use of larger screens so the visitors who are not giving input can still experience the installations. Falk states [21] that most museum visits are a social affair so when designing an informative interactive

installation for a museum this should be taken into account.

To show this framework the installations mentioned in Section 2.2, "Existing Work", work are placed inside Figure 2.6. The first aspect, the form of the installation is displayed on the X-axis, on the left side screen-based, and on the right side embodied. The second aspect is displayed on the Y-axis, at the top free exploration and at the bottom set tasks. The third and last aspect is displayed by using darkness. If the dot is darker colored this means the focus is more on multiple-user interaction compared to the dots that are a lighter color, which are mostly focused on single-user interaction.

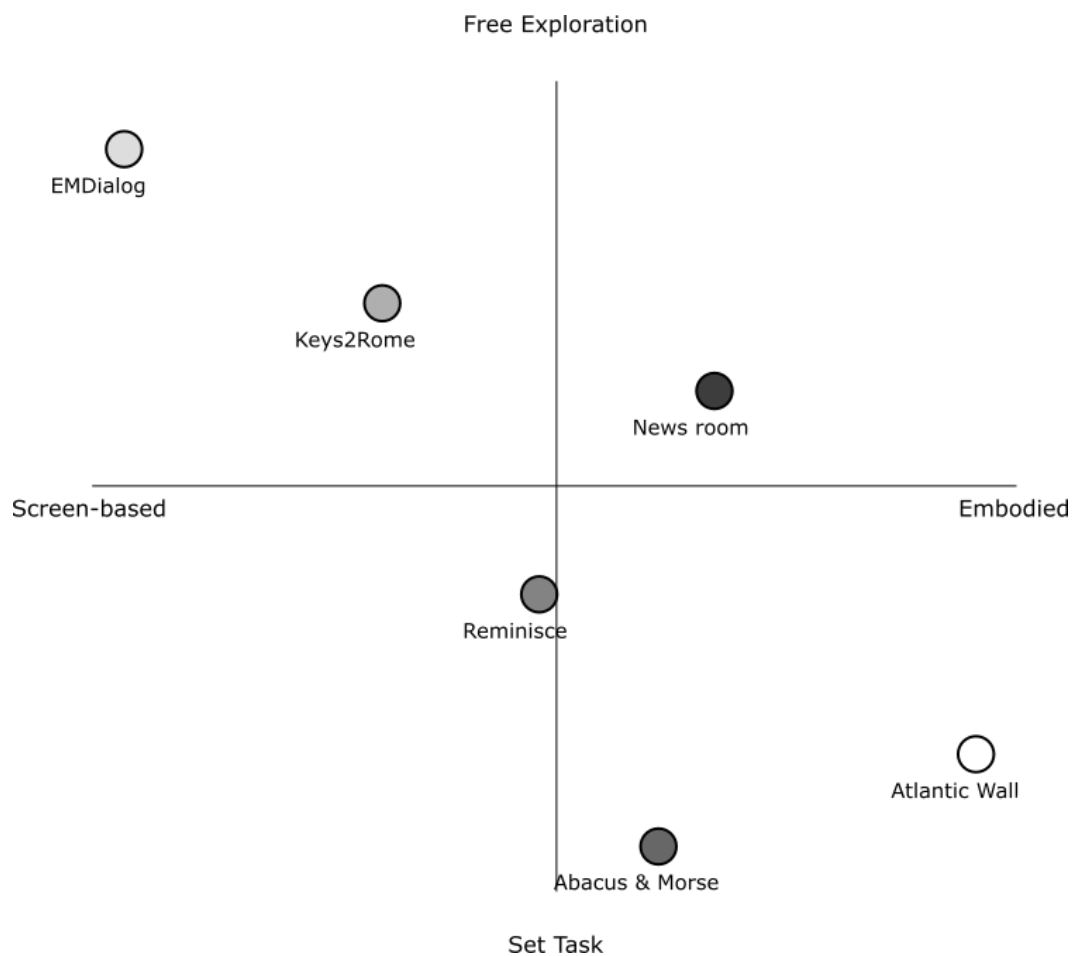


Figure 2.6: The previously discussed interactive installations placed in the framework

2.3 Frameworks for museums and The MuseumFabriek specifically

In order to understand the decision-making process of museums and how they determine what to include in their exhibits, it is important to examine established museum frameworks and whether the MuseumFabriek applies any specific framework. The available literature, however, does not offer a conclusive answer regarding what museums consider important. Dean [18] provides an overview that mentions factors such as value, balance, shape, and human factors, but lacks practical details on their implementation. To gain more insight, an interview will be held with the MuseumFabriek. The interview will focus on determining if they use a framework and, if not, understanding how and why they make decisions regarding the composition of their museum.

2.3.1 Procedure

The initial interaction with the MuseumFabriek involved engaging in informal conversations with several employees. These discussions encompassed various aspects of the museum, including past installations, desired exhibitions, and visitor preferences. Through these discussions, it became evident that a formal interview was necessary to delve deeper into these topics. The interview was conducted with one employee of the MuseumFabriek, who plays a key role in the initial stages of creating a new exhibition. This employee's responsibilities involve seeking potential objects and presenting them to the rest of the team for consideration. Ultimately, the team collectively makes a final decision and develops a design for the exhibition.

The interview is semi-structured, meaning there are 13 pre-planned questions to guide the discussion. However, if needed, additional questions can be asked or some questions can be skipped based on the conversation. These questions are based on previous informal conversations with MuseumFabriek employees and information from relevant literature. Most questions were made to encourage detailed answers. The original Dutch questions and their English translations can be found in Appendix C. The interview takes place online using Microsoft Teams, and both audio and video are recorded using Open Broadcaster Software (OBS). Before the interview, the participant receives an information brochure and signs a consent form, which are available in Appendix D. This interview process has been approved by the ethics committee.

2.3.2 Interview results

The decision-making process of the MuseumFabriek revolves around three main factors, which were identified prior to the interview and validated during it. These factors provide essential guidelines for determining what to include in the museum.

Process

The first factor is about how decisions are made and who is involved in making them. It is the most general aspect and forms the basis for the overall decision-making approach.

New exhibition sections at the MuseumFabriek can come from various sources. The process could start with a special object that the museum wants to showcase, or it could involve altering an existing part of the exhibition or creating a completely new idea. Once an idea is formed, the next step is to find objects that fit the theme or concept of the section.

To find these objects, the museum shares the theme with volunteers who have their own small collections. These volunteers are asked if they have any items that could work well with the given theme. For example, if the theme is about "night," the section might include objects like an owl, a star chart, and a meteorite. Some sections might have a common story connecting the objects, while others may have individual items that together contribute to the overall theme.

By involving volunteers with their own collections, the MuseumFabriek gets access to a variety of objects and perspectives, making the selection process richer. This approach allows for different stories to be explored and ensures that the displayed objects align with the chosen theme.

Requirements

When building a new part of the exhibition there are only a few hard requirements that need to be met. All the objects need to have **added value**, this can be the educational value of the object itself, or the object can add to the overall story of the section. The objects do not have to tell their own story; every object has to have an information sign that states what the object is and more information. This information needs to be understandable on the level of VMBO-TL 3. This is roughly equal to a 2F level from the Dutch government or an **international B1 level** [47]. Which means that difficult words need to be avoided. Other requirements about the exhibition are the layout of the space and the lighting used. For an interactive installation in specific, it is important that there is a **good interaction**, that it is understandable for all visitors, and provides an accessible way to make their own discoveries. It

should be easily **scalable** and fits the size of the museum. Besides this, the **costs** of installation and maintenance can not be too high.

Visitors

Most of the people that visit the MuseumFabriek are focused on having a fun day trip and consist mostly of families with small children. A few years ago, more people visited because they wanted to learn more about the region. The museum is now focusing on gaining more of these visitors while not losing the visiting families. The ideal result would be that families are visiting during holiday breaks and weekends while visitors interested in the region visit on weekdays. This can be linked back to the kind of visitors as introduced by Falk [21]. The parents of the families are mostly **facilitators** and the children are **explorers**, they are mostly attracted to the museum because of the possibility of tinkering, the mounted animals, and the general child-friendly nature of the museum. Other visitors that just visit to have a nice day out can be classified as rechargers. They just want to do something different from a workday and enjoy themselves. The museum wants to attract more **affinity seekers**, they visit specifically to gain more information about the region and to learn more about their own background. It would be recommended for the museum to design its exhibitions and installation with these target groups in mind.

2.4 The Strong and weak points of the various frameworks

It is important to understand the strong and weak points of the several frameworks that are discussed in this chapter. None of the design guidelines discussed here are reviewed in other literature so the strong and weak points are only based on personal observations and considerations. The first guideline made by Falk determines various types of visitors and is discussed in Section 2.1.1, “Identity Lens of Museum visitor”. This guideline is important to note who your visitors are and what they want and expect when visiting a museum. The strong points of this guideline are the clear categories and there is more literature that backs this framework. It mainly focuses on visitors as an important factor in designing interactive installations. However, to ensure a complete concept other factors need to be considered as well. This framework should be combined with others that concentrate on different aspects of the design process. By incorporating multiple frameworks, a more inclusive and balanced approach to designing interactive installations can be achieved. Section 2.1, “Existing Frameworks”, discusses multiple existing frameworks. Iván incorporates

two of these frameworks, specifically those presented by Grammenos [24] and Witcomb [52], into her own framework. While these individual frameworks have their limitations, Iván's framework is used to further explore both its strengths and weaknesses.

The strengths of Iván's framework lie in its comprehensive nature, drawing from both existing interactive installations in museums and relevant literature. However, a drawback is that the framework lacks a clear overview and presents an overwhelming amount of information. Additionally, the installations are rated using plus and minus signs, but it is unclear on what criteria these ratings are based.

In Section 2.2, "Existing work", another framework is constructed and examined. This framework focuses solely on existing interactive installations in museums. It is designed based on the similarities that can be seen between these installations and consists of three dimensions. The first one considers how the installation is formed, the second dimension is on the exploration of the installation and the third dimension analyzes the nature of the interaction. The strengths of this framework are the clear overview and its foundation in real installations developed for museums. The fact that it incorporates a larger number of installations is also beneficial. However, there are some weaknesses to consider. Firstly, the framework relies solely on observational aspects and does not incorporate underlying theories from literature. Secondly, it is limited to only three aspects, potentially overlooking other important factors.

The next set of guidelines, discussed in section 2.3, "Frameworks for museums and The MuseumFabriek specifically", is the one employed by the MuseumFabriek. These guidelines are not strict rules but rather an internal list of requirements based on intuition and experience. Although an interview is conducted to capture the most important features, the requirements still lack specific details. The strengths of this framework lie in its foundation on the experience of museum employees and its practical application. It has proven to be effective within the museum setting. However, there are weaknesses to consider. It is challenging to describe and replicate, particularly if employees with the relevant knowledge leave, as it is primarily based on intuition and not well-documented. Consequently, it is only applicable to the MuseumFabriek

2.5 Linking the various frameworks

To gain insight into the frameworks and their potential connection, it is needed to understand their relationship to each other and how they can reinforce each other. Three significant visitor categories have been identified for the museum: explorers, facilitators, and affinity seekers. Consequently, the remaining frameworks will

be examined through the lens of these three visitor types, aiming to identify which essential aspects align with each category.

To ensure a coherent overview, it is presented in three tables for the different frameworks. Not all aspects of a framework are important for every visitor category. Explorers and Affinity seekers are mainly focused on the content and less on the form, while facilitators have a big focus on their companions. So not all of the combinations are explored. For the important aspects of each visitor category, additional explanations will be provided.

	Explorers	Faciliators	Affinity seekers
Didactic Expository model	-	0	+
Stimulus response model	+	0	0
Discovery model	++	0	+
Contructivism and Interactivity model	+	0	+

Table 2.2: The didactic framework [52] combined with the three main visitor groups

In the first table the didactic framework, formulated by Witcomb [52] is combined with the three main visitor groups and can be seen in Table 2.2. Explorers prioritize the type of didactic framework the most. They are driven by their curiosity and the experiential aspect they seek, in combination with the museum's content. The discovery model offers them the greatest degree of freedom to explore and indulge their curiosity. On the other hand, the choice of didactic framework is relatively unimportant for facilitators, as their primary motivation for visiting the museum is the social context it provides. As for affinity seekers, the museum's content and theme is the most important. While certain didactic models may facilitate the inclusion of relevant content more effectively than others, the specific way of presentation is of lesser relevance to them.

	Explorers	Faciliators	Affinity seekers
Collaborative		++	
Solitary		--	
In-Bubble		-	
Heads-Up			
Person-Centric	+		+
Exhibition-Centric			
Vision-Based			
Sensor-Based			
Follow Path			
Own Path	++		
User Generated Content			+
Social Engagement		++	+

Table 2.3: Iván's framework [30] combined with the three main visitor groups

In the second table, Iván's framework [30] is combined with the three main visitor groups and can be seen in Table 2.3. As mentioned earlier, the primary concern for explorers is the relevance of the content to their interests, allowing them to delve deep and satisfy their curiosity. Therefore, the aspects of personalization and the freedom to discover their own path are the most important to them. Contrarily, for facilitators, the key aspects revolve around experiencing something collectively, emphasizing collaboration, and fostering social engagement. It should not be an isolated or solitary experience. Lastly, affinity seekers prioritize both the content itself and its connection to the community.

	Explorers	Faciliators	Affinity seekers
Screen based			
Embodied			
Free exploration	+		
Set tasks	-		
Multiple User Interaction		++	
Single User Interaction		--	

Table 2.4: Framework based on relevant interactive installations combined with the three main visitor groups

In the third table is the framework based on relevant interactive installations, made in this report, combined with the three main visitor groups and can be seen in Table 2.4. The motivations and connections mentioned earlier remain relevant for

this framework. The aspects of this framework do not address the content, which makes all of them irrelevant for the affinity seekers. On the other hand, free exploration holds significance for the explorers, while multiple user interaction is important for the facilitators.

2.6 Contributing aspects

This section will answer the first sub-research question, "What are aspects that contribute to a great design for an interactive installation for The MuseumFabriek?" The conclusion on this is that many variables can contribute to a great design. To find these aspects the frameworks are analyzed to find their strong and weak points in Section 2.4, "The Strong and weak points of the various frameworks". Consecutively, the frameworks are considered in combination with the three main visitor identities in Section 2.5, "Linking the various frameworks." With these results in combination with the wishes of the museum an answer can be formulated in the form of relevant aspects. The first aspect to consider is understanding the target audience. The MuseumFabriek attracts many children with their parents and individuals interested in the Twente region. Therefore, an interactive installation for the MuseumFabriek needs to focus on three main groups: **explorers** (children), **facilitators** (parents), and **Affinity seekers** (Twente enthusiasts). The next aspect is the pedagogical model used in the installation. The most commonly employed model for interactive installations is the **discovery model**, which aligns well with the MuseumFabriek's hands-on approach, the motivation of Explorers, and it is a suitable model to implement relevant content for affinity seekers. Thus, it would be the most suitable choice.

Other important aspects have to do with several design decisions. Placing the design within the framework shown in Figure 2.6, can assist in this process. Considering the nature of the MuseumFabriek, the motivation of the explorers as visitors, and the pedagogical model of discovery. The focus should be on visitors forging their own path and having **free exploration**. To give visitors their own freedom to explore as much or as little as they want. To focus on the facilitators as parents with children it is preferable to focus on a collaborative, **multi-user design**, that allows for multiple users and for social engagement. Additionally, as the installation will be stand-alone, it may involve a greater emphasis on **screen-based** interactions rather than physical interactions. The final aspect contributing to a great design for the MuseumFabriek is meeting the requirements set by the museum. The first requirement is a **good and understandable interaction**, every visitor should be able to easily understand the interaction. Secondly, the installation needs to be easily **scalable** or specifically suited for the museum and it should be **affordable**. In addition, the installation must

provide **added value** to the museum. It has to provide a meaningful experience with relevant content. And lastly, the language used should be simple and accessible, aiming for a level no more complex than the **international B1 level**.

2.6.1 Requirements

To keep a clear overview, it is beneficial to summarize the requirements outlined in this chapter. These are as follows:

- The installation should cater to families with children. (Explorers/Facilitators).
- The installation should cater to people who want to understand more about the region (Affinity seekers).
- The installation should make use of the discovery model as a way of informing visitors.
- The installation should allow visitors to follow their own path of free exploration.
- The installation should support a collaborative multi-user design where multiple users can enjoy or interact simultaneously.
- It is preferable for the installation to be screen-based instead of embodied.
- The installation should offer a good and understandable interaction.
- The installation should be easily scalable or fitted for the museum's specific needs.
- The installation should be affordable, with relatively low maintenance costs.
- The installation should add value to the museum
- The languages used in installation should be international B1 level Dutch

From ideation to final concept

To be able to answer the subquestion **”What kind of installation is suited for the Museumfabriek?”**, different kinds of installations need to be explored. Thus, this chapter starts with a brainstorming session, which consists of making a mindmap, see Figure 3.1, and a table to match input and outputs, see Table 3.3. The concepts mentioned in this chapter are still very global and can be applied to a broad amount of content. The museum stated a preference for the installation being suitable to present information about the firework disaster and thus that is the main focus. After the brainstorming four concepts were selected and discussed with an employee from the museum. He gave feedback and it was decided that either the tabletop or a new concept generated during the interview with the museum, would be developed. After more consideration, it was decided that the project would continue with something similar to the tabletop idea making use of the recorded videos that are already on display. The focus will remain on making the presented information interactive.

3.1 Brainstorm

The goal of the first brainstorm is to come up with multiple concepts that vary in form, input, and output. All the concepts for installations are focused on giving visitors more insight into the firework disaster that happened on the 13th of May 2000 [16]. The museum already has a setup focused on the firework disaster, there are two models of the area surrounding the factory, one before and one after the disaster. There are some personal remembrance objects from the houses of victims. And lastly, there are witness videos that talk about the day and long-term effects of the disaster. The challenge of this brainstorm is to make that exhibition interactive, either by changing or adding a new installation.

3.1.1 Mindmap

The first step of the brainstorm was making a mindmap. This was done by the researcher. The goal was to get some first concepts on paper and think about everything that was needed for making an installation, it can be seen in Figure 3.1. A mindmap is very unrestricted and helps with coming up with vague concepts like "tabletop", using the program Unity for building, "different perspective" which would later be used, as well as some very specific ideas such as "make a time mechanism round so that it resembles a clock", "roll a ball around", and "show changes through time".

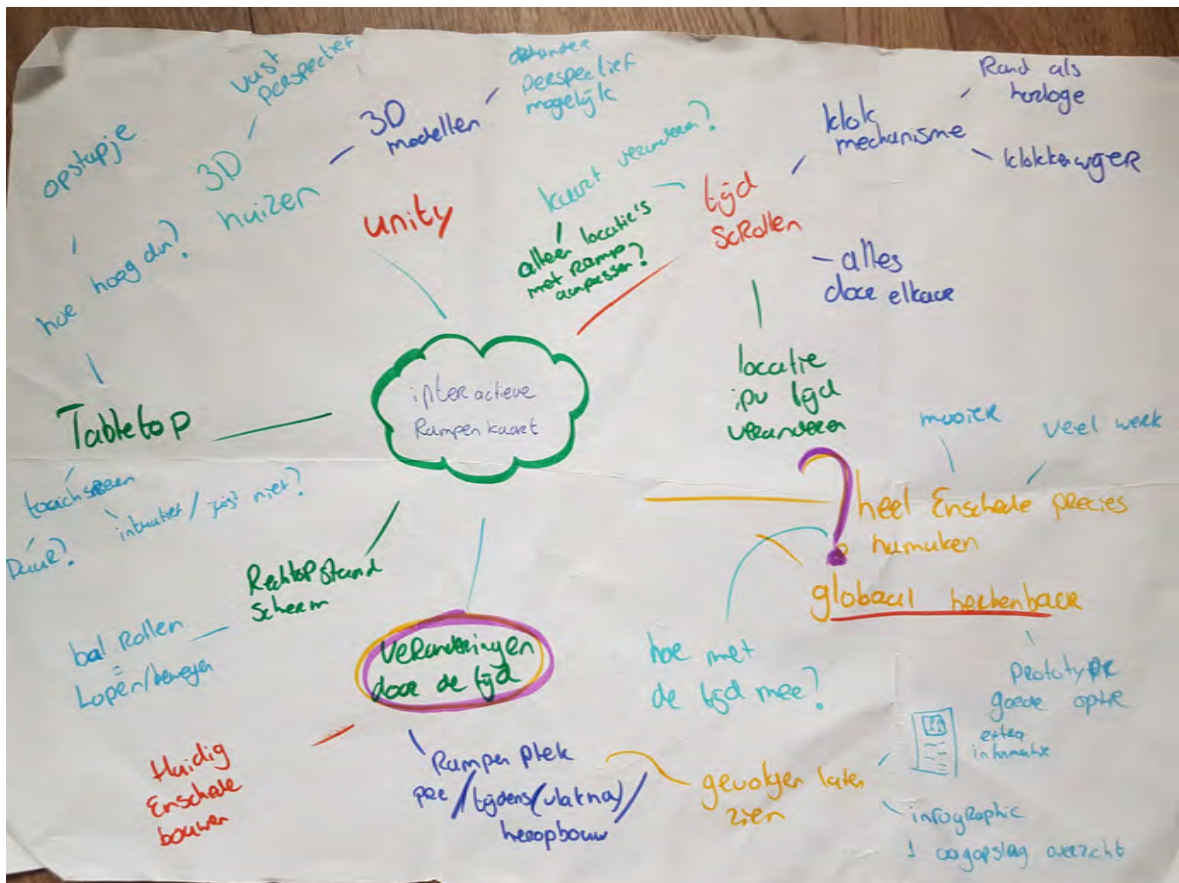


Figure 3.1: The original Dutch mindmap to generate ideas



Figure 3.2: The English translation of the mindmap to generate ideas

3.1.2 Table

After the first initial brainstorm by mindmap a second technique was used, thinking of different forms of input for the installation and combining them with different forms of output. And to use these to make a table in order to create an idea that combines those inputs and outputs. The input is what the user does to make the installation work and the output is how the installations shows the information back to the visitors. The input (e.g. clicking, standing somewhere, touch screen) goes on the horizontal axis. The output of an interactive installation (e.g. sound, small screen, tabletop) goes on the vertical axis. Thus where the input and output cross they will be combined to generate new concepts for the installation. Only a part of the table is filled in by concepts that were made more concrete. All the different inputs and outputs are considered how they would work with the firework disaster and an interactive installation. A lot of the concepts that come from this crossing are similar to each other thus they were not given a concrete name. Some cells of the table are colored, red means that the idea would not work in this situation, this could be because of various reasons. For instance, audio could cause an issue as the installation would be in an open space, or a certain type of installation would barely offer more interaction to the exhibition, or the installation makes use of a fragile model that can not be interacted with. The cells that are colored orange are concepts that could work but are decided against for various reasons. For instance too expensive

or too hard to accomplish. The green-colored cells are the concepts that add value to the exhibition, are achievable, fit with the requirements listed in 2.6.1, and can be made into a more elaborate concept. By working with the table, it is easy to come up with a lot of concepts that can be elaborated on later. The table made during this brainstorming session is shown in Table 3.3.

	Input	Standing somewhere	Clicking	Moving a tangible object	Touchscreen Tabletop	Other physical input
Output						
Sound		An audio tour with different	Different povs you can click	Having figurines that stand for different	Touching a place on a map to hear a pov	
A small screen				Similar to Reminisce (In Section 2.2.3)		
A wall screen or projection			Similar to EMDialog (In Section 2.2.1)			
Floor projection	Kinect			A big chess board with feedback projected on the floor		
Sound & a screen				Similar to Atlantic Wall (In Section 2.2.2) but with added visual output		
Tabletop				Similar to Reminisce (In Section 2.2.3) but the output would be displayed on the tabletop where the object is placed on	The output and input would be on the same display	
Projection on existing 3D model						Touching a place on the model to hear a pov
Digital map of the area				Placing a figuring on a map		Touching a place on a map to hear a pov

Figure 3.3: Table with multiple brainstorming concepts

3.2 Presenting four concepts to the MuseumFabriek

From the brainstorming, four concepts are selected and presented to the museum. All of these concepts fit the requirements the museum gave beforehand and were based on the relevant literature. The list of requirements can be found in Section 2.6.1. In addition to the requirements, the concepts are selected on the feasibility with the amount of time it takes to make them, and the achievability of the installation. To present the concepts in a way that makes it easy to convey to the museum’s employee, presentation slides are used. On the slide, the idea is explained with a few bullet points, photos of similar installations, and some pros and cons. Additionally, during the conversation with the museum, the concepts are explained verbally. In this chapter, there is a small text to explain the concepts further together with the feedback gathered from the museum. The feedback was given in an interview setting with one of their employees.

3.2.1 Interactive floor

One concept is an interactive floor composed of tiles that visitors can stand on, as shown in Figure 3.4. The floor can display a map, either as a single large image or as separate pictures representing different categories. It provides a fun way for visitors to interact. However, a significant drawback is that it may be challenging to communicate to people that it is acceptable to step on the floor, especially since museums typically discourage touching exhibits.

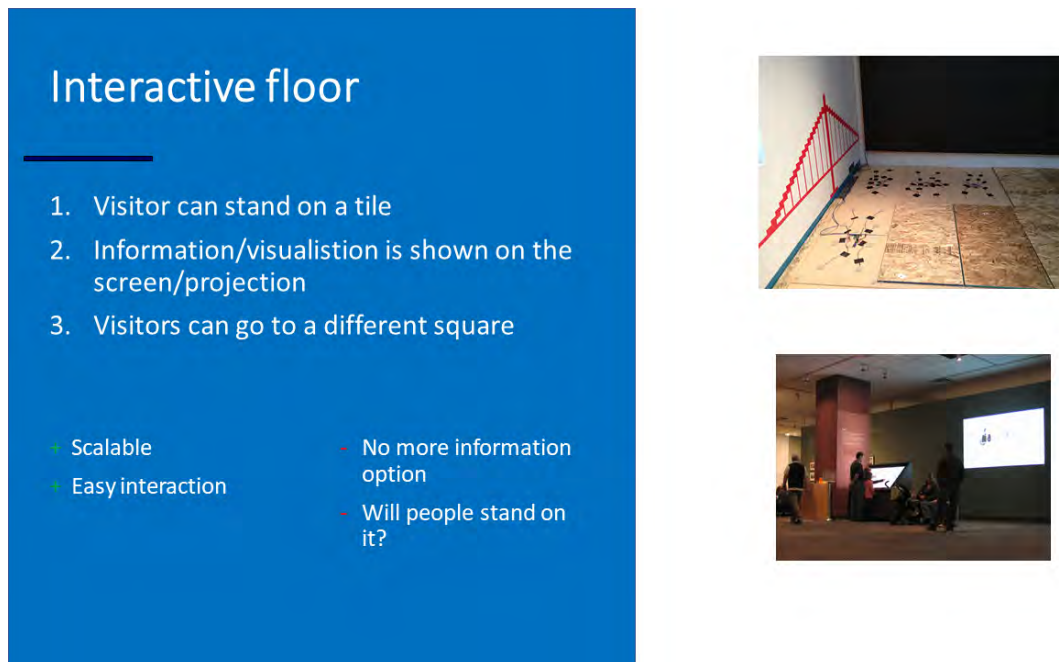


Figure 3.4: Slide containing explanation about the interactive floor [27] [45]

Client evaluation

The museum had a similar installation in the past, resembling this idea. While the concept is intriguing, there are notable drawbacks. Firstly, the installation requires a considerable amount of space, and depending on the system used, it can become expensive due to the need for individual sensors for each tile. Although there are interesting possibilities for further development, there are also limitations to consider. Overall, the initial impression of this idea is neutral.

3.2.2 Kinect Floor

Another option instead of using tiles is to employ a Kinect as an interactive floor, as shown in Figure 3.5. The Kinect is a depth-sensing device made by Windows. It can sense people's locations and movements [10]. In this case, instead of clicking on

a specific area for more information, a person standing on a particular spot would trigger a change in the projection. This approach allows for a more immersive and freely exploratory experience of information.



Figure 3.5: Slide containing explanation about the Kinect floor [4] [1] [33]

Client evaluation

The museum had a similar installation in the past. However, there are significant challenges associated with using projections on the wall and/or floor. The museum lacks a suitable space for such installations, as the presence of big windows causes visibility issues due to sunlight at certain times of the day. Moreover, the high maintenance costs associated with these types of installations pose a significant drawback. Considering these factors, the museum is opposed to utilizing this particular idea.

3.2.3 Tabletop

This idea involves allowing visitors to pick up tangible objects and place them on a table, as illustrated in Figure 3.6. The table would recognize the objects and their placement. On the table's surface, a map or different categories could be displayed. For example, using different perspectives or people as objects, visitors could place them on the map to obtain information about the combination of a location and perspective.

Tabletop with objects

1. A map is displayed on the table
2. The visitor places one object on the table/screen
3. A pop-up with information will be displayed
4. A different objects can be placed or more information can be discovered.

- + Small

- A lot of information have to be put into the installation
- A big screen is needed
- The objects need to be secured so they are kept at the installation








Figure 3.6: Slide containing explanation about the table with tangible objects [42], [49], [6]

Client evaluation

The museum responded positively to this idea. It can be implemented using various techniques that ensure durability and minimize the risk of breakage by visitors. Additionally, it can be developed at a relatively low cost. During the interview, the concept of incorporating interviews that are already part of the museum's content emerged. The museum conducted 23 interviews with individuals involved in the firework disaster, each offering a unique perspective. The installation could be designed to allow visitors to choose the perspective they wish to hear. This way, the interviews would provide a more comprehensive understanding and align better with the preferences of each visitor.

3.2.4 Screen with physical input

This idea revolves around combining a small screen with some form of physical input. It offers various options for the screen's display, such as a map, video, or general information. The method of interaction is open for discussion and depends on the specific content of the installation as illustrated in Figure 3.7. If the content involves different categories or characteristics, tiles can be used for selection. On the other hand, if the content includes numerical values or multiple categories, a wheel can be used to make choices.

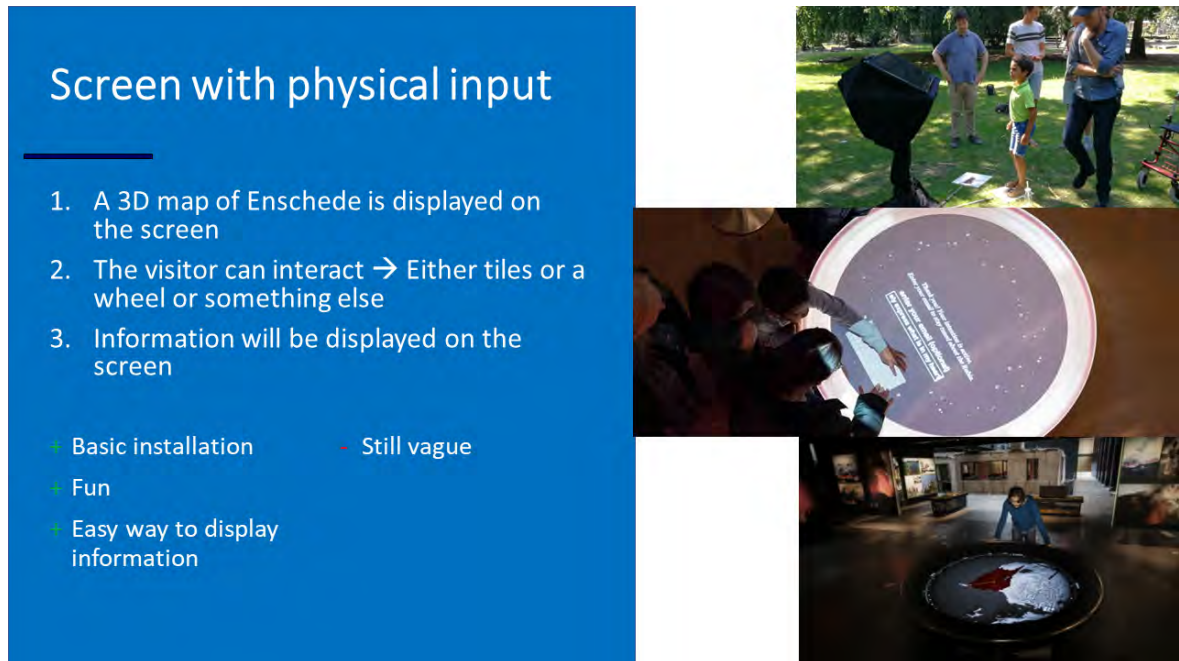


Figure 3.7: Slide containing explanation about a screen with physical input [3], [5]

Client evaluation

While the idea itself has potential, the museum struggled to determine an effective way to provide the necessary information for this concept. Currently, the idea remains too vague and requires further development and clarification.

3.2.5 Additional concept: The Factory experience

During the conversation, the employee of the museum brought up a new idea. With a focus on the textile history of Enschede instead of the Fireworks disaster. The textile industry had a huge impact on Enschede. The city grew a lot during that time, more infrastructure was built and a lot of buildings can still be found in Enschede [31]. It would be a good subject for the museum since it would attract the people that have an interest in the region more, the Affinity seekers [21]. The current exhibition on the textile factories contains multiple old machines, some of which are operated on some days. The machines are impressive but they do not give the visitor a feeling of how it was to operate them. Instead, there is more of a focus on the technical side of the machines and how they worked. The concept with a focus on this subject could simulate the factory experience, and give the visitor a feeling of how it was to operate them. It would be a small space where the working conditions of the old textile fabrics are emulated. The visitors will be asked to complete a small task with a time limit to emulate the pressure of not making mistakes while being in

severe circumstances. It would give a more engaging experience and ensure people emphasize more towards the factory workers.

3.3 Final choice on the prototype

After carefully considering the requirements and evaluating the concepts, it is concluded that both the tabletop firework disaster and the factory experience have the most added value for the museum and fit the requirements listed in Section 2.6.1.

3.3.1 Rejected concepts

The interactive floor, the Kinect, and the screen with physical input concepts are not further explored because of their limitations. The interactive floor concept, discussed in Section 3.2.1, would be challenging in terms of maintenance and cost-effectiveness. The Kinect concept, discussed in Section 3.2.2, relies on projections and thus would be difficult to implement in the museum with its multiple windows. Additionally, the concept of the screen with physical input, discussed in Section 3.2.4, is still too vague and open-ended, making it unsuitable for development on its own. It could potentially be combined with another concept in the future.

3.3.2 Factory experience concept

The factory experience concept discussed in Section 3.2.5, aims to create a more engaging experience by highlighting the operation of textile machines and emphasizing the perspective of factory workers. However, it may not fully align with visitor expectations of having a pleasant and enjoyable day out, since it would cause for a stressful experience. As the focus would be on making people feel the stress factory worker felt. Additionally, there would be a bigger challenge to maintain this within the Museum's budget. Considering the specific goals and potential impact, the tabletop firework disaster concept is deemed more suitable for improving the current situation. By introducing interactivity and enhancing the accessibility of the interviews, it has the potential to provide visitors with a meaningful and informative experience. But it is decided against this.

3.3.3 Tabletop concept

For the tabletop concept discussed in Section 3.2.3, the current exhibition could be easily integrated. In the "firework disaster" part of the exhibition, there is a set of pre-recorded interviews. Despite the lack of interactivity and choices for visitors, many

visitors stay there for a few minutes to watch the interviews, indicating their interest in the subject. Enhancing this setup with interactivity and enabling visitors to choose what they want to listen to would add a new layer to the exhibition. This could be easily done with a tabletop and a screen. The goal of this installation would be to make the interviews more accessible and provide deeper insights. Ideally, visitors could relate the interviews to a timeline, a map of the area, and the roles of the interviewees, and thus establish connections between them. A sketch is made to show the idea. It is a tabletop that shows the interview and a map from Roombeek, the area of the disaster. There are either buttons or tangible objects that represent different perspectives and a timeline. When choosing an interview will play with a corresponding interview and a light will turn-on on the place of the map where it took place.

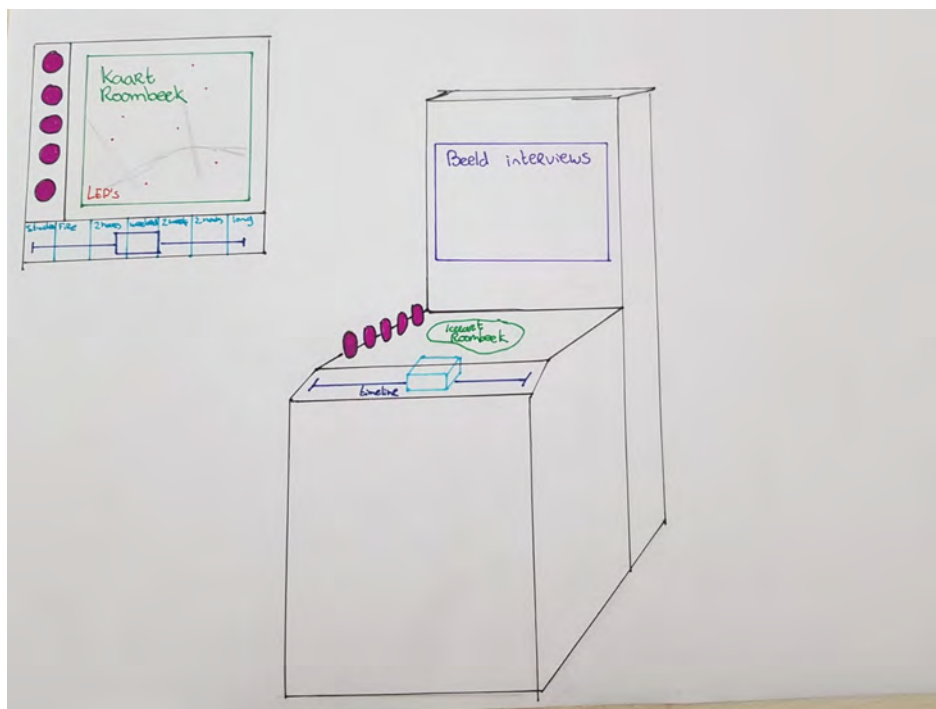


Figure 3.8: A first sketch of the tabletop concept.

The System

With the brainstorm done and a concept chosen, it is time to make the installation. The first Section of this chapter will elaborate on the content that will be used in the installation. And will answer the sub-research question **"What content should be included in an interactive installation for the Museumfabriek?"**. For this, all the interviews the museum held with involved people of the firework disaster were analyzed, sorted into categories, and put on a timeline. To create a better and more complete and cohesive storyline that visitors could connect more to, it was decided to have a recommendation system and thus the sub-research question **"How can a recommendation system be implemented in an interactive installation to make a connection between content?"** was formulated and will be answered in this chapter. The objective of this recommendation system is to provide visitors with a new video to watch once they have finished watching a previous one. The aim is to achieve a more coherent story between the interviews, lengthen the interaction time with the installation, and create better engagement. By suggesting related videos, the system intends to maintain a seamless and continuous experience for the visitors, encouraging them to explore further and stay engaged with the content. Besides the content for the installation the interaction, the technical details of the installation, and the placement in the Museum are elaborated on in this chapter.

4.1 Content

Regarding the installation's content, the museum conducted 22 interviews with individuals who were involved in the firework disaster, resulting in nearly 13 hours of raw footage. Given the substantial amount of content, it will be organized into different categories that visitors can choose from. This approach allows visitors to make their own selections and provides insights into various aspects covered in the interviews. The challenge in this phase is to arrange the interviews, edit them into segments

of a maximum of four minutes each, and determine the most suitable categories for the installation.

4.1.1 Method

A thematic analysis was conducted to examine the interviews and identify the discussed themes. The dataset consisted of 22 interviews with individuals who were in various ways involved in the firework disaster. This involvement ranged from living in the affected area to having a nearby company, being a firefighter, or being a member of an assisting organization. Out of the 22 interviews, 21 were conducted with a single interviewee, while one interview involved two participants. The analysis process involved several phases.

In the first phase, all the interviews were listened to in their entirety once, to gain a general understanding of the interviewees' involvement, the timeline discussed, and the interview topics. This phase resulted in the creation of a list of storylines that emerged from different interviews, representing various perspectives and noteworthy observations. These findings served as a foundation for subsequent decision-making on categorizing and how to make short meaningful segments.

In the second phase, codes were assigned to specific sections of the interviews, and new codes were created as necessary. The software ATLAS.ti was utilized for this purpose. The coding approach employed was emergent coding, wherein codes were generated while listening to the interviews. Some codes were derived from the participants' own words (in vivo codes), while others were conceptual labels used for research purposes. The annotation process was carried out by a single individual. The results of this phase involved dividing all the interviews into smaller segments and labeling them, as depicted in Figure 4.1.

The third and final phase entailed reviewing all the codes and determining how to present the data in the analysis. The objective of this phase was to identify the most relevant and meaningful codes that effectively conveyed the information. The outcome of this phase will be a finalized list of categories and brainstorming ideas for presenting the videos in the installation.

4.1.2 Results

Upon completing the first phase, several decisions were made regarding the installation. Firstly, it was determined that the aspect of specific locations would not be utilized, as the interviews rarely mentioned such locations related to the disaster. When locations were mentioned, they were often distant from the disaster area, making it impractical to include a map with specific locations within the affected zone.

Secondly, a few recurring themes and storylines were identified. These themes were discussed in multiple interviews and presented various perspectives:

- Communication and clarity to civilians and victims
- Uncertainty about the potential explosion of containers from Grolsch
- Role of journalists during and after the disaster
- Long-term strategies for coping with trauma
- Housing issues, including loss and rebuilding
- Investigation into the cause of the disaster
- Assistance provided by civilians to victims
- Professionals aiding victims as part of their job
- Early efforts to minimize the financial losses following the disaster

In the second phase, all the interviews were labeled, although the number of labels varied significantly among different interviews. Some interviews focused on specific events during a certain period, requiring fewer labels. For example, Peter Kuenzli, the architect of the new neighborhood, solely discussed the long-term plan for rebuilding the neighborhood. On the other hand, Jan Calis, resident, among others covers the entire timeline from before the disaster to a few years later, discussing various aspects of the event, demanding a larger number of labels for categorization. An example of a categorized interview can be seen in Figure 4.1, featuring Jeanette Peter, the former head of social affairs for the local authority during the disaster.

4.1.3 Final categories

To finish the third and last phase of the content analysis the focus needs to shift towards examining the most frequently used codes as labels. Regarding the two different axes, it became evident that a combination of a timeline and specific categories aligned best with the content. The majority of interviews followed a clear chronological order, typically starting with the participants' daily experiences, and their initial impressions, and then delving into the long-term effects. This facilitated the creation of a timeline and easy matching of interview segments with corresponding points on the timeline. On the other hand, categorizing the interviews posed a greater challenge. As the interviews were conducted in Dutch and the museum's content is also in Dutch, it was decided that the installation would be developed in Dutch as well. The English translations of the categories mentioned in this section are included solely for the purpose of this report. Therefore, both **English** and *Dutch* labels are referenced in this section.

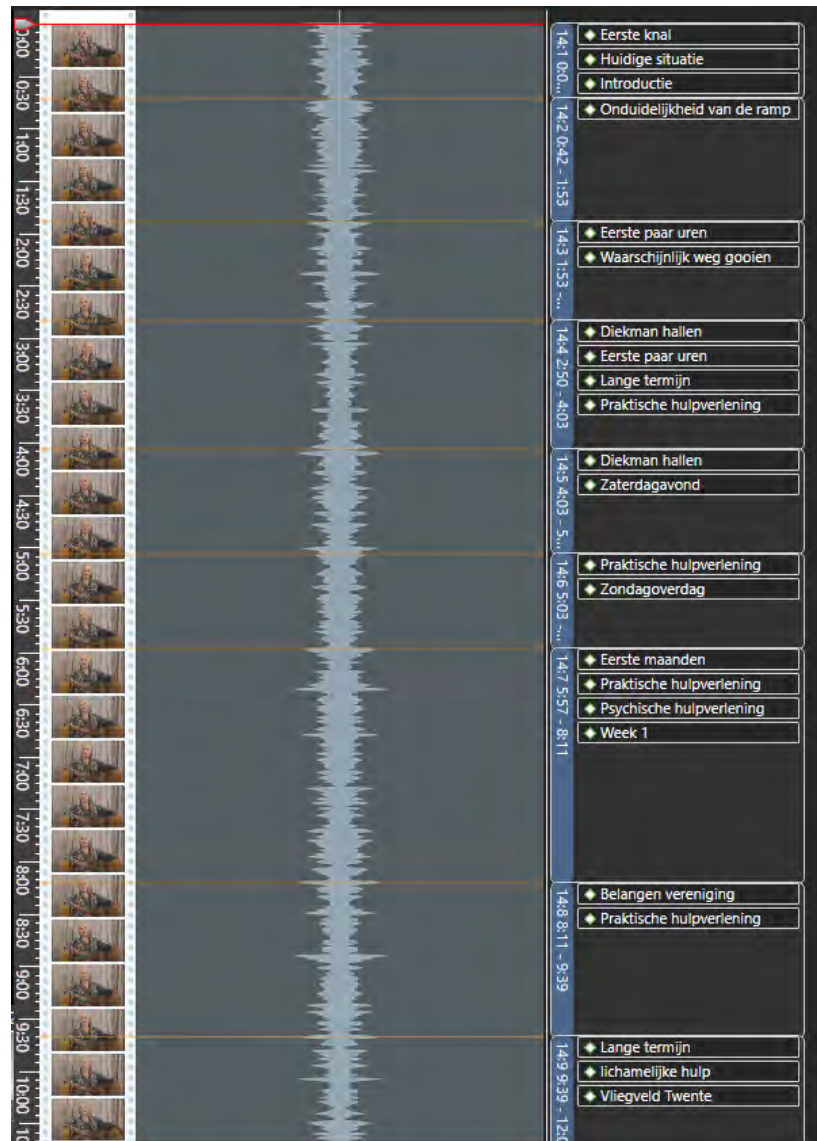


Figure 4.1: An interview with labels

The first two categories were relatively straightforward to determine. The first category, labeled "*Huisvesting*" (**housing**), revolved around the experiences of individuals who lost their homes during the disaster. They discussed the challenges they faced, including the need for temporary housing and the long-term process of neighborhood reconstruction. The second category, "*Bedrijven*" (**businesses**), focused on companies that lost their buildings and inventory. The interviews shed light on how these businesses coped with the aftermath, including dealing with insurance matters. Both museums were also included within this category, as the MuseumFabriek relocated due to the destroyed buildings, while employees of The Rijksmuseum Twente were granted access to the area when residents were not, and this caused some friction between occupants and the museum.

	The first hours/ De eerste uren	The first weekend/ Het eerste weekend	The first few weeks/ De eerste paar weken	The first few months/ De eerste paar maanden	The first year/ Het eerste jaar	Long term/ Lange termijn
Housing/ Huisvesting	Jan Calis	Persheng	Hadassa Meijer	Jolande Leferink	Jan Calis	Pi & Peter Kuenzli
Businesses/ Bedrijven	Jacques Troch	Rene koning	Frank Krake	Erik t Velde	Frank Krake	Erik t Velde
The use of stories/ Hoe verhalen gebruikt worden	Danny de Vries	Lucien	Erik t Velde	Ton Davids	Tineke Bramer	Hadassa Meijer
Help/ Hulp	Ronald Hiet brink	Wouter Alberts	Ronald Hiet Brink	Jeanette Peters	Dick Buursink	Ton Davids

Table 4.1: The different interview parts are categorized with a timeline and category

The next category was less apparent initially, but upon further examination of the codes and labels, a connection was established regarding the use of stories during and after the disaster. This led to the creation of the category "*Verhalen*" (**stories**). Journalists who shared their experiences during and immediately after the disaster were linked to how people processed the event through storytelling.

Lastly, the final category initially comprised two separate categories due to the abundance of relevant stories. These categories were "Directe hulp" (direct help) and "Praktische hulp" (practical help). However, as attempts were made to assign interviews to these distinct categories, it became evident that drawing a clear distinction between the two was challenging. Consequently, the decision was made to merge the categories into a single category focused on offering help, this category was named "*hulp*" (**help**). This category encompasses the contributions of firefighters, police officers, as well as the assistance provided by a city councilor and a doctor during various investigations, into the potential causes of the firework disaster and the potential long-term health effects.

4.2 Recommendation System

Because the content has such a clear cohesion with the timelines and categories it is decided to test if a recommendation system helps with the engagement, learning, and overall experience of the installation. This recommendation will be implemented in one version of the system while another system does not have this. The two different conditions are tested and compared to each other. To make it easily implementable the choice was made to make it a non-personalized association recommender [39]. The recommendation system is based on what the user is currently watching but it is the same for every user. The recommendation system is set and based on the categories, timeline, and content of the interviews. In Figure 4.2 a diagram can be found with all the recommendations. The choice for this recommendation system was made to keep it simple to implement. Other recommendation systems take previous interactions into account and need a lot of data to be implemented. While this recommendation system can be made based only on the

categories, timelines, and content of the interviews. Some recommendations are within the same timeline or within the category to offer a different aspect, others are a recommendation to the same person talking about a different aspect. Lastly, some recommendations are based on the content. For example how the fire brigade talks about the possibility of the Grolsch exploding while the director of Grolsch denies that possibility and says it was never possible.

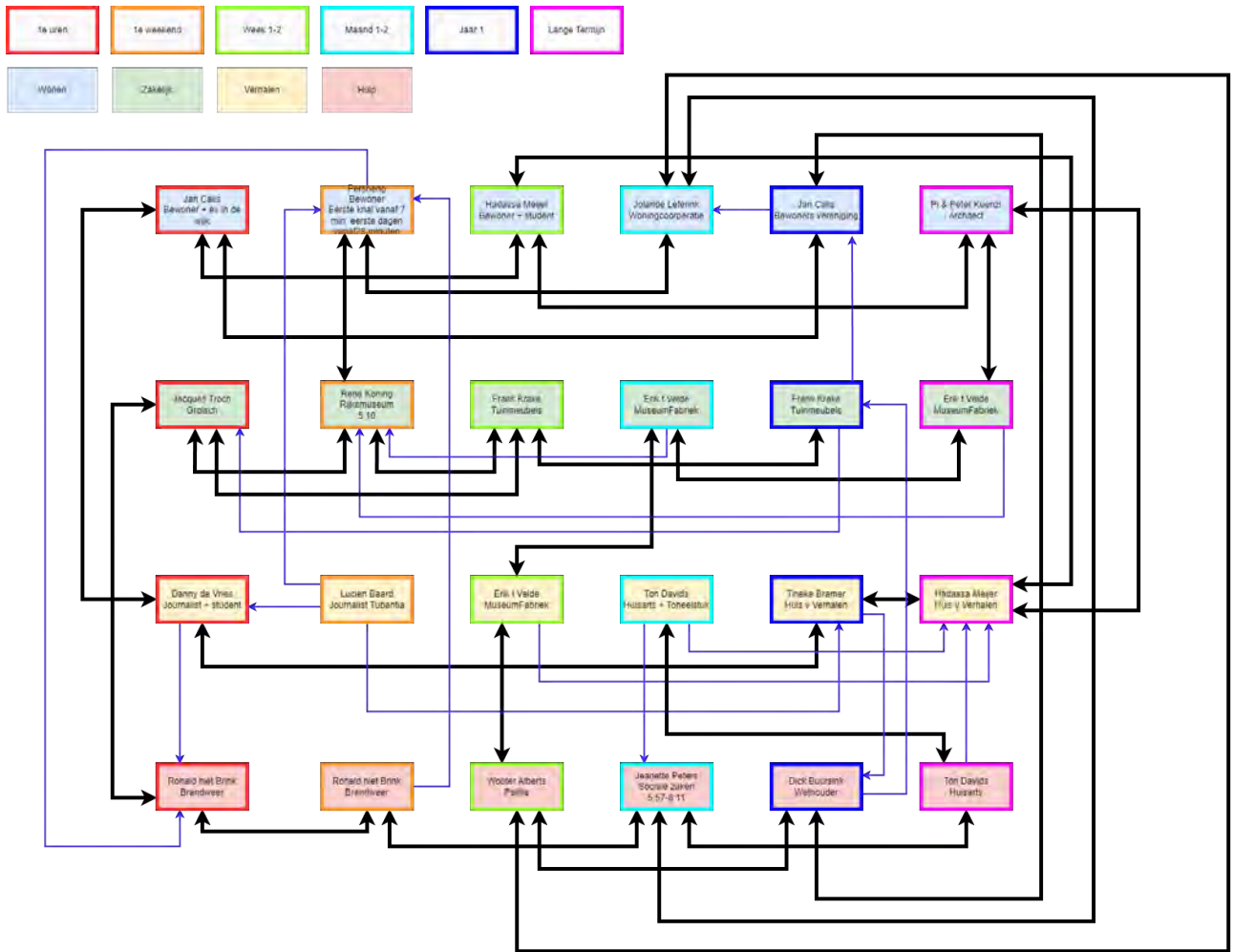


Figure 4.2: All the recommendations linked together

4.3 Interaction

Below in Figure 4.3, an interaction scheme can be found. The user starts with a start screen if they press start they go to a consent form (1). From the consent form, they can press for more information (2a) or agree and go to the main screen of the installation (2b). On the main screen, users can change the slider position to select a specific time (3a) or press a category (3b). When a category is pressed

a video will be played. Which video is being played depends on the slider position and the pressed category. For example, if the slider position is at "First few days after the disaster" and the category "Help during and after the disaster" is chosen a video consisting of Ton Davids talking about being a fireman the first days after the disaster is played. During the video, a bar at the bottom of the screen shows the progression of the video. A user can press the back button which will bring them back to the main screen (4b). Depending on the version the user is using (with or without recommendations), the user will go to the recommendation screen (4a) after the video is finished or go back to the main screen (4b). If the user gets the recommendations screen they can press a recommendation which brings them to a different video (5a) or press the back button and go back to the main screen (5b).

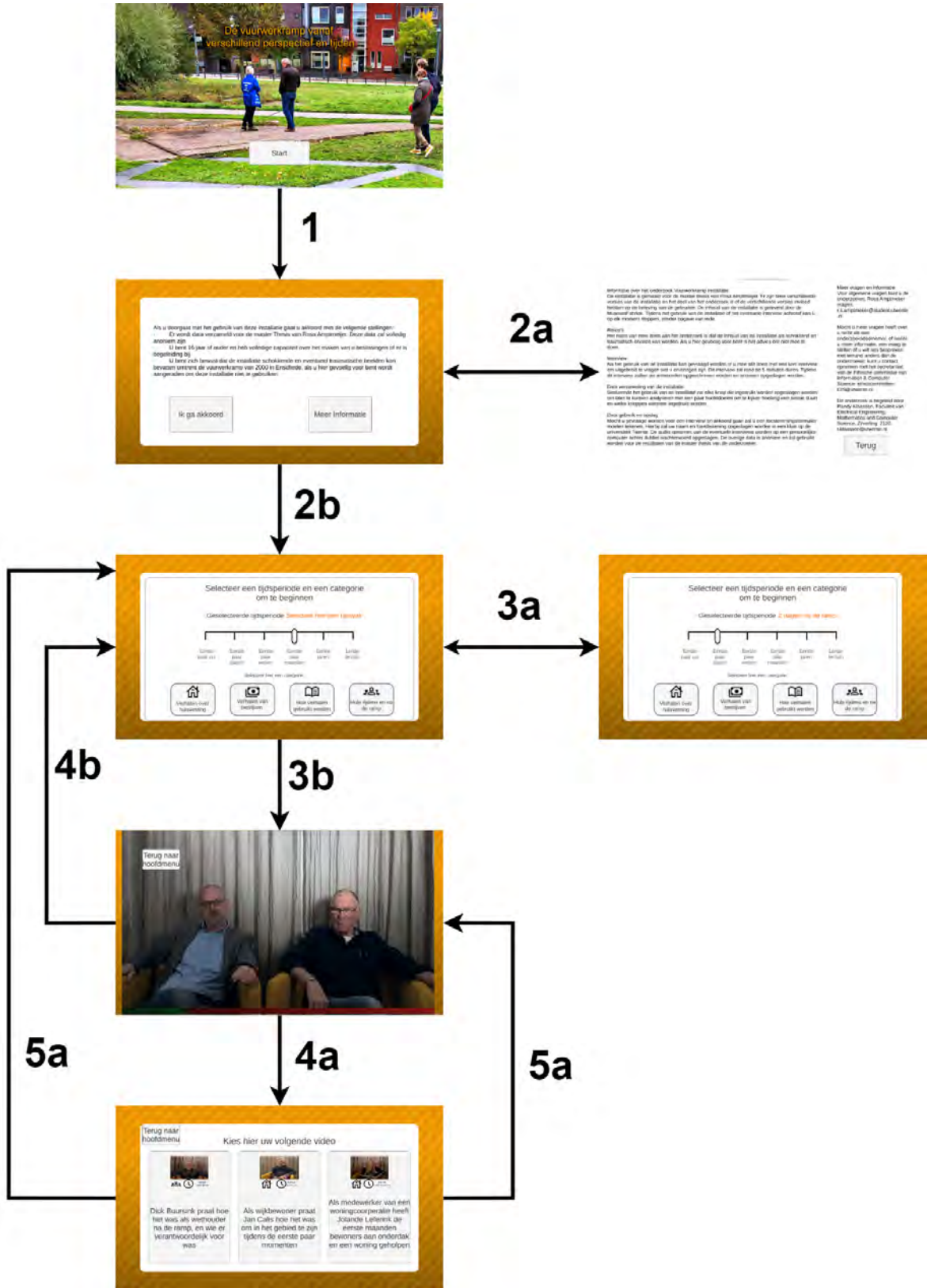


Figure 4.3: Interaction scheme of the installation

4.4 Implementation

For the creation of the installation, Unity version 2019.4.18f1 was used. This choice was driven by the abundance of online resources and visual assets available for this version. The scripts used in the installation were developed using Visual Studio 2019. As for the assets utilized, they were sourced from Tarodev [48], Google Fonts [23], and provided photos and videos from the MuseumFabriek. The videos included in the installation were edited to an average duration of three minutes and twenty seconds. This choice was based on a recommendation by the museum that three minutes videos would be optimal. The installation was set up on a designated screen within the MuseumFabriek that was already dedicated to showcasing the interviews. Ultimately, the decision was made not to create a tabletop installation since there was no need to display or manipulate additional maps or objects. Without a map featuring relevant locations, it was determined that a screen with a mouse control interface would suffice.

The installation's placement in the museum is located almost at the end of the museum and close to the weaving machines, see Figure 4.5 for a map depicting its location. This positioning carries the risk of information overload potentially resulting in reduced user engagement, this is discussed in Section 2.1.1, Identity Lens of Museum visitors, as part of the framework made by Falk [21]. Nevertheless, this placement was chosen because the current exhibition is placed there already. The name of this part of the exhibition is "Rampen: Van hagelslag tot vuurwerkkramp" and loosely translated as "Disasters: From Sprinkles to Firework Disaster." It is part of the larger Wunderkammer exhibition which encompasses 12 different themes. Please refer to Figure 4.4 for images of the installation within the museum

An Intel mini PC, concealed within a pillar, was used to host the installation. The PC was connected to the television via HDMI, and visitors were provided with a Logitech Bluetooth mouse to interact with the installation.

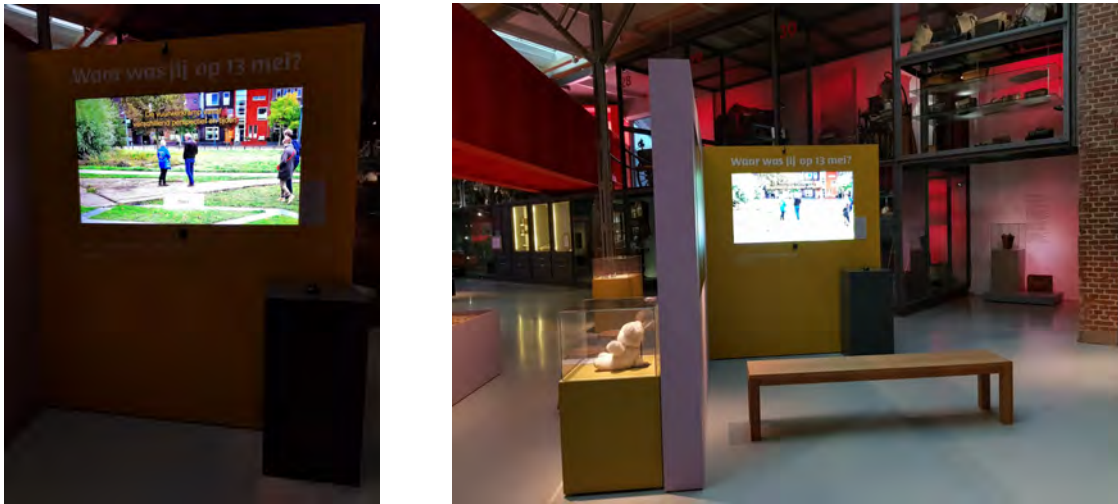
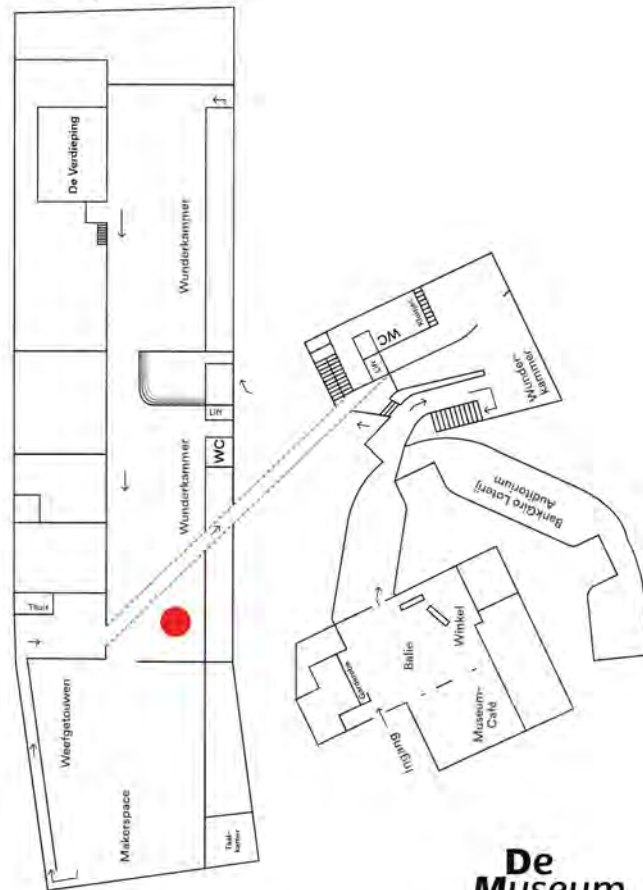


Figure 4.4: The installation inside the museum

Plattegrond



De
Museum
Fabriek

Figure 4.5: The location of the installation placed on the museum map

Method

In order to answer the research question **”Does a recommendation system change the experience of visitors who interact with an interactive installation in the MuseumFabriek?”**, two different installations with different conditions were tested. The goal is to see if there is a difference in how much people explore between the design that provides recommendations and the design that doesn’t provide any recommendations. This chapter will explain the method that is used for this data collection.

A mixed-method approach was used to collect data through four different methods: log data, interviews, questionnaires, and observations. The log data tracked how long participants used the installation, which buttons they pressed, which videos they watched, and for how long. Some participants were interviewed to gather more information. To avoid disrupting the experience, only a few interviews and questionnaires were conducted, without interrupting the natural flow of interaction. Participants who were interviewed also completed a pre-interview questionnaire based on the Museum Experience Scale, and additional questions were asked if relevant. Lastly, observations were made during the testing period to observe how people naturally interacted with the installations and identify things that couldn’t be tracked through log data alone.

5.1 Setup

When participants approach the installation, they are initially asked to agree to a consent form, which is incorporated into the installation itself. You can find a detailed description of the entire interaction with the installation in Section 4.3, ”Interaction”. The researcher will conduct non-obtrusive observations by occasionally walking by or observing from a different part of the museum. Once the researcher notices that a visitor has finished interacting with the installation, some visitors will

be approached and requested to fill out a questionnaire and participate in a short interview. This is done carefully and to not watch people interacting intensely. Considering that otherwise, it could make participants feel hurried if they noticed being watched. More information about the questionnaire can be found in Section 5.3, titled "Museum Experience Scale". The questionnaire consists of questions from five different categories, with four categories based on the MES, and the last category focusing on the visitor's inclination to explore the installation. After quickly reviewing the answers, if a participant stands out with particularly high or low responses in a category, specific follow-up questions related to that category will be asked during the interview. The interview will be semi-structured, following a predetermined set of questions outlined in Appendix B. To ensure privacy, the interview will not be recorded, but relevant sentiments and information will be written down during the interview itself.

5.2 Participants

All participants in the study are people who are already visiting the Museumfabriek and choose to interact with the installation on their own. They are not approached or asked to participate. Once participants press the start button, they are asked if they are of legal age and capable of giving consent. The testing period lasts for three weeks, with two of those weeks falling within the summer holiday period. This means that in the first week, the expected participants will mainly be Affinity seekers, while the following two weeks will have more Explorers and Facilitators. It is important to include all of these visitor groups in the user test since they are considered significant visitors to the museum.

5.3 Museum Experience Scale

To evaluate the experience of visitors using the installation, compare different aspects of the experience to each other, and to easily compare the results of the two different conditions, one installation with a recommendation system and one installation without a recommendation system. A questionnaire is used, this question consists of multiple questions from the Museum Experience Scale (MES) [37]. These questions are combined with a few questions focused on the recommendation system of the installation. The MES comprises four categories, each containing five questions. Figure 5.1 displays all four categories along with their respective questions. The scale, developed by Othman et al., aims to evaluate visitors' experiences in museums and other cultural spaces, focusing on the utilization of multimedia to

enhance the overall experience [37]. In this study conducted at the MuseumFabriek, the MES is employed to examine potential differences in the experience based on the presence or absence of the recommendation system. Additionally, four questions emphasizing free exploration and participants' desire to further explore are included. These questions have been translated and can be found in Appendix A for reference during the experiment.

Engagement		Knowledge/Learning	
I enjoyed visiting the exhibition	0.69	The information provided about the exhibits was clear	0.64
I felt engaged with the exhibition	0.69	I could make sense of most of the things and saw and did at the exhibition	0.57
My visit to the exhibition was very interesting	0.68	I liked graphics associated with the exhibition	0.52
I felt I was experiencing the exhibition, rather than just visiting it	0.65	My visit enriched my knowledge and understanding about specific exhibits	0.52
My visit to the exhibition was inspiring	0.56	I discovered new information from the exhibits	0.43
Meaningful Experience		Emotional Connection	
During my visit I was able to reflect on the significance of the exhibits and their meaning	0.74	The exhibition enabled me to reminisce about my past	0.55
During my visit, I put a lot of effort into thinking about the exhibition	0.53	My sense of being in the exhibition was stronger than my sense of being in the real world (reversed relationship)	0.52
Seeing rare exhibits gave me a sense of wonder about the exhibition	0.50	I was overwhelmed with the aesthetic/beauty aspect of the exhibits	0.47
After visiting the exhibition, I was still interested to know more about the topic of the exhibition	0.43	I wanted to own exhibits like those that I saw in the exhibition	0.45
Seeing real exhibits of importance was most satisfying aspect of my visit to the exhibition	0.43	I felt connected with the exhibits	0.45

Figure 5.1: The four components of the Museum Experience Scale, the questions and the factor loadings

5.4 Analysis

Due to the deliberate decision to prioritize natural interaction and observation over a large number of interviews and questionnaires, there is insufficient data available for extensive statistical analyses. As a result, the focus of the analyses will primarily

be on qualitative analyses. The analysis will involve combining data from interviews, observations, questionnaires, and the installation's log data. These sources will serve as the foundation for formulating conclusions.

5.5 Pilot test

Prior to the main test, a small pilot test was conducted. The purpose of this pilot test was to ensure that the test setup was clear for the participants. The pilot test involved two participants. After the pilot test, only a few adjustments were made. The buttons were given a larger backdrop to make it more evident that they are buttons and not merely borders. Additionally, two grammar mistakes were identified in the questionnaire and subsequently corrected.

Results

In Chapter 5, "Method", four main methods were utilized to collect results. The first method involved gathering log data, which provided the most quantitative data for the experiment. The second method consisted of a questionnaire based on the Museum Experience Scale (MES). The third method involved conducting interviews, while the fourth method involved making observations. This chapter will examine and discuss all of these results in detail.

6.1 Log data

During the testing phase, log data was collected to track the usage of the installation, including which buttons were pressed and when. A total of 164 participants initiated the use of the installation. Out of these, 81 participants interacted with the installation without the option of receiving recommendations, while 83 participants experienced the installation with recommendations enabled. Throughout the entire usage period, a total of 401 videos were started. Among these, 210 videos were watched in the installation without recommendations, while 191 videos were watched in the system with recommendations.

6.1.1 Results of the Log data

The average duration of usage across all sessions was four minutes and fifty-one seconds per visitor. In the condition where no recommendations were provided, the average duration was five minutes and five seconds, while in the condition with recommendations, it was four minutes and thirty-seven seconds. Out of the total of 401 videos, thirty-one were viewed following a pressed recommendation. During 292 videos, users pressed the return to the home button before completing the video, indicating that they did not finish watching it.

	The Non-Recommendation version	The Recommendation version
Total videos before any deletions	210	191

Table 6.1: The total videos across the different versions of the installation

To conduct a fair analysis of the difference in engagement time between videos watched with and without recommendations, certain data points need to be excluded. This process will be explained further. Some individuals pressed the back button in less than ten seconds, and these specific videos are also excluded from evaluation. This is because the installation ran on a less powerful computer, resulting in some videos starting only after a few seconds. As a result, people tended to press the back button before the video even began playing due to the loading time. Therefore, any video in which the back button was pressed within the initial ten seconds is disregarded.

	The Non-Recommendation version	The Recommendation version
Videos deleted because of delay from the computer	59	80

Table 6.2: The amount of videos deleted because of computer delay across the different versions of the installation

Additionally, there were some visitors who seemed to take a two-minute break between finishing a video and pressing a new button. The installation automatically reset after three minutes of inactivity, but with such a delay after watching a video, it can be assumed that the participant walked away during the video, and a new visitor started interacting afterward. Thus, these data points need to be deleted as well.

	The Non-Recommendation version	The Recommendation version
Videos deleted because of a pause longer than 2 minutes	8	5

Table 6.3: The number of videos deleted because of a pause longer than 2 minutes across the different versions of the installation

Lastly, to ensure a fair comparison, it is crucial to only consider videos that are watched consecutively after another video is finished. Since a recommendation is only shown after a visitor finishes a video, it is highly likely that those who finish

watching a video have a greater interest compared to those who have not yet completed a video. Therefore, to accurately compare the duration of videos watched with a recommendation system versus those watched without a recommendation, we must exclude all videos that are not viewed following the completion of a previous video.

	The Non-Recommendation version	The Recommendation version
Videos deleted because they are not played after a finished video	116	86

Table 6.4: The number of videos deleted because they are not played after a finished video across the different versions of the installation

After deleting these videos, there are twenty-three videos watched after a recommendation and twenty videos watched after a finished video without a recommendation. Out of the twenty-three recommendation videos, twelve were finished, which is fifty-two percent. From the twenty non-recommendation videos, eight were finished, representing forty percent. As shown in Table 6.5, both the number of finished videos and the average watch time were greater after a recommendation. However, due to the small data set, these claims lack statistical significance.

It is remarkable to note that there was one participant who gave consent to the data collection but did not interact further. Furthermore, out of the one hundred sixty-four participants, eighty-five did not touch the slider option but only chose a category.

	The Non-Recommendation version	The Recommendation version
Videos that remained after deletion the non-relevant videos	20	23
Videos that were finished watching	8	12
Average watchtime	00:01:51	00:02:13
Average length of the videos watched	00:03:29	00:04:08

Table 6.5: An overview of the remaining videos, how many of them were finished, the average watch time and the average length of the video watched

6.1.2 Discussion of the Log data

Certain data had to be deleted based on assumptions, but it is difficult to be certain if these assumptions were correct and if all incorrect data has been removed. One uncertainty is whether each participant corresponds to a single individual. Currently,

entries are deleted if there is a two minute interval following the completion of a video. However, it is possible that someone may have walked away at the beginning of a video, and a new person started interacting immediately after the video ended. This means that there could be two individuals recorded as one participant in the data. Unfortunately, with the current data, it is impossible to determine this. It would have been ideal to observe every interaction, but practical constraints made this impossible.

Apart from comparing videos with and without recommendations, there are some interesting observations that can be made from the log data. The average watch time is considerably shorter than the average video time. While it is normal for the average time to be shorter than the total time, the difference is note-worthy. Some usage times indicate multiple people, but for most usage times, individuals would only be able to watch one and a half videos. People tend to be impatient, so it is important to test installations like this on the actual equipment they will be used on. If the loading times are long and the equipment cannot be changed, it would be beneficial to add a loading screen to inform people that something will happen if they wait. Lastly, slightly more than half of the participants used the slider option and chose a different timeline. The category buttons, which automatically played the video and were bigger in size, seemed to attract more attention compared to the timeline slider.

6.2 Questionnaire

Because of the relaxed environment at the museum, there were several individuals who were willing to be interviewed and answer questions but did not want to complete the questionnaire. As a result, only eight people filled out the questionnaire. Out of those eight, only two participants used the system with a recommendation feature, but they did not utilize this feature because they did not finish watching a video. Due to these circumstances, the data from the questionnaire can only be used in an exploratory manner as a supplementary addition to the other three data collection methods.

6.2.1 Results of the questionnaire

In order to compare the categories of the questionnaire, the responses are converted into numerical values. For positive questions, "completely agree" is assigned a value of one, while for negative questions, it is assigned a value of five. Conversely, for negative questions, "completely agree" is assigned a value of one, and for positive questions, it is assigned a value of five. These numerical results are then

multiplied by their respective weights determined by the MES, which are explained in Section 5.3, "Museum Experience Scale" [37].

Category	Question	Total score across all questionnaires	Average on all questions	Average with weight incorporated across all questionnaires
E	Ik vond mijn interactie met de installatie interessant	20	2.22	1.24
E	Ik voelde me betrokken bij de installatie	20	2.22	1.53
E	Ik voelde me geïnspireerd door de installatie	33	3.67	2.05
E	Het voelde alsof ik de interactie echt een ervaring was in plaats van alleen een bezoek	35	3.89	2.53
E	Ik heb genoten van de interactie met van de installatie	25	2.78	1.92
K	Ik vond de grafische aspecten van de installatie prettig	33	3.67	1.91
K	Ik begreep de meeste dingen in de installatie	18	2.00	1.28
K	Mijn interactie verrijkte mijn kennis en begrip over bepaalde onderwerpen	19	2.11	1.10
K	De informatie in de installatie was duidelijk	21	2.33	1.49
K	Ik heb nieuwe informatie geleerd van mijn interactie	15	1.67	0.72
ME	Ik denk nu nog steeds veel over de installatie	28	3.11	1.65
ME	Ik kan reflecteren over de betekenis van de installatie	17	1.89	1.40
ME	Iets zien wat belangrijk is, gaf mij voldoening	15	1.67	0.72
ME	Na de interactie met de installatie wil ik nog steeds meer weten over het onderwerp	22	2.44	1.05
ME	Interactie hebben met de installatie gaf me een gevoel van verwondering	29	3.22	1.61
EC	Ik voelde mij overweldigd door de stijl en fraaiheid van de installatie	39	4.33	2.04
EC	Tijdens mijn interactie met de installatie vergat ik de rest van de wereld.	35	3.89	2.02
EC	De installatie zorgde dat ik nadacht over mijn eigen ervaringen	18	2.00	1.10
EC	Ik voelde een connectie met de installatie	18	2.00	0.90
EC	Ik wil zelf ook iets in mijn bezit hebben dat lijkt op de installatie	37	4.11	1.85
N/A	De installatie zorgde dat ik zelf meer wilde ontdekken over het onderwerp	17	1.89	1.89
N/A	Ik wilde graag verder door klikken tijdens het gebruik van de installatie om meer te zien	25	2.78	2.78
N/A	Ik kon door de installatie zelf beslissen hoeveel ik wilde ontdekken	19	2.11	2.11
N/A	De installatie nodigde uit om door te klikken en meer interviews te kijken	22	2.44	0.00

Table 6.6: The questionnaire questions with the total, average and weighted score per question

To obtain a total score, the answers to all the questions are added together. The average of this total score is then multiplied by the weight to obtain a final score for each question. The results for all the questions can be found in Table 6.6, where lower numbers indicate higher agreement. From these scores, category scores are calculated and presented in Table 6.7. However, the category related to the desire for more discovery, which received a score of 2.31, is not included

in the table because it is not weighted and cannot be compared fairly to the other categories.

Category	Average score with weight included
Engagement	2,94
Knowledge/Learning	2,32
Meaningful Experience	2,44
Emotional Connection	3,24

Table 6.7: The average weighted score per MES category

6.2.2 Discussion of the questionnaire

None of the questionnaire respondents utilized the recommendation feature, making it impossible to compare the setup with and without recommendations. However, the questionnaire does provide insights into which components visitors feel more strongly about. The results indicate that visitors agreed the most with statements related to the new category, knowledge/learning, and meaningful experience. It is challenging to directly compare the new category with the others due to the untested weight of the questions.

It is encouraging to observe that most visitors agreed that the installation encourages free exploration. The high agreement on the questions about knowledge and meaningful experience can be attributed to the installation's content, which focuses on educating visitors. Many visitors come from the local area and may even have personal memories related to the topic. Therefore, it is understandable that they find the experience meaningful and want to learn more.

Furthermore, it could be argued that a strong emotional connection to the installation is expected, considering the subject matter elicits strong emotions. The relatively lower score in this category can be attributed to the installation's layout, which was not a focus of the design of the installation. Some questions in this category had a main focus on the aesthetics of the installation, which was scored relatively low. This presents a valuable design opportunity to enhance the aesthetic elements and further strengthen the emotional connection.

6.3 Interview

A total of sixteen interviews were conducted, with nine interviewees using the recommendation system and seven interviewees using the non-recommendation instal-

lation. Out of the nine interviewees who used the recommendation version, two of them actually utilized the recommendation system.

6.3.1 Results of the interviews

Before conducting the interviews, certain codes were already prepared based on observations made during the initial two days (known as a-priori codes). These codes were created to gather relevant answers and can be found in Appendix B. In some cases, it was evident that participants considered certain aspects to be more important. If the researcher found this interesting, follow-up questions were asked. One common follow-up question related to the duration of the videos, as participants frequently felt that the videos were too long.

Another issue that arose during the interviews was the audio volume. Participants mentioned that it was either too soft or too loud. This audio problem was associated with the noise from the weaving machine, which had an irregular on-and-off schedule. When the weaving machine was on, it was difficult to hear the interviews. To compensate for this, the volume was raised. However, when the weaving machine was turned off, the increased volume became very loud. This loud audio was considered awkward because it could be heard by all visitors. Additionally, the audio levels of the videos varied throughout the installation, making it challenging to maintain a consistent audio level.

Some participants commented on the slow mouse cursor during interactions, specifically mentioning that it was not responsive enough (noted by two individuals). Feedback from the participants indicated that the different options for categories and timelines provided a good overview of the various perspectives. However, it was also mentioned by two people that not everyone understood that they could use the slider to explore different categories.

Regarding the content of the installation, several interviewees expressed satisfaction that such an important subject was being preserved. Some participants even shared personal experiences related to the topic, mentioning knowing people who lived in the affected area, witnessing the smoke cloud, or recalling news coverage. Younger individuals or those who did not live in the area felt a lesser connection but still showed interest in learning more.

Another aspect that multiple participants mentioned was the overall quality of the installation. Some videos were not originally intended for display on a large screen, resulting in slightly blurry visuals (mentioned by two people) or poor audio quality (mentioned by one person). As mentioned earlier, occasional delays in loading the installation also caused confusion for some participants, giving them the impression that they had pressed the wrong button since there was no loading feedback.

6.3.2 Discussion of the interviews

Many visitors expressed that the duration of three minutes per video was too long, which contradicted the museum's belief that it would be perfect. It seems that the museum overestimated the attention span of its visitors. This could be because many people wanted to watch more videos but only had a few minutes to spend at the installation. Therefore, spending all that time watching just one video seemed insufficiently valuable to them. The volume and quality of the videos also did not contribute positively to this sentiment.

Furthermore, the placement of the installation within the museum was not optimal, making it harder for visitors to maintain their attention on it. On a positive note, it was clear that the content of the installation held significant importance. As expected, considering the visitors' perspective through their identity lens [21], many people who came to the museum were from the local area. Their main goal was to learn more about their own region, and an event like this aligned with their expectations of what the museum should offer.

6.4 Observation

The exact number of people observed is not documented, but it is estimated that there were around 40 to 60 individuals observed. The majority of observations conducted align with the sentiments expressed in the interviews.

6.4.1 Results of the observations

The observations confirmed the sentiments expressed in the interviews, particularly regarding the length of the videos, which were deemed too long for most people's attention spans.

Additionally, new insights emerged from the observations that were not discussed during the interviews. It was observed that some individuals did not use the installation because they attempted to interact by touching the screen instead of using the mouse as the input mode. For future designs, reconsidering the input mode could be beneficial. However, for this iteration, a touch-screen was not used to maintain an affordable price for the installation.

During the testing period, the first week took place just before the summer holiday, while the following two weeks occurred during the holiday season. The difference in the number of visitors was noticeable. Outside of the holiday, the visitors primarily consisted of older couples and organized tours by adult daycare services. These tour groups, accompanied by a guide, had limited interaction with the instal-

lation. In the next iteration, there could be an opportunity to engage and cater to these types of groups. Conversely, during the holiday season, more families visited the museum. Many children were drawn to the crafts corner and, as a result, bypassed the final exhibitions, including the installation. Some parents returned to the installation while their children were engaged in crafting activities. Consequently, for future installations, an alternative approach could be to utilize a location near the exit and primarily target the companions of children involved in crafting.

The most notable observation, consistent with both the log data and the interviews, was that the majority of people were uninterested in videos lasting longer than a minute.

Another observation supported by the log data was that the installation was built on a faster computer than the one used in the museum. As a result, videos sometimes took too long to load, causing people to lose interest or press the back button before even watching a video. This issue could have been addressed by implementing a loading screen. Unfortunately, this discrepancy was not identified during the pilot test conducted on a different computer.

Lastly, the observations also revealed that the current location of the installation within the museum was not ideal. The presence of noise from the weaving machines and the visibility of the exhibition's end caused distractions for visitors. This observation aligns with Falk's [21] report that the surroundings of an installation play a crucial role. In a busy area with an overload of stimuli, people are less likely to engage in longer interactions and tend to seek calmer environments.

6.4.2 Discussion of the observations

Due to the summer holidays, the Museumfabriek may have attracted a different type of visitor compared to other periods throughout the year. Therefore, it is challenging to determine whether these observations apply year-round or only during those specific weeks. The observations made during the first week of testing and the week before the holidays could potentially reflect the general experience throughout the year.

Based on the interpretation of the results, it appears that people have a shorter attention span than what the MuseumFabriek initially assumed. It is possible that visitors during the summer holidays have an even lower attention span compared to regular visitors, as there are more day trips and families, and fewer individuals who regularly visit museums. However, since a significant number of people suggested this, it is plausible that the museum overestimated the amount of time people would devote to the installation.

The reason why some people attempted to use the installation as though it was

a touch screen is not entirely clear. Only a few individuals tried it, but it still indicates a design flaw in the clarity of the intended interaction method.

6.5 Discussion of the results

Based on the combined results, certain conclusions can be drawn. The main focus of this chapter was to answer the sub-question: **”Does a recommendation system change the experience of visitors interacting with an interactive installation in the MuseumFabriek?”** However, based on these results, it is not possible to determine the exact effect of a recommendation system. There is a small difference in user time and exploration in the log data between the tests that utilized a recommendation system for exploration and those that did not. However, this difference is too insignificant to draw a conclusive finding.

Apart from the impact of the recommendation system, some other points can still be concluded. It is evident that the videos used in the installation were too long. Many people mentioned this, and both the log data, interviews, and observations confirm it.

The log data and interviews indicate that the design of the slider was not clear enough for effective interaction, as the category buttons drew more attention, and clicking them immediately started playing the video.

The questionnaire and interviews also confirm that the content of the installation resonated well with visitors in the MuseumFabriek. Most comments about the installation revolved around how emotionally impactful or relatable the content was, and how visitors felt a connection to it and appreciated the continued display of this information. The questionnaire clearly indicated that people had a meaningful experience when using the installation.

Therefore, it can be concluded that while the design and location of the installation could have been improved, it was a good decision to make the subject interactive and more engaging.

Revised Iteration of the Design

In order to address the last research question **”What can be changed in the design of an interactive installation in the MuseumFabriek based on testing results and literature?”**, it is crucial to review the key insights obtained throughout this report. This chapter will begin by evaluating the main findings from the previous chapters and the important lessons derived from them.

Firstly, the testing results have highlighted certain critical considerations. It has been observed that the current installation falls short in capturing and maintaining the attention of museum visitors. The suboptimal location of the installation and the long duration of the videos have been identified as key factors contributing to this issue. Research has also emphasized that exhibits located towards the end tend to receive less attention [7] [43]. In addition to the test results, the literature on capturing and maintaining visitor attention suggests several areas where the installation can be improved. For instance, incorporating a more effective attention-grabbing mechanism prior to user interaction [25] [38] [28] and implementing a dynamic video summarization technique in the video recommendation system could enhance the click-through rate [36]. Furthermore, the concept of “glanceability,” or the ease of quickly understanding the display, should be given more consideration during the design process [35]. This chapter will discuss these aspects in detail and propose a redesign that combines these insights with the requirements listed in Section 2.6.1.

7.1 Attention grabbing

According to Bitgood, in order to capture attention effectively, it is important to consider five major factors [11]:

- Stimulus Salience or Distinctiveness
- Visual and Physical access
- Organization or Layout of the exhibit elements

- Distractions
- Perceived value

These five factors can be further divided into two categories: those related to appearance and those related to location. Section 7.1.1, “Appearance installation”, will discuss Stimulus Saliency or Distinctiveness and Perceived Value, while Section 7.1.2, “Location of the installation”, will address Visual and Physical access, Organization or Layout of the exhibit elements, and Distractions. By examining these factors, a better understanding can be gained on how to design an interactive installation that effectively captures visitors’ attention.

7.1.1 Appearance installation

The current installation features a static start screen depicting people visiting the monument. This choice was made to avoid displaying distressing images to unsuspecting visitors, as images of the disaster can be traumatizing. However, the current start screen lacks visual or auditory appeal, which is essential for grabbing attention [25]. Therefore, it is crucial to design a more engaging and captivating start screen. In addition to making it visually interesting or aesthetically pleasing, it is important to highlight the subject of the installation. Both Hornecker and Pisoni suggest that having prior knowledge of the subject lowers the threshold for interaction [38] [28]. Considering that many visitors to the MuseumFabriek are from the region and may already possess prior knowledge, it becomes even more important to create a start screen that effectively communicates the subject matter.

7.1.2 Location of the installation

An important aspect to focus on when capturing attention is the organization or layout of exhibit elements. In the current situation, the installation stands close to other objects providing information about the firework disaster. While the organization does not hinder interaction, visual and physical access present challenges. There is no clear line-of-sight, and the installation is situated outside the main pathway, resulting in reduced interaction [11]. These shortcomings are evident in the results discussed in Chapter 6.

Besides the lack of a clear line-of-sight, there are other flaws with the placement. The installation is located towards the end of the museum, where visitors are already inclined to leave. Moreover, distraction plays a significant role, as highlighted by Bitgood and Falk [11] [21]. Visitors tend to focus on louder or more visually engaging aspects of an exhibition, or they may be overwhelmed by an excess of information.

In this museum, the installation was positioned near the arts and crafts area, leading to children urging their parents to move on quickly. Additionally, it was close to a weaving machine that generates considerable noise, interfering with the installation's audio. Consequently, multiple attractions easily divert visitors' attention. The museum made this placement choice because other elements related to the firework disaster are already situated there. While it is understandable that something should be placed toward the end, it is preferably to be an element that requires less focus. Serrell [43] highlights that exhibits positioned near the entrance generally receive more attention compared to those located towards the end. This observation is supported by Akpan [7], who emphasizes the significance of both place and space in facilitating interaction with interactive installations. Place refers to the social context surrounding the installation, while space pertains to its spatial location and attributes. An example illustrating the importance of place is the challenge of engaging visitors in museums where there are no other touchable elements, as exemplified by the Rain Room [29]. Although the MuseumFabriek offers great opportunities for interaction due to its existing range of interactive experiences, the current location of the installation falls short in terms of visibility, which is crucial for encouraging interaction [7]. Hence, a redesign should prioritize placing the installation in a prominent and visible position, away from the end of the museum, ensuring it is not in close proximity to noisy installations, while still maintaining the same thematic and social place. As discussed in Section 6.4.1, "Results of the observations", there were instances where parents returned while their children engaged in crafting activities. This is a potential opportunity to modify the design and capture the attention of parents and benefit from the current location. However, it should be noted that the weaving machine is also located in that area and tends to attract more attention when it is operational due to the noise it.

7.2 Changes in Videos

To improve the installation's ability to maintain visitors' attention, two key aspects need to be redesigned: the length of the videos and the time and amount of video discovery within the installation. One approach is to implement a dynamic video summarization feature, which would provide concise summaries of the videos and encourage visitors to explore more content. Additionally, using different interviews can also be beneficial, and the necessary criteria for these hypothetical videos will be addressed in this section.

7.2.1 Length of the videos

During the user evaluation, video length emerged as a significant factor. The museum initially recommended an average of three minutes per video. However, the evaluation revealed that people tend to interact for no longer than five minutes with the entire installation, equivalent to one and a half videos per user. There is limited literature on the ideal video length specifically for museum installations and thus literature about other museum exhibitions in general and video usage is reviewed.

Existing research focuses on the average time individuals spend viewing a single exhibition, which is slightly below 20 minutes [11]. Nevertheless, this information lacks insights into video length. Nonetheless, discussions on video length, attention, and retention in online learning, marketing, and social media can offer valuable lessons applicable to museum settings. For instance, engineering students prefer videos lasting 6-10 minutes for knowledge transfer, with longer videos being less entertaining and a less effected way to transfer knowledge [32]. Conversely, in marketing, opinions on optimal video length vary. Some argue that ads shorter than 20 seconds have higher success rates [40], while others claim that 15-second advertisements lack effectiveness in terms of informativeness, emotional appeal, entertainment, and advertising value [17].

Short-form video content has gained popularity on social media platforms like TikTok, Instagram Reels, and YouTube Shorts. Even within TikTok's 60-second time limit, engaging and educational content can be effectively conveyed [17]. The consensus across these formats is that shorter videos are generally preferred until a certain point. Beyond that threshold, the video's intended message may fail to resonate with viewers.

For the museum's redesign, it is evident that three minutes is excessively long, despite visitors generally taking their time and not being in a hurry during their visit. Therefore, utilizing videos ranging from one to one minute and thirty seconds would be more appropriate.

7.2.2 Video summarization

In online video services, a way to enhance the click-through rate is by using dynamic video summarization. In the first version of the installation, a static video summarization was used and only on the screen of the recommendations. A good addition would be to make this dynamic, which means to have a few seconds of the video playing on repeat so people know what to expect when clicking on the video [36]. This could also be used on the homepage so people know which video there are going to watch when selecting the time and category. The benefits of dynamic summarization are that motion often attracts attention on a display [22] and that it could

give the user a better idea of what to expect in the video [50]. In this installation, it could be beneficial to mainly include it in the recommendation to direct the user's focus toward the new videos.

7.2.3 Different videos

As discussed in Section 7.2.1, "Length of the videos", ensuring viewer retention and maintaining their interest is crucial. Given that the current interviews were originally intended to be watched in their entirety, spanning 20 to 50 minutes, condensing the entire storyline into a two-minute or shorter video would be challenging. Therefore, it would be advisable to film new interviews. When making these, certain aspects need to be considered, drawing upon Brame's framework for effective educational videos [12]. The framework encompasses three categories: cognitive load, student engagement, and active learning. Based on these categories, the following recommendations for the new videos can be derived:

- Keep the video length within two minutes. (part of cognitive load and student engagement)
- Use audio and visual elements to convey parts of an explanation; make them complementary rather than redundant. (part of cognitive load)
- Use signaling to highlight important ideas or concepts. (part of cognitive load)
- Use a conversational, enthusiastic style to enhance viewer engagement.(part of student engagement)
- Make use of Matching modality, such as narrating while showing animations or video material related to the disaster. (part of cognitive load and student engagement)
- Ensure each video fits into a specific category, clarifying its purpose within that category and maintaining a cohesive storyline between the categories and time periods. (part of student engagement)
- Provide enough information within each video to make it enjoyable and self-contained. (part of student engagement)

By adhering to these recommendations, the new videos can effectively capture viewers' attention, enhance their learning experience, and ease their engagement with the installation.

7.3 Glanceability

Most of the other aspects of the redesign that have been discussed so far do not focus on the actual display, even though it is an important factor. The display design is crucial to initially grab attention, hold users' attention, and ensure that the information on the interface is conveyed quickly and easily. The application should be designed in a way that allows users to glance at it and understand the information effortlessly. Matthews et al. [35] have identified four main design principles for creating a glanceable display: matching **user expectations**, using **abstract representations**, making **visuals distinct**, and **maintaining consistency**. In this discussion, it will explore how these principles are incorporated into the design and the choices made to achieve a glanceable display.

7.3.1 User expectations

The design of the installation involves two equally important pieces of information: the user's selection of a time period and their choice of a category to watch. In the initial version of the installation, many users neglected to choose a time period and directly pressed the category button, resulting in the immediate playback of a video. To address this, the revised version should include a third button specifically dedicated to starting the video. The two other selection options, choosing a time period and a category, should be grabbing an equal amount of attention. While this button holds greater significance, it should be presented after the other choices have been made. Given the clarity of the information order, it is crucial to design accordingly, taking into account visual hierarchy. According to research, users' attention is typically drawn to the entry point of the display, often located at the top left corner [19]. Following the entry point, attention is influenced by factors such as motion, size, images, color, text style, and position [22]. In Section 7.2.2, "Video summarization", it was concluded that dynamic summarization could improve the click-through rate. However, on the main page, where the primary issue lies in choosing the time period and category, introducing a moving image would only serve as a distraction. Therefore, the two choices of time period and category should be visually distinct in terms of size, color, text style, and position, as further discussed in Section 7.3.3, "Visual distinctions". In contrast, for the display showcasing the three recommendations, it is crucial for the video to capture attention. Hence, a combination of dynamic summarization and yellow buttons is employed on that screen.

7.3.2 Abstraction representations

To create a glanceable design, it is crucial to present information in a simplified and concise manner [35]. In the initial iteration of the installation, this was achieved by using icons to represent the categories, and this approach will be maintained. Representing the passage of time with icons is not straightforward, so the option of displaying the timeline on a line was chosen. To enhance the clarity of the icons the decision was made to prominently display the selected options at the top so that users are aware of their choices.

7.3.3 Visual distinctions

To draw the user's attention to more important information it is important to make that element visually distinct [35]. In this display, there is chosen to use blue as a background. This is a soothing color and users are quicker to complete their goal with a blue background [44] [46]. To make a clear distinction a contrasting color, namely yellow is chosen for the main buttons. This particular yellow does match with some of the color schemes that the museum uses, so it would be both a contrast and be consistent within the museum. There is chosen to only use two colors and different shades of grey because with more vibrant colors the display could become overwhelming or cluttered [20].

7.3.4 Consistency

Consistency is key in maintaining uniformity among elements that convey similar information. This applies to factors such as color, size, placement, and behavior [35]. Therefore, in this design, every button or slider features the same yellow shade. The button leading to the home page remains in the same location on the screen, whether the video or recommendation screen is displayed. Additionally, all buttons share the same shape, while the slider has a distinct shape to indicate a different type of interaction.

7.4 Prototype

Taking all factors into consideration, a redesign was created using the wireframing program Figma. The design decisions were based on the requirements listed in Section 2.6.1, the modifications to the videos, and the changes in the display design. The location aspect was not incorporated into the design since it is a prototype not intended for exhibition in the museum. However, a recommendation for the museum

is provided. The design comprises four types of screens: the attention-grabbing start screen, the main page for selecting a time period and category, the video playback screen, and the recommendations screen. The screens are presented in this chapter with numbered labels to explain the elements and corresponding design choices. It's important to note that only one screen per category is displayed in this chapter.

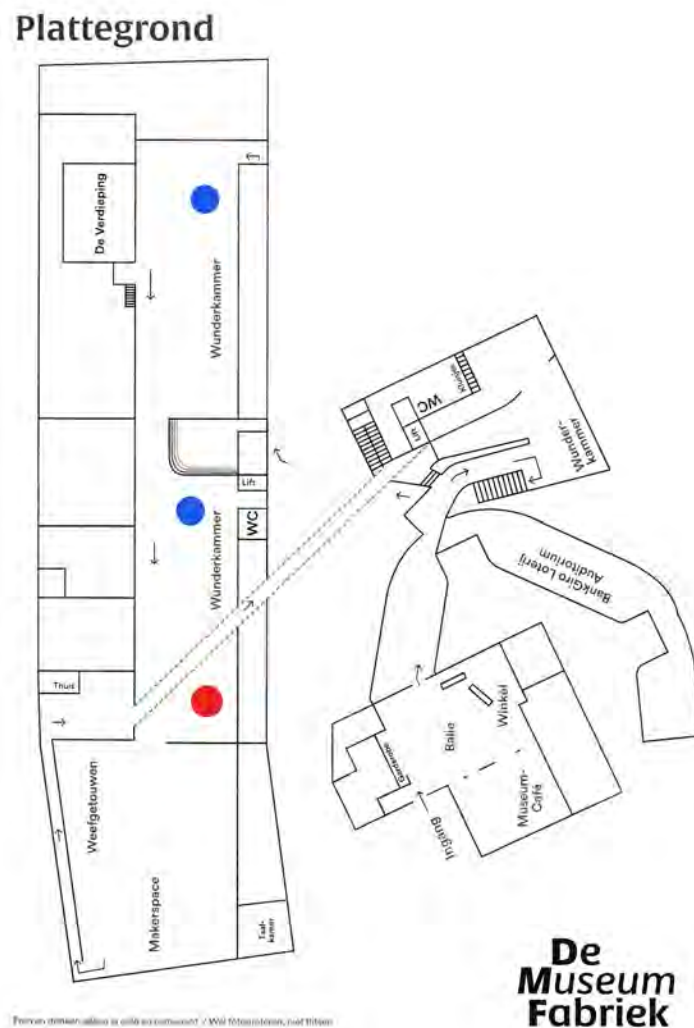


Figure 7.1: Two possible new locations (blue dots) and the old location (red dot)

7.4.1 Location

The most important aspect of the location in the museum is other distractions, visibility, and practicality. With this in mind, there are few spots in the museum the installation could work. The first part of the exhibition would not be fitting because these are

mainly exhibitions that fluctuate with different themes throughout the months. The first part of 'the wunderkammer' exhibition is not practical because it has a big focus of animals and especially night animals so having a big bright screen there would be disruptive to others. So the floor the installation was originally on is still the best floor. It only needs a different placement. That would either be near the entrance to the floor or at the entrance to the second room of the floor as can be seen by the blue dots in Figure 7.1. Both of these locations would not be close to other exhibits that have a sound and the screen would be visible from the moment people walk into that room.

7.4.2 Start screen

The start screen is the screen that will be visible when the installation is not active. This screen can be seen in Figure 7.2. The main goal is to attract visitors' attention and invite people to interact. The main elements are the background image (1), the title (2), and the start button (3). The choice of picture is made to both invoke emotion and recognition as stated by Falk [21], page 193 & 217, the use of emotion and familiarity makes it more likely that people will interact with it. The photo is a few days after the disaster and was taken from a Dutch newspaper, the AD [9]. The start button (3) is placed in the middle of the screen because the main interactions on the main screen are placed in a similar location this way [35]. The eyes of the visitor will be in the area that it needs to be to interact. The color is yellow with a blue stroke for consistency with the other screens and because yellow is salient and alerting [46].



Figure 7.2: The start screen

7.4.3 Main screen

The main screen has a lot of different elements and corresponding design decisions. The screen can be seen in Figure 7.3a.

1. The background is blue because it is a calming color and a good background color [46] [44].
2. The slider button is yellow to make it a contrasting color with the background and because yellow is salient and alerting [46] [35].
3. This is the category button, the selected button is bright yellow while the button that the visitors hover over will change a lighter shade of yellow, see Figure 7.3b. The color yellow is because of attention-grabbing so the user knows it is something they can interact with and for consistency [46] [35].
4. The start button is yellow and in the same form as the other buttons. However, there is a different stroke and it is bigger to make it clearer that it is a more important button compared to the category. This button will lead to the next screen and the video will be played.
5. This is the text that says what time period and category is currently selected. It is a different color than the other text to grab some attention that it is different and not static. Making it yellow would make it not easy to read so the choice

- was to make it blue. So there is a consistent color use and a color palette with only two clear different colors [46].
6. There are four boxes on the page. One on the top to highlight the title and three others to highlight that there are three steps in the interaction. Select a time, select a category, and press start. The boxes are lighter blue so the text is more readable but it is still conscience with the other color scheme.
 7. The title instructs the visitor. It does not need to attract attention because it is on top of the screen and people only need to see it if they are confused about the installation
 8. To give visitors a better idea of what is going to happen a static video summarization is shown [36]. This way visitors know better what to expect.
 9. The time period that is selected is bigger than the rest. This is to make it extra clear which one is selected.
 10. To not have too much text on the screen and to have abstraction representation there is chosen to have icons for the categories [35]. These icons are from Google fonts [23].
 11. The design of the timeline is close to a conventional timeline, it's linear, with small protrusions. Conventional timelines often go horizontal and the time is running left to right [51]. The choice was made to put this timeline vertically because it fits better on the screen and the time periods are next to it it will probably be clear that it is a timeline. The color is blue because of the same reasons stated before, mainly for consistency.
 12. This is an addition to the video summarization to get attention and know if they are interested in watching more about it.



(a) The main screen



(b) The color change during a hover

Figure 7.3: The main screen and different states of the category button

7.4.4 Video screen

The next screen is the screen on which the video is playing, it is designed to be plain and simple as the primary focus is on the video itself (1). The screen can be seen in Figure 7.4. The video plays immediately when clicked, because of the lack of video control ability in Figma, video controls are not considered to be added. It could be an addition but it could also provide a distraction from the video. To remain in line with the results if this iteration is played on a slower device a loading icon will be added. The videos have a duration ranging between one minute and one minute thirty seconds, aligning with the requirement of shorter video lengths. Using a shorter duration would make it challenging to maintain a cohesive storyline, hence the chosen duration. Alongside the video, there are two buttons on the screen: one to return to the main screen (2) and another to proceed to the recommendations

(3). These buttons are presented in yellow to maintain consistency with the other screens. Although these buttons may appear more attention-grabbing than necessary on this screen since they are not supposed to be the primary focus. However, for consistency purposes, this design choice was made. Lastly, the background (4) retains a calming and consistent blue color [46] [35].

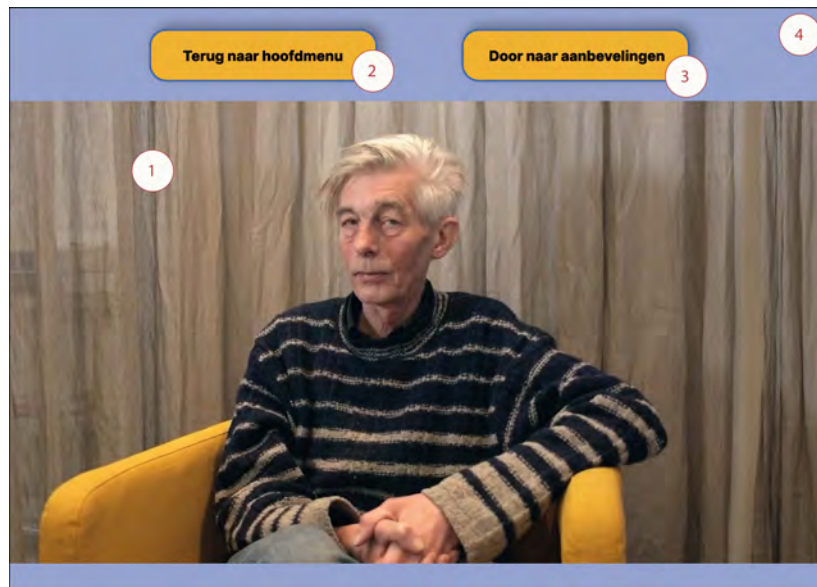


Figure 7.4: The video screen

7.4.5 Recommendation screen

Lastly, is the recommendations screen, from the past results there is no clear evidence that the recommendation helped to keep attention. The feedback however was positive so the choice was made to include it in this prototype. The screen can be found in Figure 7.5. The main part of this screen is the three boxes with recommendations. The boxes consist of the dynamic summarization of the video (2). The summarization is a GIF of three seconds that replays continually. The prototype program, Figma does not allow playing a GIF after a hover, if that was an option the choice would be to only play the GIF if a user has their mouse inside of the corresponding box. This is to not overwhelm the visitors since motion attracts the most attention [22]. In addition, the name of the subject and a small summary of what they will talk about (3) is shown. This is to make the user more familiar with the video before they will watch it. Outside of the boxes, there is a button to return to the main screen (1) this is yellow again and placed similarly to the placement on the video screen to have consistency across screens [35]. The title (5) and the background (6) are the same as on the other screens.



Figure 7.5: The recommendations screen

7.5 Insights gained and Future actions

Based on the insights gained from this iteration, it is evident that several key improvements could have significantly enhanced the initial design. Firstly, optimizing attention-grabbing elements, such as selecting a more suitable location and improving the overall appearance of the installation, would have been beneficial. The location should have been in a quieter area, away from the exit, and in a place with minimal distractions. Additionally, the start screen should have been designed to clearly convey the subject of the installation, allowing visitors to quickly grasp its purpose, relevance, and their connection with the subject.

Secondly, in terms of the videos, using specially created videos tailored to the installation would have been the ideal approach. However, if this is not feasible, keeping the videos within a duration of one to one minute and twenty seconds will help maintain viewer engagement. Furthermore, incorporating dynamic video summarization techniques could have enhanced user engagement and the amount of discovery.

Lastly, to improve the overall glanceability of the installation, it would have been advantageous to manage user expectations, employ icons instead of text, and ensure visual distinctions in both icons and objects while maintaining consistency throughout the design. This would have allowed visitors to quickly understand and navigate the installation.

To accurately assess whether this redesign would result in a more engaging experience and improved retention of user attention, conducting a new user test is essential. By utilizing the same Museum Experience Scale (MES), as discussed in

Section 5.3, questions as in the initial iteration, a fair and comprehensive comparison between the two designs can be achieved.

Discussion

To answer the main research question, it is necessary to answer the sub-questions first. Within this chapter, the answers to the sub-questions will be thoroughly examined and considered. This will aid in drawing final conclusions in the subsequent chapter.

8.1 Contributing aspects for a great design

Chapter 2, "Background", provides the answer to the question, "**What aspects from the literature can contribute to a great design for an interactive installation at The MuseumFabriek?**" It is discovered that several key aspects must be considered when designing such an installation. Firstly, understanding the primary target audience is crucial, which includes **explorers** (children), **facilitators** (parents), and **Affinity Seekers** (individuals interested in Twente) based on Falk's audience types [21]. Secondly, the pedagogical model should follow the **discovery model**, as outlined in Witcomb's didactic expository model [52], as it aligns with the installation's requirements and is commonly used in interactive installations.

Furthermore, the installation should facilitate **free exploration** and accommodate **multiple users**, aligning with similar installations described in related works and this suits the visiting motivations of explorers, facilitators, and affinity seekers. Additionally, it should fulfill specific requirements set by the MuseumFabriek, including providing **added value**, ensuring **easily understandable interactions**, **scalability** or customization to meet the museum's needs, **affordability** with low maintenance, and using language that is less complex or at the **international B1 level**. Overall, these aspects contribute to the development of a great design for the interactive installation at The MuseumFabriek.

8.2 Suited installations for the MuseumFabriek

Chapter 3, titled "From Ideation to Final Concept," addresses the second sub-question, "**What kind of installation is suited for the Museumfabriek?**". This question is tackled through a process that involves brainstorming multiple ideas, selecting four of them for further elaboration, and presenting them to the museum for evaluation. The decision is based on the installation's alignment with the museum's requirements, preferences, and feasibility. Following this process, it has been determined that the tabletop firework disaster installation is the most appropriate choice.

The tabletop concept is deemed suitable due to its seamless integration with the existing exhibition, particularly the section dedicated to the firework disaster. Visitors already have the opportunity to watch interviews in this section. The tabletop installation enhances visitor engagement and enriches the exhibition by allowing them to select and listen to specific interviews. Through a tabletop and screen setup, visitors can explore the interviews in relation to a timeline, a map of the area, and the roles of the interviewees. This fosters connections and facilitates a deeper understanding of the subject matter.

8.3 Content

Chapter 4, titled "The System," delves into the third sub-question: "**What content should be included in an interactive installation for the Museumfabriek?**". In this chapter, the 22 interviews are carefully examined, segmented, and categorized. The most commonly occurring themes are identified and grouped into multiple categories. Additionally, the interview snippets are labeled based on the timeframe in which they took place or the timeframe they reference the most.

The chosen categories for the content are **housing**, **businesses**, **stories**, and **help**. A timeline is also established, ranging from the time of the disaster to the long-term aftermath. It is worth noting that the majority of the interviews did not specify a particular location, and therefore this aspect is not incorporated into the installation.

The objective of utilizing these content categories in conjunction with the timeline is to present the underlying connections between different storylines and the experiences of the individuals involved. The aim is to provide visitors with a meaningful and engaging experience, allowing them to grasp the interconnectedness of the narratives.

8.4 Recommendation system design

The fourth sub-question **”How can a recommendation system be implemented in an interactive installation to make a connection between content?”** is discussed and answered in Section 4.2, titled **”Recommendation System.”** The objective is to explore the implementation of a recommendation system that enhances the connection between different pieces of content within the interactive installation.

Considering the clear cohesion between the content, timelines, and categories, the decision is made to test whether a recommendation system can improve user engagement and provide deeper insights. It is determined that a non-personalized association recommender is the most suitable approach for this purpose. Unlike other recommendation systems that require additional data, this system can be developed using the existing categories, timelines, and content of the interviews [39].

The recommendation system is based on a previous video that the user has watched, and it establishes links between videos based on the categories, timeline, and content of the interviews. For example, if different interviews discuss the possibility of the Grolsch factory exploding, these interviews are linked together within the recommendation system. A visual representation of these connections between videos can be found in Figure 4.2.

8.5 Recommendation system effect

The fifth sub-question, **”Does a recommendation system change the experience of visitors interacting with an interactive installation at the MuseumFabriek?”** is explored and discussed in Chapter 6, titled **”Results.”** However, due to a limited amount of data resulting from many visitors not completing the videos, it is challenging to determine the impact of the recommendation system on the overall experience.

Based on the available data, it appears that individuals who received recommendations were more likely to complete the videos, with a completion rate of 52 percent compared to 40 percent for those without recommendations. However, due to the insufficient data, these findings are not statistically significant, and no clear conclusion can be drawn regarding the effect of the recommendation system. Only two participants in the interviews and questionnaire had the opportunity to use the recommendation system, as most visitors clicked away before reaching the recommendations.

To arrive at a conclusive assessment, a larger-scale user test is necessary. In future iterations, it would be beneficial to shorten the video length to increase the likelihood of viewers watching them to completion and reaching the recommenda-

tions. This would provide a more substantial sample size and offer a better basis for drawing conclusions about the impact of the recommendation system on the visitor experience.

8.6 New iteration

The final sub-question, **”What changes can be made in a revised iteration of an interactive installation at the MuseumFabriek based on the testing results and literature?”** is discussed in Chapter 7, titled **”Revised Iteration of the Design.”**

The literature suggests several significant changes that would improve the installation in three main areas: attention-grabbing, videos, and glanceability. To enhance attention-grabbing, a new start screen is implemented to establish a quicker emotional connection between visitors and the installation [25]. Additionally, a new location is proposed, one that offers fewer distractions and is further away from the exit [43] [7].

The videos are improved by incorporating a combination of static and dynamic video summarization techniques. This allows viewers to have a better preview of what they are about to watch and helps set appropriate expectations [36]. Furthermore, the length of the videos is shortened to increase the likelihood of retaining viewers’ attention for longer periods. And additionally, recommendations are made in the situation that new videos are able to be filmed. These are based on Brame’s frameworks with a focus on cognitive load, student engagement, and active learning [12].

Regarding glanceability, changes are made to align the installation with user expectations [35] [19]. Icons are represented using abstract visuals, ensuring that the information is visually distinct without overwhelming the viewer [35]. The use of blue and yellow colors is employed to provide visual clarity while maintaining a clean and uncluttered appearance [44] [46] [20] [35]. Consistency is also maintained across the prototype to ensure a cohesive and coherent user experience [35].

By implementing these revisions based on both testing results and literature insights, the interactive installation at the MuseumFabriek can be enhanced to provide a more engaging and user-friendly experience.

Conclusion & Further research

Finally, the main research question, **“How to design an interactive installation for the MuseumFabriek to keep the visitor engaged?”** can be addressed. However, answering this question is not straightforward due to the various ways an interactive installation can be designed for the MuseumFabriek. This report focuses on one particular design approach and installation, providing a recommendation for designing it.

The recommended approach begins with determining a framework and identifying key aspects that should be incorporated into the installation. This includes considering the target audience of explorers, facilitators, and affinity seekers, emphasizing free exploration, and designing for multiple users. It is crucial to ensure the installation provides added value and uses simple language. Once the requirements are established, a brainstorming process generates concepts that meet these requirements.

The most promising ideas are then discussed with an employee of the Museum-Fabriek, resulting in the selection of one concept, an installation with a vertical screen and a tabletop for user input. The content for this installation consists of previously conducted interviews by the museum. The next step involves categorizing and analyzing the content to determine an appropriate way of presenting it within the installation. The chosen categories are housing, businesses, stories, and help, and the timeline extends from the initial explosion to a few years later. A recommendation system is implemented using these categories to potentially enhance visitor engagement. This recommendation system takes the form of a non-personalized association recommender.

Following the implementation of the installation, it is placed in the museum and tested. There are two different conditions of the installation, one that includes the recommendation system and one without. A mixed method approach is used for data collecting, consisting of log data from the installation, questionnaires, conducting interviews, and making observations. Based on the gathered data, it is

concluded that the recommendation system had an insignificant impact. However, people expressed a positive response to the content and appreciated the diverse perspectives presented in the installation. One notable concern was that the videos were too long.

Considering these results and drawing upon additional literature, a new iteration of the design is formulated. This iteration focuses on attention-grabbing, improving the videos, and enhancing glanceability. However, this new iteration has not yet undergone testing.

9.1 Further research

Before proceeding with further research, it is essential to address the missing information required to gain a deeper understanding of the MuseumFabriek's needs regarding an interactive installation. While the desired visitor types are known, their actual motivations have not been extensively studied or directly investigated. Therefore, prioritizing research on visitor motivations becomes crucial to better comprehend the target audience.

Additionally, understanding the physical space and social context of the museum is vital. This entails studying how people currently behave in the space whether they exhibit hesitancy in interacting or recognize that certain aspects of the exhibitions are meant to be touched and engaged with. Examining the duration visitors spend in specific areas, their navigation routes throughout the museum, and what captures their attention are essential considerations.

While there is extensive research on video length in social media and online learning, limited information exists on how visitors interact with videos in museums or public spaces. Therefore, understanding the ideal interaction time and design for video-based installations within a museum context is crucial.

Once these insights are obtained, it will be possible to iterate and enhance the installation based on the findings. Conducting preliminary testing followed by implementing the installation in the museum can facilitate its improvement.

Furthermore, there are various possibilities to enhance the experiment and address its limitations. One option is to utilize a more advanced computer system to reduce lag during experimentation or optimize the design to be less hardware-intensive. Minimizing loading times can prevent visitors from pressing the back button. If a hardware upgrade is not feasible, incorporating a loading screen to inform visitors about ongoing loading processes would be beneficial.

Extending the test period beyond vacations and including a diverse range of participants would provide more comprehensive results. Testing during different periods

throughout the year would attract a broader range of explorers and affinity seekers to the museum, rather than primarily families and day-trippers.

Another aspect worth exploring is conducting a test period with a similar installation placed in a different museum. While this report primarily focuses on the MuseumFabriek, it would be intriguing to investigate if the results differ across museums.

Finally, there are untapped design opportunities that could be explored in the new iteration. These include catering to and accommodating tour groups within the museum, as well as creating installations that are user-friendly for larger group interactions.

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Appendix A

Questionnaire

Bedankt dat u mee wilt doen aan het interview over de installatie.

Er volgt een lijst met stellingen waar uw moet aangeven hoe erg ons of oneens u het ermee bent.

Sommige stellingen zijn minder van toepassing, toch wil ik u vragen ze allemaal in te vullen. De vragen zijn gebaseerd op een bestaande schaal dus kunnen daardoor af en toe minder relevant zijn.

Alvast bedankt voor u medewerken, na het invullen van de questionnaire zullen er een paar verdiepende vragen gesteld worden.

	Sterk mee een	Mee eens	Neutraal	Mee oneens	Sterk mee oneens
Ik vond de grafische aspecten van de installatie prettig		X	X		
Ik voelde mij overweldigd door de stijl en fraaiheid van de installatie					X
Ik vond mijn interactie met de installatie interessant			X		
De installatie zorgde dat ik zelf meer wilde ontdekken over het onderwerp		X			
Ik denk nu nog steeds veel over de installatie			X		
Ik begreep de meeste dingen in de installatie	X				
Tijdens mijn interactie met de installatie vergat ik de rest van de wereld.		X			
Ik kan reflecteren over de betekenis van de installatie	X				
Ik voelde me betrokken bij de installatie		X			
De installatie zorgde dat ik nadacht over mijn eigen ervaringen				X	
Iets zien wat belangrijk is, gaf mij voldoening		X			

	Sterk mee een	Mee eens	Neutraal	Mee oneens	Sterk mee oneens
Ik voelde me geïnspireerd door de installatie			X		
Ik wilde graag verder door klikken tijdens het gebruik van de installatie om meer te zien		X			
Mijn interactie verrijkte mijn kennis en begrip over bepaalde onderwerpen	X				
Na de interactie met de installatie wil ik nog steeds meer weten over het onderwerp	X	X			
Ik voelde een connectie met de installatie		X			
Het voelde alsof ik de interactie echt een ervaring was in plaats van alleen een bezoek			X		
De informatie in de installatie was duidelijk		X			
Ik kon door de installatie zelf beslissen hoeveel ik wilde ontdekken		X			
Ik heb genoten van de interactie met van de installatie			X		
Ik wil zelf ook iets in mijn bezit hebben dat lijkt op de installatie			X		
Ik heb nieuwe informatie geleed van mijn interactie	X				
Interactie hebben met de installatie gaf me een gevoel van verwondering		X	X		
De installatie nodigde uit om door te klikken en meer interviews te kijken		X	X		

In te vullen door de onderzoeker:

Dag+ dagdeel:

Participant nummer:

Appendix B

Interview questions and coding

Appendix C

Interview questions with the museum

C.1 Original Dutch Question

Met wat voor doel komen de meeste mensen naar het museum?

Gebruiken jullie hiervoor een set aan regels/guidelines of gaat dit vooral op gevoel en overleg op individuele basis.

Wat kan een rede zijn dat jullie iets wel/niet plaatsen, makkelijk in gebruik? Duidelijkheid? Kind vriendelijk?

Gebruiken jullie theorieën met inrichten en bepalen wat jullie plaatsen en zo ja wat voor theorieën? Zo nee op baseren waarop richten jullie het dan in?

Zorgen jullie dat alle tentoonstellingen op een manier met elkaar te maken hebben? Delen ze een verhaallijn?

Hoe belangrijk is het of een object leerzaam is voor het geplaatst word? Moet het object zelf een verhaal vertellen of gebruiken jullie veel bordjes

Wat voor soort leerstijlen proberen jullie te hebben, veel ontdekken of veel vertellen.

Hoe belangrijk is het dat mensen zelf gaan nadenken nadat ze bij jullie zijn geweest?

Hebben jullie een klankbord van vaste bezoekers waarvan ik een paar wat vragen zou mogen stellen?

C.2 Translated english questions

What is the main purpose for most people to visit the museum?

Do you use a set of rules/guidelines for this purpose, or is it mainly based on intuition and individual consultation?

What could be a reason for you to place or not place something? Ease of use? Clarity? Child-friendliness?

Do you use theories to arrange and determine what you place, and if so, what theories? If not, what do you base it on?

Do you ensure that all exhibitions are connected in some way? Do they share a storyline?

How important is it for an object is educational before it is displayed? Should the object itself tell a story, or do you use a lot of signs?

What kind of learning styles do you aim to have, more discovery-based or more lecture-based?

How important is it for people to engage in critical thinking after visiting your museum?

Do you have a sounding board of regular visitors whom I could ask a few questions?

Consent form, information brochure and start screen

Het startscherm

Het startscherm van de installatie zal de volgende informatie bevatten:

Als u doorgaat met het gebruik van deze installatie gaat u akkoord met de volgende stellingen:

- Er wordt data verzameld voor de master Thesis van Rosa Amptmeijer. Deze data zal volledig anoniem zijn
- U bent 16 jaar of ouder en heb volledige capaciteit over het maken van u beslissingen of er is begeleiding bij
- U bent zich bewust dat de installatie schokkende en eventueel traumatische beelden kan bevatten omtrent de vuurwerkramp van 2000 in Enschede, als u hier gevoelig voor bent wordt aangeraden om deze installatie niet te gebruiken

Knop met meer informatie (linkt naar de informatie brochure)

Knop met akkoord

Informatie over het onderzoek Vuurwerkkramp Installatie

De installatie is gemaakt voor de master thesis van Rosa Amptmeijer. Er zijn twee verschillende versies van de installatie en het doel van het onderzoek is of de verschillende versies invloed hebben op de beleving van de gebruiker. De inhoud van de installatie is geleverd door de MuseumFabriek. Tijdens het gebruik van de installatie of het eventuele interview achteraf kan u op elk moment stoppen, zonder opgave van rede.

Risico's

Het risico van mee doen aan het onderzoek is dat de inhoud van de installatie als schokkend en traumatisch ervaren kan worden. Als u hier gevoelig voor bent is het advies om niet mee te doen.

Interview

Na het gebruik van de installatie kan gevraagd worden of u mee wilt doen met een kort interview om uitgebreid te vragen wat u ervaringen zijn. Dit interview zal rond de 5 minuten duren. Tijdens dit interview zullen uw antwoorden opgeschreven worden en anoniem opgeslagen worden.

Data verzameling van de installatie

Gedurende het gebruik van de installatie zal elke knop die ingedrukt worden opgeslagen worden om later te kunnen analyseren met een paar hoofddoelen om te kijken hoelang een sessie duurt en welke knoppen wanneer ingedrukt worden.

Data gebruik en opslag

Mocht u gevraagd worden voor een interview en akkoord gaan zal u een toestemmingsformulier moeten tekenen. Hierbij zal uw naam en handtekening opgeslagen worden in een kluis op de universiteit Twente. De audio opnames van de eventuele interviews worden op een persoonlijke computer achter dubbel wachtwoord opgeslagen. Mocht u later zich weer bedenken dan heeft u het recht om te vragen of u persoonlijke data verwijderd kan worden, dit zal in lijn met de AVG gebeuren. De overige data is anoniem en zal gebruikt worden voor de resultaten van de master thesis van de onderzoeker.

Meer vragen en informatie

Voor algemene vragen kunt u de onderzoeker, Rosa Amptmeijer vragen, r.s.amptmeijer@student.utwente.nl

Mocht u meer vragen heeft over u recht als een onderzoeksdeelnemer, of wenst u meer informatie, een vraag te stellen of u wilt iets bespreken met iemand anders dan de onderzoeker, kunt u contact opnemen met het secretariaat van de Ethische commissie van Information & Computer Science: ethicscommittee-CIS@utwente.nl

Dit onderzoek is begeleid door Randy Klaassen, Faculteit van Electrical Engineering, Mathematics and Computer Science, Zilverling 2120, r.klaassen@utwente.nl

Toestemmingformulier Vuurwerkkramp installatie

<i>Graag de verschillende stellingen aanvinken waar u het mee eens bent en wat u heeft begrepen. Sommige hiervan zijn verplicht om mee te doen aan het verdere onderzoek, quotes zijn niet verplicht</i>	Ja	Nee	
Deelnemen aan onderzoek			
Ik begrijp de informatie die ik gelezen heb of mij is voorgelezen. Ik heb vragen kunnen stellen over het onderzoek en die vragen zijn beantwoord naar mijn tevredenheid.	<input type="radio"/>	<input type="radio"/>	
Ik stem ermee in dat ik volledige vrijwillig mee doe naan dit onderzoek. Ik begrijp dat ik op elk moment een vraag kan weigeren of kan stoppen met het onderzoek, zonder verdere uitleg.	<input type="radio"/>	<input type="radio"/>	
Ik begrijp dat mee doen aan dit onderzoek houdt in dat er een interview met mij gehouden worden over mijn ervaringen met de installatie die ik net hebt gebruikt.	<input type="radio"/>	<input type="radio"/>	
Gebruik van informatie			
Ik begrijp dat de informatie die ik geef gebruikt wordt in een onderzoek bedoeld voor de master thesis van de onderzoeker	<input type="radio"/>	<input type="radio"/>	
Ik gebruik dat persoonlijke informatie wat mij kan identificeren, (zoals mijn naam of waar ik woon) niet gedeeld wordt met meer mensen dan de onderzoeker.	<input type="radio"/>	<input type="radio"/>	
Ik begrijp dat ik in lijn met de AVG het recht heb aan te geven dat mijn informatie verwijderd moet worden, en ik de data kan opvragen. De data wordt, in lijn met standaard onderzoek, 15 jaar bewaard	<input type="radio"/>	<input type="radio"/>	
Optioneel: Ik ga ermee akkoord dat directe quotes van mij gebruikt kunnen worden in onderzoeksresultaten	<input type="radio"/>	<input type="radio"/>	
Optioneel: Ik ga ermee akkoord dat er audio opnames worden gebruikt van het interviews (als u niet akkoord mee gaat dan worden er schriftelijke aantekeningen gemaakt	<input type="radio"/>	<input type="radio"/>	

Naam	Handtekening	Datum	
Ik heb deze gezorgd dat de potentiële participant de informatie heeft gekregen en gezorgd dat er begrepen is dat de deelname vrijwillig is.			
Rosa Amptmeijer _____	_____	_____	
Onderzoeker	Handtekening	Datum	
Als u verder vragen heeft kan u later altijd contact opnemen met de onderzoeker, Rosa Amptmeijer, r.s.amptmeijer@student.utwente.nl of de ethische commissie ethicscommittee-CIS@utwente.nl			