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# Designing interactive digital guides to increase teenagers' engagement at science centers

Master's thesis in Computer Science and Engineering

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Department of Computer Science and Engineering  
CHALMERS UNIVERSITY OF TECHNOLOGY  
UNIVERSITY OF GOTHENBURG  
Gothenburg, Sweden 2022



MASTER'S THESIS REPORT 2022

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Cover: Figure from Universeum's web page, published 2021-07-09 [1].

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## Abstract

Science centers are known for educating people and creating engagement towards science related questions, questions which often are related to important issues in society. More and more, data visualisations are used to educate exhibition visitors, as well as engaging visitors with the ability of interacting with different visualisation installments. However, these data visualisations can become quite advanced and there is an identified challenge of lowering the threshold for people to interact and learn from such installments. One tool used for explaining concepts of exhibitions are audio guides, however, it seems these guides have been slow in developing to something more than just being an audio reader. At the same time, there is an identified gap in designing exhibitions for teenagers. Today, most exhibitions are designed towards either children or adults. In this project we have researched through design on how a digital guide can be designed to increase teenagers' engagement to visualisation exhibitions.

The project use a human-centred design approach (HCD) consisting of iterative processes of understanding and specifying the context of use, specifying the user requirements, producing design solutions, and evaluating the design. The research took place at Vislab, an exhibition of interactive visualisations for teenagers and resulted in a concept of digital guide that consisted of a smartphone game called VisQuest. The game is about completing quests that require the visitor to interact with the exhibits at Vislab, and user tests show that the game successfully made teenage visitors stay longer at Vislab and enticed them to explore the exhibition.

Through the design process of VisQuest, a set of key considerations for designing a digital guide at exhibitions for teenagers was identified. These included considerations on form and interface of a digital guide, a classification on quests in a gamified guide, a set of techniques to encourage exploration, and possible future research areas. The considerations contribute with knowledge on what one should consider in projects at science centers where one want to increase teenage engagement. They can be used both in its entirety, as well as for sub-areas within the field. The knowledge can also be used as a foundation for research on digital guides for teenagers in exhibition environments of advanced interactive data visualizations.

Keywords: Interaction Design, Human-centred Design, Research Through Design, Graphical Interfaces, Science centers, Digital guides, Gamified digital guide, quests, teenagers



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Carolina Larsson  
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# 1

## Introduction

Today, the importance of science centers is high. The world faces a lot of science-based challenges and threats such as climate change, diseases, energy transitions, water allocation, pollution, and mass extinction [8]. To handle these challenges science centers contribute with environments for learning where people through interactive exploration can increase their knowledge and understanding of science. Through this acquired knowledge people can make better and more informed decisions that can make the world a more sustainable place to live in.

One common tool used at science centers for both explaining and exploring purposes, are visualizations. Data visualizations in museums is a powerful tool used to explain facts and communicate research data for visitors. Today it is not uncommon for museums to include interactive multi-touch screens presenting various visualizations that make it possible for the audience to explore and understand complex data.

Universeum, Scandinavia's largest science center situated in Sweden [9], has a variety of different exhibitions such as a space lab, a health lab and a visualization lab, all which includes different kinds of interactive visualizations. The latest, called Vislab is their newest exhibition with a direct focus on accelerating learning and increasing people's knowledge, especially teenagers', for a sustainable world with the help of interactive data visualizations. The exhibition uses a large amount of research data that brings many learning opportunities. However, this amount of data also bring challenges such as the risk of the visualizations becoming quite advanced. An identified issue of Vislab is the challenge of making teenage visitors get over the threshold to interact with the different interactive installations for more than just a few seconds [10]. Pedagogues at Vislab pinpoint the need and importance of nudging the visitors towards exploring all parts and content of the exhibition [11].

One exploratory tool that is adopted in many science centers and museums to help visitors with understanding and taking in the content, are digital guides [12]. A common and expected implementation of digital guides are traditional audio guides that provide oral information only. However, nowadays more novel technology has resulted in digital guides that are used together with graphical interfaces in smartphones and tablets. Research studies suggest and proves that digital guides make visitors linger longer at exhibitions, and that handheld digital guides result in a more active viewing behavior [12, 13]. In contrast to only having text panels, making use of digital guides leads to a more complete consumption of the exhibit. It is also said that adding an auditory layer to the visual content, while also moving your body

through an exhibition leads to a stronger multisensory and embodied experience that results in more elaborate learning [12].

Even though digital guides are known to enhance learning of the content in the exhibition, there seem to be little research available about them, especially regarding what one should consider when designing them [12]. This makes digital guides a relatively unexplored area, but with much potential to improve exhibition experiences. Another underdeveloped area of research at exhibitions are designing for teenagers, seeing as it is more common to design for children [14].

With the identified challenge of science centers adopting advanced interactive visualizations, the need for lowering the threshold for visitor interactions, and the understudied group of designing for teenagers, we set out to investigate digital guides as a possible research area for finding solutions for these challenges.

## 1.1 Research Question

With the above in mind, the aim of this master thesis is set on exploring digital guides as a way of increasing teenagers' exhibition engagement. The focus is set on exhibition environments with advanced information visualisations, since that is one identified area with difficulties of lowering the threshold for visitor interactions. The project is executed in the Vislab environment where design and in-field testing is possible. Seeing as teenagers are as aforementioned an understudied group, this is our main target group, which also correlates with Vislab's target group.

The project has the following research questions:

- What are key considerations for designing an interactive digital guide intended to increase engagement for teenagers interacting with advanced data visualizations at exhibitions?

Furthermore, the project has a focus on the following four categories:

- Making it easier for visitors to understand how to interact with the exhibits
- Making the content of the exhibits more interesting
- Contributing to an exploratory experience for teenage visitors
- Presenting the guide in such a way as to make visitors want to use it

The aim is to produce answers to these questions both through scientific research and through gaining knowledge by designing an interactive digital guide. Thus, we also add the following design challenge of how we approach the problem:

- How might we make teenagers stay longer at and engage more with the visualizations at Vislab by designing and providing them with an interactive digital guide?

## 1.2 Scope and Limitations

The scope of the project includes researching through design. Thus, it includes implementation and evaluation of design concepts through the use of prototypes. The scope of the project does not however include a fully implemented design. Furthermore, the design concepts are adapted for the exhibition environment of Vislab. While generalized learnings can be drawn from the design process, the final design concept in itself is not created for other exhibitions than Vislab.

As previously mentioned, the research question include teenagers as its main target group. Thus, the scope of the project is set on only researching solutions for that same target group. Also, because the project has a time limit, and because digital guides can be researched endlessly, the scope is not set on covering all possible areas of research. Instead, the project recognize that the result will have its limitations in the amount of areas researched within the field, and will thus end the report with recommendations of continuous research areas.

Moreover, a limitation of the project is the extent of integration of the guide in the existing environment of Vislab. Because the visualizations at Vislab are created by different parties and some are still in development, we are limited as to how much we can manipulate in the existing environment. Thus, we identify that there are some parts of research, such as communication between the guide and the existing exhibits, that we are unable to test. In this project, the design solution is therefore an addition on top of the exhibit rather than something that changes the exhibit.

Another limitation is the access to advanced technology such as eye tracking equipment or holographic projectors. Moreover, we do not have the necessary skills or knowledge of certain technologies to be able to sufficiently design and create a prototype of a product using said technologies. The project therefore only involves technologies that we think we are sufficiently skilled in or think we will be able to learn quickly enough.

## 1.3 Ethical Considerations

Since we aim to involve users in our design process it is important that we respect consent. Participants of the study are informed of what the study is about and all user participation is voluntary. The gathered data is anonymous and any data gathering is agreed upon by the participant beforehand, and they are given knowledge about how their data is used. The participants also have the opportunity to stop their contribution at any moment and have their data deleted.

Furthermore, the target group for this project is adolescents aged 13 - 19. The age of consent in Sweden is 18, which means that a large portion of the target group are under the age of consent. Because of this, when asking for consent when minors are participating in our study, we need consent from not only the children but also

their teachers or guardians.

Another important aspect to consider is accessibility. Currently, over 1 billion people in the world experience some form of disability, which is around 15% of the population [15]. This includes the visitors of Universeum, which come from various backgrounds and have various disabilities, such as cognitive or motor disabilities. Not considering this when working on the design can have the effect of excluding a portion of the population, making them unable to use the product that is being designed. To remedy this and minimize the possibility of users being excluded, we strive to involve people of diverse backgrounds into our study and make sure that the design covers their needs as much as possible.

Another aspect to consider is privacy. To address this, data such as personal details, positional data, etc. is not collected and saved during use of the design solutions.

Lastly, the project recognizes that designs are affected by the designers previous experience and knowledge. This includes the risk of design concepts being adapted to designers preferences. To minimize this problem, we communicate with and involve stakeholders while designing the digital guide so that it is based on their actual needs and goals, and to make sure the guide represents the exhibition in an unbiased way.

# 2

## Theory

This chapter will begin with introducing interaction design as a practice since that what is applied in this project of designing an interactive digital guide. With this practice, a few subareas of interaction design will be further dived into that are part of the exhibition today, or are investigated during the digital guide design process. The section of Interaction design is followed by knowledge of designing for science centers. This includes visitor research, having teenagers as a target group, exhibition design frameworks, as well as a focused section on digital guides. Lastly, a stand-alone section about the science center Universeum and the project's research environment Vislab is presented.

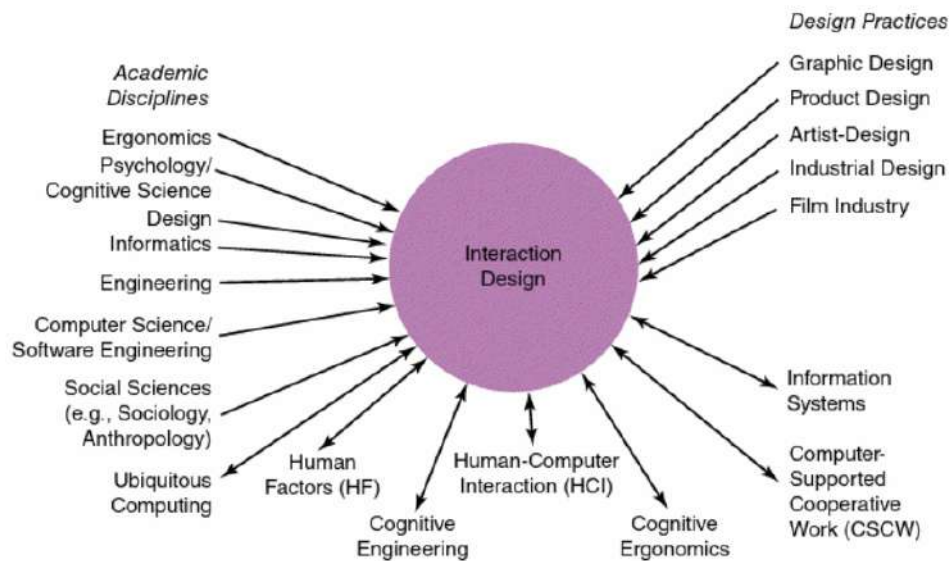
### 2.1 Interaction design

According to Preece et. al. [2], interaction design (IXD) has to do with “designing interactive products to support the way people communicate and interact in their everyday and working lives“. The Interaction Design Foundation (IDF) describes IXD similarly, defining it as “The design of interactive products and services in which a designer’s focus goes beyond the item in development to include the way users will interact with it. Thus, close scrutiny of users’ needs, limitations and contexts [...]“ [16]. Further IDF describe that the interaction designer work entails looking at five dimensions: words, visual representations, physical objects or space, time, and behaviour.

Interaction Design is a broad field with several different methods, theories and approaches that are used depending on what is being designed [2, p. 9]. A few areas of IXD are user interface design (UI), web design, user-centered design (UCD), user experience design (UXD), and human-centered design (HCD), that with their name describe what field or aspect is in focus. IXD has many other interdisciplinary and overlapping fields such as Human-Computer Interaction (HCI), Ergonomics, Software Engineering, Social Sciences, Graphic Design and Industrial Design (see Figure 2.1). A few of these approaches and concepts that already is, or are part of this project will be introduced further in the following subsections.

#### 2.1.1 Interaction design processes

As mentioned, there are several different approaches of how to address design challenges in IXD. A few known and well-used approaches are the user-centred design



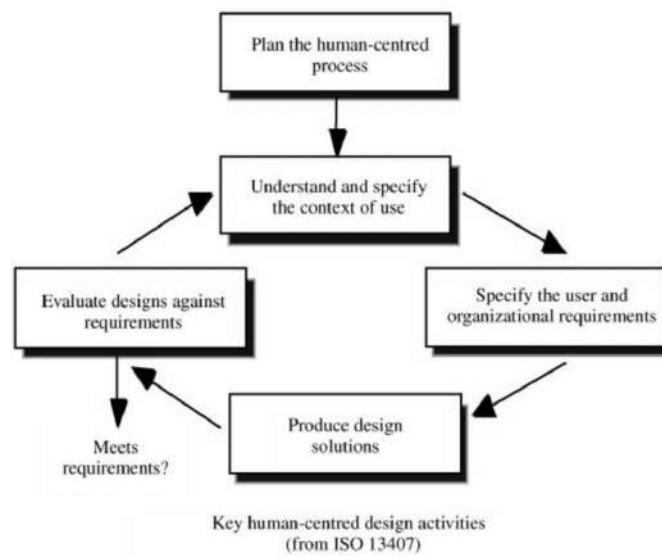
**Figure 2.1:** A visualization of academic disciplines, design practices and interdisciplinary fields concerned with Interaction Design [2].

approach [2, p. 43], the human-centred design approach [17], the design thinking approach [18], and the goal-directed design approach [19]. The approaches are often somewhat similar, and according to Preece et al., the general interaction design process consists of the steps: establishing requirements, designing alternatives, prototyping, and evaluation [2].

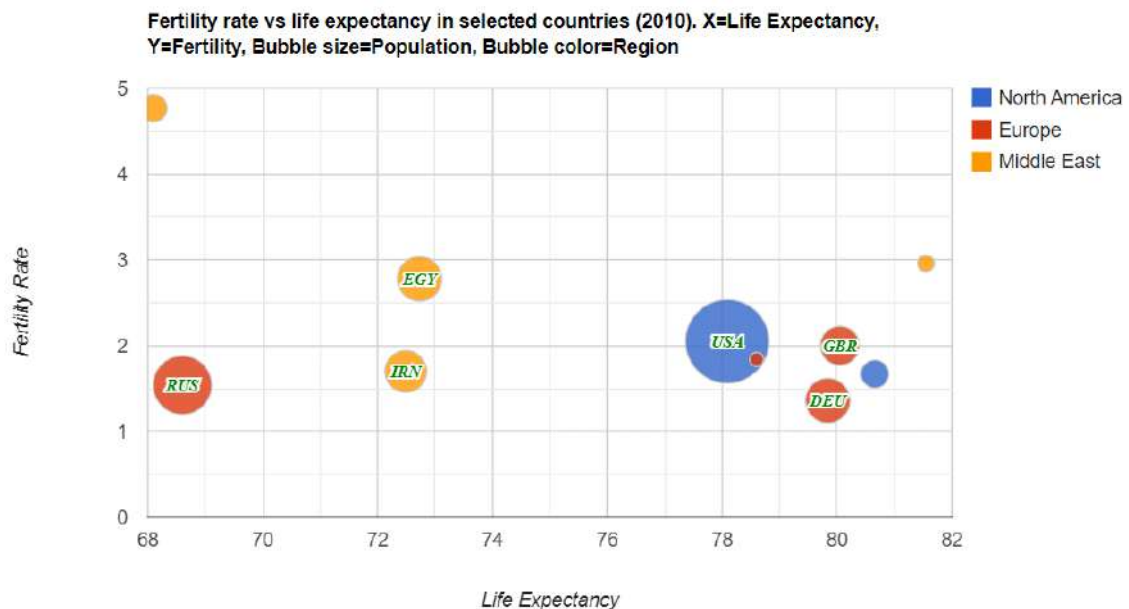
For this specific project, a human-centred design (HCD) approach is used. Within HCD the process steps are formulated as: understanding and specifying the context of use, specifying the user requirements, producing design solutions, and evaluating the design [17] (see Figure 2.2). This process is iterative, meaning that once a cycle of the process has been completed you may start over and iterate further upon your design. Moreover, it is possible to move between steps should the need arise; it is not necessary to complete a full cycle in order to get to a step that is earlier in the cycle.

### 2.1.2 Information visualization

Information visualization is a field within Interaction Design that is often used as a communication tool. As the term may hint upon, information visualization has to do with graphically representing data such that it is readable and digestible for the person viewing it [20]. One of the main goals of visualizations is to let the viewer gain insight into the underlying information or data [21]. Visualizations can be static, where the viewer can only view the data as it is. However, they can also be interactive, allowing them to interact with and alter how the data is represented, which can often lead to more insight into the underlying information [22, p. 173]. Some examples of information visualization are scatter plots, tree maps, histograms, and bubble charts [4] (see Figure 2.3).



**Figure 2.2:** A model of the iterative Human-Centred Design Process visualizing the flow of the different stages [3].



**Figure 2.3:** An example of a bubble chart, from Google Charts [4]

### 2.1.3 User Experience design

User Experience has many different viewpoints and definitions. ISO 9241 [17] phrases it as “user’s perceptions and responses that result from the use and/or anticipated use of a system, product or service“. Further they describe that “perceptions and responses include the users’ emotions, beliefs, preferences, perceptions, comfort, behaviours, and accomplishments that occur before, during and after use.“.

User experience design is sometimes mistaken as a synonym for usability [7]. However, when designing for usability, the focus lies on how we use the design, the ease of use and an importance of satisfaction [23]. When instead speaking of user experience design, the focus lies on a user’s responses, how the user feel and value a design. In UX, all emotions and attitudes matter. Thus, user experience design is about designing experiences.

User experience is often looked at in three different perspectives [24]:

- Experiencing, the verb of an individual experiencing and interacting with a system, which is dynamic in nature.
- An experience, the noun of an encounter that has a beginning and an end.
- Co-experience, experiencing something together in a group, a shared experience.

As mentioned by ISO 9241, user experiences can be measured over different time spans such as before, during and after. Roto et. al. speaks of the four different terms Anticipated UX, Momentary UX, Episodic UX, and Cumulative UX [7], which are experiences at different periods when interacting with a system. The terms are described further in the table 2.1.

<b>What</b>	<b>When</b>	<b>How</b>
Anticipated UX	Before usage	Imagining experience
Momentary UX	During usage	Experiencing
Episodic UX	After usage	Reflecting on an experience
Cumulative UX	Over time	Recollecting multiple periods of use

**Table 2.1:** User experiences at different times. Remade from [7]

There are three main factors that affect user experience: context, user, and system [7]. Regarding context, there are social, physical, task, technical or informational contexts that can have an impact on UX. One such example could be noise in the

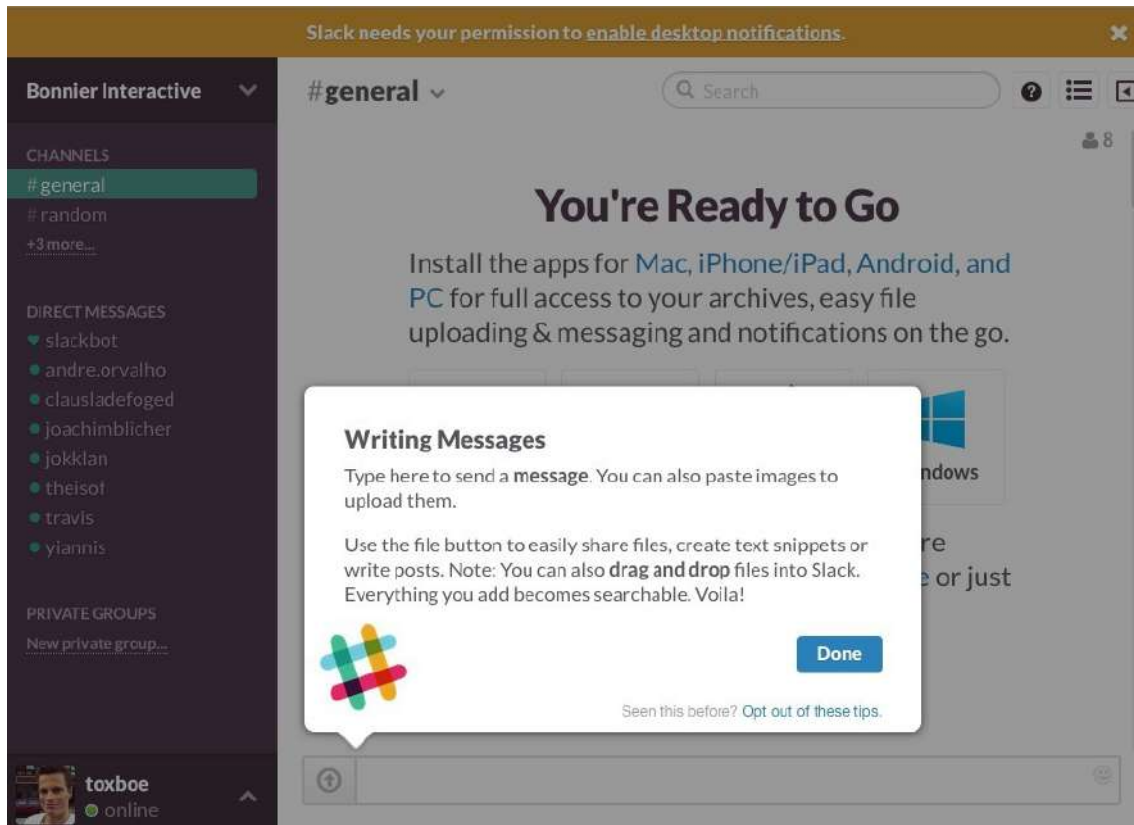
physical environment that affects the experience. An experience is also dependent on the user factor, such as the user's motivation, expectations, mood, and mental and physical state. Thirdly, there is the system factor, including the user's perception of the system with its functionality, aesthetics, interactive behaviour and image.

### 2.1.4 Graphical User Interfaces

There are several types of interfaces that lets users interact with a product or system in some way [2]. A few examples include command based, speech based, tangible interfaces, and wearables. One commonly known type is graphical user interfaces (GUI), which has to do with visually representing an interface on a screen. One way to describe GUIs is with the WIMP acronym, which stands for Windows, Icons, Menus and Pointing device.

Within the field of GUI, there are certain design principles and general guidelines to keep in mind in order to make the experience of using the GUI as good as possible. Cooper [19] brings up design principles like optimizing for intermediate users, preventing errors and informing decisions, eliminating excise and designing for different needs. Following GUI principles such as these can be helpful for designing a well-designed product. There are a few typical consequences of poorly designed digital products [19]. For one, they can feel rude, like when blaming the user for mistakes that they didn't make that rather was the interfaces fault. Furthermore, they can require people to think like computers, which might feel very unintuitive for the user. Poor designs can also entail failing to reduce workload for the user and unintentionally require them to do more work than they should need to. One can see that the consequences of failing to design one's interface in a good way can lead to a bad user experience for the users using the product.

Another way to help ensure that your product is well-designed is to make use of design patterns. In general, a design pattern is a form of reusable solution to a common, recurring problem [25]. Tidwell [26] also describes patterns as "a description of best practices within a given design domain". As such, design patterns also exist within the field of Graphical User Interfaces. A few commonly used patterns include Canvas Plus Palette, Two-Panel Selector, Carousel and Guided Tour Pattern (see Figure 2.4) [26]. Although patterns are not strict rules but more like guidelines, adhering to and using a design pattern as a starting point when designing your interface can ensure that it feels familiar to the user, and thus also feels intuitive for them [26].



**Figure 2.4:** An example of a guided tour pattern used by the communication application Slack [5]. The highlighted text box represents the guided tour and explains a part of the interface to the user.

## 2.2 Designing for interactive science centers

When designing for interactive science centers several aspects need to be taken into consideration. This chapter will dive into visitor behavior in exhibitions, how visits can take form in different constellations and formats, as well as research on visitor impressions at exhibitions and pillars of engagement. This will be followed by a deep-dive into digital guides at museums and designing for teenagers, since that is the focus of this project, and end with research on designing for interactive science centers through three identified dimensions of interaction design.

### 2.2.1 Visitor behaviour and constellations

People visiting museums consists of a broad user group where every individual has their own unique set of background, values, knowledge, experiences and abilities. They have different needs and wants, and visitor research shows that people's own agenda, also sometimes framed as visitor characteristics, plays a crucial role in how they approach and behave in exhibitions [27].

Through a museum visitor observation by Morris Hargreaves McIntyre, four differ-

ent visitor behaviours were identified: browsers, followers, searchers, and researchers [12]. Browsers are described as those that stroll around with no direct goal, followers want to follow a narration provided by the exhibition, searchers are well-read about the exhibition theme in advance and want to experience all of it, and researchers are experts only looking for specific exhibits to further their expertise.

Visitors also come in different constellations, such as exploring individually or exploring in groups with varying sizes and with varying people [28]. At the Vislab exhibition at Universeum, Boström mentions different ways of which people can choose to explore [10]. There is the traditional unguided scenario where people use the concept walk-up-and-use. In this scenario, spontaneous assistance and guidance can be given by the personnel. Vislab, similarly to other exhibitions, also holds guided tours in smaller or larger groups with content adapted to the audience group. One such audience could be teenagers visiting through a school study visit, and in such a scenario the guided tour will be more like a workshop. The last identified visit constellation he mentions is a plan for more in-depth expeditions able to be booked by the general public.

### **2.2.2 Visitor engagement**

When measuring peoples processing of an exhibit, visitor research introduce two aspects called the attracting power of exhibit, as well as the holding power of exhibit [12]. Similarly explained, Jay Rounds categorizes exhibition engagement into three phases: search rules, for when the visitor looks around at the exhibition, attention rules, for when they have attended focus onto something specific, and lastly quitting rules, for when it's time to leave that element and then usually go back to searching [29]. A third and more developed description categorises the engagement cycle into attraction, initial engagement, deep engagement, and disengagement [30].

Research by McIntyre shows that people tend to have a more selective approach in museums [12], and that people unconsciously make choices where they balance benefits with cost [31]. In this sense, success is sometimes measured in the amount of people that notice, approach and stop in front of an exhibit, as well as measuring the mean time spent in front of the exhibits. Research on visitor behaviour at museums also shows that people usually stays on the main track in exhibitions and do not generally backtrack or choose aisles. This selective behaviour is said to be mainly because of the phenomena of museum fatigue. Some factors that affect museum fatigue are environmental factors such as temperature, light, color, sound, and crowding [30].

### **2.2.3 The visitor experience**

With knowledge of visitor behaviour and engagement, it is clear that the visitor experience is affected by many factors. Jose Ocampo-Agudelo et. al. [30] states that "The visitor experience is a constructed and ephemeral relationship that exclusively occurs each time a visitor interacts with a museum." and he further says that "This

relationship will vary depending on what visitor brings to the interaction, the capability of the interactive system to respond and facilitate certain visitor actions and behaviours.” In other words, visitor characteristics, social constellations at place, the construction of the museum, what it offers and how their interactive installations and elements support visitors all plays an important role in visitor experiences.

Kira Eghbal-Azar define seven intertwined aspects that is part of visitor experiences [12]: learning, aesthetics, multisensory, bodily, emotional, social, and entertaining aspects. Learning refers to exhibitions providing learning experiences which is the core of museums. The aesthetic experience is the perception and appreciation of external objects. Multisensory aspects refers to the senses in use at exhibitions where the visual sense modality is often the strongest at exhibitions, but sound and haptic sensory are also often part of the museum experience. The walking around in an exhibition also makes a visit a bodily experience. Exhibitions also creates emotional experiences with use of media, objects and storytelling and where exhibits can create engagement through activating emotions like curiosity, meaning, relatedness, relevance, involvement, pleasure, confidence and enjoyment [30]. Furthermore, an exhibition visit is often a social experience when exploring with other visitors such as friends and family. Lastly, going to exhibitions is often not only educating, but also an entertaining experience.

#### 2.2.4 Designing for teenagers

Teenagers, aged 13-19, is a target group with needs and wants of their own, differing from those of a child or an adult. Thus, designing for teenagers should reflect and meet those needs. In a research study by Nielsen Norman Group where over 100 teenagers were observed, several design tips for designing digital media for teens were identified [32]. They noticed that teens are more successful and effective in using digital media than before because of them being a generation growing up with more tech. Nevertheless, they do identify teenagers as overconfident, impatient, and with undeveloped reading, research, and judgement abilities. Because of this they make many mistakes, and with their impatience they can easily get bored, distracted or frustrated. Further, they refute the preconception of teens often surfing the web aimlessly, and instead they describe them as goal-oriented. All in all, the six following design guidelines were brought to attention when designing UX for teens:

- Importance of content and layout
- Present interesting content professionally and clearly
- Speed is Key
- Don't talk down to teens
- Let teens control the social aspects
- Design for mobile viewing

As a summary of those points, Nielsen Norman Group recommends using plenty of space between elements. As for text it should be included sparingly and not be too small. The design should not be dull with boring content, instead it is important

with pleasant aesthetics as long as it is not to the cost of the interface being cluttered. There should be a relevant amount of interactives, and among those teenagers appreciate online quizzes, forms of providing feedback/asking questions, online voting, games, sharing pictures/stories, as well as creating and editing content. As mentioned, teenagers are impatient, and thus speed is key, meaning that it is important to minimize moments of waiting. The tone presented towards teenagers is also important, where they want to be approached in a grown-up way, and not for example be called *Kid*. Lastly, if possible, UX solutions in the form of web applications should be designed for mobile viewing since that is teenagers' most used media. Teenagers today are also daily users of social media, and designs should facilitate sharing but without forcing it.

In a study conducted regarding what things can enhance teenagers' museum experiences [14], a few factors were found. The most prominent of these factors were gaming, technology and interaction. The topic of gaming includes things such as getting achievements, getting points, answering quizzes, and going on treasure hunts. This all contributed to a sense of play and enjoyment, which some of the teenagers in the study advocated for. Some also argued that interactive technology is something that enhanced their experiences, with many of them appreciating novel technologies such as Augmented Reality, Virtual Reality, Image recognition, and holograms. Along with this, some teenagers mentioned that simplicity and usability is of high value as well.

### 2.2.5 Digital guides

Digital guides have been emerging in museums over the last two decades [12]. One form of digital guides are audio guides which gives the user oral explanations and commentary about an exhibition [13]. There are stationary guides and mobile guides. One example of a stationary audio guide can be found at Vislab's society section, where visitors can use an earpiece that is attached to a wall in order to listen to commentary about a video that is shown on one of the screens. An example of a mobile guide can be found at The British Museum [33], which lets visitors use their phone and a pair of headphones to listen to the guide. Another example of a mobile guide is Culloden Battlefield Visitor Center [34] which adds the feature of GPS tracking to track what the user sees.

However, digital guides do not necessarily have to be only audio guides. Tallon defines three characteristics of digital guides [13]:

- They are mobile, meaning that they can be accessed at any place and time
- They are digital, meaning that they are electrically based
- They are personal, meaning that they are controlled by the visitor

It could however be discussed whether the third characteristic refers to not control over the media, but a reference to the guide being interactive. Also, there is a lack of a definition relating to what the word "guide" entails in the definition of a digital guide. Thus, for the purposes of this project, a new working definition of a digital

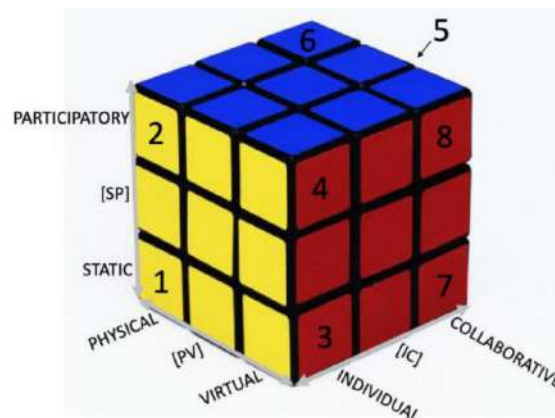
guide will be as follows:

**Digital guide** - An interactive object of digital media which helps a person navigate, and provides them with context and explanations of points of interests, on the things being explored.

### 2.2.6 A three dimensions framework for interaction

When designing interactive elements in an exhibition environment, there are different dimensions of interaction that can be good to reflect upon. Three identified dimensions are the level of participation, virtuality and collaboration in exhibits [6]. The level of participation refers to “the users’ influence over the content of the exhibit“, with a scale from fully static to fully participatory content. Fully participatory means “(the) content is co-created by the users“. Levels of virtuality refers to whether the interaction space is in the physical space or in the virtual. Lastly, the level of collaboration concerns whether interaction with the content is done individually, in collaboration between two or more people, or with both.

A way to model these dimensions are through a Rubik’s cube (see Figure 2.5). This could be used when discussing and analyzing individual exhibits.



**Figure 2.5:** The Rubik’s cube model with the three dimensions of participation, virtuality and collaboration [6]

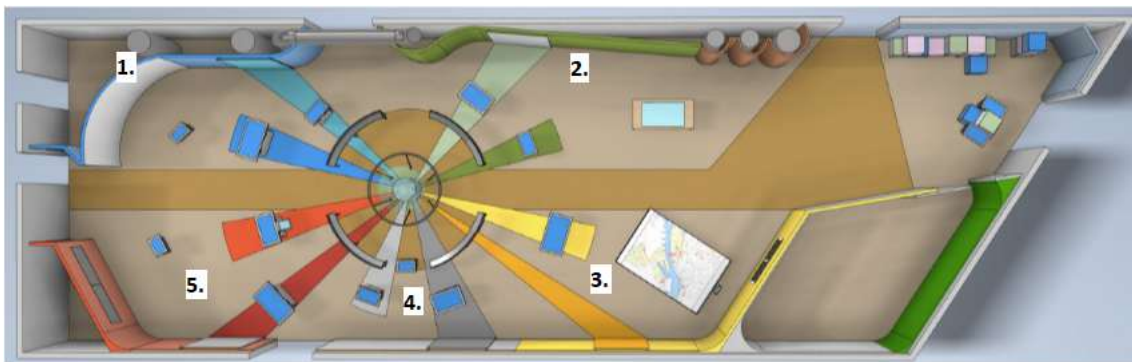
## 2.3 The science center Universeum

Universeum is the largest science center in Scandinavia [9]. Their mission is to inspire and educate people in the field of nature, science and technology, and particularly to inspire young people to make them interested and passionate about these topics. There are 600 000 visitors at Universeum annually, of which 60 000 are pupils and entire school classes.

Universeum houses several sections where the focus is on animals and nature. One of these is the rainforest, which is a room of 18 000 cubic meters with lots of different

species [35]. Another few similar sections of Universeum are the aquarium [36] and the reptilium [37], which houses aquatic species and reptiles respectively. Aside from this, Universeum also has exhibitions dedicated to more scientific and technological topics. There is for example the space exhibition, where visitors can learn about the solar system and space travel [38], or the hub, where there are guided lab-sessions [39].

One of the newest exhibitions at Universeum is Vislab, which contains 18 screen-based exhibits which use data visualizations to help communicate complex scientific data and how it relates to the world [40]. At Vislab, there are five different themes to explore: sea, land, society, space, and the human (see Figure 2.6). These themes use the global goals as a base, and aim to help people become aware of how sustainability relates to our world. Due to Vislab being our project environment, here follows a description of its content.



**Figure 2.6:** A map of the Vislab environment. 1. Sea section, 2. Land section, 3. Society section, 4. Space section, 5. Human section.

### 2.3.1 The Vislab environment

At the center of Vislab (see Figure 2.7), there is a sphere which has a projection of the earth on it. This visualization of the earth is accompanied by an exhibit that allows visitors to change what is shown on the sphere, such as bird migration patterns, forest changes, or vegetation index. Around the globe there are the five sections of Vislab, with each part of the room being dedicated to one of the five themes. Going clockwise around the room, there is the society section, the space section, the human section, the sea section and the land section.



**Figure 2.7:** The globe at the center of Vislab.

At the society section of Vislab (see Figure 2.8), there is a physical, 3D map of Gothenburg on a table. At this table, visitors can view visualizations of the city such as how the city would look if the precipitation increased, how much noise there is in certain areas, and more. Along with this table, there is also an exhibit that shows various visualizations like the flow of traffic and pedestrians in central Gothenburg or how Gothenburg looked in the 17th century. There is also another exhibit here, facing the globe in the middle. This exhibit focuses on Sweden and enables visitors to view and compare data between Sweden's 25 provinces. This data includes for example average age, income, education level, etc.. Finally, a third exhibit along the outer wall allows the visitor to input their age and then shows current and predictive future data based on how long the visitor has lived for.



**Figure 2.8:** The society section at Vislab.

At the space section of Vislab (see Figure 2.9), there is an exhibit called the space observatory station. This exhibit allows for exploring celestial bodies, orbits and satellites. It also allows for recording a user controlled journey through space which can be saved for later. There is also an exhibit that compares sizes of space related objects, beginning with an astronaut and a space shuttle and moving on to the

biggest star humans have observed so far. Finally, there is a third exhibit that shows information about meteorites and allows users to splice them and see what's inside.



**Figure 2.9:** The space section at Vislab.

At the section of Vislab which has to do with the human (see Figure 2.10), there is an exhibit facing the globe that lets the visitor explore an ethical dilemma of whom to save in a car accident. Another exhibit, also facing the globe, shows a visualization of the brain and how different parts of cognition and different subjects like math and music relate to different parts of the brain. Aside from these exhibits, there is also an exhibit that allows the visitors to view the different layers of the human body, like the skeleton and muscles, and slice it in order to see a cross section of it. Finally, there is a fourth exhibit that allows you to input data such as height and weight which then predicts other body measures based on what the user inputted.



**Figure 2.10:** The human section at Vislab.

At the sea section of the lab (see Figure 2.11), there is an exhibit that shows connections between the different species of the ocean, such as krill, penguins and orcas.

It shows a sort of web of connections, where one can choose a species to get more detailed information about them. There is another exhibit where one can view how different types of organisms relate to each other and which evolutionary group they belong to. Finally, there is also a third exhibit that shows information about the species living just off the coast of Gothenburg.



**Figure 2.11:** The sea section at Vislab.

At the land section of Vislab (see Figure G.18), two of the exhibits are very similar to two of the exhibits of the sea section. One shows an ecological web, which, like the exhibit at the sea section, shows connections between species in terms of what they feed on. Similarly, there is a exhibit for the tree of life, which like the exhibit at the sea section shows the relationships between evolutionary groups. There is also a third exhibit here, which is embedded in a wooden dinner table. This exhibit allows users to choose foods and add them to a plate to create a meal, and simultaneously presents the impact that meal has on the climate in terms of water usage, deforestation and greenhouse gases.



**Figure 2.12:** The land section at Vislab.

# 3

## Methodology

The project use a human-centered design (HCD) approach, and this chapter will describe its stages as well as prototyping tools and methods relevant for achieving the goal of each of the process stages. As aforementioned, the HCD design process consist of the following steps: understanding and specifying the context of use, specifying the user requirements, producing design solutions, and evaluating the design [17]. The HCD-approach is chosen due to its advantages of having active involvement of users, the result of enhanced empathy in the designers, increased accessibility, and solutions stronger tailored to both the end users as well as other relevant stakeholders [3] [17].

In order to make it easy to read in this particular report, we present the methods under the step in the process that we deem most relevant. However, this does not mean that each method can only be applied during that particular process step.

### 3.1 Understanding and specifying the context of use

This step is about revealing problems, needs and constraints that might go unnoticed but still be relevant for the design challenge. This can be done by creating a context-of use description [17], which includes the following:

- **The users and stakeholder groups:** you should identify all groups of users who are affected by the product in some way.
- **The characteristics of the users or groups of users:** you should identify the characteristics of each of the user groups that you identified previously. This can include experience, knowledge, preferences, physical capabilities, mental capabilities, and more. The product should be designed to accommodate people with different capabilities as much as possible for the sake of accessibility.
- **The goals and tasks of the users:** you should identify the goals of the users and the goals of the product or system. You should describe how users usually carry out tasks, how long it takes, parallel tasks, and dependencies upon other tasks. You should identify risks for the users' health and safety, and also risks for the task to be incorrectly carried out.
- **The environment(s) of the system:** you should identify characteristics of the physical, social and cultural environment. The physical environment

includes things such as space, light, temperature and noise. The social and cultural environment includes attitudes and mindsets.

These aspects can be gained with the use of methods such as context-of-use analysis, questionnaires, and field studies, as well as discussions where you identify stakeholders. These methods will be described further.

### **3.1.1 Context-of-use analysis**

Context-of-use analysis is a method for detailing information about in what context the design solution is to be used [3]. This method is especially useful for when the stakeholders already know things about the context. The method is done by meeting with the stakeholders and gathering information through questionnaires, interviews or conversation. The gathered information can be divided into user group, tasks, technical environment, physical environment, and organizational environment. For this, you can ask questions such as:

- Why is this solution being designed or developed?
- Who are the intended users?
- What tasks will the users do?
- What do the users want to achieve by finishing the tasks?
- What are the users' skill-level for relevant technology?
- What are the usability goals?

### **3.1.2 Questionnaires**

Questionnaires is a method for collecting demographic data and user-opinions [2]. The questions can be structured with a small range of possible answers, or they can be open-ended depending on what you want to learn from the answers. They are often used in conjunction with interviews in order to clarify answers or deepen the understanding of the answers. They are a good way of efficiently collecting quantitative data, as they can be sent out to a large number of participants and the participants can answer them remotely when they have the time for it.

### **3.1.3 Field studies**

Field studies, or observations, can be useful during several stages of the design process [2]. It can for instance be used early to help designers understand the context, who the users are, what they do, what their goals are and what they have difficulties with. Field studies are done by being a passive bystander and observing people without interfering. When doing this, one should have a clearly stated goal and it might help to follow a framework. One simple framework is to focus on three things:

- The person: who is using the technology at any particular time?
- The place: where are they using it?
- The thing: what are they doing with it?

There are also other, more detailed frameworks, like the one from Robson [41], where focus lies on:

- Space: what is the physical space like?
- Actors: who are the people involved?
- Activities: what are the actors doing and why?
- Objects: what physical objects are present?
- Acts: what are specific individual actions?
- Events: is what you observe part of a special event?
- Time: what is the sequence of events?
- Goals: what are the actors trying to accomplish?
- Feelings: what is the mood of the people present?

It is often difficult for people to accurately explain what they do or how they would act in a certain situation. Field studies can help show how the user would act in a natural setting as opposed to a controlled setting, and can help show how users actually behave [2]. In a controlled setting, the users may act differently than what they would have done in a real-life scenario because they are aware that they are conducting a test of the product of some sorts.

## 3.2 Specifying user requirements

This step is about creating explicit user requirements of the product you are designing [17]. These requirements should be in relation to the context of use. The requirements should state what users want or need to achieve, rather than how they should achieve it. Furthermore, ISO standard 9241-210:2019 [17] states that these requirements should not only include user requirements based on their needs, but also requirements that are derived from the constraints imposed by the context, requirements based on usability goals, requirements based on universal standards and guidelines, and requirements based on organizational requirements. Moreover, the user requirements should be verified by relevant stakeholders and should also be updated throughout the course of the project. Here follows a set of methods that can be used to specify user requirements.

### 3.2.1 Interviews

Conducting interviews is a good way of gathering data. There are four types of interviews most often seen: unstructured interviews, structured interviews, semi-structured interviews, and group interviews [2]. Unstructured interviews can go into depth for the questions if the need arises, and leaves a lot of freedom in terms of how the interviewee can answer. They can also be good when one does not know the range of answers and wish to explore the problem space. One drawback is however that the answers can vary a lot, making it more difficult to draw conclusions. On the opposite end of the spectrum, structured interviews can be good when the one has a better idea of the problem space, though they may not always leave room for the interviewee to say everything they want to say. Compared to an unstructured interview, it may be faster to conduct a structured interview for this reason.

Semi-structured interviews fall somewhere in between an unstructured interview and a structured one, and an interview may become more or less structured depending on the question and the context. If the interviewer senses that the interviewee has more to say regarding a certain question or topic for instance, they might ask the interviewee to elaborate, thus moving the interview towards a less structured point and getting more information out of it. Finally, there are group interviews, or focus groups. This involves a cross-section of the stakeholders with around three to ten people, and the discussion is led by a facilitator. This allows for more inclusion and diversity, and might raise issues that might otherwise go unmentioned.

When planning an interview and developing questions, there are a few things to keep in mind [2]:

- Think of whether a question is more suited to be open or closed.
- Think of whether a question should have a range of possible answers.
- Split up compound questions into two separate questions so that it is more easily understandable for the interviewee.
- Avoid jargon and instead use simple language and layman's terms.
- Keep the questions neutral and avoid assumptions about the interviewee's opinions and answers.

Because of the fact that interviews are so flexible, they can be used during several stages of the design process. An unstructured interview may for example be used for understanding the context of use, while a more structured one might be suited for evaluating the design solution.

### **3.2.2 Personas**

Personas are fictional characters that are essentially real users distilled into a character [42] [2, p. 357]. Personas are used for establishing details about the users, and will help you understand your users' needs, goals, experiences and behaviours.

To create a persona, you should always start with some user research to base your personas upon. It is also a good idea to have a primary persona and a secondary persona, since there might be more than one target group. As for the details about the persona, they usually include [42]:

- A picture
- A name
- Age
- Values and characteristics
- Goals, desires and needs
- Lifestyle
- Experience
- Limitations
- Interests

This is to help designers more easily relate to and empathize with the persona, and thus also with the users. To further help relate and empathize with the users,

personas are often used in conjunction with scenarios.

### 3.2.3 Existing system/competitor analysis

Competitor analysis involves taking a look at existing products that are similar to what one is designing, and analyzing it [3]. By looking at what usability problems already exist in such a product, you can more easily avoid those problems when designing your product. Similarly you can look at valuable features and requirements of an existing product and include them in your own design.

### 3.2.4 User and usability requirement specification

User requirements are about the functions that the product or system should have and descriptions of the tasks that these functions will allow for. Usability requirements on the other hand help set goals for the design in terms of usability factors. According to Maguire [3], some general usability goals are:

- Effectiveness: the degree of success with which users achieve their task goals
- Efficiency: the time it takes to complete tasks
- Satisfaction: user comfort and acceptability

Maguire also brings up some more detailed usability goals that can help specify your design objective even more:

- Understandability: whether users understand what the system can do.
- Learnability: the training, time and effort required to learn to use the system.
- Operability or supportiveness: supporting the users throughout the interaction and helping them to overcome problems that may occur.
- Flexibility: enabling tasks to be carried out in different ways to suit different situations.
- Attractiveness: encouraging user interest and motivating them to explore the system.

These usability requirements are often specified as a requirement + a measure [3]. An example of such a requirement could be “Learnability: high”.

## 3.3 Producing design solutions

This step is about coming up with solutions for the problem that you are facing [17]. These solutions should fulfill the previously stated user requirements and should be appropriate for the context of use.

When designing interactive systems, there are a few principles that should be taken into account [17]:

- suitability, how suitable the solution is for the task
- self-descriptiveness, how obvious it is to the user where they are in the process and what actions they can take

- conformity with user-expectations, how much the product matches the users' expectations
- suitability for learning, how easy it is to learn how to use the product
- controllability, how easy the product is to control
- error tolerance, how robust the product is and how forgiving it is if there are any errors'
- individualization, how much the product allows for customization and tailoring for specific users' needs

If we compare this step in the HCD design process to that of Preece's interaction design process [2] mentioned in chapter 2.1, this step would be the equivalent of designing alternatives and prototyping. In other words, you should not only come up with solutions to the problem in this step, but also create prototypes of those solutions that at least partially convey the idea and functionality behind the solutions. These prototypes can then later be used for evaluating the design solutions in the next step of the process.

### 3.3.1 Brainstorming

Brainstorming is a method used in the ideation phase for generating ideas [43]. Brainstorming is not about choosing an idea, but rather about coming up with lots of ideas so that you have a wide range of ideas to choose from later.

To conduct a brainstorming session, it is recommended to gather participants from a range of disciplines for a certain amount of time (around an hour or so), establish what you are trying to ideate on, and begin ideating. You should also have a facilitator for the session [44].

There are a few things that can help make your brainstorming session as efficient as possible [44]:

- You should begin the session with a clear problem statement.
- You shouldn't critique or debate ideas.
- You should number your ideas.
- You should build on and jump between ideas.
- You should write down the ideas and relate them to the space you are in somehow.
- You should do some form of warm up before the session begins.
- You should bring materials and physical objects to the session for helping people visualize and explain their ideas.

### 3.3.2 Sketching

Sketching is a way to get your ideas down on paper and is thus often used in conjunction with brainstorming. Sketches help you explore, propose, refine and communicate ideas, and they also help you think more openly about your ideas without worrying about their quality [45]. To help us view the sketches as such, there are a few characteristics that one should keep in mind in regards to sketches:

- The sketches should be drawn quickly. You shouldn't invest too much time into them.
- The sketches should be disposable. You shouldn't invest too much effort into making it look good.
- The sketches should be minimalist. You should keep in mind what you want to convey with your sketch and make that the focus of the sketch.

You can also enhance your sketches by adding annotations, arrows and notes to them in order to provide a bit more detailed information.

### 3.3.3 Co-design workshop

Co-design is about designers and other people that aren't designers working together creatively in the design process [46]. To conduct a co-design workshop, you as a designer therefore need to invite people that aren't designers and have a session with them where you ideate. The workshop can be together with developers, users that will use your product, users of similar products, or just people who have a passion for or knowledge in the domain. You should provide the participants with ways to ideate and express their ideas, such as pen and paper or physical objects, just as one would for a brainstorming session. It might also be a good idea to have a facilitator for the session to help guide the participants through the workshop [46]. One benefit of a co-design workshop is that it can help reveal subconscious needs and goals of the user. They might not be able to articulate these needs in an interview or even realize that they have them, but they might be able to express these needs when ideating and designing something.

### 3.3.4 Affinity diagram

An affinity diagram is a way to group ideas and insights and relate them to each other [2, p. 292] [47]. It can be useful for making sense of a large number of ideas, which you will often be what you have after a brainstorming session and which is why affinity diagrams are often created as a follow up to brainstorming sessions. To create an affinity diagram, you need a space to position all your ideas, such as a board or a wall. You then begin by putting up ideas one at a time. As you put up ideas, you should consider whether or not an idea is similar to another idea that has already been put up on the board or wall. If it is similar you should put them next to each other, and if not you should put the new idea somewhere else. By the end when all ideas have been put up, you should have a few clusters of similar ideas. At this point you should name the clusters appropriately and rank them based importance [47]. There is also a possibility of the ideas ending up in a hierarchy of bigger ideas that branch out into smaller ideas.

### 3.3.5 Paper prototyping and wireframes

Paper prototyping has to do with creating interface elements using paper [3] [2, p. 395]. When showing this prototype to a user, the user can interact with the prototype by pointing at elements to indicate that they want to click on it. A person

then acts as “the computer“, moving around elements and adding or removing elements based on what the user does. Paper prototypes are appropriate when you are dealing with a graphical user interface.

A wireframe is a higher fidelity prototype when compared to paper prototypes. Wireframes are prototypes that are made using programs that are dedicated to this, and thus they can be viewed and interacted with using a keyboard and mouse rather than by the user pointing at things [2, p. 449]. This allows for a more realistic representation of the interface, and is especially useful if technical performance is of importance. The main difference between paper prototypes and wireframes is that paper prototypes are faster to create but come at the cost of lower-fidelity, while wireframes are higher-fidelity but take more time to create. Because of this, wireframes are often used after paper prototypes when one has a better idea of how the interface should look and function.

### **3.3.6 Digital prototyping**

Digital prototypes are a form of prototypes that are higher fidelity than paper prototypes and sketches, and which are made with software [48]. Examples of digital prototypes are video prototypes, 3D models and GUI prototypes.

The advantage of digital prototypes are that they more accurately represent the final product and how users interact with them [49] [48] when compared to a lower fidelity prototype like a sketch or paper prototype. Aside from interactivity, a digital prototype is also often higher fidelity in terms of visuals and content [50]. Another advantage of digital prototypes are that they are easier and faster when used for testing [50] [49].

## **3.4 Evaluating the design**

This step is about evaluating how well the design solution(s) fulfill the requirements and enable the user to achieve their goals with the product [17]. This evaluation should be done with real users from relevant target groups and is often done using a prototype of the design solution to communicate the idea of how the design works. If circumstances where testing with actual users may not be possible, the design should be evaluated using methods such as simulations or against a set of heuristics.

The evaluation can be used for [17]:

- collecting new information about the users’ needs
- provide feedback on strengths and weaknesses of the design
- comparing design
- assess whether or not user requirements have been achieved

### **3.4.1 Controlled user testing**

Controlled user testing has to do with evaluating a design in a controlled environment, such as a laboratory [3]. The user tries to do a set of tasks while the researcher

observes. The user may comment on things that come to mind as they are using the product or system and the researcher can ask questions about certain things if needed. You can also have a session with a set of questions after the tasks have been attempted to be completed by the user. The main advantage of controlled user testing is that the product or system is tested in a setting which is similar to the environment where it will actually be used once it is fully developed.

### **3.4.2 Participatory evaluation**

In a participatory evaluation, which is often called think-aloud, users perform a task while using a prototype of the design solution and are then asked to verbally express their thoughts, or in other words, think aloud [3]. To make this more effective, the person observing and evaluating the participant can ask questions in regards to their intent and experience when the participant seems to be beginning to talk less. One form of participatory evaluation is an evaluation workshop, where the user tries to achieve a task while the designer observes without asking questions, but instead asks questions and has a discussion afterwards.

### **3.4.3 Satisfaction questionnaires**

Satisfaction questionnaires are questionnaires that users are asked to fill in after having tested a prototype [3]. The goal of these questionnaires are to gather information about the user's experience with the product. This information does not have to come from a questionnaire either, but can come from simply asking the users about their thoughts and opinions after they have used the prototype. One example of a satisfaction questionnaire is the SUMI questionnaire [51] which measures perceived efficiency, likeability, control, learnability, and helpfulness.

## **3.5 Tools**

When designing and conducting various methods to develop designs and create prototypes, it is common to use supporting tools. Here follows a set of tools often used for these purposes in the design phase.

### **3.5.1 Figma**

Figma is a free online program for creating mockups and prototypes of graphical user interfaces [52]. It allows for collaborative creation, enabling multiple people or teams to work on the same design project at the same time. It is used commonly by designers, both by individuals and by large-scale companies. Figma is often used for coming up with designs in the ideation phase and for creating prototypes when producing design solutions.

### **3.5.2 Miro**

Miro is a free online collaboration software that works similar to an online whiteboard [53]. It was created in 2011 and has over 35 million users worldwide and enables teams to create mind-maps, notes, ideas and designs through its suite of tools. Because of its variety of uses, Miro can be used in several stages of the design process. A few examples include analysing user research, creating personas for the user requirement specification, and brainstorming in the ideation phase.

### **3.5.3 Visual Studio Code**

Visual Studio Code (VScode) is a free code editor created by Microsoft [54]. Compared to other integrated development environments (IDEs), it is more lightweight and aims to leave out complex functions. It also comes with many helpful extensions and plugins, making it easier for developers to quickly write code and create applications. In particular, it has become well-known for web development. Because of this, and its quickness and ease-of-use, it is a suitable tool for constructing prototypes of graphical interfaces.

# 4

## Planning phase

The following chapter describes how we identified the issue of digital guides, and how our problem statement came to be, see 4.1 Research and pre-study. This is followed by the section 4.2 Planning the design process, which describes how we from that problem statement planned the process of our project, including what design approach and use of methodology frameworks we aimed to use.

### 4.1 Research and pre-study

The project began with a research and pre-study phase. A study visit to Vislab at Universeum was made where we got an introduction to their exhibition content and technology, as well as information about their main target group and what challenges they face at the exhibition. The goal of the visit was to learn more about their environment, explore the visualizations at the exhibition, and to gain insight on how we with the help of interaction design could contribute to visitor engagement at Vislab, as well as for other similar exhibitions.

To learn more about interactive exhibitions and related work, a literature study was conducted. We identified relevant topics such as explanation, data visualizations, digital guides, interactive exhibitions, introductory installments, and designing for teenagers, and set out on finding scientific literature through research databases such as Google Scholar [55]. We then selected, read and summarized those we deemed most relevant.

With our findings, we identified a knowledge gap in research about digital guides at exhibitions. There were research saying that guides made the visitor learn and explore more of an exhibition, but little research was found about more in-depth detail about why that is, and how they can be developed further to support exhibit exploration and leave the stage of only being an audio guide. The development of them has been minimal considering the opportunities all novel technology of today brings. Also, little research was found on how digital guides specifically could help with engagement at visualization centers. Visualizations is known to be a commonly used tool today for learning and connecting data, but with the growing amount of research data, the more advanced the visualisations. Thus, we wanted to research if and how digital guides could help with creating engagement to technically advanced visualization labs. This resulted in our research question: “ *What are key considerations for designing an interactive digital guide intended to increase engagement*”

*for teenagers interacting with advanced data visualizations at exhibitions?* “. With this question and our research and pre-study, our project was planned.

## 4.2 Planning the design process

The project was planned to use a human-centred design (HCD) approach, with a process consisting of three iterations of the HCD-cycle. The first and second iteration was planned over four weeks, while the third and final iteration was planned for two weeks. This was because of the assumption that the project’s context and requirements would be well established by then, and the design faster to iterate on. The intention was thus to focus less on the steps of specifying the context of use and establishing requirements from the third iteration, and focus more on final tweaks of the design and evaluation on the final design concept.

For the first iteration we planned to conduct a thorough background and user research mainly focusing on understanding, specifying context of use and requirements. All in all, ending with a couple of initial design concepts to evaluate. The second iteration would consist of re-evaluating our requirements, continuing to iterate on our design concept, and creating prototypes to evaluate higher-fidelity designs. The third and last iteration would include further development on the design, and conclude the project in relation to the research question and turning our learnings into a set of guidelines.

In the following subchapters, we will present our initial plan for these iterations, including the methods we aimed to use. The plan was then expected to be constantly re-evaluated during the process and most likely changed in some ways.

### 4.2.1 First iteration plan

The first iteration was planned to begin with a context of use analysis through a meeting with Jonas Boström and Catharina Djurelind, educators and co-creators of Vislab, where we go through relevant questions such as those mentioned in subsection 3.1.1. The method was deemed particularly appropriate because we had direct access to stakeholders that already knew things about the context. This analysis was planned to give us a broader insight to the problem, technical feasibility, and open up discussion and reflection on the topic of designing for exhibitions.

The next step was to create and send out questionnaires to users and stakeholders to learn more about the context. From the result, the plan was to similarly to the field study, analyse the result, likely through a thematic analysis.

Moving on to the stage of specifying requirements, the plan for the first step was to create personas based on the answers we received from the questionnaires and the learnings we gathered from the context-of-use analysis and field studies. The purpose of personas was to help with getting a more accurate and concrete description of the various users, which could help when coming up with relevant design

solutions. Personas would help us focus on actual user needs, and not what we as designers think they need.

Afterwards, a competitor analysis of existing systems was planned to be done. The intention was to look at the existing audio guide at Vislab and look into what works and what works less well. We would also be researching other similar products and see if there are any features or requirements that we would want to take inspiration from or if there are any problems to avoid.

We would then be creating a requirement specification so that there is a concrete requirement list. These requirements would be divided into usability and user requirements so that we specify both the requirements of the digital guide and what usability goals we should prioritize.

The next step was to come up with design solutions. The plan was to begin by having a brainstorming session where we ideate broadly on what forms the digital guide can take. Since brainstorming is an effective way to come up with a lot of ideas, it would be appropriate for this stage where a large quantity of ideas is preferred. In conjunction with brainstorming we would be sketching on ideas to better illustrate and communicate the gist of them. Then, because the brainstorming session would likely result in a large quantity of ideas, we would group the ideas through the affinity diagram method to better make sense of them. Lastly, to begin honing in on a few ideas, the plan was to pick out the ones that fit the design objective best and create more detailed solution sketches of them.

Finally, as a last step of the first iteration, the plan was to have interviews with Boström and Djurelind in order to receive feedback on the ideas we picked out. We would then be discussing how well each idea might fulfill the goal and how feasible it might be.

### **4.2.2 Second iteration plan**

The second iteration was intended to begin by looking at the context of use and requirements that emerged from the previous iteration and evaluate, with our newly gained knowledge, if they were still appropriate. Once that is done, we would then be having a co-design workshop with a group of teenagers, since that is the target group of this project. The workshop was planned to use the design solutions from the previous iteration as a base and will likely be held in the conference room at Vislab. The intention as also that it would focus on the entire use-cycle of a digital guide, including how we can encourage people to choose to use the guide, what the entry point for beginning to use the guide might look like, how it works in-use, and how one might stop using the guide. We would explain basic concepts of a design process, examples of technology that can be in the design, and include paper tools that can be used for sketching. As a follow up, general reflections and another affinity diagram would then be created to analyse the results from the workshop. From the workshop the hope was to gain knowledge of what teenagers feel are important

in a digital guide, which might lead to an update of the requirement list, as well as resulting in possible development of digital guide concepts in our design process.

The plan was then to have another brainstorming and sketching session, with this session having a narrower goal than that of the previous iteration. The intended focus of this session was iterate on the existing ideas and concepts, both our own and those of the workshop. The plan was to choose only one concept to go forth with, after which we would create prototypes of the design solution we chose. This prototype would be dependent on what is relevant for that specific idea. We might for instance find that a paper prototype or a wireframe is more appropriate, or we might find that a digital prototype is more suitable. It was also intended that the prototype should reflect what is needed to be explored further, keeping in mind our research question of finding key factors for an interactive digital guide.

The next step in the plan was to evaluate the design using the prototype. For this we would be conducting a controlled user-test with teenagers including think-aloud, followed by having post-experience interviews. Finally, an affinity diagram of the interview answers and the observations was planned to be done.

### **4.2.3 Third iteration plan**

With the knowledge gained from the analysis from the previous iteration, the plan was then to evaluate the requirements one final time to make sure that the right things are being prioritized. We would then be doing some final tweaks on the design based on these requirements, which would likely be smaller changes compared to the first and second iteration.

Finally, we would sum up our findings and what we have learned throughout the project. The idea was that by this point we would have collected and analysed data which will hopefully have given us insights into what key factors there are for designing an interactive digital guide. At this stage we would be gathering these learnings into a set of guidelines.

# 5

## Process

The design process included three iterations of the Human-centred design (HCD) cycle. The methods used and the length of the steps of the design process varied between iterations. The first iteration had more of a focus on the early stages of the design process, since this was the very first step in our design process and we needed to learn about the context of use. Because of this, we spent more time and conducted more methods for understanding the context of use and specifying user requirements. The need for this was diminished in later iterations, since by the second and third iteration we already had an idea of the context, which meant that the second and third iteration had more of a focus on developing our solution and evaluating it. Similarly, the second iteration and third iteration differs slightly as well. The focus of the second iteration was to develop our concept from the first iteration, which meant that we spent more time on producing design solutions and ideation. The focus of the third iteration however, was to finalize the design solution and evaluate it, which meant that we spent more time on creating a prototype that could be tested and spent more time on evaluating the design solution.

Below follows a presentation in more detail about what we did during the design process in the three iterations that were performed, as well as the result and insights that were gained.

### 5.1 First iteration

The first iteration was mainly about understanding the context of use and coming up with an initial concept, intended to be further iterated upon in the next two iterations. The following section covers the process and methods that were used for this first iteration: an initial Brainstorming session, Context of use analysis, Competitor analysis, Field studies, Personas, Requirement specification, Brainstorming to bring forth a first design concept and then an Evaluation meeting.

#### 5.1.1 Initial Brainstorming

Before researching the context of use and specifying user requirements, we began the project with a brainstorming session. This was not a part of the original plan but at this point in the design process we as designers felt the need to get inspiration and to broaden our own scope of what a digital guide could entail. All in all, it was done not to create design solutions but to help us in our creativity when approaching the

other methods in the first iteration. The brainstorming question used were "What might a digital guide look like?". This resulted in various concepts with different forms, features, technologies, ways of communicating and social contexts (see Figure 5.1 and Appendix C).



**Figure 5.1:** A photo of the affinity diagram conducted after the initial brainstorming where the different ideas were grouped into different themes.

### 5.1.2 Context of use analysis

A context-of-use analysis was conducted together with stakeholders from Universeum in the form of a meeting. The project's focus on designing a digital guide was discussed together with Universeum's challenges at the Vislab exhibition. Some of those discussions included the relevance of a digital guide implementation, how similar audio guides at Universeum works today including whom uses them, why some do not, and how they are being marketed. Further discussions were about the main goals for Vislab as an exhibition, about their target group, what challenges they face, if certain visualisations are more important or more difficult to interact with than others, the feasibility in us as designers to make changes in existing visualisations, as well as what usability goals they deem most important in a digital guide at Vislab.

The context-of-use meeting resulted in answers to the above questions, including general design tips from Universeum (see Appendix B). Vislab's current main challenge was identified is to be "How to get people to approach the visualisations (screens) and make them to stay and interact with them." The most important things to consider when designing a digital guide were:

- Make sure the guide still encourage exploration of the exhibition room, e.g. make sure the visitor do not end up only having attention on their smartphones during the whole visit.
- Have in mind that there is a threshold to start using the current audio guide.

- It is important that different parts of the guide does not takes too long to go through, e.g. eventual video clips should stay under 30 seconds.
- Nudging is a good way to make people interested in things, e.g. such as visitors "Have you tried this?" or "What would you do?".
- A way to make people interested in the screens is to make the visitors feel the relevance to him or herself in the content.
- People generally don't read instructions, thus the user of the guide should not need to read how to use the app, but instead approach it and start using it directly.
- It is important that the guide can be used together with others.
- The two most important usability goals for a digital guide should be learnability, i.e. it should be easy to use the app st first try, and error handling, i.e. it should be easy to recover from an error.

### 5.1.3 Competitor analysis

After the context-of-use analysis, a competitor analysis was conducted. Five museums and exhibitions were attended: Naturhistoriska muséet [56], Göteborgs stadsmuseum [57], Världskulturmuséet (see Figure 5.2) [58], Älvrummet [59], and finally Vislab itself. The analysis was done by using audio guides or similar instruments at each museum respectively and noting down thoughts regarding how the visit felt in general and how the guides worked. Afterwards, the guides were analysed in terms of attributes, such as what input they allowed for, what type of output they had, whether they were mobile or stationary, etc. Moreover, strengths, weaknesses and important findings were noted down (see Appendix A).



**Figure 5.2:** The interface of the digital guide at Världskulturmuseet, showing a map of the exhibition.

Some of the most important findings from the competitor analysis were:

- The visitor should be introduced to the guide no matter what entry or order of exploration they take. It should be easy to find, including how to begin using it.
- The entry threshold to using the app should be low.
- The guide should not include too many navigational steps, and those that exist should be clear and evident.
- If the guide use a graphical interface, it is helpful to include a map of the exhibition area in the guide.
- Teasers about exhibits is a good way to pique user's interest and then urge them to find out the information for themselves through own exploration.
- Having a narrative in a guide is great way to get a nice thread through the experience.
- Could be a good idea to create some kind of game to nudge people to explore all parts of the exhibition.

#### 5.1.4 Field studies

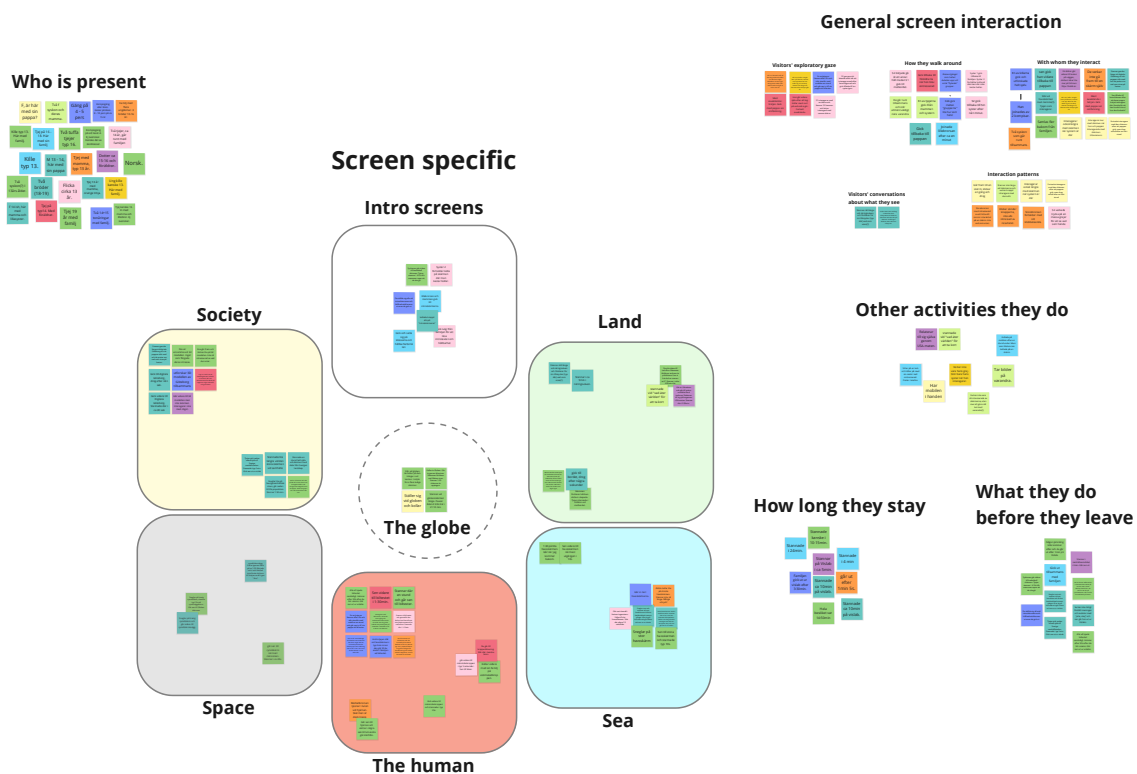
Field studies were conducted in Vislab. We went to Vislab and observed visitors who looked to be in their teens and looked at their behaviour. For the field studies, the following questions were kept in mind (see Table 5.1).

What	Main question	Follow-ups	How
Objects	What exists in Vislab?	What does Vislab look like? What feeling do one get?	Note down one time
Actors	Who are the visitors?		Recorded over time
Feelings	What is the mood of the room?		Recorded in interval of 30 min
Activities	What are the visitors doing?	What seems to be their goal?	Recorded in interval of 30 min
Acts	What does the individual visitor do?	Why? At what time? And at what place?	Recorded over time
Time	How do people move through Vislab?	What is their sequence of events?	Recorded over time

**Table 5.1:** Table over what was observed during the field study, together with observatory questions and the frequency in which they were going to be answered.

The answers to these questions as well as other stray thoughts were noted down using sticky notes on the Miro android app. The notes were then analysed and grouped (see Figure 5.3) in order to help make sense of the data, which were then summarized into a set of important findings such as:

- People seldom come alone
- People stayed at the screens for longer if they were interacting with the screens alongside someone else
- Some of the teenagers had a phone in their hand while moving through Vislab and interacting with the screens
- Those who were looking at their phones while entering Vislab seemed to leave more quickly compared to those who weren't looking at their phones
- There were both Swedish-speaking and non-Swedish-speaking people attending the exhibition



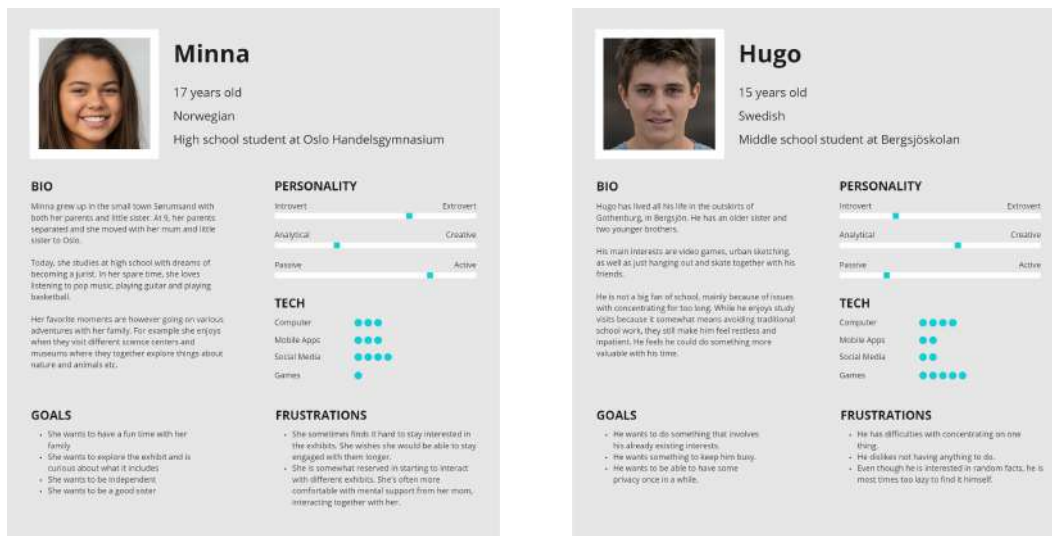
**Figure 5.3:** The affinity diagram that was made from the field studies, created in Miro. In the diagram there is gathered data about who the visitors are, their interactive behaviour, visit duration, their action before leaving the exhibit, as well as insights related to different screen exhibits at Vislab.

### 5.1.5 Personas

Afterwards, personas were then created based on the findings from the field study. When creating the personas, the following were taken into consideration and included:

- Name
- Age
- Grade and school
- Bio
- Personality
- Tech knowledge
- Goals
- Frustrations

Two personas were created - one primary persona called Minna and one secondary persona called Hugo (see Figure 5.4).



**Figure 5.4:** A screenshot of the two personas that was created to have a common picture and understanding of possible end-users.

### 5.1.6 Requirement specification

With the context of use specification, the findings from the competitor analysis, the findings from the field studies and the personas in mind, a requirement specification was created to serve as a starting point for the upcoming brainstorming (see Figure 5.5).

### 5.1.7 Designing a first concept

To begin designing an initial concept, another brainstorming session was held. Judging based on the findings from the literature study, competitor analysis and field studies, it seemed as though a game of some sort would be an appropriate concept, at least in this case where teenagers were the target group. The same way was felt about designing for a smartphone. The starting point of the brainstorming session was thus to come up with ideas that involved mobile phones and could be played by the user as some form of game.

Two of the most promising ideas that emerged were Idea 1, using Augmented Reality (AR) (see Figure 5.6) and Idea 2, without AR (see Figure 5.7). Both of these ideas involved the user completing quests of some sort for each of the screen at Vislab, and both showed a map of Vislab to help with navigation. Solution sketches of these two ideas were created and the details and functionality of them were specified further. The ideas were evaluated together with Josef Wideström, a hired design expert at Universeum and supervisor of the project, it was decided that Idea 2 would be further developed and it was thus translated from paper into a Figma prototype. Idea 2 was chosen mainly due to its simplistic interface, to make the use as easy as possible. Also, because of a recommendation not base the whole guide on AR

## Requirement Specification

### Must have

#### Presentation

- Visitors should be informed that the **guide exists**, and **how it can be "reached"**.
- **Entry information** about the guide's existence should not solely be available at the main entry.
- The guide should be **easy to find**.

#### Interface of guide

- The **first-time-use** of the guide's interface should have a low threshold.
- How the overall interaction with the guide works should have **consistency**.
- The guide should not have too many navigational steps (**little navigational excise**).
- The guide should entail a **graphically pleasing** interface in a way that it uses colors, layout, fonts, sizes in an inviting and non-cluttered way.
- The guide should **handle errors** and mistakes efficiently, making the user recover quickly.
- Learnability should be prioritized.

#### Guide content

- **Information** about specific parts of the exhibits should be **available at one and the same place**.
- Only **relevant information** should be displayed and available.

#### Connection to exhibition

- The guide should provide the user with **navigational support** (in the physical room).
- The guide should **relate the user to the content** of the exhibition.
- The guide should **make users dig deeper** into the visualizations (Measure: Stay longer than 30s?).
- The guide should provide the user with a **red thread of the exhibition**.
- The guide should encourage and **make people interact** with the exhibits at Vislab.
- The guide should provide **teasers** for the different screens so entice visitors to begin interacting with them.

#### User-specific

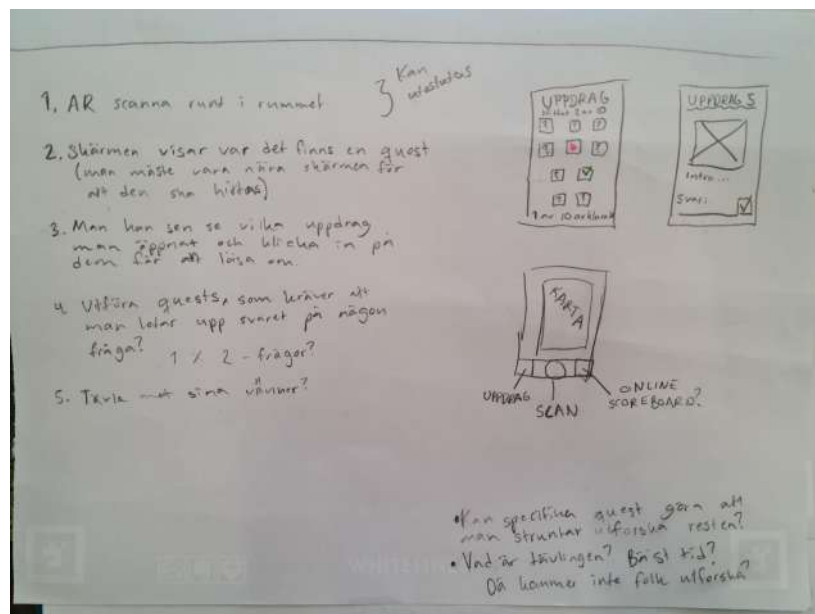
- The guide should be able to be used both by **individual visitors** and by a **group of visitors coming together**.
- The guide should be able to be used by **non-swedish speaking people**.

### Want to have

- The guide should **encourage visitors to find information** from the screens by **themselves**.
- The guide should inform the user that the visualizations use **research data**.

**Figure 5.5:** A screenshot of the Requirement specification made for designing a digital guide at Vislab. It is divided into *Must have* and *Want to have* were the former includes requirements in the areas Presentation, Interface, Content, Connection to exhibition, and User-specific.

technology, and instead see AR as a possible technology to include in certain chosen quests of Idea 1.



**Figure 5.6:** Idea 1 - a mobile interface using AR technology. The interface consist of a main screen including a map of the exhibition, as well as three tabs at the bottom where the user can choose to scan the room for quests, open a view of found and performed quests, as well open a view of an online score board.



**Figure 5.7:** Idea 2 - a mobile interface that does not use AR. This interface is viewed in landscape mode and has only one view (a map of Vislab) with quests showing up as overlays.

The concept for Idea 2 was that the home screen showed a map of Vislab with each

of the screens (see Figure 5.8). Users could then click on one of the screens to view information about that particular screen, as well as answer the quiz for that screen (see Figure 5.9). The idea was that by prompting the user with a question, the guide would pique their curiosity and hopefully make them investigate the screen in order to answer the question and see if they had gotten the answered correctly. Moreover, once a question had been answered, the user would not only get to see what the correct answer was but also they would see what other people had answered (see Figure 5.10). Users can also click on the walls to get information about that area of Vislab and what visualizations they can find there.



Figure 5.8: Figma prototype v1 - Home screen.

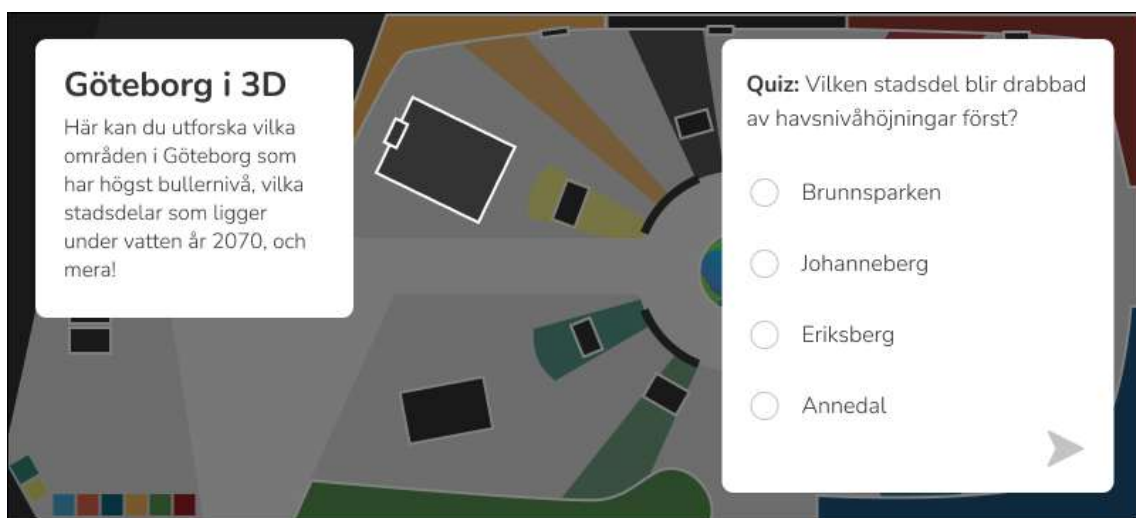


Figure 5.9: Figma prototype v1 - Quiz question.

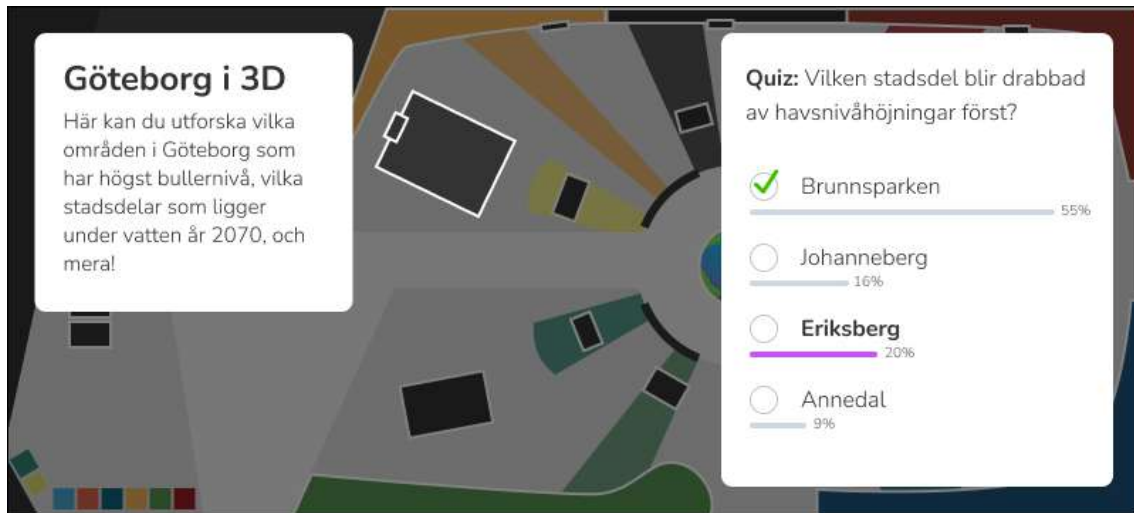


Figure 5.10: Figma prototype v1 - Quiz answered.

### 5.1.8 Evaluation of first concept

Once an initial concept had been established, it was evaluated with the stakeholders at Universeum; Jonas Boström and Catharina Djurelind as pedagogues at Universeum, as well as the lead in digital development at Universeum, Christa Törn-Lindhe. The concept was presented and a few general questions were asked, such as what they thought of the concept, whether or not they think a quiz would be a good way of increasing engagement, what challenges there might be, etc.

They expressed concern that according to their previous experiences, a quiz may not be the best way of getting people to engage with the screens at Vislab. Instead, they suggested ways of letting the visitor express their opinions somehow, such as by implementing some form of feedback-box in Vislab where visitors can share what they think about the exhibition. Moreover, it was stressed that it would be nice if the concept provided some form of digital assistance in making the visitors *see themselves* in the visualizations. One example that was brought up was that the first thing most people do at the 3D map of Gothenburg is pointing out where they live. People seemed to really enjoy feeling like they were a part of the information presented in the visualizations.

Aside from the feedback above, the focus of the meeting strayed at times from our intentions. The purpose of the meeting was to receive feedback on the concept of a gamified Vislab experience. However, instead the focus became mainly on the content (such as whether our quiz-question was good) and technical details (such as if we have thought about setting up a server, whether we have thought about checking for bad language in user inputs). Those were details that had less to do with our concept. Another difficulty was discussions of how our solution could be adapted to fit into Universeum's existing content, thus putting restrictions on our exploration to our research questions. All in all, an important learning gathered from the meeting was to make it more clear from the start on what the purpose of

scheduled meetings are.

## 5.2 Second iteration

The second iteration is about involving actual users in the target group in the process and then updating the initial concept based on previous feedback. The following section covers the process and methods that were used for this second iteration: a Co-design workshop, a substantial update to the concept, and a controlled-user test to evaluate the concept.

### 5.2.1 Co-design Workshop and analysis

Five Gothenburg based upper-secondary schools were contacted in search for teenagers to participate in a co-design workshop for a digital guide, at Vislab. The workshop was conducted to get direct input from the target group about what they deem fun to do in an exhibition environment. The incentive for the pupils was that they got to contribute to a design at Universeum in a 2 hour workshop, get a free entry ticket to explore Universeum, and learn more about studying to become an interaction designer and generally be a student at Chalmers University. 12 pupils from two different schools responded with interest and later participated in the workshop. 10 of them were female, 2 of them were male, all in ages between 16-17. The majority studied nature science, and some studied technology, as well as one who studied economics, and another social education.



**Figure 5.11:** A photo of the learning studio room next to Vislab, in which the Co-design workshop was held.

The workshop was divided into five main phases: Introduction, Exploration, Ideation, Prototyping, and Presentation. In the first phase the participants got an introduction about us and we about them, and we introduced what the project was about and gave them some insight to the problem challenges. The participants then got to explore the Vislab exhibition freely to get familiar with and inspiration of its content. Afterwards, they were divided into groups of three and we presented the design challenge of creating a mobile app/game that would help teenage visitors explore Vislab. They began with a brainstorming session to ideate a lot of ideas, then they got to choose one idea and make a detailed paper prototype of it (see Figure 5.12), then ending with a presentation and discussion of their ideas.

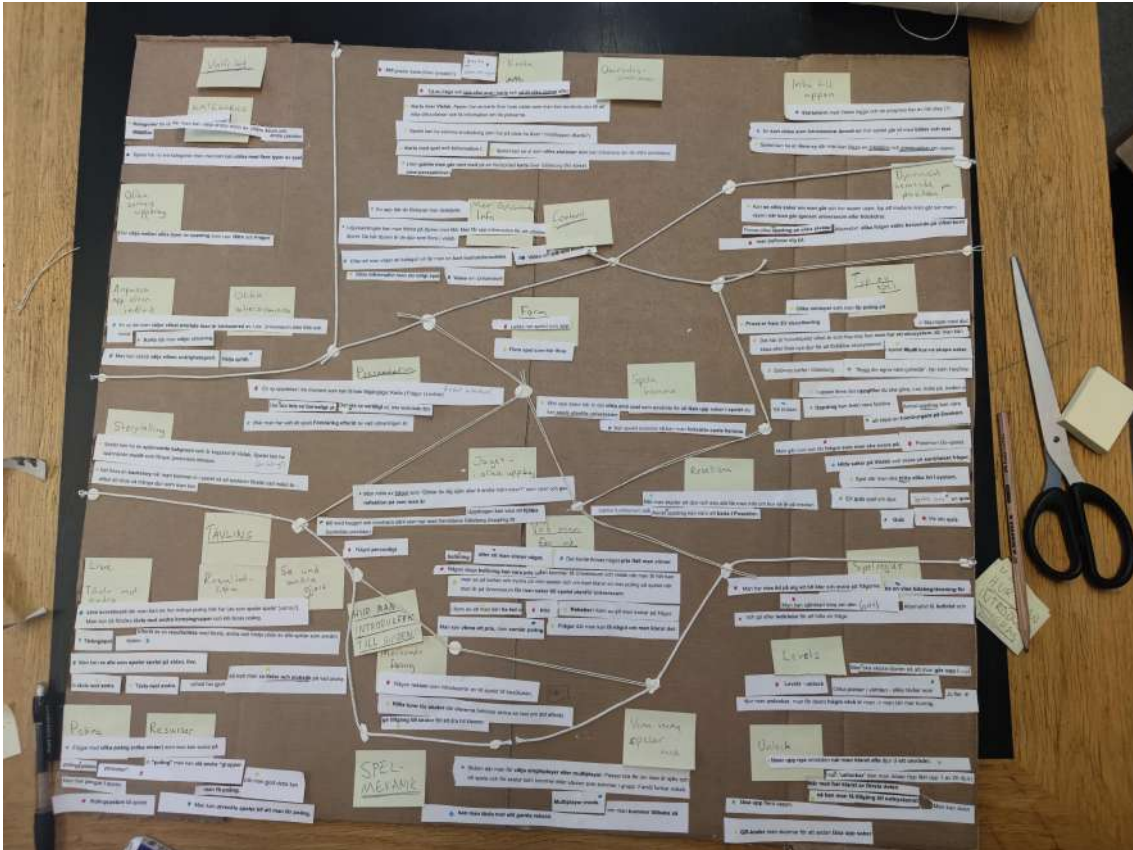


**Figure 5.12:** Workshop participants sketching on their final solution.

After the co-design workshop, an analysis of the workshop was performed. All participants' notes from the brainstorming phase were transcribed together with notes from think-aloud, as well as the participants' presentations of their ideas. An affinity diagram was made of the content, which resulted in 9 identified main themes, including several sub-themes under each main theme (see Figure 5.13). The main themes identified were:

- Introduction of guide
- Content
- Presentation of content
- Game form
- Game mechanics

- Freedom of options
- What the user gets out of using the guide
- Dynamic behaviour



**Figure 5.13:** An affinity diagram of the ideas from the workshop, made with paper, cardboard and post-its. The ideas were grouped into 9 themes separated with lace.

The content of each theme was then further analyzed through oral reflection in order to examine the underlying wants and needs of the teenage target group. Here follows a summary of each theme and its insights.

### Freedom of options

The participants showed great interest in including freedom of options in the exploration of a mobile game, and in doing so encourage the user to explore what they themselves are interested in. For example by making the user able to choose which area in Vislab it want to explore, and what type of challenge it want to complete, such as the choice between performing a physical activity in the room or just answering questions. Other examples of eligibility that were presented were the possibility of being able to choose the degree of difficulty and language.

The insights that were found were:

- It seems important for users to be able to focus on their interest, by presenting different choices the user can make in the exploration. For example, allow the

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user to choose an area of interest to explore, and for the user to choose the type of task / game / challenge they are interested in performing.

- It is important that the guide can be adapted to the user's capacity and language comprehension.

### **Game form**

The participants had different suggestions for game forms. Some of these were:

- FPS game
- Several mini-games that form a larger game
- Explore Vislab through VR
- Managing your ecosystem game (similarly to HayDay [60])
- Quest
  - Perform physical activities
  - Find things
  - Answer questions (quiz)
- Puzzle

The insights that were found were:

- Quests were the form mentioned by all participants, which may indicate that it is generally something teenagers think is fun to do.
- An example of a quest that was mentioned was a search hunt mission where the user would find things, or find answers to questions, that were hidden in the visualizations. Another was to perform activities such as checking out something specific in a certain screen. These can be general tips on different types of missions that stimulate and is appreciated by teenage players.

### **Game mechanics**

Several ideas included some form of competition in their game along with a results list. Above all, there was a desire to compete against other guests and other friends, but also to be able to compete against oneself. In connection with competition elements, it was noted that the player could collect points or resources, and that the user could reach different levels, and the idea that higher levels unlock new things in the game. Also, for certain competition elements, it was mentioned that the player would have a certain time limit, that you could redo game steps if you failed, and that you could get clues to succeed in different tasks.

Other ideas that did not include the competition element were games such as taking care of your own ecosystem, trying out different technologies, solving puzzles, or building things in a game. When it came to who you play with, the workshop participants presented ideas where the user could choose whether he wanted to play by himself or with others, the player was never locked to a specific choice, instead the choice was open.

The insights that were found were:

- It seems important for the user to be able to choose to play by themselves or with those around them, that you as a player should be able to choose.

- In some types of games, competition is suitable, for example when the game is some sort of mission or quiz. In other games such as taking care of their ecosystem, competition becomes less relevant.
- It can be justified that games with quests linked to Vislab are better for exploring the physical space, compared to games like taking care of their ecosystem that focuses more on the mobile screen content.
- It seems important for the participants that it is okay to fail and to be able to ask for help if needed.

### **Content**

Apart from the game itself, all groups discussed having a map of Vislab in their design solutions. Three out of four groups also discussed that the app should contribute more info about Vislab and how to explore the exhibition. For this, short instructional video was mentioned as a means they preferred. Some groups wanted intro video at the beginning of the use of the app as a presentation, others advocated videos when you have immersed yourself in a certain interesting area.

The insights that were found were:

- A map seems like a good idea to include in a digital guide.
- Communicating information through short instructional videos seems like a great means.

### **Presentation of content**

When it comes to how the app is presented, two groups wanted the app to include an exciting background story and music linked to Vislab. They also did not want the interface to look childish, but appreciated if it looked real and did not use cartoon animals as an example. The graphical interfaces that were designed included mainly a mobile main view, and included at most one additional view.

The insights that were found were:

- Teenage participants seem to appreciate that the game follows a narrative, such as exciting background and music.
- It seems appreciated with a simple interface with few navigation steps.

### **Introduction of guide**

When asked about how the guide should be introduced to visitors, the answers were few. Some group mentioned that you can attract visitors through free tours for schools, as well as making the visit part of a school assignment, or through general advertising.

It also varied where the participants could play the game. Some ideas presented the notion that the game could be played at home, and in one idea solution the game was to explore an entire city, and where Vislab was only part of the exploration.

The insights that were found were:

- We as designers need to be clearer about what we mean by being introduced to the guide. We were mainly looking for ideas on how the visitor would find out that the mobile guide exists when at Vislab. However, this was not clarified because of not wanting to use leading questions and stop the participants' own idea generation.
- If the goal is to get more visitors to Vislab, it could be relevant to look at existing city exploration games to see if you can get Vislab to a part of the game as it seems to be games that the teenagers used.

### **What the user gets out of using the guide**

In the games that included competition against others a desire to win a prize was presented. Examples of appreciated prizes mentioned were discounts, some physical thing, free tickets to Universeum and resources / codes for other games outside Universeum. The reason was that it would provide motivation to use the guide.

In the participants' idea presentation, keywords also emerged for what they appreciated with their ideas. For example, in a mobile guide with a quiz, it was appreciated if the user was met by questions that made one reflect on what he himself had done in different situations and also questions where the user's answers helped with something concrete in society.

The insights that were found were:

- Some form of reward seems to motivate visitors to use the guide.
- Teenagers seem to like when it can connect itself to the use, for example by contributing its opinions, reflecting on one's choices, and as mentioned under game mechanics to be able to compete against oneself and friends.

### **Dynamic behaviour**

Three out of four groups showed interest in the mobile game being affected depending on your location in the room. One example was to search for quests by going around in the room.

The insights that were found were:

- To increase the exploration in the room, it can be a good idea to use location tracking as part of the game.

## **5.2.2 Iteration on the design - An updated second concept**

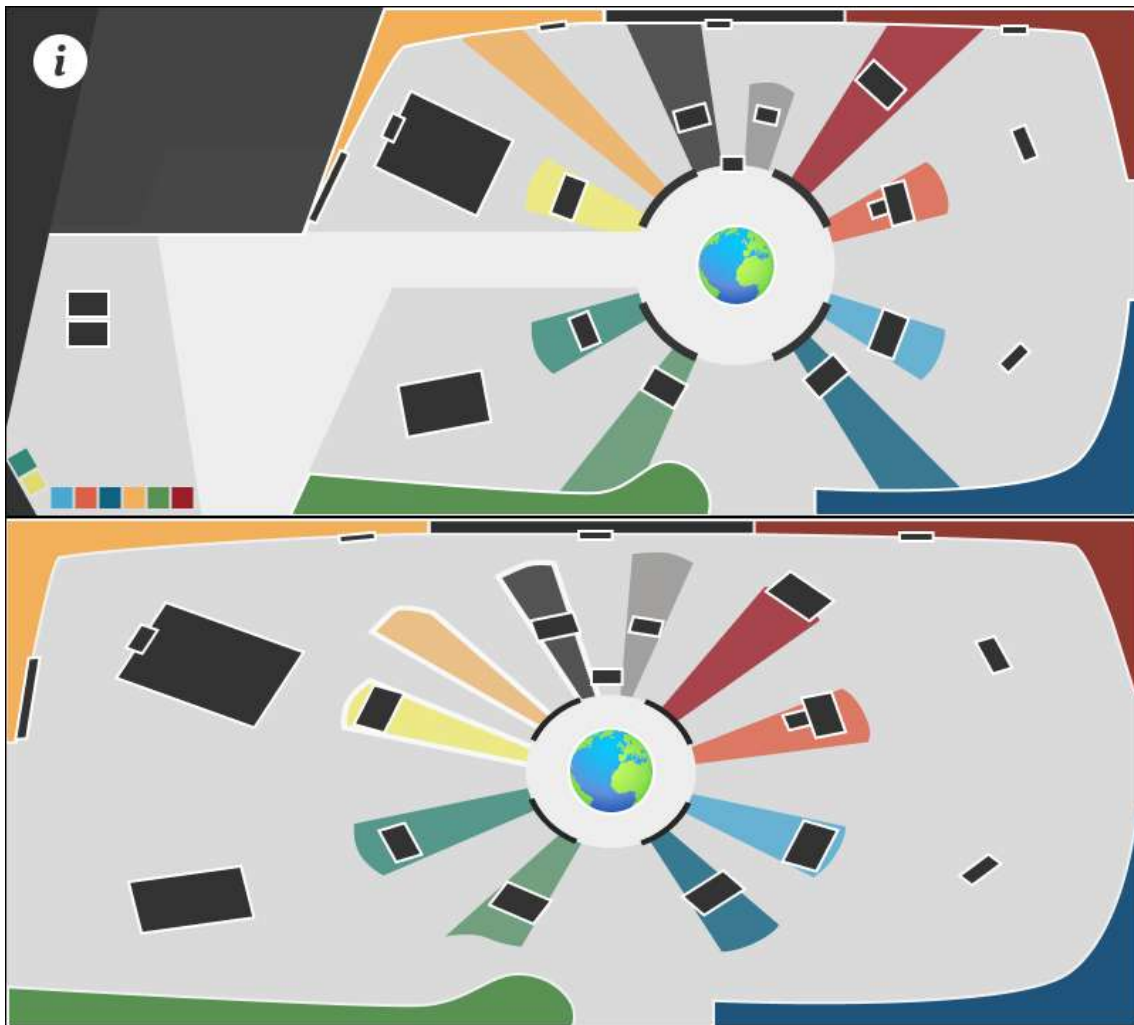
With the learnings from the design workshop and from the evaluation meeting with the stakeholders at Universeum, the concept was iterated upon. We compiled all insights and created a list of change areas for our existing design. The most prominent planned changes were to:

- Simplify the interface as well as make it more graphically pleasing
- Tweak the design so that it encourages people to explore what they are interested in
- Go from having quiz to instead have quests of different kinds, and change the way the result is presented

- Introduce more features such as an introductory start screen, clues to quests, presentation of quest progress, and an info and score board view.

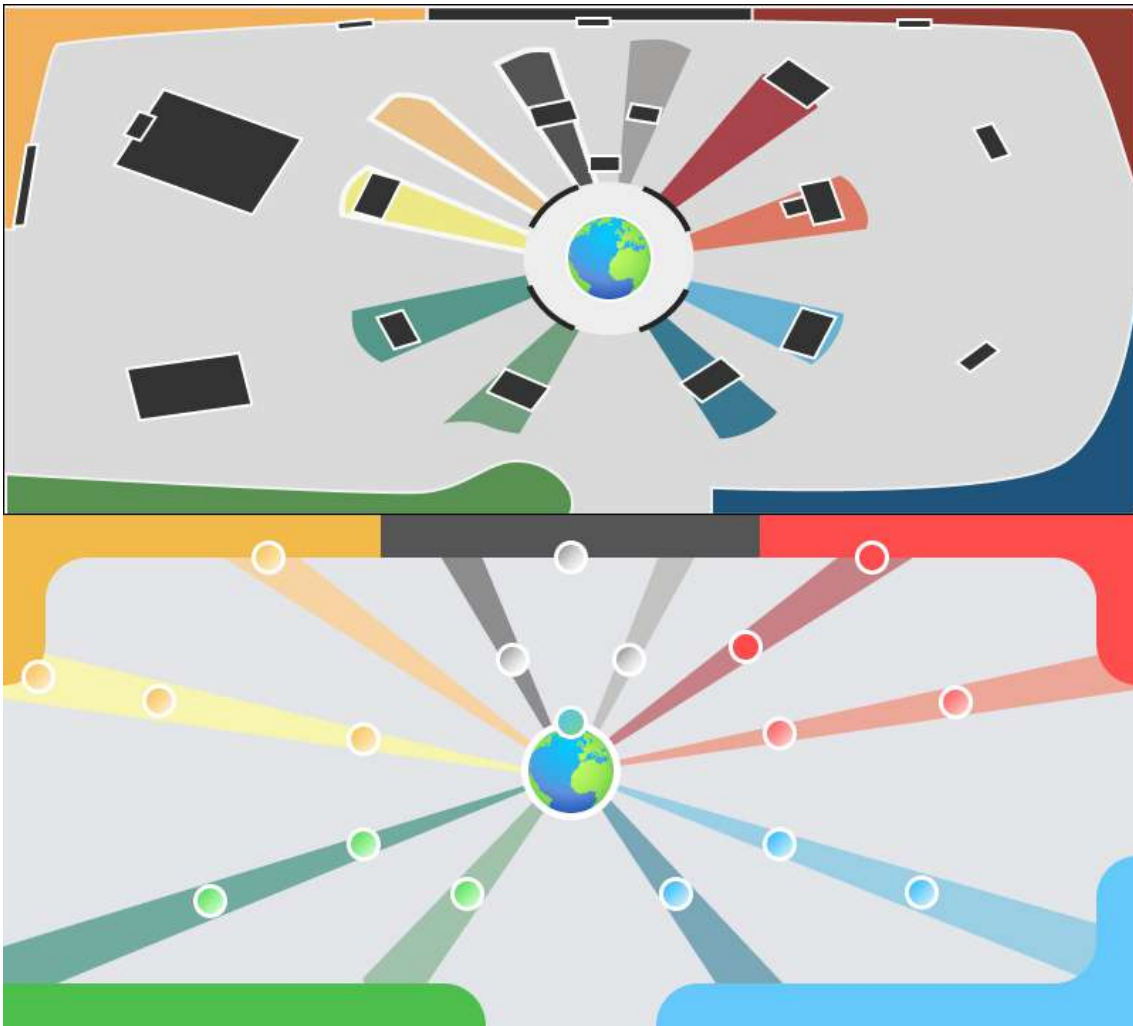
The changes to the design is presented below. Other things that also were discussed but not implemented at this stage, were how the application should be introduced to attract users, if finishing quests could give user some kind of reward as an incentive to use the application, as well as implementing a way were user can choose difficulty level.

One of the overarching goals was to simplify the interface, since it was identified that learnability is of high importance during the context of use analysis (see Section 5.1.2 ). The old interface felt cluttered and visually unappealing by us designers, so there were a few changes made to fix these issues. The green screen room and the introductory screens that can be seen on the left side of the old map were removed. Instead, the interface only showed a map of the main screens of Vislab, i.e. the screens that belong to the five themes: society, space, the human, sea and land (see Figure 5.14).



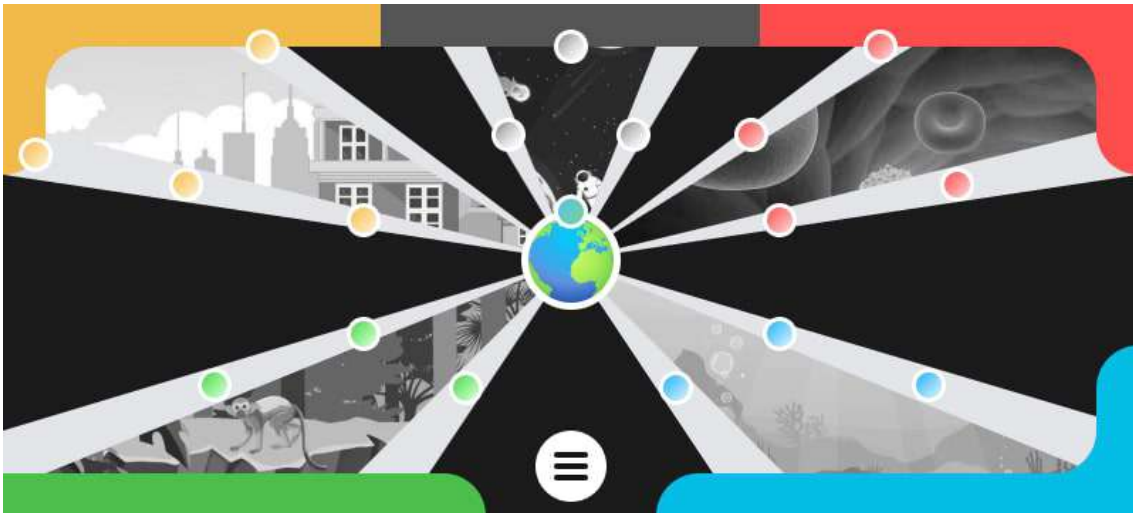
**Figure 5.14:** Old interface (top) vs. when green screens and introductory screens had been removed (bottom).

Furthermore, the screens' shape, and size have all been simplified to smaller dots, which have also been colored according to each of the themes in Vislab. The position of the screens have also been altered slightly; instead of being placed on the map at their exact corresponding location in Vislab, they have been placed roughly where they should be (see Figure 5.15). The omission of the left side of the map in conjunction with the repositioning and adjustments of the screens has led to the interface being symmetrical. Moreover, the colors have been changed in favor of more vibrant colors. To reiterate, these changes were made with the intent of making the interface simpler and more aesthetically pleasing, since teenagers do not want a dull interface (see Section 2.2.4).



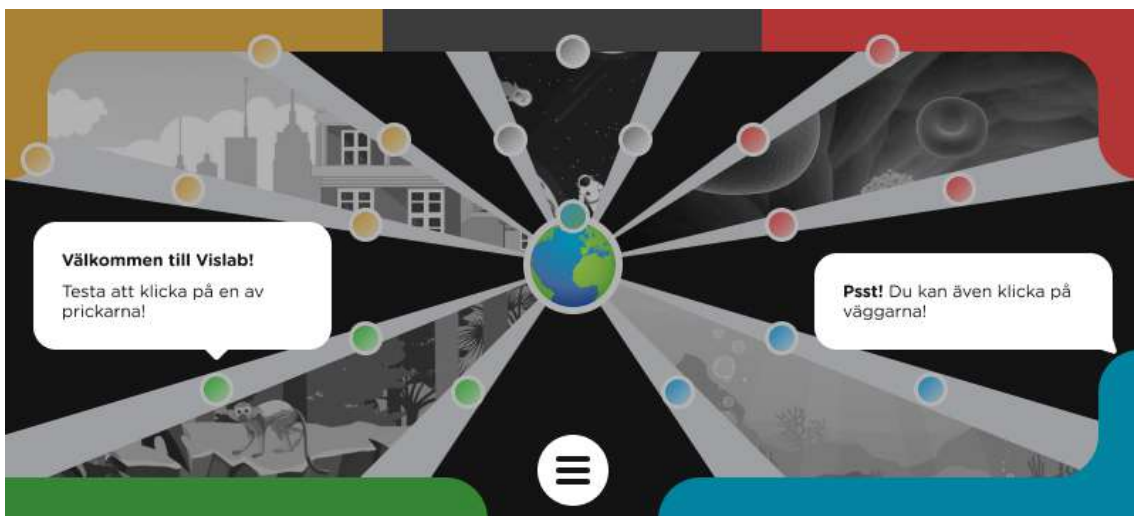
**Figure 5.15:** Old interface (top) vs. progress towards a new interface (bottom). Screens have been simplified into dots and re-positioned to be symmetrical.

The beams that can be seen in the old interface have been extended all the way to the walls and have also been re-positioned to be symmetrical. Now, the beams are positioned so that each of the screens (which are now dots) are positioned upon one of the beams. In between these beams, there is a matching picture for each of the five areas of Vislab, intended to help the user be able to tell at a glance what a certain area is about (see Figure 5.16). This was done mainly to help in encouraging people to explore the topic they are interested in.



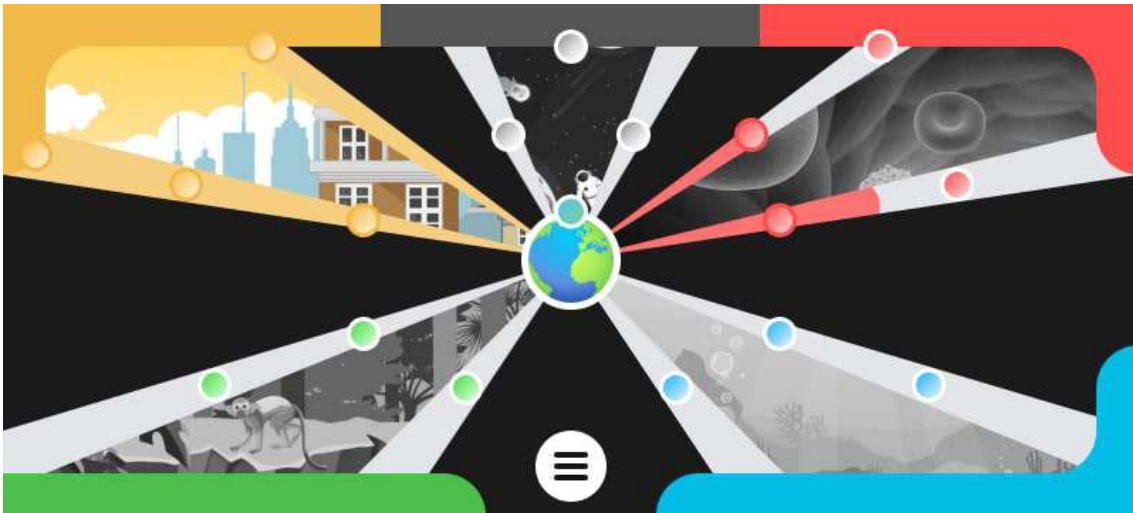
**Figure 5.16:** The final second concept with dot quests of the five different areas. The beams have been extended to the walls and there are pictures in between beams hinting upon the area.

When starting the application, the user is met by an overlay welcoming the user and gives hints upon how to interact with the application (see Figure 5.17). This help can also be found in a newly added hamburger button menu.



**Figure 5.17:** Introductory help text-boxes.

The user can still click on the screens and complete quests just as before. Now, however, once a quest is completed, the border of that quest's dot turns from white to the color of the theme that said quest belongs to. Moreover, a portion of the beam that that quest is situated upon is also colored (see Figure 5.18).



**Figure 5.18:** Beams are partially colored when user completes quest.

This was done so that the user can easily see their progress in terms of which quests they have completed. Furthermore, once the user has completed all quests for one of the areas, that area's picture turns from grayscale to colored as well. This was done in order to provide a small incentive for users to complete quests.

As for the quiz being changed into quests, a brainstorming session was held at Vislab to create quests that stronger involved the user in different ways. For example, varied quests such as find hidden things, find answers to questions, perform activities, give opinions, and reflect when faced with different choices, were explored. Side by side, different kinds of feedback from doing quests was brainstormed on.

Thus, the view for doing quests were remade where the picture for each corresponding theme showed up as a background when the user clicks on a dot/quest (see Figure 5.19). Three quests in the land section was fully implemented in the Figma prototype for testing purposes, where Figure 5.20 is one such example. Once the user sends in their answer, another box shows up where the user can see what others have answered in a word cloud. The question were adapted to be more in line with what Universeum had suggested: less of a quiz and more of questions that is more personal to the user.

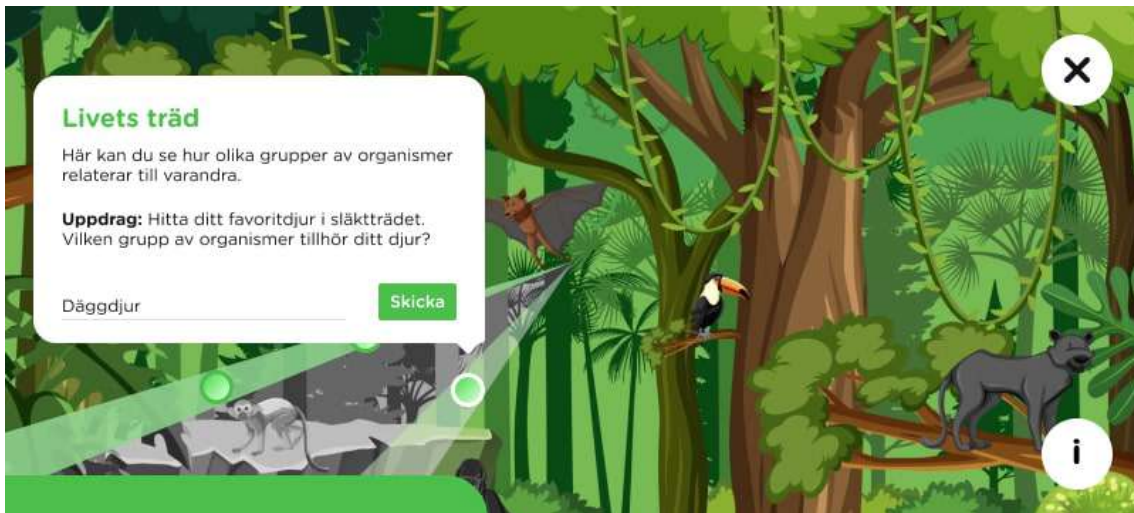


Figure 5.19: The quest for Livets träd, an exhibit in the land section.

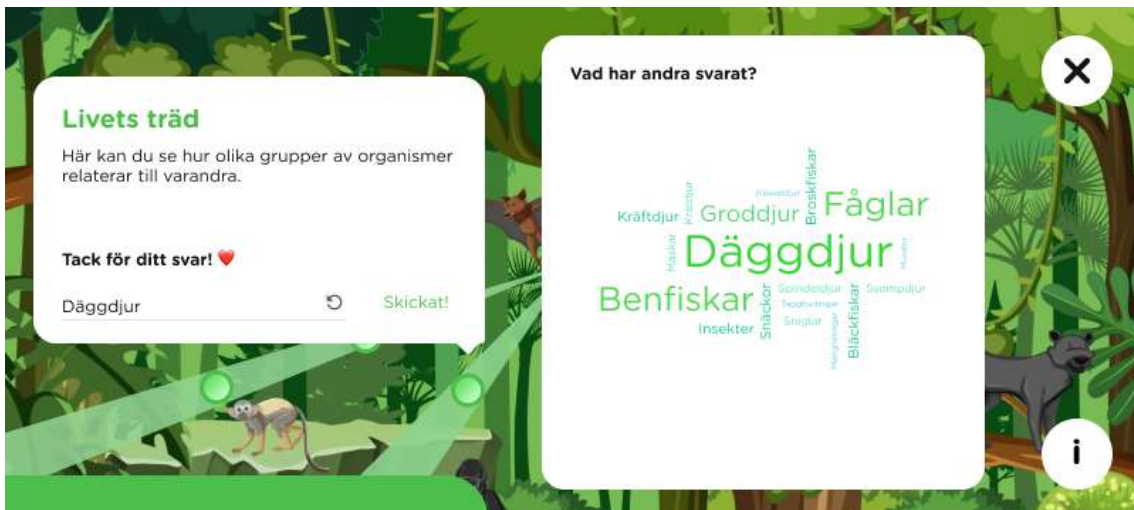


Figure 5.20: The word cloud that shows up once a user sends in their answer for a quest.

Moreover, a menu button has been added to the bottom of the screen that gives the user some information about the interface (see Figure 5.21). This menu also shows how much progress they have made so far, and also allows for changing the language or showing helpful information. As mentioned, the helpful information is the same as the introductory text-boxes that is displayed when opening the app (see Figure 5.17).



Figure 5.21: Information and progress menu for the application.

### 5.2.3 Evaluation of second concept

For the evaluation of the prototype in the second iteration, a controlled user-testing was conducted. Four interaction designers participated between 24-28 years old were chosen via convenience sampling. The aim of the evaluation was mainly to gather feedback regarding the learnability and intuitiveness of the interface and whether or not the concept was helpful for engaging with the screens. The user-testing was held in Vislab with an interactive prototype of the new concept made in Figma. Participants were asked to perform a series of tasks while also expressing their thoughts verbally. Afterwards, they were asked a few questions, which were a mixture of qualitative and quantitative questions (see Appendix E).

One insight from the evaluation was that although the interface was easy to learn, it was unclear that the main view was supposed to be a top-down map of Vislab and that the circles represented the screens that are at each circle's respective location. Furthermore, the content of the menu at the bottom of the screen was slightly mismatched in regards to the participants' mental model. Some did not expect this menu to show your progress in terms of how many questions you have answered. This was in large part due to the icon that was used for this menu.

Most participants said that the questions that were presented made them feel that the content of the screens were relevant for them, which is a positive sign for engagement. They also mentioned that the quests made them interested in exploring different screens and that they were driven to complete quests. However, there were mixed responses in terms of whether or not participants would use the guide at all if they were visiting Vislab. One suggestion to help remedy this problem included making sure that visitors at Vislab knows that the guide exists at all, and that it was presented in an inviting way.

Here follows some of the derived findings from the controlled user-testing:

- A guided tour pattern where the user is introduced to how the app works at the beginning of use is important to clarify the app's purpose, and also to clarify elements that is not fully obvious and intuitive.
- Minimalistic design with a limited amount of interaction and functions is important to make the interface simple and easy to learn, as well as good for minimizing the risk for the user to make mistakes.
- Progress nudges make users want to continue using the app, and to complete more tasks.
- It is important to make it clear from the beginning that the guide are intended to be used together with the physical exhibition, in order to minimize the risk that the app is used by itself and thus affecting the physical exploration in a negative way.
- If the interactive exhibits can get stuck in used-states, it is important that the guide suggest how the visitor can reset the screens. It is especially important to reduce impatience.
- Quests are a good thing to attract people to explore screens, as well as to increase learning.
- Exploring novel technology as a way to attract people to want to explore an exhibition should be tested
- An incentive to get people to use the guide can be that the guide contains elements or a new experience, which can not be experience without using the app.
- It is important that the app does not take too much time to use.
- It is important to avoid registration, log-in, download, etc. to reduce the threshold for starting to use the app.
- It is important with a good balance in difficulty of challenge, to accommodate users of different experience and skill level in order to not make the user feel stupid.
- It is important with a relevant presentation of the guide. In general, a large sign, simplicity of opening the application, and attractive choices of words about what to do with the application are appreciated.

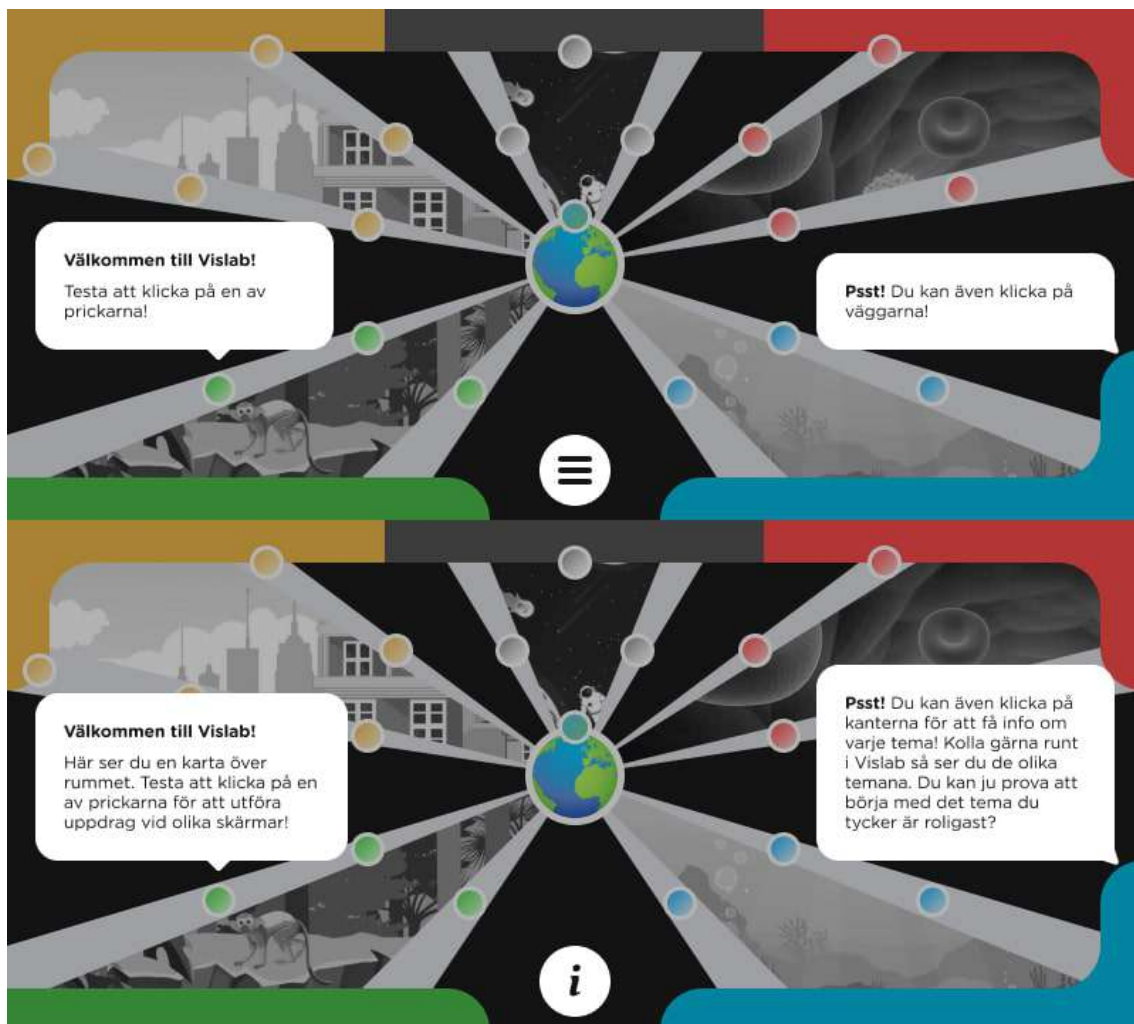
## 5.3 Third iteration

The third and final iteration is about adding some finishing touches in terms of changes to the concept, as well as evaluating with visitors in Vislab how well the concept fulfils its purpose. The following section covers the process and methods that were used for this third iteration: small changes to the concept, building a prototype in code, a feedback meeting with Universeum, and the final evaluation with Visitors.

### 5.3.1 Iteration on the design - An updated third concept

To address the feedback from the previous evaluation, some quick adjustments were made to the interface. Firstly, some more descriptive text were added to the text boxes on the intro screen in order to help make it clearer that the interface was a

top-down map of Vislab. Furthermore, the icon for the menu at the bottom of the screen was changed from a hamburger menu icon to an info icon (see Figure 5.22).



**Figure 5.22:** Old interface (top) vs new interface (bottom). The text boxes on the intro screen are now more extensive and the icon for the menu has been changed.

Finally, the questions needed to be looked at again. While there were already some questions for the land section that emerged from the second iteration, the quests in the other four sections still lacked questions. For this, a sort of brainstorming session was held in Vislab, where we looked at all the screens that were there and tried to come up with questions. Similar to the second iteration, these were intended to be questions that were not quiz-questions, but rather questions that focused on the user and helped make them feel like a part of the visualizations (as the stakeholders at Universeum had suggested in the first iteration). Once the brainstorming session was over, the questions that seemed to be most interesting and seemed to be able to entice people to answer them were chosen for each of the screens, resulting in all of the screens now having questions.

### 5.3.2 Prototype in code

For the final iteration, it was deemed that a prototype in code would be more appropriate than a prototype in Figma. This is because the guide contains lots of different states, and the guide should in reality be able to go from any of the states to another. Because of the fact that there are 18 different screens with one quest each, and because users should be able to complete these quests in any order they like, the prototype had to cover way too many permutations for a prototype in Figma to be feasible. Thus, work began on a prototype in code. There were several options for what form this prototype should take, but in the end it was decided that the prototype should be a website and that it should be made with HTML, CSS and JavaScript, developed in VScode. This would allow for visitors at Vislab to just scan a QR code with their phone to get to the prototype instead of having to download an app, making it easier to start using. The coded version of is presented in Section 6.1.

### 5.3.3 Feedback session on final concept with Universeum

The final iteration of the concept was re-evaluated with stakeholders at Universeum. As last time, two pedagogues and the lead in digital development at Universeum attended. They had not seen the interface since the first iteration, and lots of things had been changed since then. This time, the evaluation was conducted with the finished prototype implemented in code (presented in Section 6.1).

The new concept of using user-related quests, and the decreased focus on quiz-questions were appreciated. The dynamic responses (result boxes) from answering quests were also appreciated as it gave a feeling of a conversation between the user and the guide, and that it felt as if the guide used AI. Furthermore, the new concept with the beams being colored as the user completes quests was well received, as well as the score board presenting how many quests the user has completed. The new, simplified interface also got positive feedback, and overall, they stated that they were satisfied that we had received their previous input and processed it into our new design.

### 5.3.4 Final evaluation with end users

A final evaluation of our smartphone game concept was conducted over three days through in-field testing with visitors visiting Vislab (see Figure 5.23). It was divided into two parts: one part for visitors trying out the application, and one part for visitors that did not try out the application. All in all, to gather quantitative data where the answers could be compared between users and non-users of the guide (see questionnaires in Appendix F).



**Figure 5.23:** Testing of the final prototype with users in Vislab.

To gather application participants, visitors within the target age group (and sometimes older or younger people) were randomly asked if they wanted to participate in the study. The application was introduced as something they could use while exploring the exhibition. After they had finished exploring Vislab with the app, they answered a questionnaire. All in all, 26 people aged 11-27 participated.

As for the second part of the evaluation, visitors that did not use the app were asked to only fill in a questionnaire. In total, 12 people aged 18-36 participated in this part of the study.

For the analysis of this data, only the answers from people within the target age group (13-20) were taken into consideration. We summarized the data in Google Sheets and calculated the average and median scores for the questions. We also looked at common or recurring answers. These scores and common answers were then compared between people who used the app and people who did not, and conclusions were drawn thereafter. The results from this evaluation are presented in the results chapter and can be found in Section 6.2.

# 6

## Result

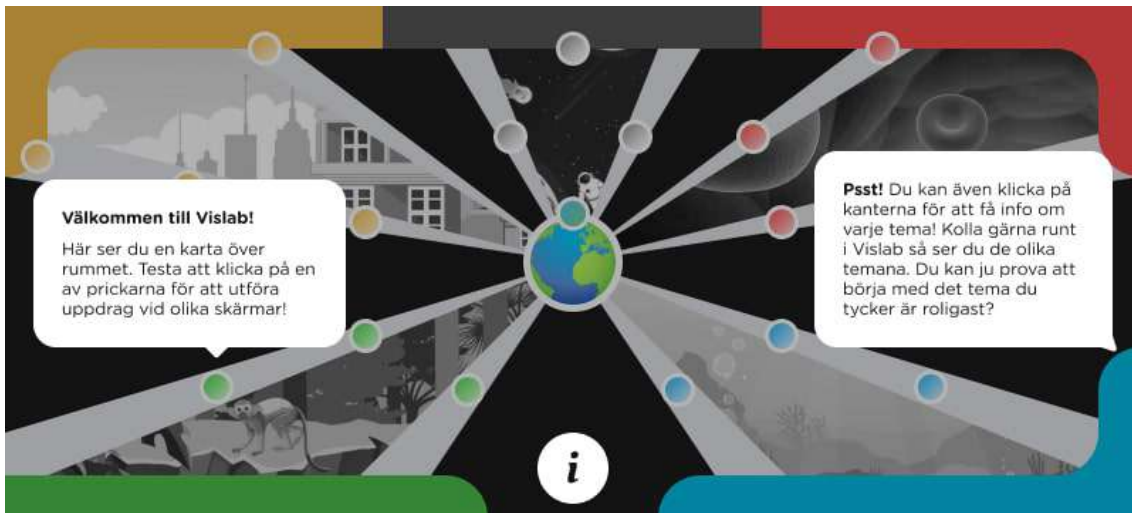
The following chapter describes the end results of the project. These include a presentation and explanation of the digital guide concept (see Section 6.1), the results from the final evaluation (see Section 6.2), and considerations for designing a digital guide (see Section 6.3). The presentation of the digital guide, named VisQuest, begins with an explanation of how it works and ends with an explanation of the different types of quests present in it. The results from the final evaluation firstly goes through metrics of visits in Vislab which includes comparisons between people who used the guide and people who did not use the guide, and ends with metrics regarding different aspects of the guide. The considerations for designing a digital guide is divided into considerations regarding the design process, general considerations, and designing a digital guide for teenagers.

### 6.1 VisQuest

VisQuest is the name that has been given to the final design of the digital guide. It is a gamified digital guide used on a smartphone where visitors can choose and complete quests. The game is meant to be played while the visitor is exploring Vislab and interacting with the different exhibits at the exhibition, and the quests reflect this. There is one quest for each exhibit at Vislab, and the intent is for users to interact with the quest's corresponding exhibit in order to complete them. The following sub chapter will describe in detail how the game works. The complete set of quests and other views can be found in Appendix G.

#### 6.1.1 How it works

When opening the application, the user is met with an introductory screen (see Figure 6.1). The text boxes work like a guided tour pattern (see Section 2.1.4) and explain that the interface shows a map of Vislab, that you can click on the dots to do quests and that you can click on the edges to view information about that area. These text boxes are there to encourage users to look around in the physical room (Vislab) and suggests that they could begin by completing quests within the area they find most interesting. From here, the user can click on the screen to go to the main view.



**Figure 6.1:** The introductory screen of VisQuest where the visitor is presented with introductory text bubbles.

In the main view (see Figure 6.2), the user is met with a map of Vislab. Each dot represents an exhibit roughly at its location in the physical room of Vislab. Similarly, the colored shapes around the edges of the screen of the interface represents the five different areas in Vislab dedicated to the five themes of the exhibition. Starting from the top left and going clockwise, these are: society (yellow), space (gray), the human (red), sea (blue) and land (green). These colors also roughly match the colors for the walls of each area in Vislab. The different themes also has an image intended to indicate visually what each colored section is about, and there is also an info button at the bottom of the screen.



**Figure 6.2:** Main view.

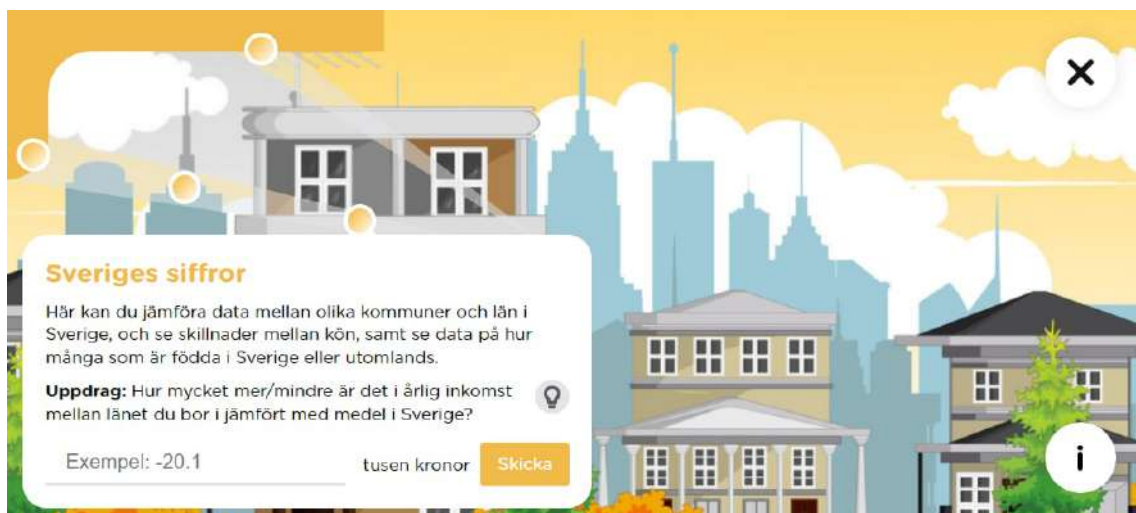
If the user clicks on one of the colored shapes around the edges of the interface, the overlay screen for that particular area shows up (see Figure 6.3 for an example). While the main view shows parts of images for each area, the overlays show the full

images. The user is also presented with a text box with information about the area and what visualizations can be found there.



**Figure 6.3:** The overlay screen for the society area.

If the user instead clicks on one of the dots, a text box for that particular exhibit shows up (see example in Figure 6.4). There, the user can read about what the exhibit is about, as well as completing the quest for that exhibit. There is a text field and a send button which the user can use to send in their answer and complete the quest. For Sveriges Siffror in Figure 6.4, the quest is about finding out the difference in yearly income between the average of Sweden and the average of the municipality that the user is from.



**Figure 6.4:** The quest view for the exhibit called Sveriges Siffror.

Should the user need help with understanding the exhibit or how to complete the quest, there is a button with the icon of a light bulb above the send button. If this button is clicked, another box is shown with clues for how to complete the quest, and

if appropriate, instructions for how to reset the screen of the exhibit (see example in Figure 6.5).



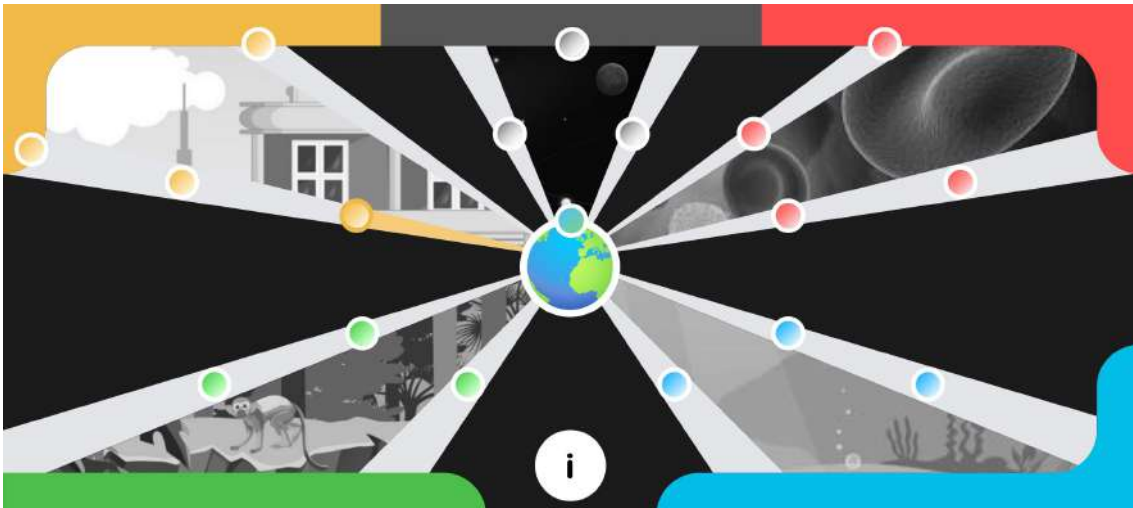
**Figure 6.5:** Clues to help users complete the quest for Sveriges siffror.

To complete a quest, the user can input their answer in the text field and then send it in using the send button. Once they have sent in their answer and completed the quest, a box with feedback is shown (see Figure 6.6). This feedback box is different from quest to quest. For Sveriges Siffror, the feedback box makes a guess about where the user is from, based on the answer that they put in. Other types of feedback are a presentation of what other visitors have answered, right or wrong answers for quizzes, or conversation-like answers where the guide relates to the user's input.



**Figure 6.6:** The resulting feedback box for the quest Sveriges Siffror.

Once a quest has been completed, the beam that said quest is situated upon is partially colored (see Figure 6.7). The beams are colored according to how many quests that have been completed on each particular beam.



**Figure 6.7:** One of the yellow beams is partially filled.

In the main view (or home screen), there is a button with an info icon. Clicking on this button shows a menu with information of what the app is about, and the user can also see their progress regarding how many quests they have completed (see Figure 6.8). They can also click the help button to bring up the introductory, descriptive text boxes again (see Figure 6.1). This menu was also intended to allow for users to change the language of the app, however this is not implemented yet.



**Figure 6.8:** The menu screen, showing information about the app and the progress that the user has made.

Once all the quests in a certain area has been completed, the image for that area is colored (see Figure 6.9).



**Figure 6.9:** The quests for the society section have all been completed, and the image between the yellow beams has thus been colored.

### 6.1.2 Types of quests

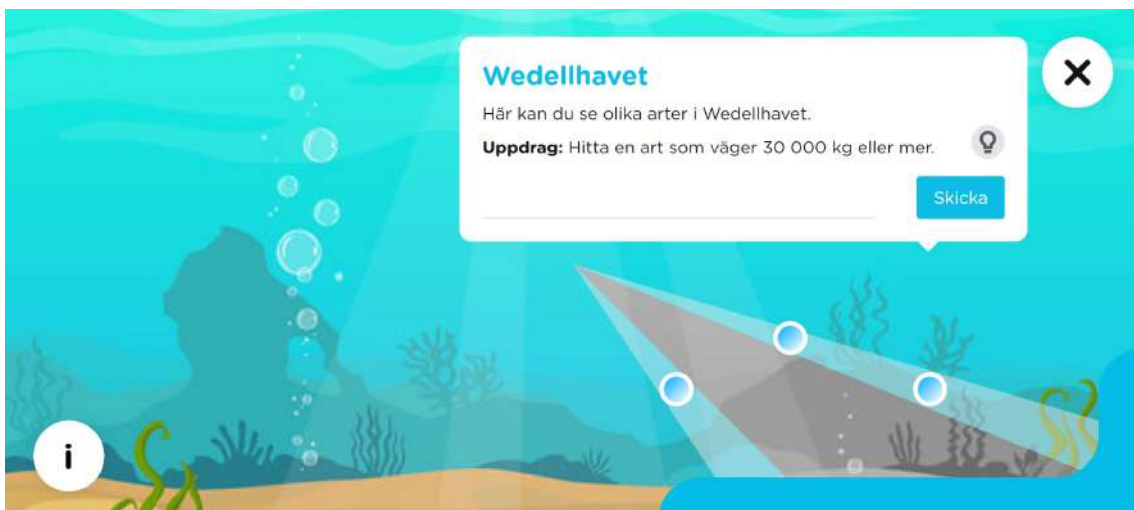
VisQuest contains one quest for each exhibit. The quests are tailored to suit the content of the exhibit they belong to. There are four identified types of quests in the game: "Find-outs about user", "Quizzes", "Opinions/Thoughts", and "Activities".

The quest shown in the previous figures for Sveriges Siffror belongs to the group called "Find-outs about user". These quests are about making the user use the exhibits to find out something personal or unique related to them. Another example of this type of quest is the quest for Matbordet, where the user is asked to build their ideal birthday meal and then find out which part of the meal has the highest amount of carbon dioxide emission (see Figure 6.10). There are eight "Find-outs about user" quests in total in VisQuest.



**Figure 6.10:** An example of a "Find-out about user" quest in the VisQuest application.

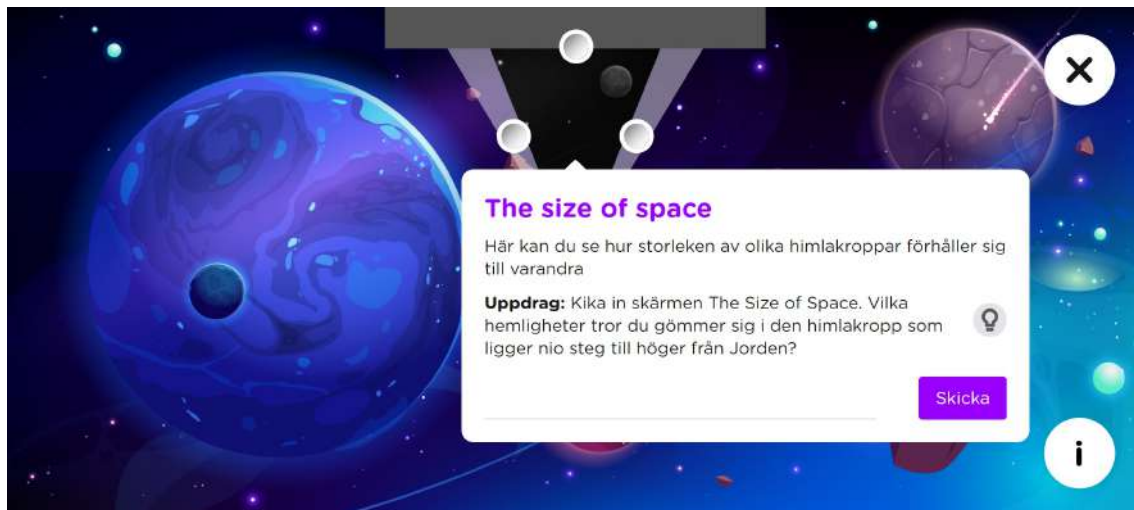
The second type of quest are "Quizzes". Unlike "Find-outs about user" quests, "Quiz" quests have one or more correct answers, and the information about the answer(s) can be found somewhere in the exhibit for a particular quest. An example of this is the quest for Weddellhavet, where the task is to find a species living in the Weddell sea that weighs 30 000 kg or more (see Figure 6.11). There are four "Quiz" quests in total in VisQuest.



**Figure 6.11:** An example of a "Quiz" quest in the VisQuest application.

The third type of quest are "Opinions/Thoughts". These quests do not have a correct answer, but rather ask the user what they think about a particular topic or question. An example of this is the quest for The size of Space, where the user is asked what they think can be found in the celestial body 9 steps to the right of the

earth (a black hole) (see Figure 6.12). There are five "Opinions/Thoughts" quests in total in the application.



**Figure 6.12:** An example of an "Opinions/thoughts" quest in VisQuest.

The fourth and final type of quest are "Activities". These quests do not require the user to input an answer, but ask the user to perform a certain activity at the quest's corresponding exhibit. An example of this is the quest for Body Visualiser, where the user is asked to recreate themselves (see Figure 6.13). The quest for Body Visualiser is the only "Activity" type quest in the app.



**Figure 6.13:** An example of an "activity" quest in VisQuest.

## 6.2 Results from final evaluation

In total, 17 people participated in the final evaluation. 10 out of 17 people used the app, while 7 people visited Vislab without the app. In the following subsections,

people who used the app are called users and people who did not use the app are called non-users.

Of the users, 5 were male and 5 were female. Their age ranged from 16 - 19 years old and they were on average 17.4 years old. Of the non-users, 3 were male and 4 were female. Their age ranged from 18 - 19 years old and they were on average 18.3 years old.

### 6.2.1 Metrics of visits in Vislab

The following subsection presents metrics regarding Vislab. Data for these metrics were gathered from both users and non-users, and the metrics are compared between users and non-users (see Table 6.1 for a summary).

	Non-user span	Non-user average	User span	User average
Number of exhibits tested	1-3	2	5-18	10.2
Visit duration (minutes)	2:00 - 10:00	4:00	15:00 - 20:00	17:30
Interest for content in exhibits	3-10	6.7	6-10	6.9
Understandability of content	3-10	6.3	4-10	6.9
Understandability of interaction	4-10	6.9	5-10	7

**Table 6.1:** Metrics of users and non-users of VisQuest during the final user tests. The spans presents the lowest and highest answers on each specific topic.

#### Visit duration

People who used the app stayed longer at the exhibition; more than 4 times longer. Non-users stayed for 4 minutes on average, while users stayed for 17 minutes and 30 seconds. Users of the app also interacted with more exhibits. On average, non-users interacted with 2 exhibits while users interacted with 10.2 exhibits.

#### Interest and understandability of Vislab

There were no notable differences of scores between users and non-users regarding interest for the content of the exhibits, how easy it was to understand the content of the exhibits, and how easy it was to interact with the exhibits. Regarding how interesting the contents of the exhibits at Vislab were, non-users gave a score of 6.7 on average while users gave a score of 6.9 on average (with 1 being not interesting at all and 10 being very interesting). Regarding how easy it was to understand how to interact with the exhibits at Vislab, non-users gave a score of 6.3 on average while users gave a score of 6.9 on average (with 1 being very difficult and 10 being very easy). Regarding how easy it was to understand the contents of the exhibits and

what they tried to convey, non-users gave a score of 6.9 on average while users gave a score of 7 on average (with 1 being very difficult and 10 being very easy).

### **6.2.2 Metrics of the app VisQuest**

The metrics in the following subsection is only applicable to participants who used the app, and there is no data to compare with from non-users.

#### **Understandability of the app**

Everyone who used the app gave a score of 5 - 10 regarding how easy it was to understand the app, with an average score of 7.3 (with 1 being very difficult and 10 being very easy to understand).

#### **Entertainment**

Everyone who used the app gave a score of 6 - 10 regarding how much more entertaining their visit was when using the app, with an average score of 7.3 (with 1 being not entertaining at all and 10 being a lot more entertaining). Thus, all participants thought the application increased their entertainment in some degree.

#### **Quests**

On average, visitors who used the app completed 10.2 quests. The lowest number of quests completed was 3 and the highest number was 16.

Some quests were more popular than others. Livets träd and Ecoweb were the most popular quests, being completed 8 times, and Rymdresan, Size of Space and Weddellhavet were the least popular quests, being completed 1 time (see Table 6.2). Similarly, some areas of Vislab were more popular than others. The land section was the most popular with 23 quests completed and the space section was the least popular with 5 quests completed (see Table 6.2). As for what people considered to be the best quests, the responses were varied and there was no conclusive answer (see Table 6.3).

Moreover, some types of quests (see Section 6.1.2) were also more popular than others. By taking how many times players completed quests belonging to a certain type and dividing it with the number of quests of that type, we get the average number of times a quest of said type was completed. Using this calculation, we get the following averages: 5.6 for "Find-outs about user", 3 for "Quiz", 2.8 for "Opinions/thoughts", and 3 for "Activity" (see Table 6.4). This suggests that quests which let the user find something out that is relevant for them seem to be the most effective type of quests for getting users to engage with the exhibits.

Exhibit name	Number of times completed
Fönstret	4
Life stats	4
Digitala Göteborg	5
Sveriges siffror	4
Rymdresan	1
Size of space	1
Meteoriter	3
Hjärnan	5
Bilbeslutet	5
Body visualizer	3
Människan Ben	3
Weddellhavet	1
Kosterhavet	3
Livets ursprung	3
Livets träd	8
Ecoweb	8
Matbordet	7

**Table 6.2:** A table presenting how many times each quest of VisQuest was completed during final user tests.

Exhibit name	Number of responses
Matbordet	2
Life stats	2
Fönstret	2
Digitala Göteborg	1
Sveriges Siffror	1
Body visualizer	1
Livets träd	1
Ecoweb	1

**Table 6.3:** The votes on what quest the testers liked the most.

	Find-outs about user	Quiz	Opinions/thoughts	Activity
Average number of times completed	5.6	3	2.8	3

**Table 6.4:** The average number of times a type of quest was completed in one use of VisQuest.

### Exploration enticement

All participants felt that the app nudged them to explore the exhibition to some

degree. Most people (7 of 10) felt that the app *somewhat* nudged them towards exploring, while a few people (3 of 10) *fully agreed* that the app nudged them towards exploring (see Table 6.5).

	No	Not so much	Neither / Don't know	Some	Yes
Did the app entice you to explore the exhibition?				7	3

**Table 6.5:** Answers for how much the app enticed visitors to explore Vislab.

### Making interaction easier

Most people (7 of 10) felt that the app made it *somewhat* easier for them to interact with the exhibits, while a few people (2 of 10) *fully agreed* that the app made it easier for them to interact with the exhibits. 1 participant answered that they didn't know (see Table 6.6).

	No	Not so much	Neither / Don't know	Some	Yes
Did the app make it easier to interact with the exhibits?			1	7	2

**Table 6.6:** Answers for how much the app made it easier to interact with the exhibits at Vislab.

### Likelihood of use

Regarding whether or not people would have used the guide if they were not introduced to it by us designers, most people (6 of 10) answered that they probably would not use the guide, a few people (2 of 10) answered that they would use the guide, and 1 person answered that they would maybe use the guide. 1 person did not answer (see Table 6.7).

	Yes	No	Maybe / I don't know
Would you use the app if there was only a QR code?	2	6	1

**Table 6.7:** Answers for whether or not people would use VisQuest if they went to Vislab.

### Other

Before use, when gathering participants to use VisQuest, most people were apprehensive of using the guide because of the fear that it would take too much time.

During use, some users mentioned that some quests were more difficult than others.

After use, when answering what the user got out of using the app, some mentioned the application got them thinking and reflect more. Others mentioned they learned new things and got more info about the exhibition as a whole. Two participants also mentioned they explored and read more on the screens than they would have without using the app, and that they got more interested in what was inside the screens when they had a purpose (finishing a quest).

## 6.3 Considerations for designing a digital guide

The following section presents considerations for designing a digital guide that we have identified when conducting the project. These are divided into considerations regarding the design process, general considerations, and designing a digital guide for teenagers. Subsection 6.3.1 *Considerations regarding the design process* include considerations regarding visits to the exhibition, stakeholder meetings, field studies, co-design, types of prototypes, and user testing. Subsection 6.3.2 *General considerations*, present considerations for the threshold to use a digital guide and guiding and encouraging exploration. Subsection 6.3.3 *Designing a digital guide for teenagers*, present considerations for teenagers' preferences, physical form, important attributes of the interface, considerations for quests. While some of these considerations apply for general design projects, they are listed as considerations here because they are important specifically when designing for exhibitions, teenagers and digital guides.

### 6.3.1 Considerations regarding the design process

During the design process, there were certain considerations identified for the process of designing a digital guide for science centers. The following subsection describes some identified methods that are suited for this purpose, as well as things to keep in mind when conducting said methods.

#### **Recurring visits to the exhibition**

A key consideration for designing experiences at exhibitions is to have recurring visits to the exhibition environment. Throughout the project, Vislab was visited regularly and often, for stakeholder meetings, field studies, brainstorming sessions, testing and evaluation sessions. Aside from visiting Vislab for conducting these specific methods, there were also visits for general work. This proved very helpful, as it resulted in a better contextual understanding in every visit that was made. Furthermore, this provided an ease of access to the exhibition and stakeholders whenever questions arose spontaneously.

#### **Stakeholder meetings**

It is important to have stakeholder meetings continually throughout a design project. This will help ensure that the designers and the stakeholders have the same vision regarding the product, which will lead to easier cooperation between designers and stakeholders. When designing for exhibitions there is the opportunity to involve

people who work at the exhibition, such as exhibition guides who has met, knows and understands the visitors. This means that these meetings will also help designers understand the contextual things like who the users are, what they do, what challenges they face, etc., which is especially important to understand early on in the process.

When having stakeholder meetings, it is worth considering making extra sure to be clear to the stakeholders about what the purpose of the meeting is. An example of this not being done happened early on in the process for designing VisQuest, where it was not clearly stated that the meeting was for evaluating whether or not the concept of a game with quizzes would be appropriate. This led to the conversation moving to topics that was not relevant at the time for the design, like implementation details such as word-filters, servers, databases, etc. Thus, if the purpose of the meeting is not clearly stated, there is the risk of the conversations straying away from the questions that the designers actually want to get answers to. A few examples of what the purpose can be are the design solution's context of use, the graphical elements of the interface, the content and phrasing of the text in the interface, or technical details of implementation. It is also important to clarify that prototypes in these meetings are used for communicative purposes, and should not be seen as a the final solution where everything is finished.

### **Field studies**

Similar to stakeholder meetings and visits to the exhibition, conducting field studies can be of great use for understanding the context. For this project, field studies were held in Vislab where the visitors were observed and various things were noted down. For similar projects which involve designing a product for an exhibition, field studies might be very suitable since there is a given location with regular visitors.

### **Co-design**

In the second iteration of this project, a co-design workshop was held. Letting the actual target group reflect and design on experiences they would want made us as designers identify hidden wants, needs and behaviours from the actual users, instead of just guessing on what they would want. This led to several insights, such as possible types of games or forms the guide could assume, new learnings about the target user group, and other contextual things (see Section 5.2.1). For other projects, having a co-design workshop like this might similarly lead to many key insights that can be helpful for the project.

### **Types of prototypes**

Depending on the type of digital guide that is being designed and depending on what the purpose of the prototype is, different prototyping methods might be better suited than others.

For instance, in VisQuest, there are 17 quests (one for each of the exhibits at Vislab) which can be completed in any order the user likes. Furthermore, there are several different frames for each quest and there are elements of the interface which change

depending on variables like how many quests within a certain area have been completed. In cases similar to this where the digital guide might have lots of different states that the user can move between in any order they like, creating frames for all the different permutations and wireframe connections in a prototyping tool like Figma can be difficult and time-consuming. A prototype in code might thus be more appropriate since there are variables and conditional logic which can be beneficial for constructing a prototype which closely resembles a finished product. The high fidelity of this prototype might then be of use for testing purposes where one wishes to evaluate the product as a whole.

On the other hand, the purpose of the prototype might instead be to merely to test a particular function or convey the concept to stakeholders. In this case, where a fully interactive prototype is not needed and it is enough to show a handcrafted sequence of frames, a prototype in code might not be needed and a prototype in a prototyping tool like Figma might suffice.

### **User testing**

User testing conducted in the real setting, with users in their natural behaviour, is essential to learn how well a concept actually works. An exhibition environment is especially suited for this since you as designers do not need to set up an imaginary test environment with pre-decided testers. Instead, the design concept can be evaluated directly at the exhibition with actual visitors. Utilizing this is of high value to evaluate design concepts and learn of what works and not.

However, an important notion to this is that it can take some time to gather data. If there is a tight time limit it could be relevant to consider gathering participants beforehand. When conducting the final evaluation sessions at Vislab without gathering participants beforehand, there were times when visitors were sparse and getting visitors to want to participate was difficult.

Furthermore, when asking visitors to test VisQuest it was also identified that the presentation of the prototype matters in order to get a valid test result. It is important to be clear when presenting the purpose and context of the guide, as to not affect how the guide would have been approached naturally.

Another consideration regarding user testing with prototypes is to make it testable for the whole target group. While conducting the final evaluation at Vislab, there were times when there were visitors present at the exhibition who were not able to use participate in the tests because they only spoke English, while the prototype was in Swedish. When creating a prototype for testing purposes, it can therefore be a good idea to ensure that the prototype can be used by as many as possible within the target group, for instance by providing the prototype in several languages. The same goes for providing questionnaires (if there are any) in multiple languages. This is especially important when designing for exhibitions at science centers and museums similar to Vislab, where there are often tourists who do not speak the native language of the country that the exhibition is located.

### 6.3.2 General considerations

When designing a digital guide for science centers, the interplay between visitor and the exhibition context, is a key factor to consider. As mentioned in section 2.2, visitors appear at science centers in different constellations, and with different characteristics, knowledge and experience. When interacting with exhibits, such as a digital guide, they go through the stages of attraction, initial engagement, deep engagement and disengagement (see Section 2.2.2). Or through terms of UX, a visitor goes through anticipated UX before usage, momentary UX during usage, and episodic UX after usage (see Section 2.1.3). Thus, a digital guide, should be designed and reflect upon all those stages.

Below follows key considerations regarding the attraction and initial engagement, presented as the threshold to use a digital guide. This section is followed by consideration regarding the transition from initial to deep engagement, presented as important guide attributes for adaption to visitors. Lastly, techniques for guiding and encouraging exploration is presented, which is related to deep engagement and support of episodic UX in disengagement.

#### **The threshold to use a digital guide**

Although digital guides such as VisQuest have been proved to increase visitor engagement towards exhibits, there is a threshold to using a guide in itself. Through user-testing it was shown that a common reason for not using VisQuest was because of the fear of it taking too much time to use (see Section 6.2.2). Visitors mentioned they would like to have the time to experience all parts of the science center, while also avoiding museum fatigue. Thus, it was identified that good presentation is of high value, that the interface is simple and not overwhelming, and that it does not take too long to use.

#### *Learnability and Error handling*

With the above needs, Learnability and Error handling was identified to be critical for a digital guide, and thus also the most important usability goals. Learnability refers to the guide being easy to use at first try, which was found essential in user tests to get a visitor to use it, and also since the guide is something you use once (during your limited visit) there is a need for it to be understood directly. Especially since it is not certain that personnel at exhibitions are available to help. Learnability is also important to minimize the risk of museum fatigue. Identified solutions to achieve high learnability, were to have a minimalistic and consistent design, as well as having a clear entry point, e.g. by implementing the guided tour pattern similar to VisQuest (see Figure 6.1). This also means avoiding user- registration, log-ins and downloads. Regarding error handling, it refers to the user being able to recover from mistakes. This was deemed important to make the user feel safe in their exploration, which was identified as an important factor to encourage exploration.

#### *Presentation*

Another critical key consideration is the presentation of the guide. Through the competitor analysis and field studies (see Section 5.1.3, respectively 5.1.4), it was

identified that a digital guide should be presented no matter what entry or order of exploration the visitor take since visitors often walked in their own order. All in all, to make the guide easy to find no matter what order the visitor goes through an exhibition, and to make sure it does not go unnoticed.

It is also important to consider how it is presented. During the design process visitors, testers and co-designers said it was key to whether they would use the guide at all. General suggestions that was identified as appreciated were:

- A large eye-catching sign
- Few captivating words that mediates what the guide is about and why it is fun
- Simplicity in start using the application, such as having a QR-code to scan.

As for mediating the purpose, this was to be adapted to what kind of audience the guide should be aimed at.

### **Adaption to the visitor**

Field studies, final user tests, as well as the literature research in 2.2, showed that visitors come both individually and in different group constellations. They also have different nationalities as some visitors are on visit from out of country. This means that for the guide to be useful, a key consideration is to adapt it to different visitor constellations and nationalities. As for the constellations, the guide should encourage both individual or group use. Regarding nationality, the guide should provide the user with the alternative to change language.

It is also important that the guide is adapted to user's capacity in difficulty level. For example by using words and phrasings that is understood by the entire audience, or having the option to receive help if needed. This need was identified during the final evaluation when receiving questions on different words by testers. All in all, this is important for the guide to be useful, as well as to not make the user feel stupid.

### **Guiding and encouraging exploration**

Another identified key factor for designing a digital guide is to make sure it encourages exploration, since that is what a visit to a science center is about: exploring and learning things about science. To encourage exploration the following recommendations was identified:

- The guide should be mobile, and not stationary, to support bodily movement of the visitor.
- The guide should include help in physical navigation and include content that is related to the exhibition.
- The guide should take use of hinting and teasers to attract people to the exhibits.
- The guide should counteract challenges of visitors interacting with exhibits by providing the user with help.
- The guide should make use of ways to make the experience and exploration feel pleasant and fun, for example through including a game.

Here follows a more in-depth description of the above points.

#### *Navigational help and related content*

Providing navigational help in the guide facilitate exploration by giving knowledge on what there is to explore at an exhibition and nudge visitors to what they find interesting. If the guide consist of a graphical interface, this can be done by providing a map of the exhibition. Other ways to help in mediating content is through short informational texts and video clips.

#### *Counteracting challenges*

At Vislab it was identified that some interactive exhibits were more difficult to understand than others. This affected visitors experiences' and people often left those screens quickly and with confusion. A digital guide has the opportunity to counteract those difficulties by providing the user with help in those interactions. In reducing the challenges you facilitate the visitors exploration. Thus, a key consideration when designing a digital guide is to identify the challenges of the current exhibition and investigate how the guide can minimize them. For VisQuest, this was done through providing the user with tips and hints on each interactive exhibit (see Figure 6.5).

#### *Hinting and teasers*

A guide does not necessarily need to give full explanations of the content in an exhibition. Instead it can be enough to provide hinting, teasers or questions to pique people's interest in exploring the different exhibits themselves. During the stakeholder meetings it was identified that questions such "Have you tried this?" or "What would you do?" are questions that works in nudging people to approach different interactive exhibits.

#### *Make it a fun experience*

Presumably, visitors at exhibitions want to have a pleasant and fruitful experience. Thus, when designing a guide a designer should research what the target group is interested in, and how to integrate it to be an exploring experience of the exhibition. One way to do this was identified to be through including a game in a digital guide, and mainly through the use of quests. The use of quests tightly coupled to exhibits encourage exploration of the room, and it was found as something visitors appreciated. During the design process, it was noted that people tend to have a desire to complete quests in general, which make it a useful nudging technique to make people explore an exhibition. The phrasing of quests can also be used to hint on what one can find or do at different exhibits, which also can spur someone's interest. Including quests in a digital guide was especially identified as something teenagers want to experience in their visit to a science center, which can be read more in Section 6.3.3.

### 6.3.3 Designing a digital guide for teenagers

When designing a digital guide in an exhibition for teenagers there are several aspects to consider. Teenagers have their own distinctive characteristics, behaviours and interests that differs from those of children and adults (see Section 2.2.4). During the design process, these factors have resulted in different design considerations which are presented below.

#### Teenagers' preferences

When designing a digital guide for teenagers one should make sure it includes aspects that is adapted to their motivations and preferences. When researching what it is that teenagers want to experience in an exhibition three main factors were identified: Teenagers enjoy games, novel technology, and to relate the content of the exhibition to themselves.

#### *Quests*

Quests were found to be the most appreciated type of game, whilst simultaneously encouraging exploration of the exhibition. This was identified through the Co-design workshop where all participants presented ideas of quests, as well as through the final user tests of VisQuest where average of increased visit entertainment was 7.3 (see Section 6.2.2). Through the final user tests it was also identified that people that used VisQuest stayed longer at the Vislab exhibition and interacted with more exhibits compared to non-users of VisQuest. In some free text responses in the questionnaire visitors also mentioned that the quests increased their learning and made them reflect about themselves and science.

#### *Novel technology*

Another thing that teenagers appreciate are novel technologies, which thus should be considered for a digital guide. A few examples of this are Augmented Reality (AR), Virtual Reality (VR), image recognition, or holograms. Generally, teenagers enjoy trying out new experiences. Thus, it can be discussed whether one want the digital guide to be more of its own exhibit, including a new experience to the exhibition that cannot be experienced without the guide. In the case of VisQuest, ideas of including AR to search for quests or hidden information, as well as using location tracking to follow where you or others are in the room, were presented as examples that teenagers deemed fun. Using dynamic behaviour in guide that is depend on where the user are in the exhibition encourage exploration.

#### *Relate user to the content*

During stakeholder meetings it was identified that teenagers generally are more self-centered than adults. Thus, to make a teenager interested in an exhibition, one should consider how to make the visitors feel the relevance to themselves in the content of the exhibition. A few identified ways of doing this is to let visitors:

- Contribute with their opinions
- Share stories
- Reflect on themselves and their thoughts
- Find out something new about themselves

Other ways to nudge people to explore the exhibition is to ask personal questions such as "What choice would YOU make?". It was also recognized that teenagers feel it is important to be able to focus on their interests in an exhibition. Thus, a consideration is to design the guide in a way that encourage people to find and choose between different topics. As an example, VisQuest used coloring and background images to convey different fields of the exhibition that the user then could choose between (see Figure 6.2).

### **Physical form**

Because teenagers were identified to often walk around with a smartphone during field studies at Vislab, this was identified as a relevant medium for a digital guide. Instead of forcing the teenagers to stop using their phone, the aim was to transform the use to something more valuable to their exhibition visit. During the final user tests, five of the VisQuest users were not planning to visit Vislab, but when presenting them with a mobile application, their interest piqued. Thus, implementing a digital guide for a smartphone interface proved in this regard to increase engagement to the exhibition. Through observations of the final user tests the use of a smartphone also proved relevant in the way that it naturally could be put aside for a moment to explore the content without it, and then be re-used again. A stop in using the guide is not necessarily a bad thing, especially if it has lead the user to explore on their own.

However, something to consider when using a smartphone as a tool is to make sure that it still encourage exploration of the physical room, and that the visit not has consisted of attention to their smartphones during the whole exhibition visit. This would counteract the purpose of exhibitions in general.

### **Important attributes of the interface**

As mentioned, teenagers have their own characteristics which has resulted in the following considerations regarding interfaces of a digital guide:

- The guide should include pleasant aesthetics. It should use uses colors, layout, fonts and sizes in an inviting and non-cluttered way. The aesthetics should also reflect that teenagers do not want to be treated as children.
- The guide should have a simple interface. As mentioned, this help with learnability and makes it easy to use the guide. This is especially important for teenagers since they known to be impatient, they do not want to think about how to do something, it should just be work.
- The user should be able to recover from mistakes. Since teenagers are known to be overconfident and impatient it is important that this is facilitated by making it OK to fail, which help in creating a safe space for exploration.

### **Considerations for quests**

Because of the identified interest in using quests in an exhibition experience for teenagers, this was specifically investigated during the design process. It resulted in the following considerations and insights regarding its implementation.

*Variation in quest types*

If the guide involves the user completing tasks or quests of some sort, it was identified as important to include variation in what kind of tasks a user is met by. This is good both for making the user stay interested in the exhibition and also for meeting the desires of people who prefer different kinds of tasks. This can be done by for instance making use of different types of quests. The types that were identified as appreciated during the co-design workshop and final user tests were the following:

- Contribute with opinions
- Share stories
- Reflect on one's thoughts and choices
- Perform activities
- Find hidden things
- Find answers to questions (Quiz)
- Find answers to user-related questions / Find out something about yourself

Quests which let the user find something out that is relevant for themselves (called "Find-outs about user" in Section 6.1.2) was identified to be the most effective type of quest for getting users to engage with the exhibits, according to the final evaluation results (see Section 6.2). Thus, it is a good idea to prioritize that type of quest when possible.

#### *Difficulty level*

As mentioned, it seems important for users to be able to explore the exhibition based on their knowledge and experience level seeing as there could be knowledge gaps between a 13-year old and a 19-year old. This could be done beforehand by letting the user choose difficulty level for all quests, or the difficulty level of the quests could variate but be presented and thus known to the user. All in all, to let the user choose what they prefer.

#### *Competition*

During the co-design workshop it was identified that teenagers appreciate games where you can compete against friends. Quests have the opportunity to be formed in a way where this is possible. At science centers it is common with school visits, where competition was identified to be especially applicable. However, since as all users do not want to compete, in case it is implemented it should be optional to partake in the competition.

#### *Narrative*

Through literature research (see Section 2.2.4), and the co-design workshop it was identified that teenagers appreciate for an experience to follow a narrative. This was said to make an exhibition experience more immersed and fun, and would help in providing a context to the content. In these discussions, exiting aesthetics and music was also mentioned as parts of making the narrative and use of the guide more interesting.

#### *Reward*

Finally, implementing some form of reward for using the digital guide to a certain extent can be a good motivator for people to use it. In this project, there were

suggestions from some users that if one completes all of the quests there could perhaps be a reward in the form of a coupon at Universeum's cafe. Having some reward similar to this for other similar products might be beneficial.

# 7

## Discussion

This chapter describes points of discussion for several topics of the project. These include how well the research questions were answered (see Section 7.1), reflection on the final evaluation (see Section 7.2), notes on the app VisQuest (see Section 7.3), reflection on ethical issues (see Section 7.4), as well as thoughts regarding process and methodology (see Section 7.5) and future work (see Section 7.6).

### 7.1 The research questions

The project resulted in various considerations related to the research question "What are key considerations for designing an interactive digital guide intended to increase engagement for teenagers interacting with advanced data visualizations at exhibitions?". We identified how a guide can be implemented as a smartphone game and ways of personalizing the content and experience, which through user tests comparing users and non-users of VisQuest proved to increase engagement, entertainment and visitor duration at Vislab. Overall, insights gained during the design process of VisQuest resulted in considerations in areas such as the process of designing a digital guide, general presentation and usability considerations, encouraging of exploration, as well as important attributes and preferences of a guide for teenagers. Thus, including parts of the whole use-cycle of a digital guide.

The research on how to design a digital guide resulted in VisQuest, a gamified digital guide which had the form of a website for a smartphone, and a use of quests. This was identified as relevant through for example field studies (see Section 5.1.4), and the co-design workshop (see Section 5.2.1). This is thus one way of implementing a guide, but it also means that there are further areas that can be researched on the topic of digital guides. With that said, we have generalized our identified considerations to be valid for other forms of digital guides.

Furthermore, because the test environment of Vislab consisted of an exhibition with advanced data visualizations we believe that our insights and consideration to be applicable in other similar environments of visualizations. Also, because the design concept was implemented and evaluated with teenagers as co-designers and testers, we believe our result represent considerations when having teenagers as a target group. However, one should reflect on that contextual differences can make considerations more or less important.

Below follows discussion on how well our sub-research questions were answered.

### **Making it easier for visitors to understand how to interact with the exhibits**

During the project we identified that teenagers wanted hints and that these hints should be optional so that they can choose themselves whether or not they wanted to see them. Hints were thus implemented for each quest in VisQuest. Sometimes, these explained how to interact with a particular exhibit, such as how to reset the screen back to its initial state. Other times, these hints explained where to find particular pieces of information.

However, when comparing the understandability of content between users and non-users of VisQuest, it was slightly lower for users. One explanation to this could be that because the app explained what could be found in the visuals, and included at times challenging tasks, this could have made the user feel less confident if they did not find all those things. While if the visitor did not use the app, they would not reflect on what could and could not be found. However, the slightly lower score could also be attributed to variance, seeing as the difference was not substantial. Furthermore, the final user test did not ask specifically if the hints were found or used at all. Thus, we cannot say for sure how hints work in practice.

### **Making the content of the exhibits more interesting**

One way that we tried making the content more interesting was by designing some of the quests such that they involve the user's personal opinions and experiences, as well as things that they care about and can relate to. Although completing quests made users stay longer at the exhibition and these personal quests (called "Find-outs about user", see Section 6.1.2) were the most popular, the quests did not seem to make the content of Vislab more interesting. The results from the final evaluation show that, regarding how interesting the contents of the exhibits were, the average score for people who did not use the app was 6.7, while the average score for people who used the app was 6.9 (see Section 6.2). Although this is a slight increase, the difference is negligible, suggesting that despite the quests making the user stay longer and interact more with the exhibition, and despite that the quests was related to the user somehow, the quests did not make the contents of the exhibits at Vislab more interesting compared to non-users. With that said, users of VisQuest did at least feel that their entertainment increased, and made them interact and learn more through staying and interacting longer than a non-user which is more important.

One possible explanation for the content not being more interesting for VisQuest users is that finding or learning things when someone asks you to, may not be as enjoyable as finding or learning things on your own. When the app asks the user to answer a question, it spoils the content and gives the user a task, instead of letting the user exploring because of their own curiosity. And so, even though personalized quests felt entertaining, the interest in the content might have been reduced by not drawing the insights on your own.

As mentioned, interestingly enough, people who used the app *seemed* to think that it made their visit more enjoyable. The average score for how much more entertaining the app made the visit was 7.3 (see Section 6.2). However, while the participants may have felt that the app made their visit more entertaining, as aforementioned the results from the question regarding how interesting the contents of the exhibit were still suggest that the app was not fully successful in achieving the goal of making the contents more interesting. Thus, the consideration regarding how a guide can make the content of the exhibits more interesting did not get a conclusive answer.

### **Contributing to an exploratory experience for teenage visitors**

We identified various ways to entice people to explore Vislab. Among those were implementing quests including "find out something about yourself"-quests that encouraged exploration of the room. Other identified considerations were hinting at and providing visitors with teasers of what can be found at the exhibits which seemed to pique their curiosity of the exhibition. Moreover, providing the visitors with navigational help such as a map helped by providing the visitor with a holistic view of the content. Lastly, providing explanations for each screen helps by making people less discouraged by the challenge of understanding the content of and how interact with the exhibits.

The results from the final evaluation show that all participants felt that the app enticed them *some* to explore the exhibition, while most people even *fully agreed* that the the app enticed them to explore the exhibition 6.3.2). This suggests that the above concepts seem to have been a success in making visits a more exploratory experience.

### **Presenting the guide in such a way as to make visitors want to use it**

The project identified that there is a threshold to start using a guide, including various considerations as to how one should counteract this challenge in regards to both interface and presentation. However, the considerations regarding presentation was mostly based on wishes from the target group, but not actually verified through user tests. Thus, we cannot say for sure how the recommendations for presentation work in practice.

We also believe that presentation is dependent on how much focus you want the guide to have. If the guide should be passive, then most likely the presentation should be likewise. If the guide instead is an important part of the exhibition, then that could indicate the presentation should be more eye-catching, or maybe even a mandatory part of entering the exhibition.

## **7.2 The final evaluation**

The learnings for designing a digital guide was developed through the literature research as well as continuously throughout the design process. These learnings resulted in VisQuest, thus making the final user testing an important aspect regarding how well these insights worked in practice, and the final user test transformed these

learnings to key considerations. Because of its importance we here reflect on how the final evaluation were conducted and the reliability of the result.

### **Amount of participants**

Throughout the testing it was difficult to gather both users and non-users of VisQuest to answer our survey. This resulted in quite few answers in total for the final evaluation, which means that each individual answer had a relatively big impact in user average. Because of this, the results may not represent the target group as a whole and further testing should be conducted before one makes any conclusive statements.

### **Age of the participants**

Most of the answers come from older teenagers, around the age of 18 - 19. Although they are a part of the target group, there is still a difference between a 19-year old and a 13-year old. The results from this study may thus not be indicative of the entire target group, and further testing with teenagers of all ages may need to be done. Moreover, teenagers can be impatient and mischievous (according to our own observations during field studies and testing), and at times we wondered if the survey answers were fully honest or not.

### **Limitations of the prototype and the Vislab environment**

It is worth mentioning that the prototype had some bugs which might have affected the results. For one, the interface was not working correctly for some iOS versions. This led to some participants either using the app while trying to understand an interface that misrepresented the actual interface, or using it together with a friend. Another factor was that some of the participants had rather small phones, which made some elements of the interface show up incorrectly on their phones.

Furthermore, there was a power failure during one of the days of the evaluation, which cut the power from most of the exhibits at Vislab making them unusable for a short while. This might also have affected the results of the final evaluation.

### **The users of VisQuest**

As aforementioned and as the results from the final evaluation show, participants who used the digital guide were present for longer and interacted with more screens than those who did not use the guide (see Section 6.2). One suggestion for the reason behind this is that those who used the guide were already interested in the exhibition and would have stayed for as long as they did regardless of whether or not they had used the guide. However, as previously mentioned the results also showed that there was almost no difference in interest for exhibition between people who used the guide versus people who didn't. In short, the participants who used the guide didn't seem to be more interested in the exhibition than those who didn't use the guide, yet they still stayed longer at and interacted with more screens in the exhibition.

### **Visitor duration of VisQuest**

One thing worth considering is that there might be a risk that people who tested the

app stayed longer at the exhibition than people who did not use the app (see Section 6.2.1) because they were asked to test an app and partake in a study. However, during the evaluation the app was presented as something to use during one's visit and not to be the focus of their visit, and the survey was presented as optional. This could indicate that the results were not affected much, since the purpose of their visit continued to be their own free exploration.

### 7.3 VisQuest - Types of quests

When developing the concept and prototype of the app, we came up with quests to complete for each screen. These quests were then categorized by us into four different types (see Section 6.1.2). These were: "Find-outs about user", "Quizzes", "Opinions/Thoughts", and "Activities". Different quests had differences in how effective they were for encouraging exploration at Vislab.

The results from the final evaluation show that "Find-outs about user" was the most popular type of quest (see Section 6.2). This aligns with the feedback from Universeum in the first iteration of the process (see Section 5.1), where we learned that questions which were related to the visitors' personal experiences and opinions were thought to be effective. According to this feedback, people seemed to really enjoy feeling like they were a part of the information presented in the visualizations.

The second most popular type of quest was "Quizzes" (see Section 6.2). This aligns with the literature studies where we learned that teenagers liked quizzes, and it aligns with the ideas the teenagers designed during the co-design workshop. However, this does not align with the feedback from Universeum where the idea of using quiz-type questions was thought to not be very effective for increasing engagement.

The least popular type of quest was "Opinions/thoughts" (see Section 6.2). However, the difference in popularity between these quests and "Quizzes" is so small that it is negligible and is likely due to variance.

Finally, "Activity" was equally popular as "Quizzes" (see Section 6.2). However, there was only a single quest of the "Activity" type, so it is difficult to draw any accurate conclusions regarding these types of quests.

Apart from the type of quest, there are other aspects that seem to affect why some quests were completed and others not. One such example is the quality of the existing exhibits, both the user interface as well as the physical presentation. While all interactive exhibits at Vislab consisted of screens, there were a few that played with aesthetics such as making a screen look like a table, a window, or such as the Digitala Göteborg that included a 3D model of the city. It was noticed through observation that physical attributes affected what felt enticing for visitors. Regarding the user interface, there were exhibits that, according to us as designers, had a bad and cluttered interface that a guide could not affect. This was noted as something that could affect whether a visitor wanted to complete quests at a specific exhibit.

Other aspects that seem to have affected what quests a user wanted to complete is the theme of the exhibit. As mentioned in the final evaluation (see Section 6.2), the Land area is the most popular theme in VisQuest, and in visitor observations a common thing to hear was that people liked animals, which would describe its high quest response. Lastly, also mentioned in Section 6.2, people mentioned that the quests had different difficulty level, which also could be a factor to why some quests were done and not.

## 7.4 Ethical issues

Throughout the design project we strived to reflect about ethics and morals. This was especially thought of when involving others in the design process such as in meetings, co-designing and evaluations. This included trying to gather diverse participants, being transparent about their contribution and our work as to not manipulate or mislead them, and also to interpret their data in a valid way and strive to design solutions adapted to their wants and needs.

When gathering knowledge and evaluating concepts with Universeum we made sure to receive input from people of different professions, which made the insights broad and not one-sided. For example we were in contact with lead in digital development, an interaction design expert, as well as pedagogues that work directly with the visitors.

When gathering teenagers to participate, such as in the co-design workshop (see Section 5.2.1), we wrote to schools and teachers, since many of them were under the age of consent. We also strived to contact schools in different areas, as to not only include a homogenic group. Unfortunately, we only got responses from two different schools. Nevertheless, they studied different programs and seemed to derive from different backgrounds with different interests which could indicate that a good enough of degree of diversity was met. In final user tests, it was not possible to go via parents or teachers for consent in teenagers' participation. In this case, we made sure to make it extra obvious that the participation was voluntary, and we made sure that the prototype did not save any user-data as well as making the survey afterwards anonymous.

Overall, throughout the project we always made sure to include informed consent in all user participation. We also made sure that all data gathering was done anonymously and that age and gender was the only personal data that was gathered.

On another note, a larger focus could have been put on accessibility throughout the design process. When gathering participants, this was not something that was reflected upon. With that said, if the concept of VisQuest and the research on digital guides were to continue, this could be a possible focus for the next iteration. Some identified areas that could be improved are the lack of language options, adaption to poor eye sight, and color blindness. While the intention is for the app to have

language options such as Swedish, English, Danish and Norwegian, this was only reflected in a prototype of an earlier version (see Section 5.2) and was not present in the final prototype (see Section 5.3). Moreover, the interface could be improved for people with low vision by for instance including options for increasing font size and button sizes or an option to change to a high-contrast interface which would make it easier to distinguish between different parts of the interface. There could also be options to change the colors of the interface to be more viewable for people with color-vision deficiencies. Including a larger focus on accessibility would probably result in more key considerations for digital guides.

## 7.5 Process & Methodology

The design process, including the work with the HCD-process, choices of methods and how they have transpired, has worked very well in this project. The satisfaction derives from the fact that we did profound background research on the topic of guides, teenagers, exhibitions and visitor behaviour, and that we have involved a large and relevant group of people through-out the design process. For the latter, we have included the target group of teenagers in the design as well as through evaluation, we have had continuous meetings with stakeholders, and also received input from other interaction designers. This has resulted in broad and relevant input, and through an iterative process a strong concept of VisQuest was developed, alongside with many key learnings.

As mentioned in Section 6.3.1, we feel that recurring visits to the exhibition, stakeholder meetings, field studies, co-design with target group, and user testing in the natural environment of an exhibition have been especially important for the project.

If we would re-do the project, the only wishes would be to include a broader user group when having co-design workshops, as well as having more participants for the final quantitative evaluation. Lastly, when evaluating a higher fidelity prototype, such as the coded prototype of VisQuest (see Section 5.3.2), we would have wanted to include other languages than Swedish. While this made for a quicker prototype since we only had to include one language, it also led to a lower response rate during the evaluation. There were times when we saw people who looked to be within the target group, but we did not ask them to test the prototype since they did not speak Swedish.

## 7.6 Future work

If the project would continue forward, there are a few areas that we recommend further iterations on, as well as new areas that would be interesting to dive into. These include research on how to further gamify the experience of VisQuest, how to facilitate interactions with exhibits, as well as research on presentation, stronger integration, and different physical forms.

**Furthered gamified experience**

One thing to potentially investigate in the future is to further gamify the experience, since games were something teenagers like. One thing could be to implement the functionality of unlocking questions as you complete them, which has been in discussion since the first iteration of this project, but was never implemented. This would work by presenting some questions for each area as locked until the user completes a certain number of the existing questions. According to the co-design workshop (see Section 5.2.1), unlocking of things nudge teenagers to complete more tasks, so by gamifying the exhibits through a digital guide they would hopefully engage with the exhibits more. However, it is also worth noting that this function was thought of when the guide contained "quiz"-questions with a correct and incorrect answer. It is not certain if having unlockable questions is suitable when the questions do not have correct answers.

Another way of gamifying the experience could be to make it more of a competition, where visitors could compete with or against each other. One idea that was presented during the design process was to include a live score board in the room, which could enhance the experience of using a guide to something more than just being a traditional passive guide.

**Facilitate interactions with exhibits**

It is worth further researching how a guide can facilitate interaction with exhibits. One way we tried to do this was by providing users with optional hints which they can view if they need help, which explain things such as how to reset the screen of an exhibit or where to find certain information. While hints were implemented in the app, they were not researched in terms of how well they make interacting with the screens easier. Further testing needs to be done to research this and research how the hints can be developed to help fulfil their purpose better.

**Presentation**

One area that we touched upon, but did not fully investigate, was what one should consider regarding presentation of a digital guide. The presentation is important to make visitors want to use it. As mentioned in Section 6.3.2, we identified some general considerations such as an eye-catching presentation, that in few words mediate purpose and fun, including simplicity in starting to use the guide. However, we believe that further research could be done in how one could lower the threshold to get visitors to use a digital guide.

**Stronger integration**

One thing worth researching in the future is how people would feel about the guide if it was less passive and worked more as an exhibit on its own. As it is now, the app is something to use while exploring Vislab, and do not add much extra to the visit apart from the quests. Another option however, is to present the guide not as an add-on but as an individual exhibit that present Vislab in a new way, or even to make the guide a semi-mandatory part of the exhibition. During the evaluation in the second iteration (see Section 5.2.3), one of the participants stated that they would

not use the guide as it was currently presented, but they would if it was presented as something that provided them with a new way of experiencing Vislab. Moreover, people wished for stronger integration and communication between the guide and the existing exhibits, to create a more dynamic behaviour. Another idea that arose during a supervision session was to create an imaginary portal when entering the exhibition, and where the visitor would be presented to the guide before entering the exhibition. The idea was that the visitor would then get a sense of entering into another world with data visualization as its theme while going through the portal, and where the guide would be a large part of the experience.

### **Physical form**

The digital guide that was being developed in this project took the form of a smartphone app. However, this is only one possibility, and the guide might take other forms such as something more physical and tangible. We chose to develop the guide for smartphone because that seemed appropriate considering the fact that teenagers at Vislab often had their phones in their hands (see Section 5.1.4) and previous research states that designing for smartphones is appropriate when designing for teenagers (see Section 2.2.4). While this seemed to have worked well, there might be other forms that are even better for getting teenagers to engage with the exhibits. This is a question worth looking into in the future. Lastly, with other physical forms, other forms of content (i.e. something that is not a game with quests) may arise.

# 8

## Conclusion

The project set out to research what key considerations there are for designing an interactive digital guide intended to increase engagement for teenagers interacting with advanced data visualizations at exhibitions. The project used design as a research form and was conducted at Vislab at Universeum, an exhibition focused on visualisations of research data, with teenagers as its main target group.

The project resulted in a prototype of a smartphone game for Vislab called VisQuest. The game is intended to be used while exploring Vislab and revolves around completing quests. These quests work as a form of enticement for the visitors to explore and interact with the interactive data visualisations at Vislab. Furthermore, the game includes a top-down map of Vislab and explanations of areas and exhibits to help with navigation and orientation in the room. It also includes help for how to interact with exhibits in and where to find certain pieces of information in order to complete quests.

The concept of VisQuest is developed with the research question in mind, and evaluation show that the application is successful in making teenage visitors stay longer at exhibitions and increase their engagement towards exploring more parts of an exhibition. The design process resulted in a set of key considerations when designing a digital guide at exhibitions for teenagers. These include considerations on form and interface of a digital guide, a classification on quests in a gamified guide, a set of techniques to encourage exploration, and lastly future work areas.

Regarding the interface for a digital guide at an exhibition for teenagers, it is critical that it is simple and easy to learn. It should be possible for the guide to be quick to use and not take up much time, and it should thus not include too many functions and content that take time to go through. Moreover, the interface should be able to handle mistakes and allow for users to explore the interface freely without the fear of making mistakes. Regarding the form of a guide, a mobile-based solution is appropriate for teenagers, since they often have their phones in their hands while exploring exhibitions.

It was also identified that teenagers like game experiences in digital guides at exhibitions, particularly games which revolve around quests or missions. A classification of different types of quests that evoke teenage engagement were created. Firstly, there are quests that let users contribute with opinions, share stories and reflect on one's thoughts and choices. We call these types of quests "*Opinions/thoughts*". There are

quests which are about making the user find out something or learn something about themselves or something related to them. We call these types of quests "*Find-outs about user*". There are quests which are about finding answers to questions, and which have correct and incorrect answers. We call these types of quests "*Quizzes*". There are also quests for performing certain activities or finding hidden objects or information, which we call "*Activity*" quests.

Out of the above mentioned quests, "Find-outs about user" are the most appreciated, and the type that evoke engagement the most. "Quizzes" and "Activity" are the second most appreciated, and "Opinions/thoughts" the least appreciated by a slim margin. While some quest types are more popular than others, it is important to still have variation in types of quests.

Furthermore, the project resulted in a set of techniques to encourage exploration. These included that the guide should include help in physical navigation (e.g. a map) and include content that is related to the exhibition. It should also make use of hinting and teasers to attract people to the exhibits (e.g. nudging questions such as "have you tried this?"). The guide should also facilitate interacting with exhibits to counteract challenges of visitors interacting with exhibits (e.g. through clues in quests). Lastly, the guide should encourage people to explore areas of interest, and strive to relate the user to the content of the exhibition, to make it more interesting for the teenage visitor.

To conclude, the project presents various key considerations that contribute to research on designing for teenagers in an exhibition environments of advanced interactive data visualizations. The considerations contribute to projects at science centers, and possibly elsewhere, where one want to increase teenage engagement. The knowledge can be used both in its entirety, as well as for sub-areas within the field. The knowledge can also be used as a foundation for research on digital guides for teenagers, where other areas such as presentation, physical forms, and the level of integration in exhibitions are suggestions for further research within the field. The project has broadened the view of what a digital guide can entail, as well as contributed with a design process and result for other interaction designers to learn and be inspired from.

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# A

## Competitor Analysis

This appendix include raw data and a summarized set of findings from the Competitor Analysis on existing digital guides at exhibitions in Gothenburg. The analysis was conducted in February 2022 through visits to Naturhistoriska muséet, Göteborgs stadsmuseum, Världskulturmuseet, Älvrummet and Universeum. The analysis was written in Swedish, thus the raw data is in Swedish, while the identified findings are translated to English.

### **Translated findings:**

- The visitor should be introduced to the guide no matter what entry or order of exploration they take. It should be easy to find, including how to begin using it.
- The entry threshold to using the app should be low.
- The guide should not include too many navigational steps, and those that exist should be clear and evident.
- If the guide use a graphical interface, it is helpful to include a map of the exhibition area in the guide.
- Teasers about exhibits is a good way to pique user's interest and then urge them to find out the information for themselves through own exploration.
- Having a narrative in a guide is great way to get a nice thread through the experience.
- Could be a good idea to create some kind of game to nudge people to explore all parts of the exhibition.
- It is important with a graphically inviting interface to create good user experience
- Consistency of how you interact with the guide is important to make it easier for users to feel confident and to meet their expectations.
- Information about a certain area should be found at one and the same place.
- When using the app only relevant information should be displayed and available, the rest is better to hide.
- It is good to encourage the visitor to explore on their own, maybe even by saying it directly.
- If you have recordings, do not make them too long. The shorter the better and stronger change to keep the interest of the listener.
- It can be a good thing to divide the content in a way that make sure that the user gets pauses when using the guide.

### **Raw data from the analysis**

Competitor	About the visit in general	Description of the digital guide	Strengths	Weaknesses	Important findings	Social context (used? individual?)	Aesthetic attributes	Mobile or Stationary
Världskultur museet	<p>Som två helvt förvirrade ugglor steg vi in. Personal tog våra saker och tog oss till en virtuell utställning. Här berättades att det fanns tre utställningar. Vi frågade om det fanns en digital guide, svaret var att det endast fanns kompletterande audioguide-liknande lösningar på om på vid vissa moment i utställningen.</p> <p>Utställningarna:                      - Mind the gap (Bestod av ett rum där man kunde lyssna på folks berättelser. Ingen guide)                      - Viva Mexico (hade lurar vid skärmar med video, och så, men ingen riktig guide)                      - Korsvägar (Hade QR koder som tog en till två olika ställen. Ett ställe var en länk till ljudklipp, ett annat till en karta av utställningen där man kunde klicka in på olika områden och läsa/lyssna på info om olika artefakter)                      Trevlig tur! Inte så långa utställningar. Lämnade fortfarande pågga.</p>	<p>Guide 1:                      Ett web interface: <a href="http://korsvagar1.vardskulturmuseet.se/">http://korsvagar1.vardskulturmuseet.se/</a>                      Inkluderade en karta av utställningen där man kunde klicka på olika områden och både läsa och lyssna om på info om det området och om de artefakterna.</p> <p>Guiden hittades både genom tillgängliga QR koder, men den fanns även att interagera med på diverse skärmar på plats utan att man behövde en egen mobil.</p> <p>Interfacet var i ganska gammal stil. Lite halvauddig karta, pop-up rutor som kunde anpassas bättre till skärmarna. Lite ointuitiva knappar som gjorde att det var lite förvirrande var i navigationsstegen man behövde säga.</p> <p>Guide 2:                      Ett web interface: <a href="http://dex.korsvagarguide.srvk.se/wordpress/">http://dex.korsvagarguide.srvk.se/wordpress/</a></p> <p>Inkluderade olika avsnitt:                      - AUDIOSPAR: en karta av utställningen där man kunde se ljud-ikoner utplacerade på kartan. Om man klickade på en av ikonerna kom man till ett inspelat ljudklipp med information om just den platsen i utställningen. Interfacet var i lite mer modern stil med mer inbyggande färger och där man kunde välja vilken avsnitt man ville lyssna på.                      - Ett avsnitt för varje OMRÅDE i utställningen inom ett sådant avsnitt fanns videoklipp med förklarande person och textinfo. Inbyggande tema-enligt och grafiskt.</p>	<p><b>Guide 1:</b>                      Tillgängligheten på statiska skärmar gjorde att man inte fasnade med blicken i sin mobil istället.</p> <p><b>Guide 1:</b>                      Tydlig navigering med karta som utgångspunkt.</p> <p><b>Guide 2:</b>                      Bra och inbyggande grafisk design. Placering var tydligt.</p> <p><b>Guide 2:</b>                      Ingen navigational excise. Bara en nivå och ett pop-up fönster framme som max. Avsnitten visade endast det relevanta.</p> <p><b>Överlag:</b>                      Tydlig navigering med karta som utgångspunkt.                      Mobilvänlig.</p>	<p>Lite utdrägg mellan buttons och vad dem avsettde.                      Lite utdrägg aesthetics.  <b>Guide 2:</b>                      Tydligt att ha Audiospar och Ordspår på samma nivå när ordspår innehåller alla områden, men inte det som Områdesavsnitten innehåller.</p> <p><b>Överlag:</b>                      Att utställningen använder sig av tre olika sätt att ge info om samma områden.</p>	<p>Positivt att utgå från en <b>karta</b> på området med audioguides för olika delar av rummet <b>ett och samma ställe</b>.</p> <p>Information om ett område <b>bör finnas på ett och samma ställe</b>.</p> <p>Viktigt med <b>gratis</b> inbyggande interface.</p>	<p>Social context (used? individual?)</p> <p>Output</p> <p>Input</p> <p>Functions</p> <p>Environment</p>	<p>Guide 1:                      Karta lite ofördig som en pop-up, lite fyrkantigt</p> <p>Guide 2:                      Pleasing. Bra användning av färger, ikoner och bakgrund.</p>	<p>Mobile or Stationary</p> <p>Mobile</p>

Figure A.1: Analysis of digital guides at Världskultur museet.

Competitor	About the visit in general	Description of the digital guide	Strengths	Weaknesses	Important findings	Social context (used? individual?)	Aesthetic attributes	Mobile or Stationary
Göteborgs stadsmuseum	<p>Vi frågade i receptionen om audio guide, svaret var att det inte fanns.</p> <p>Vi fick en papperkarta i handen och började utforska museet ändå. Utställningarna kom i relevant kronologisk ordning. De var tema-enliga med tydliga mood, luftig miljö, grafiskt inbjudande texter och bra användning av ljus och stämningfullt ljud.</p> <p>Efter ett tags utforskande möttes vi av det närmsta som liknade en audio guide, ett par minuter senare fick vi en digital audio guide. Den fanns kvar det ett par sekunder, sedan blev hörlurarna så man kunde lyssna med rön. Vid en annan utställning klickade man på en knapp på väggen så att innehållet lästes upp högt. Vid andra ställen fanns högtalare i väggen till bankar så man kan kunde stanna och lyssna. Det som spelades upp i hörlurarna var ofta ljudet till videos på skärmar, och för knapparna på väggarna var det ofta en sammanfattning av en text i väggen, för högtalarna så var det mest tema-enligt prat för utställningen (tor v). Features för dessa audio guides: <a href="#">Stärkningar</a> → <a href="#">Förhållanden</a> → <a href="#">Stärkningar</a> → <a href="#">Förhållanden</a></p> <p>I en av utställningarna fanns det ikoner för "Synkroniserad audioguide" men den var inte gångbar (Läs mer i Beskrivning av digital guide). Enda stället där det fanns information om hur man fick tag i audioguiden var på skyltar precis vid ingången till en utställning.</p>	<p>De hade ingen audio guide utan utställningen innehöll främst stationära hörlurar vid vissa skärmar, artefakter, textuppläsning, samt i korridorerna.</p> <p>Utställningen "Göteborgs Födelse" verkar ha haft en audio guide om mobilapp kalledd "Göteborgs Födelse", den var dock inte tillgänglig när vi gick igenom.</p> <p>Utställningen "Göteborgs Födelse" verkar ha haft en audio guide om mobilapp kalledd "Göteborgs Födelse", den var dock inte tillgänglig när vi gick igenom.</p> <p>Vid sökning framkom det att appen endast innehöll uppläsning av texter, och även videos med teckenspråk. Alltså inte så mycket av en guide, utan mer ett verktyg för syn och hörselskadade.</p>	<p>Att appen är anpassad för syn och hörselskadade.</p> <p>Tydliga "ikoner" i utställningen om att en audioguide fanns.</p> <p>Knapp-guiderna följde ett tydligt narrativ i ordningen och innehållet (de hade)</p> <p>(Att guiderna på inom varje utställning var konsekvent i hur de användes och till vad.)</p>	<p>Att audioguiden inte var igång.</p> <p>Att hur man använde guiden (genom att ladda ner en app) endast informerades om vid ingången till utställningen på en skylt man kanske inte ens läste.</p> <p>(Att vissa hörlurar var främliga)</p>	<p>Att ha ett narrativ var ett bra sätt att få en röd tråd genom det hela.</p> <p>Att där man förmedlar att en guide finns, där kan man även få reda på <b>hur den</b> nås.</p> <p>Att tänka på vilka vägar folk går igenom utställningen och se till att man <b>kommer åt guiden i början</b> oavsett vilken väg man tar.</p> <p>Att det underlättar för användaren att känna igen sig och uppfylla förväntningar om man är <b>konsekvent med hur man interagerar</b>.</p>	<p>Tech</p> <p>Output</p> <p>Input</p> <p>Functions</p> <p>Environment</p>	<p>(Some only individual, some are open for co-listening)</p> <p>(Magnetsism för att fåsta lur på väggen.)</p> <p>(Nagon sorts klockad relationsaxel. Fanns en plastskärm framför projektorn som stoppade video från att visas på väggen, den roterade bort när videon skulle starta)</p> <p>Svartvit, skarpa kontraster, stora knappar. Minimalt innehåll.</p> <p>Mobil (Stationär)</p>	<p>Web interface</p> <p>Video</p> <p>Text</p> <p>Audio</p> <p>(Läs upp texter, spela ljudet till videoklipp)</p> <p>Spela ljudklipp som läsa upp skriven text</p> <p>Spela videoklipp med teckenspråk som alternativ till att läsa text</p> <p>Läsa kort sammanfattning av innehåll</p> <p>(Läs upp texter, spela ljudet till videoklipp)</p> <p>Varje utställning hade temaanlig miljö. De jobbade mycket med mörka rum med stämningfullt ljud.</p>

Figure A.2: Analysis of digital guides at Göteborgs Stadsmuseum.

Competitor	About the visit in general	Description of the digital guide	Strengths	Weaknesses	Important findings	Social context (used? individual?)	Aesthetic attributes	Mobile or Stationary	
Naturhistoriska	<p>När vi skulle starta vår besök var det oklart var vi var. Var där man in? Behöver man gå till informationsdisken? Vi hittade ingen informationsrohyr. Man kunde gå i flera olika riktningar men tillslut hittade vi en skylt "Till utställningen" på en trappa.</p> <p>När vi kom in på utställningen möttes vi av en karta som visade övergripligt vad som fanns på olika ställen och väningar. Denna karta var den enda i sitt slag.</p> <p>Vi utforskade innehållet i utställningen men utan att hitta något insteg av en digital guide. Vi möttes endast av ett fåtal interaktiva skärmar, talande skärmar och förklarande texter brevid vissa moment.</p> <p>Vi kände ett visst behov under turen att en guide hade varit trevligt för att ge mer djupgående information, göra att man vet var i utställningen man är och vad som ligger åt olika håll, samt för att göra det tydligare vilka texter som tillhörde vilka djur i vissa fall.</p> <p>Efter 30min hittade vi ett litet visittkort i tilli grönfärg. Efter det hittade vi ett yttre lager vid en etefant, pigvin och en fågel. På visittkortet fanns en bild på en mobil och så stod det https://appguide.me. Länken tog oss till en sida med ljudklipp för några diverse utställningar, en av dem för Naturhistoriska i Göteborg.</p>	<p>https://appguide.me hänvisades till på några få ställen på små lappar.</p> <p>Länken tog en till en lista av olika utställningar och län (Lex. Bata Shoe museum, Blekinge, Jönköpings läns museum).</p> <p>Användaren fick själv trycka in sig på Naturhistoriska där man möttes av fyra områden: Fågelsång, Fågleras familjeliv, Livets historia, Läten av däggdjur.</p> <p>På vissa lappar kunde man se vilket område man skulle in på, andra inte.</p> <p>Guiderna bestod sedan av korta klipp i tidigt 2000-tal stuk (Lyv windows movie maker. Vissa klipp var endast av djurfilmen, andra en kortare uppläst beskrivning, andra bildspel med jazzmusik. Nedanför klippen fanns informerande text om djuret som avseddes.</p>	<p>Man fick lyssna och läsa saker från guiden i sin egen takt, för den var upplasad efter monterarna. (Osäker på om det här ens är en stycka också)</p> <p>Texten som förklarar monterarna var helt okej ändå. Mycket bättre än videorna.</p> <p>När man väl hittat sidan, och sen om man tagit sig tiden att förstå den, och lärt sig att inte trycka på bakaknappen... Då var det kanske inte så krångligt användarmässigt.</p>	<p><b>Svar att upptäcka.</b> Vi visste inte ens att det fanns en audio guide, det var bara en liten lapp längst ner vid vissa djur.</p> <p><b>För många navigationssteg.</b> För att komma till audio guiden behöver man gå till appguide.me, ladda ner appen, logga in på appen, hitta naturhistoriskas guide, och till och med då fanns det ingen guide för hela utställningen. Utan det fanns bara förklarande text + video för ett par få av monterarna.</p> <p><b>Vi har lärt oss att det är viktigt att:</b></p> <ul style="list-style-type: none"> <li>• Guiden ska vara lätt att hitta</li> <li>• Inte ha för många navigationssteg</li> <li>• Navigationsstegen ska vara tydliga</li> <li>• Bara relevant information ska vara tillgänglig</li> </ul> <p><b>Saker att reflektera över:</b></p> <ul style="list-style-type: none"> <li>• Borde den fysiska informationen skilja sig från den i guiden? Kan det vara förvirrande?</li> <li>• Ska guiden vara ett annat sätt att ta in samma information som finns fysiskt, eller ska huvudsyftet vara att ge fördjupande, fun facts, eller annan info?</li> </ul>	<p><b>Output</b></p> <ul style="list-style-type: none"> <li>• Klippen bidrog inte med någon vidare ny info (ger inte något som inte redan fanns på utställningen).</li> <li>• Vajldigt rörligt user interface.</li> <li>• Svårt att veta vilken extra information man skulle nås av då klippen var väldigt okonsekventa.</li> </ul>	<p><b>Tech</b></p> <ul style="list-style-type: none"> <li>• Web interface</li> </ul>	<p>Individual, or co-used, depending on what the user wants.</p>	<p>Ganska basic, den tillhör en webbsida av onspolstory (tror jag). Inte så fin. Rörlig.</p>	<p>Mobile</p>
	<p>I samma omgivning som utställningarna</p>	<p>Spela upp video. Läsa text.</p>	<p>Touch</p>	<p>Video Text Audio</p>					

Figure A.3: Analysis of digital guides at Naturhistoriska Museet.



Competitor	About the visit in general	Description of the digital guide	Strengths	Weaknesses	Important findings
Älvrummet	<p>Vi möttes av 3D-modellen av Göteborg. Förutom denna skapelse så fanns en interaktiv skärm där användaren kunde fördela prioritet mellan områden i ett cirkeldiagram. Områdena var Utbildning, Klimat, Näringsliv, Infrastruktur, Sjukvård, Kultur och Industri. Beroende på hur man fördelade vikten av de olika områdena så fick man olika slutscenarion på hur det påverkade framtiden. Exempelvis kunde leg kultur göra att folk har långtråkigt etc.</p>	<p>Hade endast mänskliga guider.</p>	<p>Spelet var lite kul, kändes lättare att engagera sig när man vred på knapparna, såg vad följderna var och sen försökte få ett bättre resultat</p> <p>Spelet medförde att användaren fick ett bredare perspektiv på hur samhälleliga saker hänger ihop.</p>	-	<p>Kanske hade varit en idé att försöka leda runt folk med hjälp av ett spel på nåt sätt?</p>

Figure A.5: Analysis of digital guides at Älvrummet.

# B

## Context of Use

This appendix include summary of the information that was gathered through a Context-of-use meeting between the project designers and Universeum as stakeholders. The meeting was held in February 2022 for the designers to build a better understanding of the target group of teenagers, designing for exhibitions, as well as information about the Vislab existing environment including content, challenges and existing similar solutions.

### Summary

#### Goals and target group at Vislab

- High school student and up
- Goal is to learn about sustainability
- Get teenagers more interested in technology, and do this through the help of visualizations

#### Challenges at Vislab

- Get visitors to begin interacting with the screens
- Get visitors to stay and interact with the screens and look more in-depth at the information they provide
- Communicate that the theme of the exhibition is sustainability
- Make visitors see the relevance of the information, why it affects them

#### How their current audio guide is presented and used today

- It is passive, something the visitor has to approach
- The visitor begin using it through scanning a QR code
- The current users are mostly families with children, they use and listen to it together

#### Why the current guide is needed:

- The exhibition is not always staffed, digital guides are needed for when it is not
- Digital guides was a way to create space between people during the pandemic, in a way that companies could be guided individually.
- They are a complementary way to access information, listening before reading.

#### Things to keep in mind when designing an interactive guide

- Make sure the guide still encourage exploration of the exhibition room, e.g. make sure the visitor do not end up only having attention on their smartphones during the whole visit.
- Have in mind that there is a threshold to start using the current audio guide.
- It is important that different parts of the guide does not takes too long to go through, e.g. eventual video clips should stay under 30 seconds.
- Nudging is a good way to make people interested in things, e.g. such as visitors "Have you tried this?" or "What would you do?".
- A way to make people interested in the screens is to make the visitors feel the relevance to him or herself in the content, that is a key factor for visitors to learn things.
- People generally don't read instructions, thus the user of the guide should not need to read how to use the app, but instead approach it and start using it directly. Thus, the guide should be intuitive and fast to use.
- It is important that the guide can be used together with others.
- The two most important usability goals for a digital guide should be learnability, i.e. it should be easy to use the app st first try, and error handling, i.e. it should be easy to recover from an error.

### **Specific information about the interactive screens at Vislab**

- Matbordet - It is pretty easy once you have put a playe in fron of you, but it is important to first know that you can do that.
- Globen - Many people get very interested and stay long viewing data here, but it is not that lear that there is a screen conntected to the globe.
- Digitala Göteborg - Many people get very interested in the 3D model, but they walk away if they don't find the belonging interactive screen.
- Life stats - This screen has received postive feedback.
- Eco web - People stay quite long interacting with this screen, it is also the screen that is most finished at the exhibition.
- Sveriges Siffror - It is pretty easy interacting in it, but they are not sure visitors understand the bubbles of info.
- For some screens it is easier if you are more people interacting with it at the same time, such as Globen, Havets näringsväv (Weddellhavet) and Digitala Göteborg.
- Some screens include real time data, such as Globen, Fönstret, Snabba bilbeslutet, Rymden and Digitala Göteborg.

# C

## Initial Brainstorming

Here follows data about the different physical forms, tech, features, communication forms, context and space use an initial brainstorming of "How a digital guide might look like" resulted in.

Form	Tech	Feature	Ways for the guide to communicate	Ways for users to communicate	Social context	Physical space
Smartphone	Artificial intelligence	Track position	Visual guide	Gestures	Individual	Neutral
Headset	Radio control	Track activity	Audio	Speech	Collaborative	Dark
Torch light	Physical height and lowerability tech	Get feedback by pointing the guide in a direction	Visual text	Tactile	Competitive	(Prep-phase?)
Mini-car	The space lab's floor tech at Universeum	Show direction / Lead the way	Haptic			
Shoes	Range finder (radar? laser?)	Gives tutorial	Light			
West	Biosignal readers (heart beat, steps, gyroscope, SPO2)	AR layers to nudge visitors to different screens (eg. descriptive text, videos of animals on wall, flowing light that arises from the interactive screens)	Colour feedback			
Bracelet	Hologram	Screens adapting to the knowledge level the user stated in the guide				
Watch	GPS or similar	Gives challenges as in a treasure hunt				
Robotic ball	Optical tracking (like how VR tracks where you are in the room)					
Self-autonomos robot	Microphone					
Wearable robot	Image recognition					
AR glasses	Eye-tracking					
VR headset	Gesture recognition					

**Figure C.1:** A table of the data from the initial brainstorming.

# D

## Field Studies

This appendix include data collected from field studies at Vislab in February 2022. The study was conducted in Swedish, thus the raw data is in Swedish, while the used framework and identified important findings are translated to English. The field study was took use of the following self-created framework (see Table D.1). Observations were noted down on sticky notes on the Miro android app (see Figures D.1-D.5).

<b>What</b>	<b>Main question</b>	<b>Follow-ups</b>	<b>How</b>
Objects	What exists in Vislab?	What does Vislab look like? What feeling do one get?	Note down one time
Actors	Who are the visitors?		Recorded over time
Feelings	What is the mood of the room?		Recorded in interval of 30 min
Activities	What are the visitors doing?	What seems to be their goal?	Recorded in interval of 30 min
Acts	What does the individual visitor do?	Why? At what time? And at what place?	Recorded over time
Time	How do people move through Vislab?	What is their sequence of events?	Recorded over time

**Table D.1:** Table over what was observed during the field study.

## Vad gör den individuella besökaren?

Two females, 13 years.  
With family.

Två syskon(?) i 13års ålder. Interagerar med bilskrämen. Samlas fler bakom från familjen.

De körde varsin gång och diskuterade sedan varför de valde som de gjorde. Kollade inte jättemycket på statistiken. Stannade cirka 2:30 min vid skärmen.

Gick vidare till människokroppen och stannade i typ 25s. Sen till havet och stannade typ 10s. Sen vidare till havsskrämen närmast utgången i 10s. Sen tillbaka till havsskrämen efter att deras pappa börjat interagera där. Kanske för att han kunde lista ut hur den funkade?

Female, 19. With family?

Tjej 19 år. 1:30 på lilla havsskrämen. Går när jag kommer bakom. Sneglar på stor havsskrämen går sen till rymskrämen närmast människan. Stannar i ca 20s. Går sen till hjärnan och väntar i några sek till två andra går därifrån. Norsk.

Kollar vidare med sin familj på estimatedkroppen . Stannar där en stund och går sen till biltester.

Alla vill spela biltestet samtidigt. Lämnar efter 30s efter de blir osams. Går sen ut ur vislabs.

Stannade kanske i 10-15min.

Two females, 14-15 years. With parents?

Två 14+15 tonåringar med familj. Går in mot havsskrämarna.

En av tjejerna lämnar efter 20s och står utanför med mobilen en stund och går sen in till sin pappa vid biltester.

Andra tjejen står vid havsskrämen i typ 2min innan den går till de andra i familjen vid biltestet.

Alla tre vill vara delaktiga vid biltestet men endast en kan köra i taget. Blir lite irriterade på varandra. Första tjejen som ställde sig där är där i 2min. Den som anslöt stannar i ca 30 sekunder.

Familjen gick ut ur vislab efter 3:30min.

Three brothers, 10, 13, 16? With parents.

Familj med flera ungdomar. 3 bröder 10-16 år. Äldsta kollar lite på största havsskrämen. Stannar inte så länge. Många uttryck?

De alla stannar vid bilskrämen. Blir lite irriterade på varandra. Behöver turas om stannar typ 1min, endast lillebrors an gjorde. Äntigen får storebrorsan gå dit. Klickar sönder knapparna, inte alls intressad av resultatet.

Storebrorsan mest intresserad av att hitta allt som är interaktivt på en skärm. Inte vad som visas. Mellanbrorsan lyssnar i luren vid hjärnan. Skärmen är dock trasig.

Storebrorsan fortsätter med sitt klickbeteende.

Figure D.1: Sticky notes from the field study.



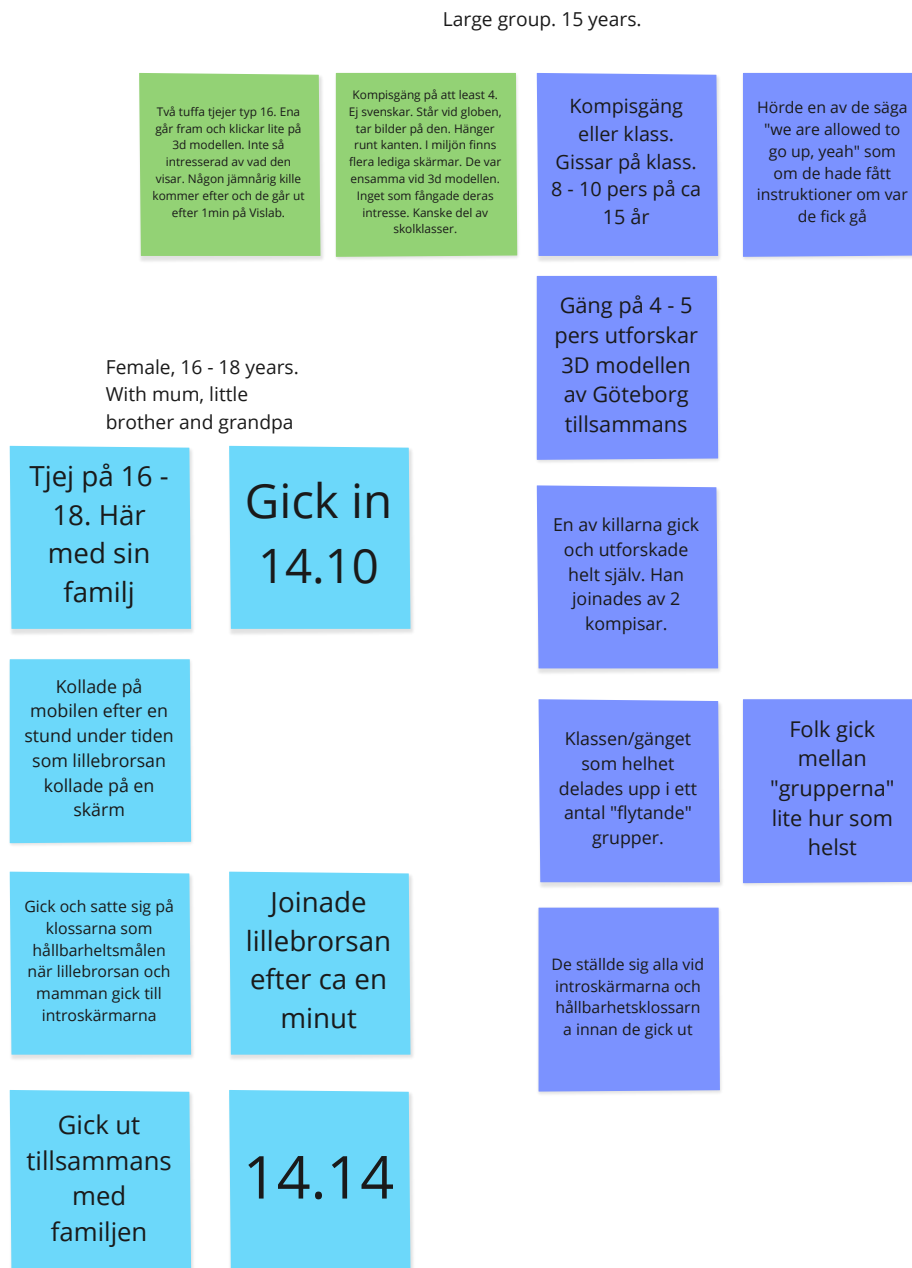
Figure D.2: Sticky notes from the field study.



Figure D.3: Sticky notes from the field study.



Figure D.4: Sticky notes from the field study.



**Figure D.5:** Sticky notes from the field study.

The notes were then grouped through and structured via the affinity diagram method in order to make sense and derive learning's of the data (see Figure D.6). The sticky notes were grouped into the following groups and subgroups:

- Who the visitors are
- How long the visitors stay
- What the visitors do before they leave
- Other things visitors do
- Screen specific notes
  - Intro screens

- The globe
- Society
- Space
- The human
- Sea
- Land
- General screen interaction notes
  - Whom visitors are interacting with when using the screens
  - How visitors are moving through Vislab
  - Interaction patterns
  - The visitors' exploratory gaze
  - The visitors' conversations about what they see

The analysis of the affinity diagram distilled into the following set of important findings:

- People seldom come alone
- People stayed at the screens for longer if they were interacting with the screens alongside someone else
- Teenagers had a tendency to explore together with whom they were accompanied by compared to younger children
- Some of the teenagers had a phone in their hand while moving through Vislab and interacting with the screens
- Those who were looking at their phones while entering Vislab seemed to leave more quickly compared to those who weren't looking at their phone
- Visitors stay for different amounts of time. Those who aren't hooked by the screens stay for around 1 - 4 minutes. Those who explore and engage with Vislab stay for 10 - 20 minutes.
- Lots of people went to the 3D map of Gothenburg
- The screen with the trolley problem dilemma seemed to engage visitors
- Compared to girls, boys showed a tendency for indifference towards the screens as well as showing a behaviour for clicking on the screens aimlessly, repeatedly.
- There were both swedish-speaking and non-swedish-speaking people attending the exhibition

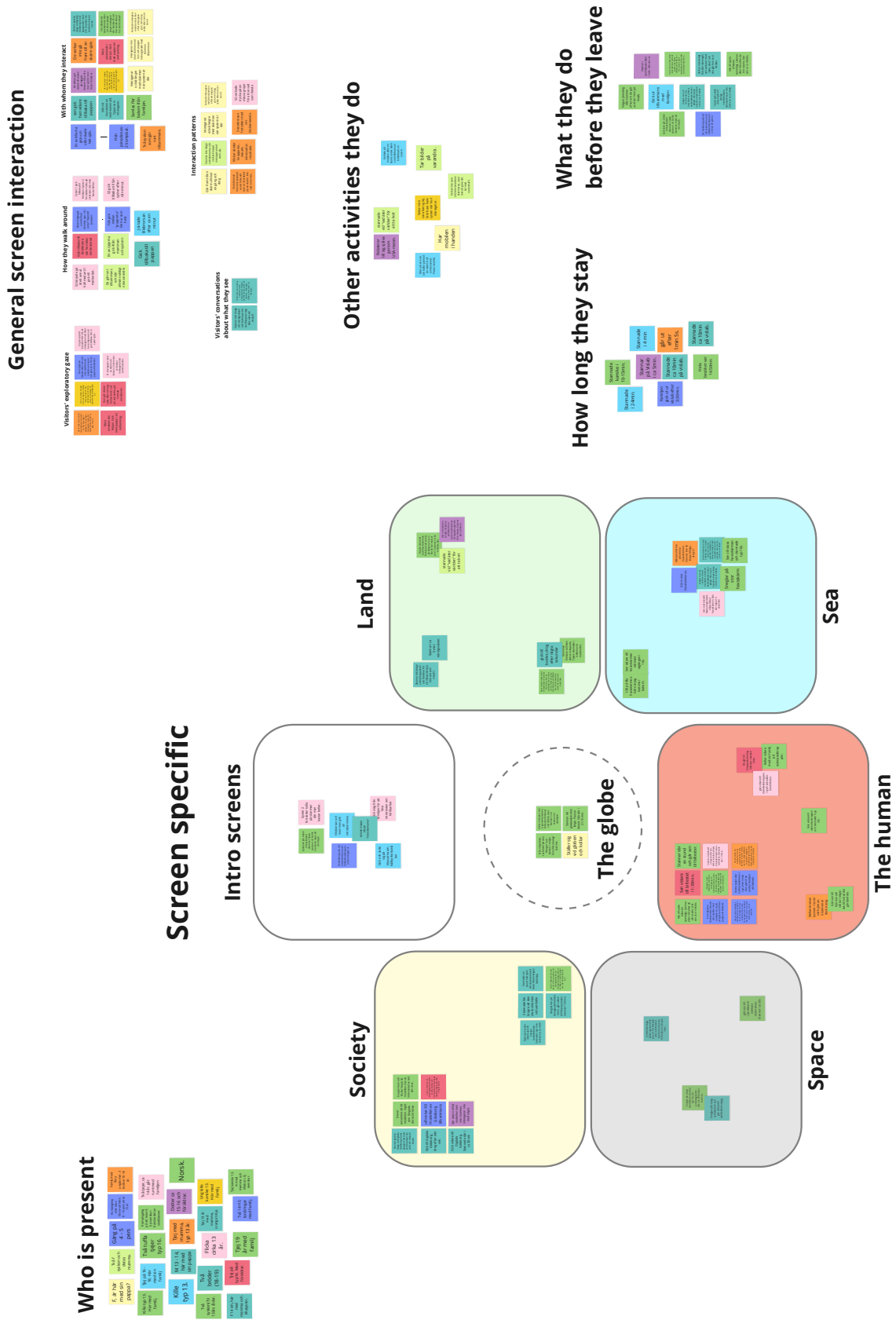


Figure D.6: Overview of the affinity diagram of the sticky notes gathered from the field study.

# E

## Controlled User Testing

This appendix include data collected from a controlled user-testing conducted at Vislab in April 2022. The questionnaire used is presented (see Figure E.1-E.3), together with a summary of the data collected, as well as the gained learnings. The study was conducted in Swedish, thus the questionnaire and collected data is in Swedish, while the identified important findings are translated to English.

### Summary of the testing

#### Deltagarna:

4 st män

23-28 år gamla

Studenter inom interaktionsdesign

#### Startskärmen:

De vita inforutorna hjälpte tydligt till med första interaktionen med appen, gjorde det tydligt vad man kunde klicka på. Det hjälpte även till med att förstå att väggen var interaktiv då det inte upplevdes lika tydligt som knapparnas interaktivitet.

#### Att lära sig interfacet:

Alla deltagare upplevde att interfacet var enkelt och lättförståeligt. En av anledningarna var att de upplevde att det inte fanns så mycket saker och alternativ så det gick snabbt att lära sig, och det kändes inte som man kunde göra så mycket fel. Efter att man interagerat med något element så kunde man förstå hur resterande liknande element skulle bete sig. Designen var minimalistisk och utan clutter, och lätt att överblicka.

#### Interaktiva elementen:

- Alla deltagare förstod att prickarna var interaktiva och anade att de skulle få någon sorts info av att trycka på dem. Dock förväntade de sig inte uppdrag, men förstod det efter att de tryckt på en prick.
  - Alla deltagare förstod inte att prickarna föreställde skärmar. En av deltagarna påpekar dock att det antagligen hade varit tydligare om man hade utforskat det fysiska rummet lite innan man fick ta del av guiden.
  - Andra tips är att ha tooltip i början om att det är en skärm.
- Några deltagare upplevde att väggarna inte hade så tydligt klick-pliancy, andra tyckte att det ändå var tydligt. Men vita hjälprutorna i början hjälpte att förstå det. Dock hade det kunnat göras tydligare.

- Otydligt att statistik fanns under hamburgarmenyn
  - Alla drog båda utestlutningsmetoden av uppdraget de fick (fanns inte så många andra alternativ). En deltagare klickade dock först på jordgloben.
  - Hamburgarmenyn förknippades för alla att man skulle få fler menyalternativ.
  - Vissa upplevde dock att den var okej.

**Angående uppdragen och kartan:**

- Tre av deltagarna tyckte det var kul att strålarna fyllde i sig när man utfört uppdrag, men en person påpekade att det blev på bekostnad av att det var lite otydligare att de svartvita strålarna representerade färgade strålar i det fysiska rummet.
  - 1-2 deltagare märkte även att bakgrunden fylldes i när man var klar.
  - Deltagarna såg det som nudgande till att klara av fler uppdrag
- De första två deltagarna gick inte runt och interagerade inte med skärmarna samtidigt som de använde appen i början. De utförde uppdragen utan att använda skärmarna.
  - Bakgrunden för land verkade vara förvirrande. För uppdraget där man skulle hitta sitt favoritdjur så trodde två att man skulle hitta det på bilden i bakgrunden, inte i skärmarna.
    - \* Kan tyda på att bakgrunden behöver vara lite mer abstrakt samt uppdraget tydligare formulerat
  - Att appen representerade en karta över Vislab var inte helt tydligt från start. Deltagarna hade därför svårigheter att hitta rätt skärm, och att ens veta att rummet skulle användas.
    - \* En önskade att det skulle vara starkare koppling mellan rubriker i appen och rubriker på de fysiska skärmarna.
    - \* En annan tanke var som sagt att de svartvita strålarna i färg hade gjort kartan mer lättförståelig
    - \* Deltagare påpekade dock att de antagligen hade insett det fortare om de var här som riktiga besökare och först hade tittat runt lite i rummet innan de öppnade guiden.
    - \* Två deltagare önskade att kartan anpassats beroende på var man är i rummet, exempelvis roteras åt hållet man är på eller visas var man själv är i rummet.
- Flera av skärmarna som möttes var väldigt cluttered vid start, exempelvis matbordet. Gör det svårt att utföra uppdragen, men också att hitta rätt skärm.

**Syfte:**

- De flesta deltagare upplevde att uppdragen kopplade hållbarhet och relevansen till sig själv.
  - Speciellt matbordet. Med djuren var det inte lika tydligt.
- De flesta tyckte inte att appen hjälpte en att hitta på vislab eftersom de inte förstod att prickarna representerade skärmar, samt tog tid innan de förstod att appen var en karta över rummet. Men de påstod att appen skulle göra det om detta framgick tydligare.

- Alla deltagare upplevde att uppdragen fick en att vilja kolla in olika skärmar, samt att de drevs av att slutföra uppdrag.
- En deltagare upplevde att uppdragen underlättar vid inläring, att man lägger saker på minnet, jämfört med att bara leka runt och inte bry sig så mycket.

**Skärmspecifikt:**

- Flera deltagare trodde livets träd var näringsväven eftersom den hade ett träd och den andra hade ofta upp ett slice:at djur.
- Matbordet var lätt att hitta, men oftast helt crowded med clutter
- Livets träd har begränsad upplaga av djur, kan vara värt att göra om frågan.

**Annat:**

- Två hade troligtvis inte använt appen om de kom hit som besökare, och två hade det.
  - En påpekade att den hade velat utforska rummet på egen hand och klarar sig själv.
  - En påpekar att den dock hade använt appen om den gav en ny upplevelse av Vislab som man inte kunde få utan appen och drog en liknelse till att man får testa på ny teknik och där appen och skärmarna samarbetar och påverkar varandra.
  - En deltagare hade använt den och sa att han lockades av att göra något medan man går runt och utforskar. Kul med ett mini-game, roliga uppdrag och få poäng och kunna jämföra med andra.
  - En deltagare påpekar att appen inte får ta upp för mycket tid och uppmärksamhet utan att huvudfokuset är på den fysiska utställningen.
  - En deltagare påpekar att log-in, nerladdande av app, samt registrering hade gjort att den inte skulle använt appen. Bra att ha webbsida utan registrering.
  - Flera deltagare uppfattar det som att appen kan användas ensam, men också av flera samtidigt där man kan kolla på skärmen och diskutera det som visas även om uppdragen svaras av endast en person.
- Deltagarna blev utåt taggade när de drog insikter om hur appen relaterade till rummet, och när de hittade rätt skärmar och sånt.

**Introduktion:** En tipsar om: stor skylt, en qr kod, enkelt som möjligt att komma igång. presentera på roligt sätt med att det är uppdrag.

**Derived learnings**

From the summary the following findings were derived:

- A guided tour pattern where the user is introduced to how the app works at the beginning of use is important to clarify the app's purpose, and also to clarify elements that is not fully obvious and intuitive.
- Minimalistic design with a limited amount of interaction and functions is important to make the interface simple and easy to learn, as well as good for minimizing the risk for the user to make mistakes.

- Progress nudges make users want to continue using the app, and to complete more tasks.
- It is important to make it clear from the beginning that the guide are intended to be used together with the physical exhibition, in order to minimize the risk that the app is used by itself and thus affecting the physical exploration in a negative way.
- If the interactive exhibits can get stuck in used-states, it is important that the guide suggest how the visitor can reset the screens. It is especially important to reduce impatience.
- Quests are a good thing to attract people to explore screens, as well as to increase learning.
- Exploring novel technology as a way to attract people to want to explore an exhibition should be tested
- An incentive to get people to use the guide can be that the guide contains elements or a new experience, which can not be experience without using the app.
- It is important that the app does not take too much time to use.
- It is important to avoid registration, log-in, download, etc. to reduce the threshold for starting to use the app.
- It is important with a good balance in difficulty of challenge, to accommodate users of different experience and skill level in order to not make the user feel stupid.
- It is important with a relevant presentation of the guide. In general, a large sign, simplicity of opening the application, and attractive choices of words about what to do with the application are appreciated.

## The questionnaire

### Bakgrundsfrågor

Kön:  
Ålder:

### Användarvänlighet

1. Hur **lätt** var det att lära sig interfacet? (Motivera)

Väldigt lätt | Väldigt svårt

--	--	--	--	--	--	--

2. Hur väl **matchade appen din mentala modell** helhetsmässigt? Dvs, hände det du trodde skulle hända när du interagerade med något visst element? (Motivera)

Inte väl alls | Väldigt väl

--	--	--	--	--	--	--

3. Hur tydligt var det att **cirklarna representerade skärmarna** i Vislab? (Motivera)

Väldigt otydligt | Väldigt tydligt

--	--	--	--	--	--	--

4. Hur tydligt var det att formerna vid **kanterna representerade väggarna** för varje område? (Motivera)

Väldigt otydligt | Väldigt tydligt

--	--	--	--	--	--	--

**Figure E.1:** The questionnaire for the task-based controlled user-testing (1 out of 3).

5. Hur tydligt var det att man kunde **klicka på väggarna och skärmarna**? (Motivera)

Väldigt otydligt

Väldigt tydligt

--	--	--	--	--	--	--

6. **Vad förväntade du dig** skulle hända när du tryckte på en skärm respektive på en vägg?

7. **Vad förväntade du dig** skulle hända när du tryckte på hamburgarmenyn?

8. Upplever du att man kan **använda appen själv, tillsammans med familj och vänner**, båda, eller någon annan konstellation?

### Frågor kring syfte

9. Vad upplever du att syftet med utställningen Vislab är?

*En av tankarna med Vislab är att visualisera forskningsdata om hållbarhet i fem olika områden (land, hav, människa, rymd och samhälle) och få besökare att kunna relatera hållbarhetsämnet till sig själva.*

10. Hur väl upplever du att appen **hjälpde till och stöttade uppfyllandet av det syftet**? (Motivera)

Inte väl alls

Väldigt väl

--	--	--	--	--	--	--

11. Hur väl upplever du att appen **hjälpde dig att hitta** på Vislab? (Motivera)

Inte väl alls

Väldigt väl

--	--	--	--	--	--	--

12. Hur väl upplever du att uppdragen i appen **gjorde att du ville utforska** skärmarna? (Motivera)

Inte väl alls

Väldigt väl

**Figure E.2:** Screenshot of questionnaire for the task-based controlled user-testing (2 out of 3).

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13. Hur väl upplever du att **appen gjorde det lättare att interagera** med skärmarna i Vislab? (Motivera)

Inte väl alls Väldigt väl

--	--	--	--	--	--	--

14. Hur väl upplever du att appen hjälper till att **göra innehållet i skärmarna** relevant för dig? (Motivera)

Inte väl alls Väldigt väl

--	--	--	--	--	--	--

### Avslutningsvis

15. Hade du använt guiden om du kom som besökare på Vislab?

16. Vad hade krävts för att du skulle börja använda appen som besökare?

17. Upplevde du att något specifikt uppdrag var roligare än ett annat?

18. Övriga tankar och funderingar?

**Figure E.3:** Screenshot of questionnaire for the task-based controlled user-testing (3 out of 3).

# F

## Final Evaluation

This appendix include the questionnaires used and answers gained in the final evaluation of the VisQuest application, conducted at Vislab in May 2022. The first questionnaire were made for users of the application (see Figures F.1-F.3), and the second questionnaire were made for non-users of the application (see Figure F.4). The questionnaires have the same questions about the Vislab visit in general, and the users of the application also get to answer questions regarding VisQuest. As for the answers from these questionnaires, they are presented in Figures F.5-F.6. The study was conducted in Swedish, thus the questionnaires and answers are also presented in Swedish.

Masterarbete inom interaktionsdesign  
Chalmers Tekniska Högskola

## Undersökning Vislab

Din ålder: \_\_\_\_\_

Din könsidentitet (valfritt): \_\_\_\_\_

### Frågor om VisLab-utställningen (ej om appen)

1. Hur många skärmar interagerade du med?

2. Ungefär hur länge varade ditt besök på Vislab?

3. Hur intressant tycker du innehållet i skärmarna var?

Inte alls intressant					Väldigt intressant				
1	2	3	4	5	6	7	8	9	10

4. Hur lätt eller svårt var det att förstå innehållet i skärmarna, i helhet?

Väldigt svårt					Väldigt lätt				
1	2	3	4	5	6	7	8	9	10

5. Hur lätt eller svårt var det att förstå hur du skulle interagera med skärmarna, i helhet?

Väldigt svårt					Väldigt lätt				
1	2	3	4	5	6	7	8	9	10

**Figure F.1:** Screenshot of questionnaire for the users of VisQuest in the final evaluation (1 out of 3).

## Frågor om applikationen

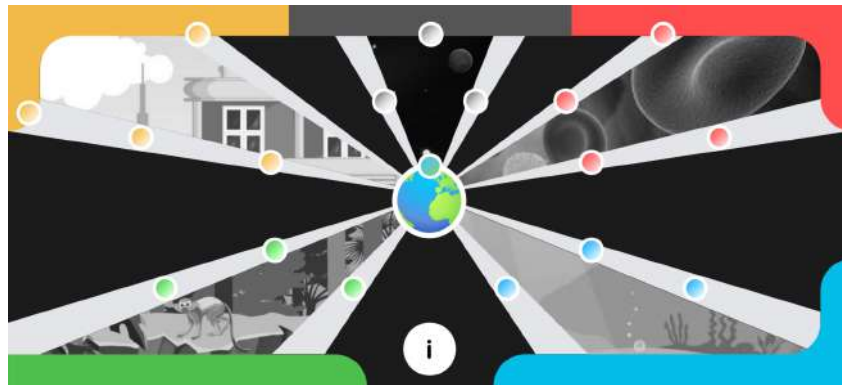
6. Hur lätt var det att förstå applikationen?

Väldigt svårt Väldigt lätt

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

7. Vilka uppdrag utförde du? (Markera uppdragen i bilden nedan)

*Hoppa över den här frågan om du inte utförde något uppdrag*



8. I hur stor grad upplever du att uppdragen gjorde din vistelse på Vislab mer underhållande? *Hoppa över den här frågan om du inte utförde något uppdrag*

Inte alls underhållande Varken eller Mycket mer underhållande

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

9. Upplvde du att något specifikt uppdrag var roligare än ett annat? Om ja, varför var det roligare?

*Hoppa över den här frågan om du inte utförde något uppdrag*

**Figure F.2:** Screenshot of questionnaire for the users of VisQuest in the final evaluation (2 out of 3).

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10. Upplevde du att appen lockade dig till att utforska skärmarna på Vislab?

Nej	Inte så mycket	Varken eller/vet ej	Litegrann	Ja
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

11. Upplever du att appen gjorde det lättare att interagera med skärmarna i Vislab?

Nej	Inte så mycket	Varken eller/vet ej	Litegrann	Ja
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. Upplever du att du fick ut något av appen? (motivera gärna)

13. Hade du testat applikationen även om den endast hade marknadsförts med QR-kodsaffischen (och inte med personer)? Om inte, vad hade krävts för att du skulle testa?

**Figure F.3:** Screenshot of questionnaire for the users of VisQuest in the final evaluation (3 out of 3).

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## Undersökning Vislab

Din ålder: \_\_\_\_\_

Din könsidentitet (valfritt): \_\_\_\_\_

1. Hur många skärmar interagerade du med?

2. Ungefär hur länge varade ditt besök på Vislab?

3. Hur intressant tycker du innehållet i skärmarna var?

Inte alls intressant					Väldigt intressant				
1	2	3	4	5	6	7	8	9	10

4. Hur lätt eller svårt var det att förstå innehållet i skärmarna, i helhet?

Väldigt svårt					Väldigt lätt				
1	2	3	4	5	6	7	8	9	10

5. Hur lätt eller svårt var det att förstå hur du skulle interagera med skärmarna, i helhet?

Väldigt svårt					Väldigt lätt				
1	2	3	4	5	6	7	8	9	10

**Figure F.4:** Screenshot of questionnaire for the non-users of VisQuest in the final evaluation.

Type	Age	Gender	Nr of Screens tested	Visit duration (minutes)	Interesting content	Understandability of content	Understandability of interaction
Non-user		19 Female	2	2	3	5	5
Non-user		36 Female	4	15	7	7	7
Non-user		18 Male	3	2	10	3	6
Non-user		18 Male	3	2	7	7	7
Non-user		18 Male	1	5-10	8	8	10
Non-user		18 Female	2	5-10	5	6	6
Non-user		26 Female	2	5	8	6	10
Non-user		33 Female	3	3.5	10	4	5
Non-user		33 Male	3	3	10	5	5
Non-user		36 Male	4	5	9	8	8
Non-user		20 Female	1	5	6	10	10
Non-user		19 Female	2	2	8	5	4
<b>Non-user Average</b>	<b>18-19</b>		<b>2</b>	<b>4</b>	<b>6.7</b>	<b>6.3</b>	<b>6.9</b>
<b>Non-user Median</b>	<b>18</b>		<b>2</b>	<b>2</b>	<b>6</b>	<b>7</b>	<b>7</b>
<b>Non-user Summary</b>	<b>18-20</b>	<b>4 female, 3 male</b>	<b>1-3</b>	<b>2-10</b>	<b>3-10</b>	<b>3-10</b>	<b>4-10</b>
User		16 Male	5	15	8	5	5
User		16 Male	5	15	7	6	6
User		17 Male	5	15	10	10	10
User		17 Male	5	15	6	8	7
User		27 Male	17	30	8	8	8
User		17 Male	5	15	8	7	10
User		19 Female	13	20	6	4	6
User		18 Female	15	20	6	5	5
User		18 Female	16	20	6	8	7
User		18 Female	18	20	6	5	6
User		18 Female	15	15	6	9	8
<b>User Average</b>	<b>17.4</b>	<b>-</b>	<b>10.2</b>	<b>17.5</b>	<b>6.9</b>	<b>6.9</b>	<b>7</b>
<b>User Median</b>	<b>17.5</b>	<b>-</b>	<b>9</b>	<b>17.5</b>	<b>6</b>	<b>6.5</b>	<b>6.5</b>
<b>User Summary</b>	<b>16-19</b>	<b>5 female, 5 male</b>	<b>5-18</b>	<b>15-20</b>	<b>6-10</b>	<b>4-10</b>	<b>5-10</b>

**Figure F.5:** Answers from users and non-users regarding questions 1-5 in the questionnaires.

Type	Age	Gender	Understandability of app	Which quests performed	Nr of Quests performed	Increased entertainment	Best quests	Nudging to explore	Easier to interact	Other things they got from using the app	Would you use it?
User	16	Male	8	sveriges siffror, alla gröna, alla blå	7	7	-	Some	Some	More info	-
User	16	Male	5	-	-	-	-	Some	Some	Your read more on the screens than I would have otherwise	No, I would have wanted more quests you should accomplish
User	17	Male	10	alla grön	3	10	-	Yes	Yes	Yes	No
User	17	Male	8	alla förutom blå	14	7	-	Some	Some	Yes more info about everything	No I wouldn't
User	27	Male	9	All yellow and green	-	-	Digitala Göteborg, it did not distract me as much from the exhibition experience	Neither / Don't know	Neither / Don't know	Not that much. The thought was good but the time I spent finishing tasks took the time I could have used in exploring (the game got very goal-oriented, I only looked for the answers and did not read the rest)	I would have tried it, I am generally a curious person. PS. I have ADHD, which can be good to have in mind (when looking at my answers)
User	17	Male	6	alla gröna, fönstret, life stats	5	7	Society questions were funny and easy to understand	Yes	Neither / Don't know	That you got to learn things	Probably not
User	19	Female	9	life stat, digitala göteborg, meteoriter, hjärnan, människan ben, bilbeslutet, alla blåa, alla gröna	12	8	Life stat & skyfallet (fönstret)	Yes	Yes	You got more interested for what was in the screens when you had a purpose	Maybe but easier to begin using with help of people asking you to
User	18	Female	7	All but Size of Space	16	7	Body visualizer was an eye-opener/food for thought	Some	Some	Yes, you got to think a bit more	Possibly, I would probably have scanned the QR code anyway
User	18	Female	7	all yellow, all green, livets ursprung, kosterhavet, bilbeslutet, människan ben, hjärnan, meteoriter	13	7	Matbordet, I am interested in the environment (miljö)	Some	Some	Yes, it got me thinking more about what I was doing	No, I don't think so
User	18	Female	6	fönstret, digitala göteborg, all green, all blue, bilbeslutet, hjärnan, body visualizer	11	6	Middagsbordet	Some	Some	Yes, it was interesting	Maybe not
User	18	Female	7	all green, digitala göteborg, sveriges siffror, meteoriter, body visualizer, hjärnan, bilbeslutet, kosterhavet, livets ursprung	11	7	The animal questions, I love animals	Some	Some	Yes, I got to learn how long the crocodile have been on earth	Yes, if I had seen the QR-code
<b>User Average</b>	<b>17.4</b>	-	<b>7.3</b>	-	<b>10.2</b>	<b>7.3</b>	-	-	-	-	-
<b>User Median</b>	<b>17.5</b>	-	<b>7</b>	-	<b>11</b>	<b>7</b>	-	<b>Some</b>	<b>Some</b>	-	-
<b>User Summary</b>	<b>16-19</b>	<b>5 female, 5 male</b>	<b>5-10</b>	<b>Fönstret: 4 Life stat: 4 Digitala Göteborg: 5 Sveriges siffror: 4 Rymdresan: 1 Size of Space: 1 Meteoriter: 3 Hjärnan: 5 Bilbeslutet: 5 Body visualizer: 3 Människan Ben: 3 Weddellhavet: 1 Kosterhavet: 3 Livets ursprung: 3 Livets träd: 8 Ecoweb: 8 Matbordet: 7</b>	<b>3-16</b>	<b>6-10</b>	<b>Matbordet x2, Lifestat x2, Fönstret x2, Digitala Göteborg, Sveriges Siffror, Body visualizer, Livets träd, Ecowebb</b>	<b>Some (7st) Yes (3st)</b>	<b>Neither (1st) Some (7st) Yes (2st)</b>	-	<b>No / probably not (6), Maybe (1), Yes (2)</b>

Figure F.6: Data from the survey questions that were additional for the users of VisQuest.

# G

## VisQuest

This appendix include screenshots of the application VisQuest. It was developed for this master thesis using Visual Studio Code, and developed through the use of HTML, CSS and Javascript. The guide was published at <https://vislabgame.vercel.app/> for the final user tests conducted at Vislab. In figures G.1 - G.9, you can follow a scenario of how the flow of using the application could look like. In figures G.11 - G.13 you can see examples of four types of Quests that Vislab include. In figures G.15 - G.19 you can see all overlays for each area at Vislab. Lastly, in figures G.20 - G.36 you can see all quests that are included in VisQuest.

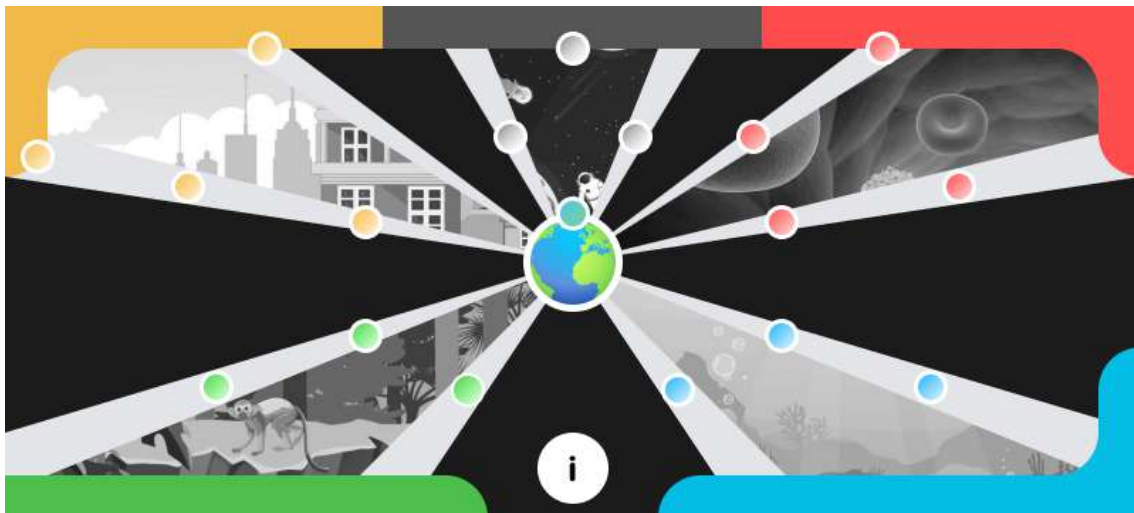


Figure G.2: Main view.

### A flow scenario:

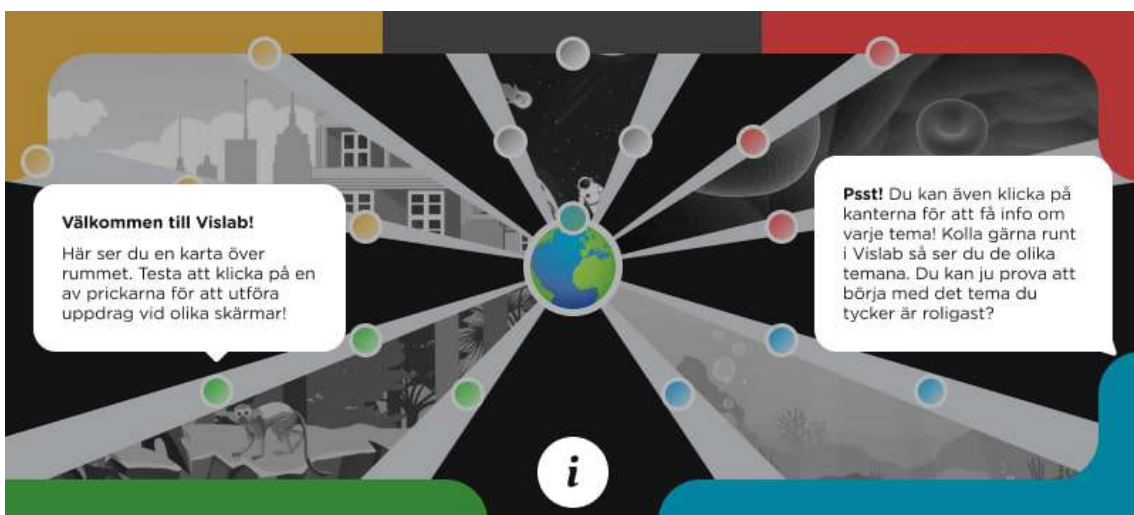
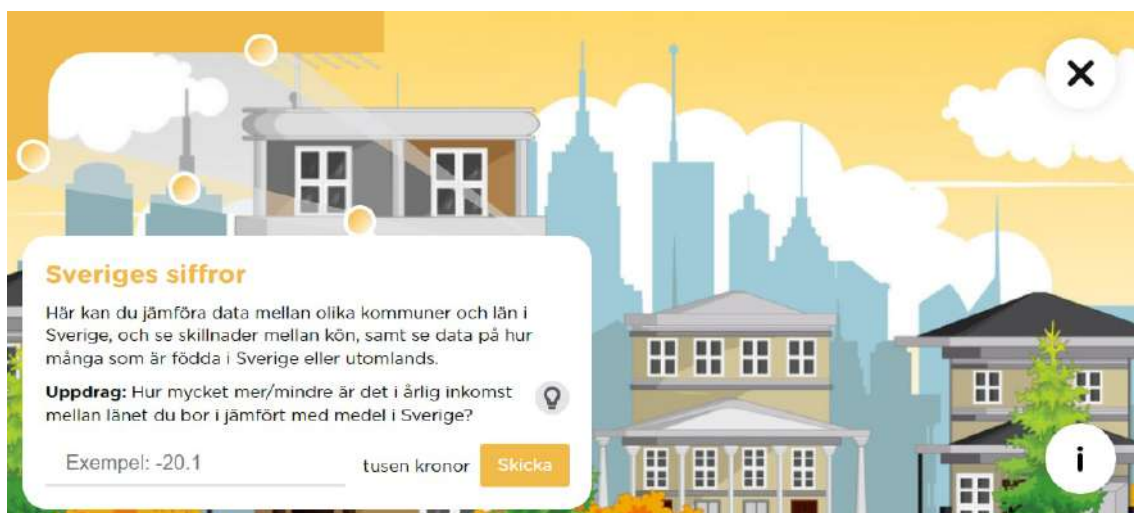


Figure G.1: Introductory screen.



**Figure G.3:** When clicking on a wall, an overlay appears with information about a that section of the exhibition. In this case the overlay screen for the society area is shown.



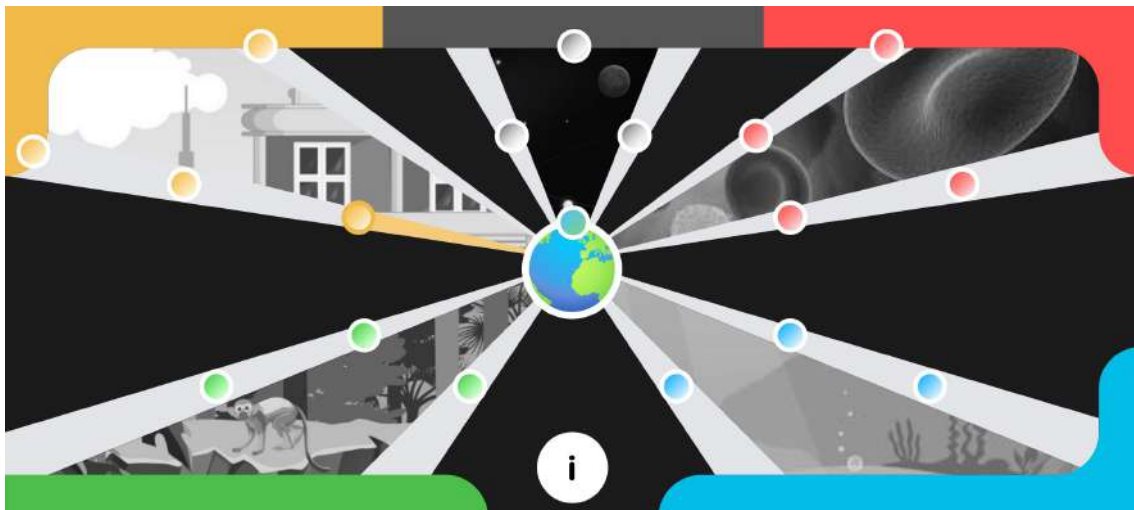
**Figure G.4:** When clicking on a dot, a info box appears for a quest. In this case the quest view is for the screen called Sveriges siffror.



Figure G.5: Clues to help users complete the quest for Sveriges siffror.



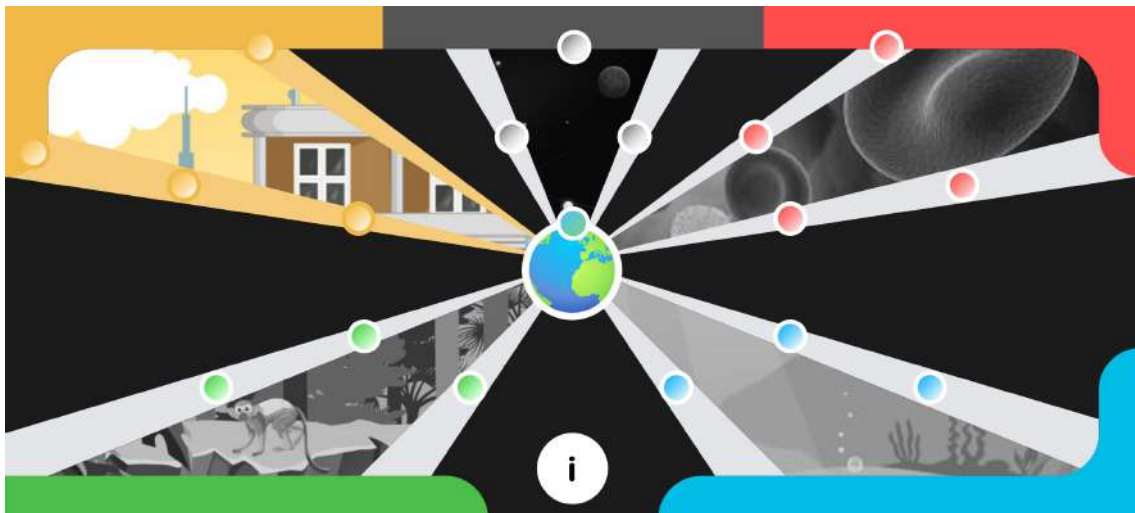
Figure G.6: Resulting feedback box for the quest for Sveriges siffror.



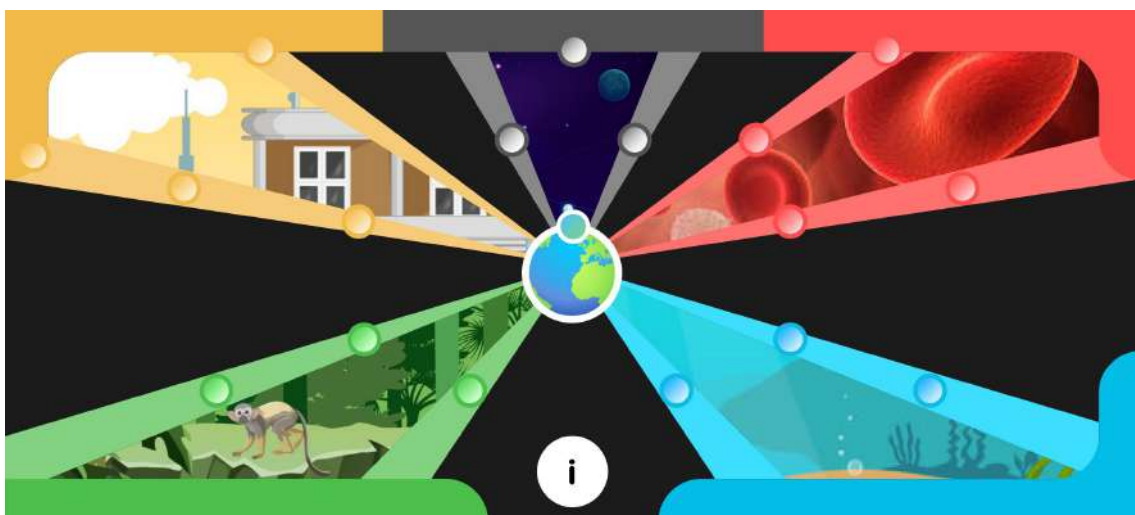
**Figure G.7:** One of the yellow beams is partially filled since one yellow quest has been completed.



**Figure G.8:** The menu screen, showing information about the app and the progress that the user has made.



**Figure G.9:** The quests for the society section have all been completed, and the image between the yellow beams have thus been colored.



**Figure G.10:** The view for when all quests have been completed.

## The four types of quests:



Figure G.11: An example of a "Find-out about user" quest.

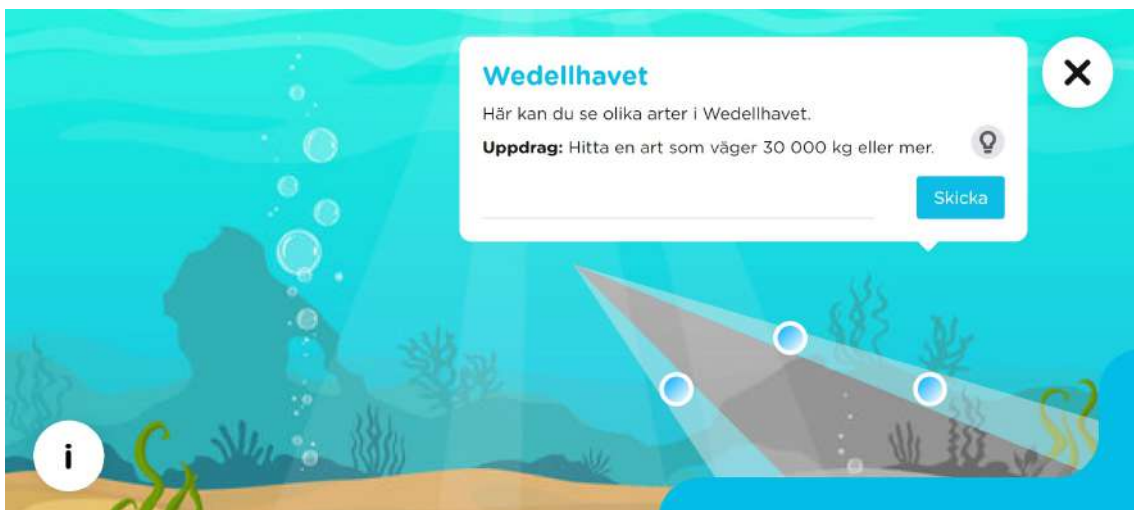


Figure G.12: An example of a "Quiz" quest.

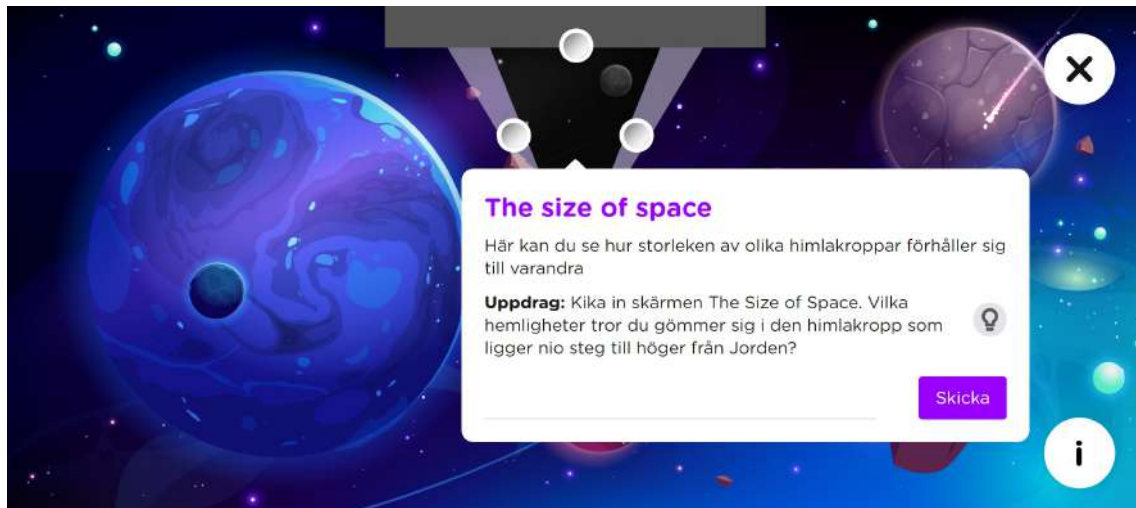


Figure G.13: An example of an "Opinions/thoughts" quest.



Figure G.14: An example of an "activity" quest.

## All areas of Vislab:



Figure G.15: Area: Society

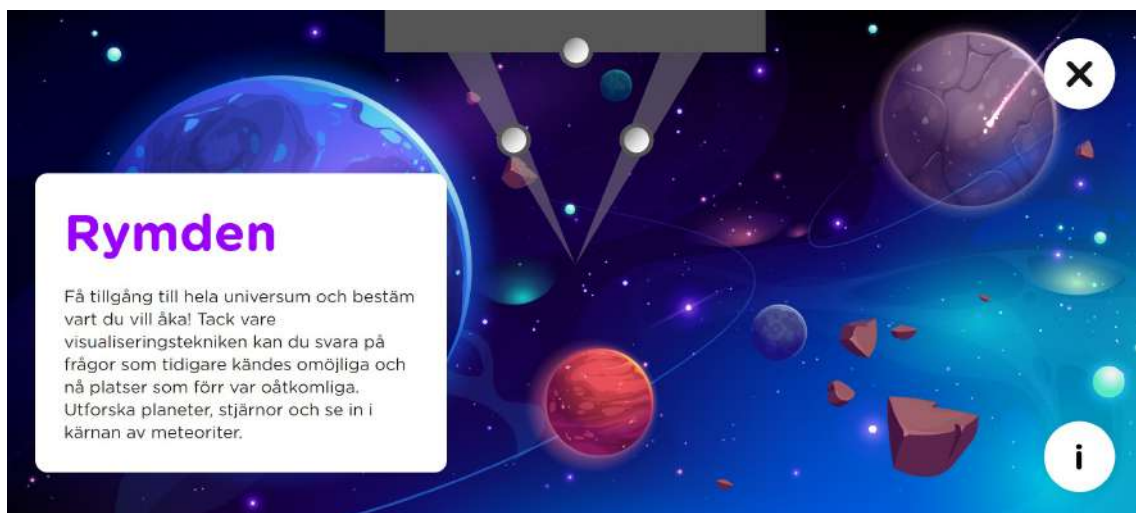


Figure G.16: Area: Space

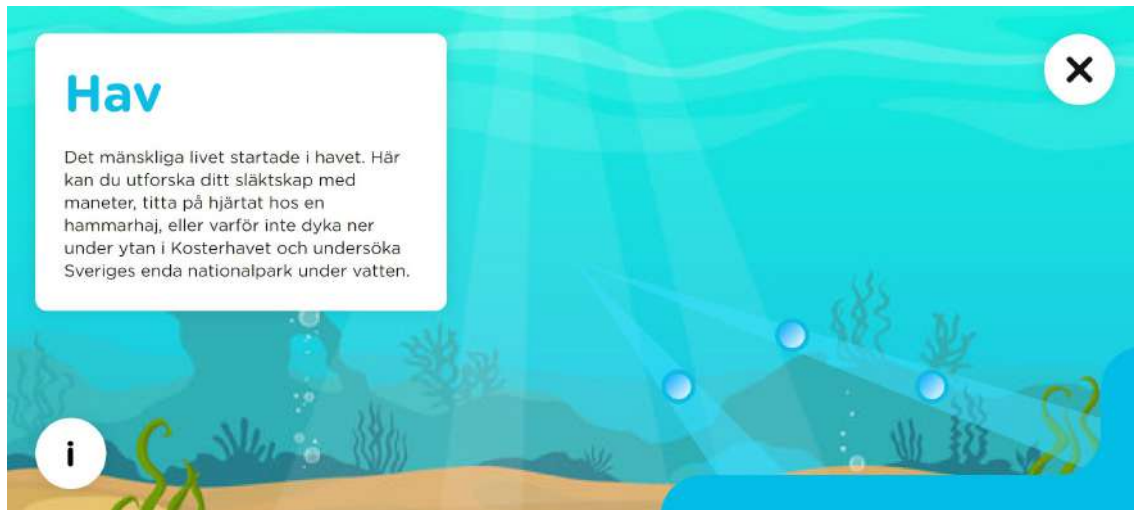


Figure G.17: Area: Sea



Figure G.18: Area: Land



Figure G.19: Area: Human

## All quests:



Figure G.20: Quest: 3D Göteborg

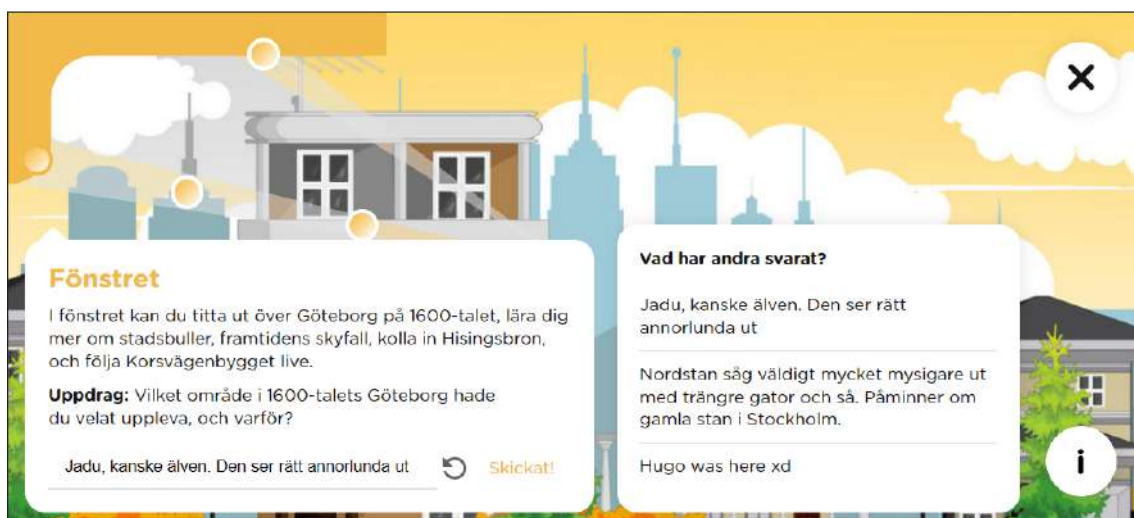


Figure G.21: Quest: Fönstret



Figure G.22: Quest: Life stats



Figure G.23: Quest: Sveriges Siffror



Figure G.24: Quest: Rymdresan

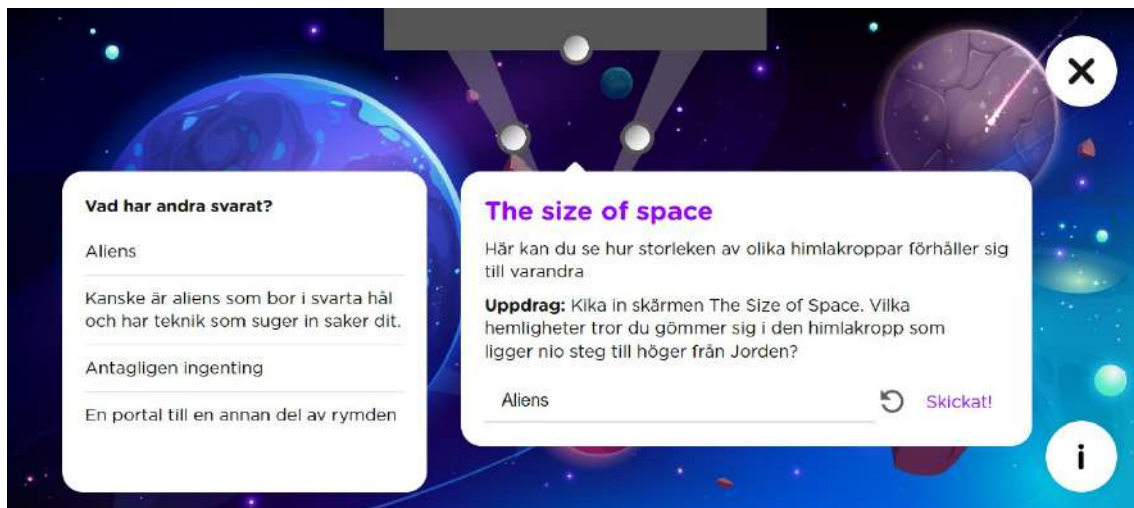


Figure G.25: Quest: The size of space

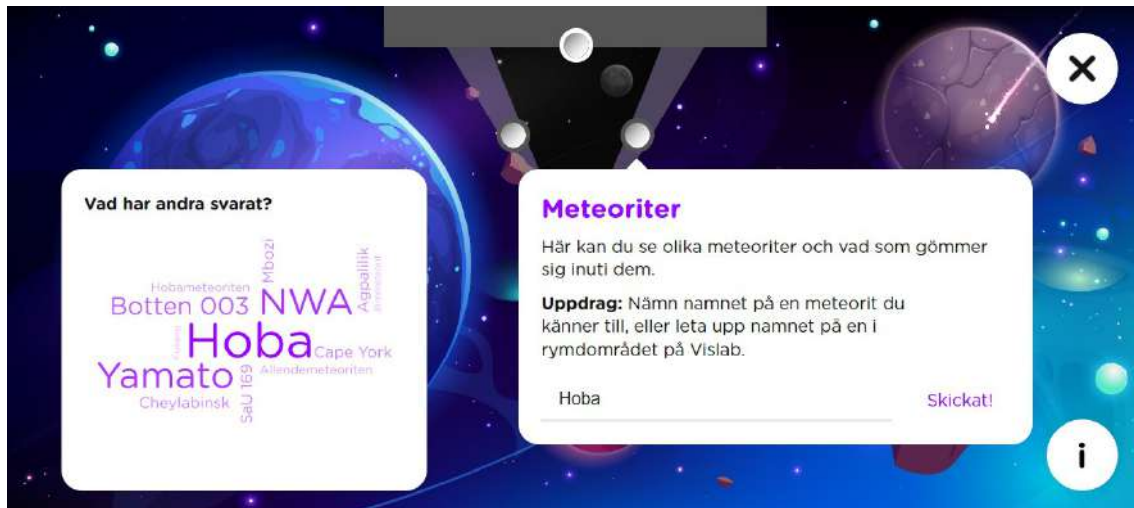


Figure G.26: Quest: Meteoriter



Figure G.27: Quest: Hjärnan



Figure G.28: Quest: Body Visualiser



Figure G.29: Quest: Snabba Bilbeslut



Figure G.30: Quest: Människan Ben



Figure G.31: Quest: Kosterhavet

The screenshot shows a quiz interface with a blue and green underwater background. On the left, a white box contains a list of whale species and their weights. On the right, a white box contains the title 'Wedellhavet', a question, and a task. Below the task is an input field with 'Knöval' and a 'Skickat!' button. A close button 'X' is in the top right, and an information button 'i' is in the bottom left.

Här är några av de rätta svaren. Har du prickat rätt?

- Blåval (Blue whale) 150 000 kg
- Knöval (Megaptera novaeangliae) 40 000 kg
- Sillval (Balaenoptera physalus) 60 000 kg
- Kaskelot (Physeter macrocephalus) 30 000 kg

**Wedellhavet**

Här kan du se olika arter i Wedellhavet.

**Uppdrag:** Hitta en art som väger 30 000 kg eller mer.

Knöval  Skickat!

Figure G.32: Quest: Wedellhavet

The screenshot shows a quiz interface with a blue and green underwater background. On the left, a white box contains a confirmation message. On the right, a white box contains the title 'Livets ursprung', a question, and a task. Below the task is an input field with 'Stingrocka' and a 'Skickat!' button. A close button 'X' is in the top right, and an information button 'i' is in the bottom left.

Du svarade rätt:

Stingrockan!

**Livets ursprung**

Vid livets ursprung får du lära dig om havslevande djur och organismer.

**Uppdrag:** Ett av djuren har två stycken pelvisklaffar, kan du hitta vilket?

Stingrocka  Skickat!

Figure G.33: Quest: Livets Ursprung

**Livets träd**

Vid livets träd får du lära dig om och olika djur genom tiderna.

**Uppdrag:** För hur länge sedan uppkom ditt favoritdjurs evolutionära grupp?

200 \_\_\_\_\_ miljoner år sen

Kan ditt favoritdjur tillhöra...  
Däggdjur

Figure G.34: Quest: Livets Träd

**Näringsväven**

I näringsväven kan du se relationer mellan olika arter i Serengeti.

**Uppdrag:** Hitta ditt favoritdjur och se vilka näringsrelationer det har. Vad är under ditt djur i näringskedjan?

Topi

Vad har andra svarat?

Buskbock, Korvträd, Stoppzebra, Vårtsvin, Flodhäst, Julgransgräs, Stora kärleksgräs, Ollea capensis, Panicum repens, Grotf, Kvittegräs, Julgransgräs, Vårtsvin, Grotf, Stoppzebra, Korvträd, Buskbock, Flodhäst, Vårtsvin, Stora kärleksgräs, Kvittegräs, Julgransgräs, Grotf, Ollea capensis, Panicum repens.

Figure G.35: Quest: Näringsväven



Figure G.36: Quest: Matbordet