



UNIVERSITY
OF SKÖVDE

THE INTERACTIVE MUSEUM LAB DESIGN OF A MOBILE ROOM THAT INCLUDES PEOPLE WITH DISABILITIES IN A CULTURE HOUSE SETTING

Master Degree Project in Media, Aesthetics and
Narration A1E

One year Level 30 ECTS
Spring term 2016

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Abstract

This study has been carried out from two points of view: how museums have changed to adapt to new technologies and the inclusion of people with different disabilities as a target group when developing a new product. This study is done through a series of qualitative interviews made to museum staff and personnel related to the target group, belonging to working directly any of the groups in which the disabilities are divided. Through the study and the application of their answers and contributions as well as the data collected in previous studies, the development of an interactive-multimedia Lab was accomplished, which is installed in the museum Kulturfabriken in Skövde. In order to execute a product development process properly, an adequate methodology was developed, which combines working methods, focused directly on the elaboration of the product from the most practical point of view and analysis methods, which helped analyze the process in an appropriate way through the different interviews and meetings held with the focus groups, to make a customized product with the needs of the museum, but also to combine the needs of the groups with disabilities and special features such as: surround sound system and immersive space, in order to create a suitable multimedia space.

Keywords: inclusive design, accessibility, museums, interactive spaces.

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1 Introduction

The purpose of this project has been to design an inclusive and interactive Lab that also could be mobile in a museum space. The project leans on theories about interactivity, inclusivity, diversity, accessibility, usability and flexibility.

The lab is placed in a municipal cultural institution that recently was opened in the city of Skövde, named The Culture factory (Kulturfabriken). This place is a combination of the municipality's music school (Musikskolan) and the City museum (Stadsmuseet) under the same roof.

In this paper the function of the Lab is described, as well as its different objectives, for both learning and amusement, inside of a museum with its principal characteristic to be accessible for everyone. This includes elderly people and young music school children and also including people with a range of different kinds of disabilities.

A mobile multimedia and interactive room was built and placed in the central area of the house with the idea that it can attract everybody visiting the house. The way this multimedia and interactive room serves is as a platform for diverse projects. The room is designed for multimedia artists and programmers to use in future projects. These projects will have as a principal theme something related to the museum, different themes that can be related with the stations that are places in the museum; each of these stations have as a theme diverse area of the history of Skövde.

Two secondary questions that was of interest in this project were: can the lab be used to attract people to the museum and can visitor experiences be intensified by the lab?

The main question for the study is to clarify which working analysis and design methods could be useful when creating a mobile interactive lab that includes a surround sound system in an immersive space inside a culture house setting. It is of importance that the design should also include people with various kinds of disabilities, the disabilities can vary and are divided into four groups: mobility, vision, hearing and cognitive. The objective was to analyse which impediments can affect to a user's experiences with disabilities and in which way it can be minimized or adapted.

This report describes the process of design of a multimedia and interactive installation, from the initial conception of the idea, to the final design, going through the process and explaining the development changes that has been made on it. It has been specially customized with the requirements of the clients, following the suggestions from other professionals involved in the process. And most importantly, the changes and suggestions given in the interviews by the participants have been taken into consideration. In every step, the most suitable solution has been chosen after analysing the needs for the design process of a physical product which has been built for its use by museum visitors and pupils of a music school.

2 Background

This background chapter presents the goal of the study, theories about interactivity, inclusivity, diversity, accessibility, usability and flexibility. The problem definition and methods used, working, analysis and design methods and finally the evaluation method are also outlined.

2.1 Kulturfabriken: Space - public and distributed

A new cultural place has opened in the city of Skövde with the name of the Culture Factory (Kulturfabriken). The Culture Factory is a combination of the municipality's music school (Musikskolan) and the City museum (Stadsmuset) under the same roof (<http://www.skovde.se/Kultur/Musikskolan/>).

The Culture Factory is meant to be a social place based in a modern and innovative house for the culture and the entrepreneurship. Different activities with different themes will be held here: music, art, photography, film, and computer game development ("Första spadtaget för Kulturfabriken", 2015-11-04).

The objective of this study was to create a mobile interactive laboratory /room that may have a more or less permanent place in the museum, but also could be moved to the various thematic stations that are proposed in the museum. This is because kulturfabriken is divided into different subspaces, intended for each activity: rooms for classes with a personal teacher, a concert hall, group workshops, etc. All the entrances and rooms are connected by the main space, which is the biggest space of the building. In this main area, the exhibition of the objects for the museum related with the history of the city will be shown. Those objects will be allocated in shelves surrounding all the walls around the area. Inside this main area, some thematic stations will be situated in different spots. Each station is different from one another, and they are based in different themes allowing diverse activities and information related with cultural activities and people of the city (cultural heritage, entertainment, rest or concentration/study space). The idea is to move this lab into the different stations around the inside of the museum with the purpose to serve as a supportive installation to enrich visitor experiences.

2.2 The Multimedia Interactive Installation: General design requirements

A mobile multimedia and interactive room was built in the central area of the house with the idea that it can attract everybody visiting the house. The way this multimedia and interactive room serves is as a platform for diverse projects. The room is designed for multimedia artists and programmers to use in future projects. These projects will have as a principal theme something related with the museum. The ambition of this installation is to intensify the experience of the museum, bringing a higher experience to the visitors and letting them be part of the exhibition, interacting with their bodies.

The public attending this culture factory will be mainly the young pupils of the school of music, but also, as a cultural place and city museum, it is going to be visited by a diverse audience, which means that people of all ages will be users of this place.

One of the principal intentions concerning this museum is that it should be inclusive for society in general, being an open place with the idea that everyone has the right to enjoy the place without discrimination. This is one of the main characteristics of this project and therefore is going to be present in the 3 main parts of this report: the research, the process and the evaluation.

This multimedia interactive installation is going to be designed from different requirements meeting the users and the client's needs. The theories for the work came from the courses in the master program Media, Aesthetics and Narration, and they convey the ideas of the different uses of media, interactivity, experiences in museums.

The clients are the staff of the museum Kulturfabriken, that is the museum pedagogue and the museum technician; they have been guiding the process through to the final phase of design, development of the final product. It was specifically designed according to their knowledge and experience regarding exhibitions in museums and needs for the accomplishment of the complete museum. The process was also assisted by some computer game students from University of Skövde, primarily in audio, music, and programming. They were also in charge of the election of the most suitable technical equipment. The target audience is very wide, as it is important with the inclusivity and diversity, for that reason the project been focused on people with disabilities, and that ensures a standard design for the general public.

Within the following research, I will refer to this multimedia room as a "Lab", since it is aimed to be a platform for future research in different fields, and it will be prepared with the required technical equipment.

The main characteristics that this lab includes are: interactivity, inclusivity, diversity, accessibility, usability and flexibility.

- **Interactivity** – The lab will be designed to be a platform on which it is possible to create installations with different kind of user interfaces for interaction.

- **Inclusivity** – Diversity and accessibility - Inclusive design: The lab is adapted for people with different kinds of disabilities (cognitive or physical disabilities).

- **Usability** – The lab will be easy to use and understand for the people that will work with it, that is the museum staff and the future creators of new content for the lab.

- **Flexibility** – The lab's hardware and software is designed to be adaptable for different contents for a range of presentations and functions.

2.2.1 Which projects will be shown in this Lab?

As an interactive exhibition lab inside a museum, it will be used as a combination of leisure and learning space. It could be used for play and fun, but also as a part of the learning process for computer game development programs at University of Skövde – and for visitors using it.

It could be used for projects related with cultural heritage, for example with mini-games where the visitor's senses perceive stimuli from interactive audio and graphics.

This lab is equipped with technology that makes it easy to integrate projects from other platforms to this one. Since the core of the lab is a regular PC, many different types of projects can be imported to it. But the first project created for the presentation of this room is an interactive music installation, created specifically for the lab.

2.3 How museums are changing

Currently, museums and galleries are reinventing themselves, and they need to create a new identity for the new cultural aspects. Many of the changes are done because of the relationships with audiences, both current and potential audiences. It is expected by the society that the museum need to do everything for everyone, and they are conceivable to be a guide for the progress of the economic evolution, community integrity and a platform of the social equality. Museums all over the world are receiving pressure in different ways, but specially to make access greater for all sorts of people, creating new activities and exhibitions that can be interesting for the broad public. Nina Simon (2010) writes about this in *The Participatory Museum*, a book that is also available on the Internet (<http://www.participatorymuseum.org/>).

One aspect that the museum can change in order to create integrity and social equality, is with the use of new technologies. Nowadays, computers are having a significant role in the museums, they are elements in their construction. This fact can give museums a new perspective with digital solutions, getting the opportunity to expand collections according to the new social history and other research areas in general. In the book *Recording the museum Digital Heritage and the Technologies of Change*, there is a series of articles that describe the establishment of the innovative technologies into the museum and how it can affect in the way of interaction of traditional requirements of treatment of the physical things with the impact of technology and “new media” in museums. (Parry, R. 2007)

Museums in a digital age (Parry, R. 2010), describes the evidence of change in the museum with the digital areas. The audience can be both online or physically on site, and museum had to address the problem of showing the object that normally is shown physically. But now, with the new media, there are differences between be in presence with the object, that can lead you feel its essence, and the digital experience of the new media, which otherwise, can allow to experience in more flexible, creative and empowering ways.

In 'The end of the Beginning: Normativity in the Postdigital Museum ', Parry, R. (2013) is presenting the understanding of the museum after the digital revolution and how digital media is presented in museums as the normative taking part of the organization and framework of it. Through a series of interviews with different senior managers of new media in six different nation museums in the UK, Ross is analyzing the experiences of the digital media in museums as part of the visit experience, and he reflects upon the meaning of the digital media to be normalized in the future visitors to museums as part of the experience. There are some examples in the text from the participants in the interviews recognizing how the presence of the digital media in museums helps the museum is more open and “participatory with audiences”.

The future of museums has become a reflection of the social future, and they are trying to give inspiration to people through emotional experiences for their lives and engage them in the world around them. Exhibit designers are getting inspired from UX (user experience) to change the concept of the exhibition and start thinking of them as a platform of ideas exchanging and social engagement (The #FutureMuseum Project, 2016-02-22).

2.4 Interactive spaces as a way of learning

Traditionally, museums have an educational role for the public that can be varied and changed into different types depending on their audiences: schoolchildren, teenagers, adults, for example. And the concept of museum is evolving since they integrate more activities and features such like workshops, touch displays and apps for mobile phones... (The #FutureMuseum Project, 2016-02-22)

In the last 20 years, the approach of teaching methods in museums have changed to include more face-to-face teaching with the students. Museums are now more actively involved with visitors, and this mean that the user can interact directly with the exhibition, and therefore, learning too is also more active. Also, learning through object oriented method, can catch the attention of the involved more easily, since they get fascinated with the result of their actions. Ken Arnold, Creative Director, Medical Museion and Professor at Copenhagen University, writes about these ideas in his short essay “Future of Museums: Public Research and Enquiry” (The #FutureMuseum Project, 2016-02-22)

An interactive space is a space that can create a mutual or a reciprocal action or influence in the user. In the case of a learning platform, especially for a multimedia space, the advantages that this kind of platform present are multiple. The way of learning is engaging and it is easier to get the attention of the student and also the exhibitions turns more attractive to the visitor.

These interactive spaces might make the museums and art centers more attractive, and since museums wants to attract more people, the experience from the visit gets more enjoyable. The feeling of immersion is created by the room and the surrounding feeling. At least this is the idea.

Problems in the future museum could be that in order to make different tasks, activities and forms of interaction that are provided for differentiated model of learning, one needs a design that facilitates diversity and different learning needs. Flexible delivery of education resources must take account of cultural variables and recognize the specific learning needs, preferences and styles of learners. They may be a test between the need to ensure access for a diverse pupil and student population, while at the same time taking into account the need for localization to accommodate learners’ particular cultures, cognitive style and preferences.

The disposition and structure of the space of the museum, affects directly to the perception of the exhibition. The connection with its visibility construct and patterns of access affects directly to the way the visitor is observing the exhibition, is moving through the space and the interaction with the exposed objects. In the text *Spatial Affordances in Museum Design* (Wineman, J.D., Peponis, J, 2.010), it is presented tools of analysis for the museum and exhibition designers, to bring the idea of the disposition of space in the museum in order to achieve a guided movement in the exhibition with both circulation and viewing sequence. The ideas of the awareness of others, and how the presence of other is influenced in the structure of the space generating a social character in the museum, are presented also a part of the space design, but at the same time, the visitor can have their own routes through the display, to experience an individual learning.

2.5 The aesthetic experience for learning

For this project, the experience of learning through the aesthetics is of interest. The interactive multimedia lab is planned to be used in the future for pleasure as well as for educational reasons.

The importance of the aesthetic experience in the development of cognitive, affective and imaginative sides has been described by professionals of different areas such as philosophy and education (Kokkos, A., 2010). One of the ideas that has contributed in this field is the idea that there are different kinds of intelligence that a person can possess (verbal-linguistic, logical-mathematical, kinesthetic, musical, spatial, interpersonal, and intrapersonal and others). Every person has her own experience from the world and therefore a unique symbolic system also is created by each person. The aesthetic experience could be used as a mode of extending the use of symbols. These symbols help express different approaches to reality through the emotional and imaginative situations (Kokkos, 2010). Another approach related to the aesthetic experiences is that it makes the imagination and the emotional expression increase meanwhile it stimulates the cognitive functions (Eisner, 2002).

In the paper *Designing Interactive Museum Exhibits!: Enhancing visitor curiosity through augmented artefacts* (Ciolfi, L., Bannon L.J., 2002), it is analyzing through different design scenarios located within a specific room, basing the study in the human behaviors within the museum environment. In this particular case, the object of study is an exhibition of objects presented in a room of a museum, where the objects are placed in different cabinets with glass doors and drawers, and the exposed objects are distributed in them as *cabinets of curiosities*. In this exhibition, the visitors are free to open each door and drawer to discover the objects for themselves, and they have the possibility to interact with the object, observing its characteristics, and understanding the placement of each one as part of the “story”. Also, the fact that the objects can be discovered in the drawers, cabinets, boxes, creates a stimulation of their curiosity and involve the visitors in an engaging-experience.

2.6 Identifying disabilities

The interactive room is supposed to be accessible to as many people as possible. This also applies to disabled people. To create an inclusive design, the designer needs to identify the specific difficulties that different people with disabilities may have. To start identifying the possible special needs of the different types of people with disabilities it is important to have a clear idea of what could be the most representative persona.

The world health organization estimate in the *World report of disability* (2011) that more than a billion people has some form of disability, or about 15% of the world’s population (based on 2010 global population estimates). It is reported here also that the number of people with disabilities is growing. The report also presents a list of which people are more vulnerable to suffer from a disability condition, which it can be “*wheelchair users and a few other “classic” groups such as blind people and deaf people. However, the disability experience resulting from the interaction of health conditions, personal factors, and environmental factors varies greatly*”.

In this study, we have divided the disabilities in 4 groups, with the objective to be more precise in the focus group and relating each group with one of the problem that can be addressed through a multimedia physical artifact and how the user interacts with media forms.

Mobility

This is the largest category for disabilities and it can be affected in different areas of the body: arms, legs or even eyes. But at the same time is the mobility barrier that can be more easily solved with design solutions.

The features to take into account when designing games are related with input devices, having different options for one hand, two hand, use of one finger or various, movement of the head and the eyes, and basically movement of every part of the body.

Vision

This is one of the widest disability issues in the world. Almost 75% of the population need some sort of vision correction, and it can be varying in different kinds of visual impairments, from myopia that most people experience with age, to, color blindness: that is an inability to differentiate colors from each other: For example, there are some people who cannot distinguish the difference between key colors (green and red: deuteranomaly) and some who cannot see any difference at all (monochromacy), and even those who are completely blind (Types of Colour Blindness, 2016-02-20).

Hearing

The hearing-impaired gamers can be lost in the story since the music and sound is a big part of the whole. This because some cues can be sound to increment the grade of importance of a scene or events where you are supposed to listen to dialogues (this can be solved with subtitles, but the feeling is different). Also the ambient music is missed. Hearing impairment can be partial, just in one ear or a complete deafness.

Cognitive

Cognitive disabilities are extremely broad, the main categories of functional cognitive disabilities include deficits or difficulties with (*Centre for Persons with Disabilities, 2016*):

- Memory
- Problem-solving
- Attention
- Reading, linguistic, and verbal comprehension
- Math comprehension
- Visual comprehension

(*Center for Persons with Disabilities, 2016*)

There is a specific group to describe in this section and it is persons of the autism spectrum disorder and Asperger's syndrome. There are many types in the autism spectrum, but there are some general characteristics that commonly define autism:

- Ongoing social problems that include difficulty communicating and interacting with others
- Repetitive behaviors as well as limited interests or activities
- Symptoms that typically are recognized in the first two years of life
- Symptoms that hurt the individual's ability to function socially, at school or work, or other areas of life

Asperger and Autism are development disorders that affect people on a communicative level and on interpersonal relations. This has actuating aspects in socialization, because people affected by this do not understand how to interact according to traditional social norms. This is because their brain works differently, but it has nothing to do with intelligence. For example, people with Autism and Asperger's do not conceive of abstract concepts. When they work to comprehend objects or concepts, they may get ideas in pieces, instead of conceiving of the whole concept itself (*Autism Spectrum disorder. National Institute of Mental Health*).

2.7 Accessibility and games

The possibilities of learning and amusement with games are large. A reasonable percentage of the population has a range of disabilities at different levels, some of them are evident at birth and others, as with the physical disabilities, can be acquired over time (The Ablegamers foundation, 2015).

The reason why games should be accessible is democratically important, due to the large population that can be disabled. Disability is a contextual experience, depending on the way the users can interact with the environment. It can have physical, social or communicative effects (Art Beyond Sight, 20??).

The implementation of the accessibility in the design process of video games is much needed. Not least due to the large amount of games that can be found in the market and are widely spread throughout all countries and societies. It is part of the integration in society, and everybody need to feel like they are part of the culture regardless of their disabilities.

Glinert, E. (2008), describes in its study about the usability and accessibility in Video Game Interfaces the needs the importance of design games for just one group contribute to segregation, and putting disabled gamers outside of the group. He remarks the importance of a good user interface in the game, which can make them more accessible and fun to many users, and presents a guideline for creating accessible user interfaces keeping two ideas:

“Key Ideas to Remember:

1) When developing a game one should think about which user groups could play an accessible version, and which interface changes could help achieve that end without changing the core game aesthetic or incurring huge added costs.

2) Even if it is not clear how to make a game accessible, there are certain design principles which can be followed that tend to increase usability across the board. This increase in usability may in turn lead to accessibility.”

Also, the author emphasizes in the concepts of **usability** and **accessibility** and related the two concepts with this idea: *accessibility is an extreme form of usability and making a game accessible to one group usually makes it usable to many!*

Talking about accessibility, not only the UI should be present in the design process, but also it is important to think about the controllers and different input methods (hardware).

Savidis, A. & Stephanidis C. (2009) describe in *Designing Universally Accessible Games* the concept of universally accessible games (UA-Games) as a way to create games that can be accessible to people with a wide range of diverse requirements and/or disabilities, as a response to the problem with games that exists nowadays, which cannot be played by a person with disabilities or a person who does not have.

2.7.1 Playing with disabilities: inludification

People with disabilities can face different problems of interaction in the daily life, for instance, when they want to use household objects, software, electronic appliances, input methods. Those barriers need to be removed to make their lives easier. But disability barriers can also be found when it comes to entertainment. A new concept of inclusivity has in this area been created by the The AbleGamers Foundation, a nonprofit organization that advocates for gamers with disabilities, opening the possibilities to enjoy the games also for these people (the Ablegamers Foundation 2015). They have presented a practical guide to game accessibility called Inludification which explains the main characteristics that should be incorporated in a game to make it inclusive to the end-user, in a clear way to assist those with mobility, hearing, visual and cognitive disabilities.

Inludification can be one answer and solution for universal design. It can eliminate or at least minimize the possible interferences that can be present in the activities for many humans.

Gaming is also a learning experience, and many ideas can be discovered by the user when playing. Players can train to act in a faster way, taking decisions can be easier, and players can learn strategies through cooperation with other players. Games, then, can be an open window to communicate with the world and among people who share the same interests. Some users can be made to feel part of a social group, and this group can help and be helped by the user. These are just some of the social and learning advantages of video games. Gaming is an activity that should be participatory. Most importantly, playing games for people who have a physical disability can lead them to experience things that in real live would be impossible, thus enabling them to feel more socially included.

2.8 Inclusive design

Inclusive design is the way to create the product with the perspective that it will be used by everybody and not only by people with the standard abilities. To include the people who are do not meet traditional standards means to consider those measurements, characteristics, features that ideally fulfill the needs of every person.

“Design for inclusion” is a method that includes a variety of perspectives: design for disability and universal design, for example follow the principles of inclusion. Universal design is the answer to create an equality of access to the environment as a civil right (Steinfeld, E. 2012). And design for disability is more inclusive also to people with mental or physical disabilities.

When we think about design, we need to think also of evolution. Every person or being exists by interacting with their environment, and this interaction is created through movement within space, with objects, and with the way the connection is created among these elements. This interaction is determined by the characteristics of both the object and the person. Those characteristics can vary depending on adaptive behaviors, depending on each person and their capacities. The same is true for all objects meant to be used via interactions. The purpose of such interactions is to help people with their potential, not only from an aesthetic point of view, but it can also work to support their decision-making about the size and the control technology used in interactions. This difference is made with the identification of the barriers and the elimination of them, and this is made through a process of design thinking (Connell et al. 1997). Universal Design, is about creating inclusive environments. The principles of Universal Design define seven basic universal design attributes (Connell et al. 1997):

- *Equitable use. The design does not disadvantage or stigmatize any group of users.*
- *Flexibility in use. The design accommodates a wide range of individual preferences and abilities.*
- *Simple and intuitive use. Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.*
- *Perceptible information. The design communicates necessary information effectively to the user, regardless of the ambient conditions or the user's sensory abilities.*
- *Tolerance for error. The design minimizes hazards and the adverse consequences of accidental or unintended actions.*
- *Low physical effort. The design can be used efficiently and comfortably, and with a minimum of fatigue.*
- *Size and space for approach and use. Appropriate size and space is provided for approach, reach, manipulation, and use, regardless of the user's body size, posture, or mobility. (Connell et al. 1997)*

The *EIDD Stockholm declaration* (2004) states that the design for everyone (“*design för alla*” in Swedish) is an innovative approach that constitutes ethical and creative challenges for all business designers, managers and political leaders. Design for all is a philosophy that aims to ensure that environments, products, services and systems can be used by as many people as possible. It is a design model based on human diversity, social inclusion and equality central claim is that “*Good design enables, bad design disables*” (*The EIDD Stockholm Declaration, 2004*). *Design för alla* was a Swedish project create by EIDD with the objective of showing the applicability of the Design for all concepts within different areas of society in both public and private sectors (*Design för alla, 2008*). They published a document called *Liberate diversity* setting the idea that despite being a common factor of being human, this does not mean that all people are the same. It explains that there is no one average person, as this this is just a statistical claim. In the practicality of a society based on equality, where everyone must be treated the same, and yet sometimes equality is confused with similarity (*Liberate diversity, 2007*).

2.9 Universal design in product development

To develop a new product from the point of view of universal design, we must take into consideration the user's needs as a primary condition and use it as information. This information is going to be the base for creating the product from the general to the details, as a practical way (Schon, 1984) and finding the specific way to do this in each case, because each product has a unique process of design thinking. This process has as main objective to create better conditions for the human performance, health and social participation and there are described eight Goals for Universal design (Steinfeld, E.2012):

- *Body fit. Accommodation a wide range of body sizes and abilities*
- *Comfort. Keeping demands within desirable limits of body function*

- *Awareness. Ensuring that critical information for use is easily perceived*
- *Understanding. Making methods of operation and use intuitive, clear, and unambiguous*
- *Wellness. Contributing to health promotion*
- *Social integration. Treating all groups with dignity and respect*
- *Personalization. Incorporating opportunities for choice and the expression of individual preferences*
- *Cultural appropriateness. Respecting and reinforcing cultural values and the social and environmental context of any design project (Steinfeld, E. 2012).*

3 Problem definition

The **purpose** of this project is to design an inclusive and interactive lab that also could be mobile.

The project aims to design an interactive Lab for learning and amusement inside of a museum with the principal characteristic to be accessible for everyone: for people of all ages, because the city museum and music school will attract both elderly people and young music school children, as well as people with different kinds of disabilities.

As it has been described before, the culture factory is the fusion of two different institutions in Skövde city: the city museum and the school of music; this means that the public attending or visiting the place will be diverse. The lab needs to be the place that enriches the *Kulturfabriken*, while it also can be a workplace for new creations. Also, the importance of this space is to be accessible to people with disabilities. Therefore, it should be created with a universal design which includes most people.

One of the intentions of the museum Kulturfabriken in Skövde, is to create a cultural space that serves as a claim for the families, for students and friends to have some cultural and amusement time, or even for an individual who wants to spend some time disconnecting; And therefore, the museum should bring these different possibilities to the people who visit the place.

One of the other principal intentions of the museum is to create this open space for everyone and take into consideration people with disabilities. As described previously, there are different types of disabilities which can be grouped in 4 types, even though each case is different to other and the characteristics of each person are never the same as others, but using those 4 groups as reference leads us to start sorting the ideas in function of them.

Taking this as a principal ground for the project, there are two secondary questions that will be directed in this project:

How can the lab be used to attract people to the museum?

How can the visitor experience be intensified?

The **goal** of the project is to gain understanding of how to design an interactive room that includes people with different kind of perceptual and / or physical disabilities, in a culture house setting. By doing so, it is important to understand which measurements that are required to fulfill the requirements and the features needed to accomplish a project oriented to universal design.

Research question

When the project started the research question was approximately: Which methods are useful to design an interactive lab in a culture house setting? The design should also include people with various kind of disabilities? The project ended thanks to the previous research and the working method up with the question below:

Which methods are useful to create a design of a mobile interactive lab that includes a surround sound system in an immersive space inside a culture house setting? The design should also include people with various kind of disabilities.

3.1 Methodology and description

In this section, the iterative working and evaluation methods will be described. The methodology was divided into two intertwined groups: working methods and analysis methods. Also the analysis method is divided in two: the focus group interviews, and reflection upon the process and final design.

The working design methods are divided in function by the designer, and his/her own way of working. But something that needs to be considered here is that all design methods must keep two important qualities: one is creativity, and the other, a systematic method as a working tool to create the desired. (Österlin, K.,2003).

The structure of the design process is divided in steps, with the idea to process starting from the function to the form. Designing can be understand as a special form of problem solving, when a problem is something that need to be reached which is not immediately obvious (Roozenburg & Eekels, 1995).

3.1.1 Working method – a part of the design process

Methods used for the creation of the visual aspect, technical solutions and possible proposal for the client, are the working methods, and they are described in more detail in the project section of the report.

The design process needs a cycle of activities to get organized. In this case, the cycle of activities is divided between phases:

- First step of concept generation: this step gathers all the information obtained from the beginning and the transformation of them through ideas to the first solution.
- Second step of concept generation: here the most convenient concept created in previous steps is selected and developed to a possible solution.
- Third step of concept generation: in this part of the process, the most important features that needed to be the principal keys of the design, were selected, and after that a more defined product was projected in detailed renders.

After the third step, the concept was presented as a prototype in focus group interviews as part of the analysis methods. Some questions were answered from the people of the focus group, this is the part of the analysis methods: interviews and reflection, that are described below.

With this information, the conclusion and the prototype, the final design was developed with all the details necessary for its creation and installation in the museum: construction plans, detail of the electronic elements and description of the materials and colors.

For every step in the process of design, images (like sketches, 3D models and explanations of them) are included to support a deeper understanding of the process.

3.1.2 Analysis method – focus group interviews

The analysis method concerning the prototype was performed with focus group interviews. The people interviewed were people with disabilities, pedagogical people who work with them or some experts who know about the area. **Interviews** were done after the result of the second

step of concept generation obtained with the working methods and the prototype obtained. After analysing the data, it was converted into a physical solution that can be incorporated to the solution created until that moment.

In the methodology there are two focus groups. The **first focus group** is composed by the people who were interviewed in the analysis methods, and they represent one or some groups related with the different types of disabilities described in the section “2.6: Identifying disabilities”.

This group was interviewed individually and the interviews are described in future chapters.

Qualitative methods have been chosen because we need to collect data directly from the users. This kind of research is used as a strategy that gives more importance to words than the collection of data. There are some characteristics for type of research strategy and is that it can be inductivity, constructionist and interpretivist, but a researcher does not always need to follow these three characteristics (Bryman, A., 2008)

The Lab is an inclusive space, which means that it should be accessible and easy to use for as many people as possible. As there are four principal groups to identify people with disabilities (mobility, hearing, vision and cognitive), one or two representatives of each can be enough to understand the requisites that the lab should accomplish to meet the requirements.

The idea is to start with a conversation with them that helps them to understand what the topic of the survey is and show some prototypes of the future lab, explaining what the principal activity of each part is. Also, we must listen to from them different experiences that they have had before when visiting a cultural or just a public space that can enrich the process. We give them a brief explanation of what the objective of this research is and what the product that is requested to be developed is. Then start we start with a list of some semi-structured and follow-up questions which will be conducted in the conversation with the users. These questions are a guideline that can vary depending of the person who is being interviewed, adding some questions if needed. With this method, there is a use of open questions, giving them freedom of speech that can lead them to a small conversation with the interviewer. Use questions that can help to identify what their needs are when they are visiting a cultural place, and the idea with the questions is not to get a clear response from them, but to understand what the relation is of the user/interviewed with museums, public spaces, videos games, and interactivity. From the responses, we can get some conclusions that can be used as contributions as concepts that were not previously conceived.

It is important to know how people interact with the product, and allow them to express their feelings and perceptions after using it. This conceptual design shows the principal characteristics that the room should have with the prototype. This prototype is the result from the first and second steps of the creation of the concept and the users can see and explain how they would use it, but there is no a real use of it. This is why it is important, that to complete the research, the evaluation part should take part in the place or, if it is not possible, in a prototype of the place, with the more accurate similarities. This part will be complete after the construction of the Lab.

After the interviews, the answers were collected and analyzed and used to create new concepts that could be incorporated in the next phase of the concept generation.

The **second focus group** is comprised by the workers at the museum, in particular the museum technician and the museum pedagogue. They gave the information needed for the project as well as reviewing the process to control that everything was going as expected.

Various meetings were held during the design process, taking all the guidelines for desired results. The first two meetings were taken in place at the very beginning of the process, at that point, with the second focus group. In the first meeting, there were four people present: the museum pedagogue, a teacher from the Digital Narratives Master’s Program, an audio technician and a design developer. During the meeting, the general idea of the lab was presented and a general view of the lab were discussed: every member participated in a first brainstorming session. These ideas were written down and formed the basis for the first steps and an outline of the early sketches.

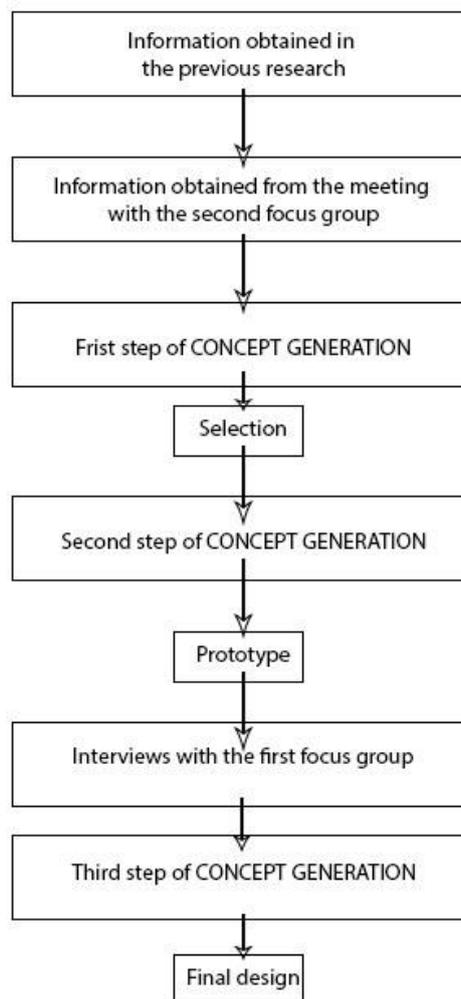


Table 3.1 – Methodology description chart. This methodology has been selected specifically for this project taking into account the research question, as well as specific needs described in the first parts of this paper.

4 Project description

4.1 How to take disabilities into account in the design of the Lab

A multimedia-interactive space will increase the senses playing with media (visual and audio) and will bring the experience of learning with the interactivity, releasing the imagination of the creator (the user) because there are things that cannot be learned by reading.

When identifying disabilities, there are different groups according to disability, but they can be sorted depending on the needs required in the design relevant to them:

- Two groups that are related with senses: the visually impaired and the hearing impaired. The idea is to emphasize the stimuli generated in an audio and visual way so that, if there is lack of perception from one sense, the other can capture the motivation of the exhibition.
 - o The use of a surround sound system: the sound is emitted from the different five speakers placed in a specific place of the Lab, and the sound waves are captured by the perceiver so that It can sense the direction from which they come. This is very interesting for the visually impaired.
 - o The use of immersive space: this will enhance the feeling of a visitor being in a place even when they are not actually there, but at the same time increasing the sense of the sight, since the visual stimuli will also be given from different directions.
- The mobility group – For this group the focus will be easy access by removing architectural barriers and taking into account measures recommended by specialists.
- The cognitive group – removing architectural barriers is also very helpful, so there is no danger for them. But the focus for this group comes from the creation of content designed specifically for them. From the point of view of the design, it should be the easiest and simple to understand for them.

4.1.1 Elimination of barriers

The features that the lab need to reach in order to be accessible are more physical measurements

Now, a series of measurement that need to be taken into account for the elimination of architectural barriers is listed, and they are important measurements that the lab need to include:

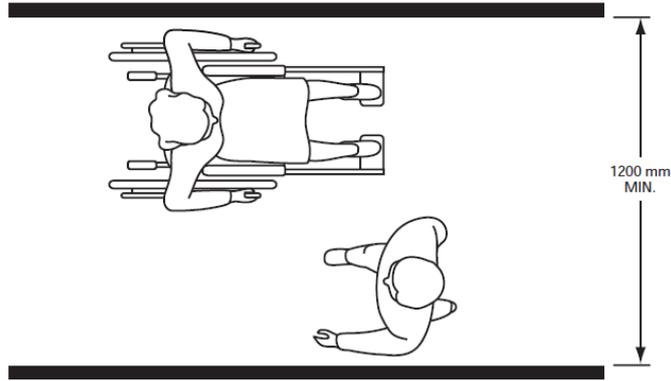


Photo 4.1 - 1 – Interior routes: where a wheel chair and a person have enough space [Smithsonian Guidelines for Accessible Exhibition Design]

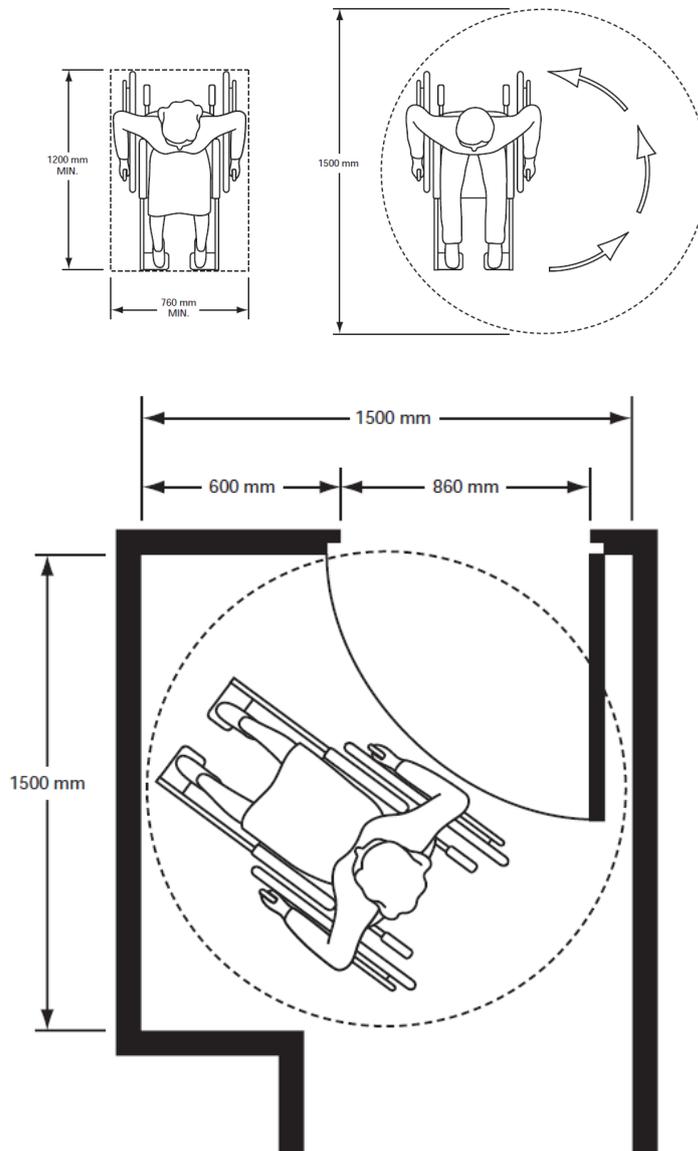


Photo 4.1 - 2 – Minimum space for wheelchair: wide, large, inscribed circle and door [Smithsonian Guidelines for Accessible Exhibition Design]

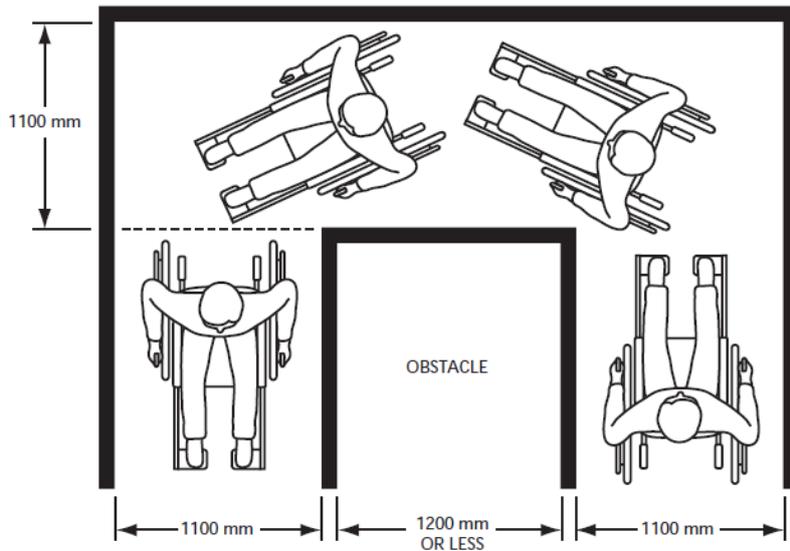


Photo 4.1 – 3 Interior Routes: space with obstacles [Smithsonian Guidelines for Accessible Exhibition Design]

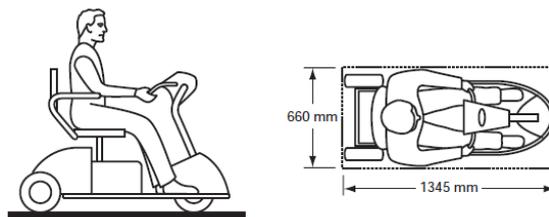
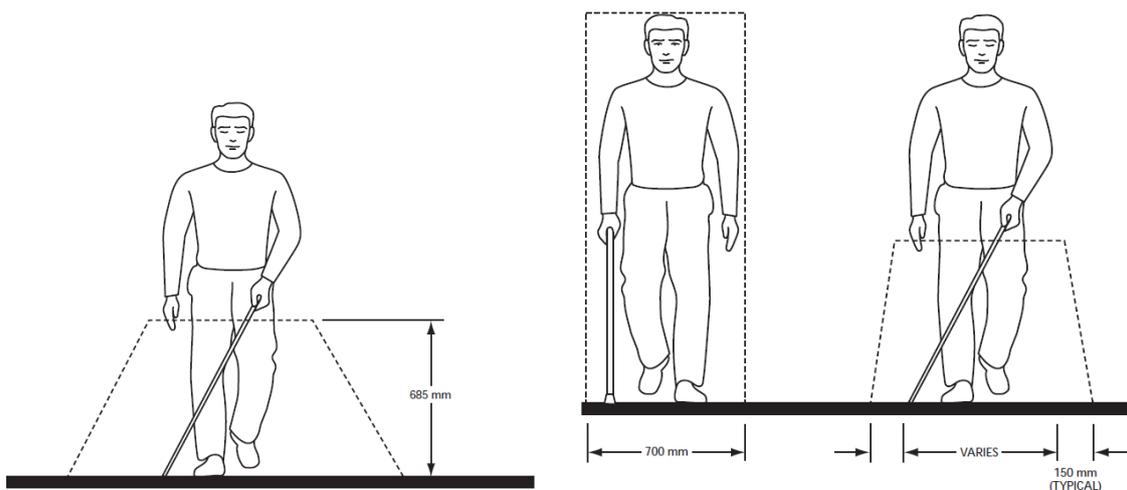


Photo 4.1 – 4 – Interior routes: dimension of the scooter [Smithsonian Guidelines for Accessible Exhibition Design]

Interior routes for the visual impaired:



Photos 4.1 – 5 and 6 – Interior routes: Visually impaired / Walking stick / cane [Smithsonian Guidelines for Accessible Exhibition Design]

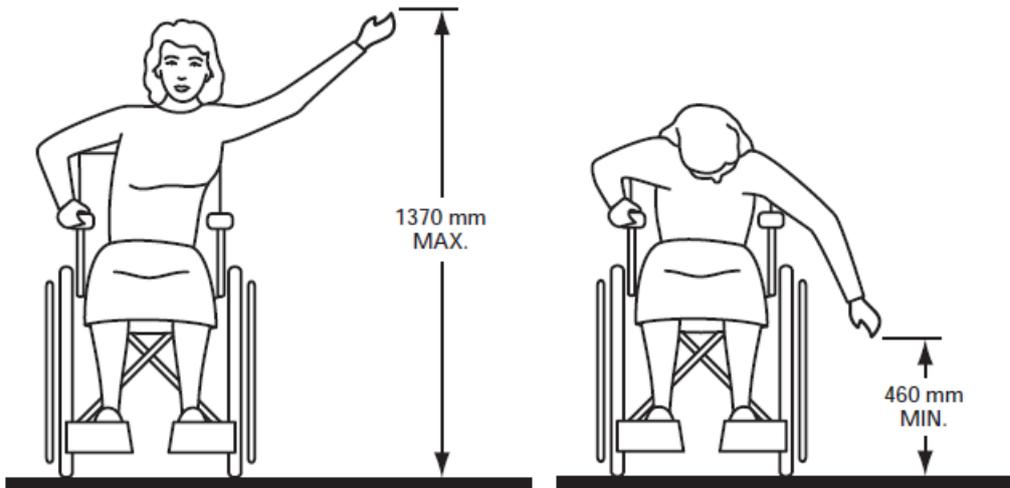


Photo 4.1 - 7 – Maximum and minimum reach [Smithsonian Guidelines for Accessible Exhibition Design]

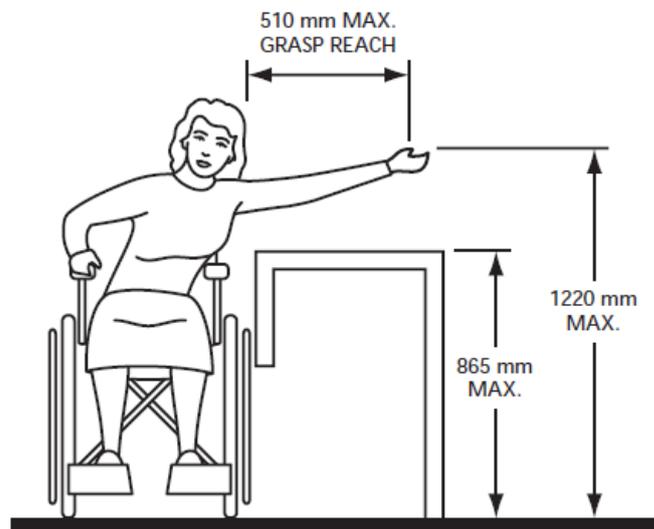


Photo 4.1 – 8 – Grasp reach [Smithsonian Guidelines for Accessible Exhibition Design]

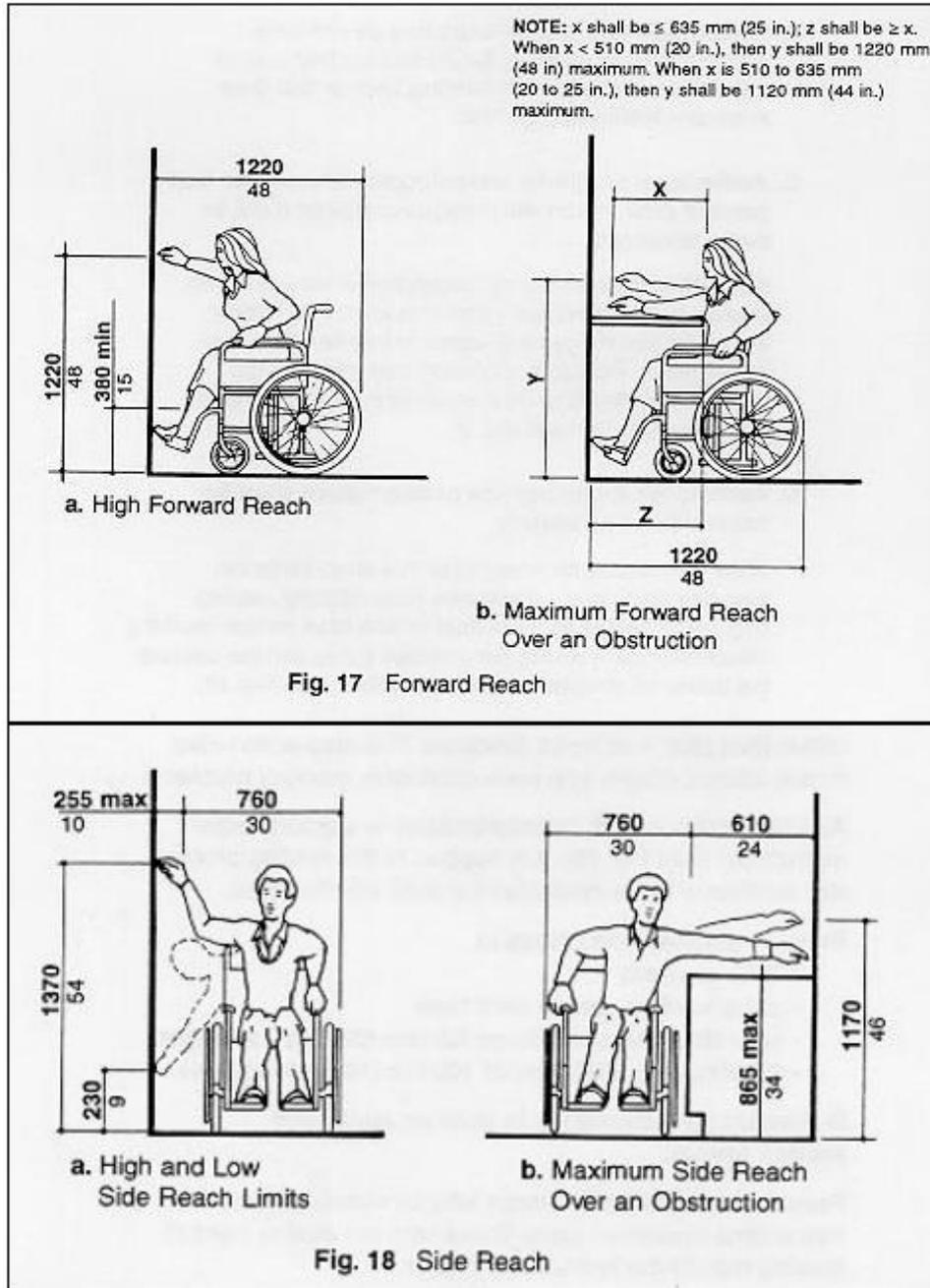


Photo 4.1 – 9 and 10 – forward reach and side reach. [Smithsonian Guidelines for Accessible Exhibition Design]

Number and name of the photo	Important measurement
1.- Interior routes	1200 mm
2.- Minimum space needed for wheelchair	1200 mm large 700 mm wide 1500 mm diameter– inscribed circle 860 mm – opening door
3.- Free space between obstacle and wall	1100 mm wide corridor
4.- Interior routes: dimension of the scooter	660 mm wide 1345 mm large
4 y 5.- Interior routes: visually impaired / walking sick / cane	685 mm vertical free space 700 mm horizontal + ~150 mm each side (typical)
7.- Maximum and minimum reach	1370 mm maximum 460 mm minimum
8.- Grasp reach	510 mm 865 mm minimum 1220 mm maximum
9.- Forward reach	a. High forward reach 1220 mm high forward reach b. Maximum forward reach over and obstruction $x < 635 \text{ mm} - z > 635 \text{ mm}$
10.- Side reach	a. High and low side reach limits 230 mm minimum vertical 1370 mm maximum vertical b. Maximum side reach over an obstruction 610 mm horizontal - 1170 mm vertical

*Table 4.1 – List of measurement for the elimination of the architectonic barriers
[Smithsonian Guidelines for Accessible Exhibition Design]*

4.2 Working methods - The Concept generation process

The concept generation process is based in the idea to develop something that can be interactive, in order to reach this, we want to focus on the space, create a space that can invite people to enter as well as be an open space, a **semi-open space** that invite people to be inside, and they can feel like they are in another place. There are some characteristics that can make this space more interactive:

- **Immersive space** – In virtual reality, an immersive space is the perception of being physically present in a non-physical world. This project is not meant to create virtual reality itself, but a space that makes users feel they are actually in another place. We thought that having a projection of 180 degrees would be suitable to create this feeling, as this allows images to be viewed from different perspectives, not only a flat screen.
- **Surround sound system** – the surround system speakers are placed in a circle, so it is interesting to keep the shape of an inscribed circle inside of the room that help to place the speaker.
- **Input and Output Devices** – The peripheral devices that will give control to the user giving answer to the stimuli. This will be the key to create interactivity.

4.2.1 First step of concept generation

4.2.1.1 Working method – Check list

This method is making a list of the necessary requirements that the clients has ordered, but also the suggestions from the teachers in my Master’s program. The requirements listed here are those related with physical features, as for example, things that can be seen, touched or counted. Keeping all the requirements in a list is a way to remember all details in the process of concept generation. Requirements will change as the project progress, and this assures consistency. Also, one needs to consider that we are presenting ideas, and therefore, they will evolve depending on the rest of the whole project. After the first step, when a requirement is fulfilled, the boxes needs to be checked (Cross, 2008).

Mobile walls	x	Projector	x
False ceiling	x	Movement receptors	x
“Invisible”	x	Lights	x
Screen / display	x	Adapted for people who use wheel chairs	
Interactive	x	Adaptable for different activities	x
Chroma key			

Table 4.2.1 – Check list

4.2.1.2 Working method – Bench marking

Ulrich and Eppinger (2011, p.107) define benchmarking as “the study of existing products with functionality like that of the product under development”. Similar project has been done in different scenarios: airports, hotels, stands for marketing purposes. And some also have been

done in museums, but it is important to mark that in the academic context, there are not so many projects that are similar to this one. For existing projects, their goal is more to create something for entertainment, and the objective in this project is to create something from an educational point of view.

4.2.1.3 Working method – Visual theme board

Visual theme boards are used to convey the overall feel for the product, and this is done by putting together images that inspire and facilitate creativity (Design Skills, 2007). This is how the overall style, shape, surface and color of the concept are formed, inviting the designer to think outside the box and visualize a style that could be impossible to imagine before.

In this step, we need to consider that a museum is visited by a wide audience and the style should not define just one type of visitor. This is also why we wrote in the requirements that the installation must be aesthetically appealing but not defined by any color, using white as the neutral color and creating different atmospheres with the lights. Simplicity, minimalist and functional, are also adjectives that should define this lab, created by soft shapes and organic curves.

4.2.1.4 Result of the first step of concept generation and selection

As the result of the first concept generation we have some conceptual designs that are shown from the *Images 4.2.1 - 01 to 4.2.1 - 05*.

In this first step, the design is focused on the main shape of the room: we want to acquire a shape that can be interactive with an immersive space.

- *Image 4.2.1 - 01* and *Image 4.2.1 - 02* are based on a square shape. The difference between them is the way the mobile door opens: the one on the left has the door that can drop in one point, and on the right, the doors slide on two rails. Both of them result in having the same space when they are open and when they are closed.

- *Images 4.2.1 - 03* and *4.2.1 - 04* are based on a round shape.

- *Image 4.2.1 - 05* is based on a “leaf shape”

Having the square, the round and the leaf shape as primary shapes, we can see that the three of them can be immersive spaces, but the round and leaf shape are more suitable to create a comfortable zone regarding movement and the visual perception.

The square shape will need two or three flats projector in 90 degree each, which will make the immersive space more difficult to interact with, since a person will need to move the head more degrees in order to get the 180 degrees (or almost) space.

Focusing in the round (*Images 4.2.1 - 03* and *4.2.1 - 04*) and leaf shape (*Image 4.2.1 - 05*), It has been chosen the leaf space, because the leaf one creates a more inviting place to move, and someone does not feel as it is stuck in the place, that happen with the round one.

For the next steps, the *leaf shape* of the *Image 4.2.1 - 05* is chosen to continue working as a base.

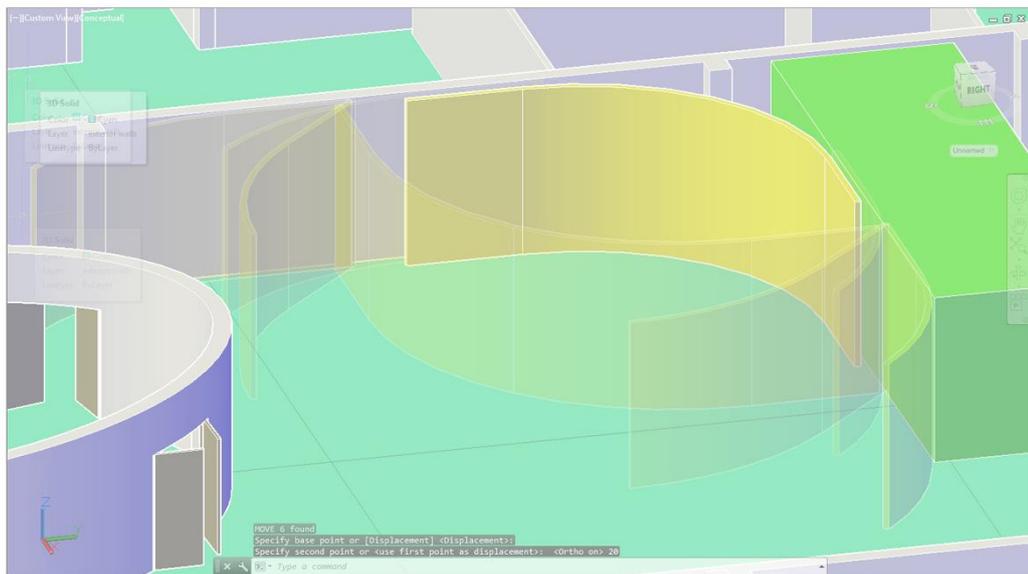
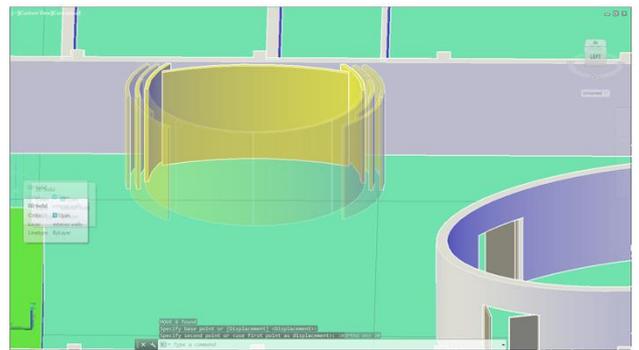
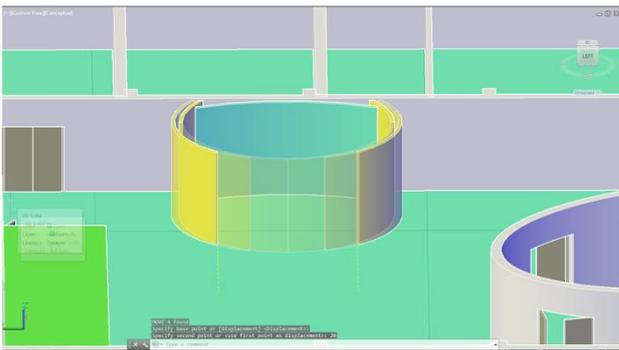
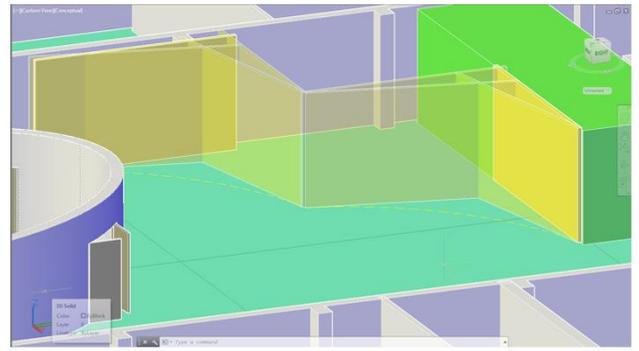
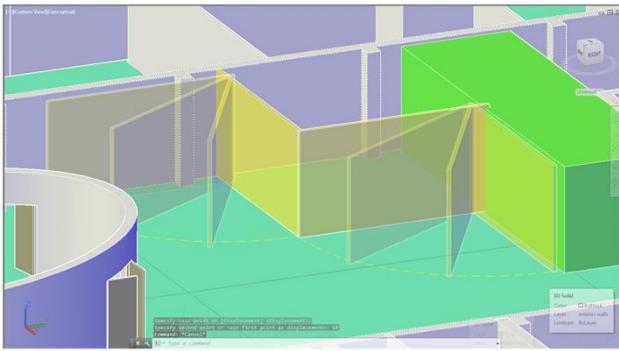


Image 4.2.1 - 01 left top, Image 4.2.1 - 02 right top, Image 4.2.1 - 03 left center, Image 4.2.1 - 04 right center and Image 4.2.1 - 05 bottom – Result of the first step of concept generation – “An overview of the distribution space and main shape”.

4.2.2 Second step of concept generation

In this second step, we focused in other requirements listed in the check list (*Table 4.2.1*). This step is based on the leaf shape, which is placed in a corner of the museum, and the detail that needs to be developed in this step is as follows:

- **The false ceiling.** The use of a false ceiling will help to have the appearance and give the sensation of a cave as well as it will have a clearer appearance, because the cables and everything that is loose are going to be inside of it. There is also the possibility to have a floor, but that will depend on having the table with a touch screen in the center of the room. In the case that this table is not needed, the floor will not be in the design.
- The selection of the **input and the output devices** as well as the placement of them. The selected devices are:
 - o Input devices: One touch screen. In the *Image 4.2.2 -02*, it is seen that there are two different touch screens. The one that is in the center, this one is static and it is placed in the center of the room, meanwhile the other is placed in a corner and it has some movement to make it more usable.
 - o The other input device is a Kinect, which is a sensor that can track up to 6 people inside of the room and will interact with the movement of the users. This should be placed in the front of the screens.
 - o Output devices: The projector (s) (*Image 4.2.2 - 06 and 4.2.2 - 07*), the touch screen and the speakers (*Image 4.2.2 - 05*).
- Option of using **chairs**. That will be disused with in the participants of the interviews in the qualitative methods, because it is more a matter of usability and practicability than design or aesthetic, (*Image 4.2.2 - 02*).
- **Open and closed space**, created by the mobile walls, (*Image 4.2.2 - 04*). The room will be white entirely in the inside, giving the option to create different colors with the projections (*Image 4.2.2 - 03*).

With all of these elements and the election from the museum pedagogue and the designer, it the most suitable solution was selected to move forward.

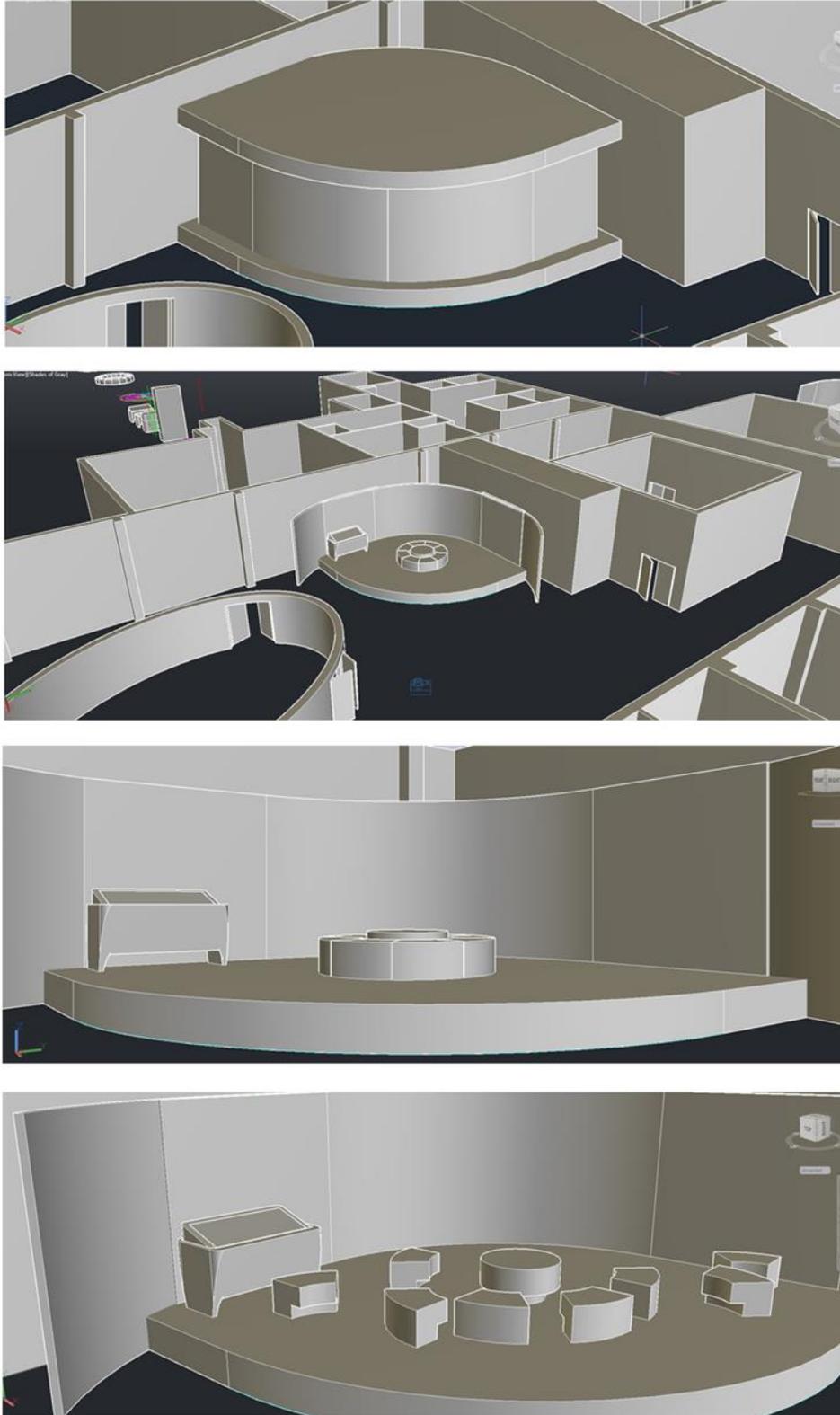


Image 4.2.2 - 02 – Result of the second step of the concept generation: general view of the open space.

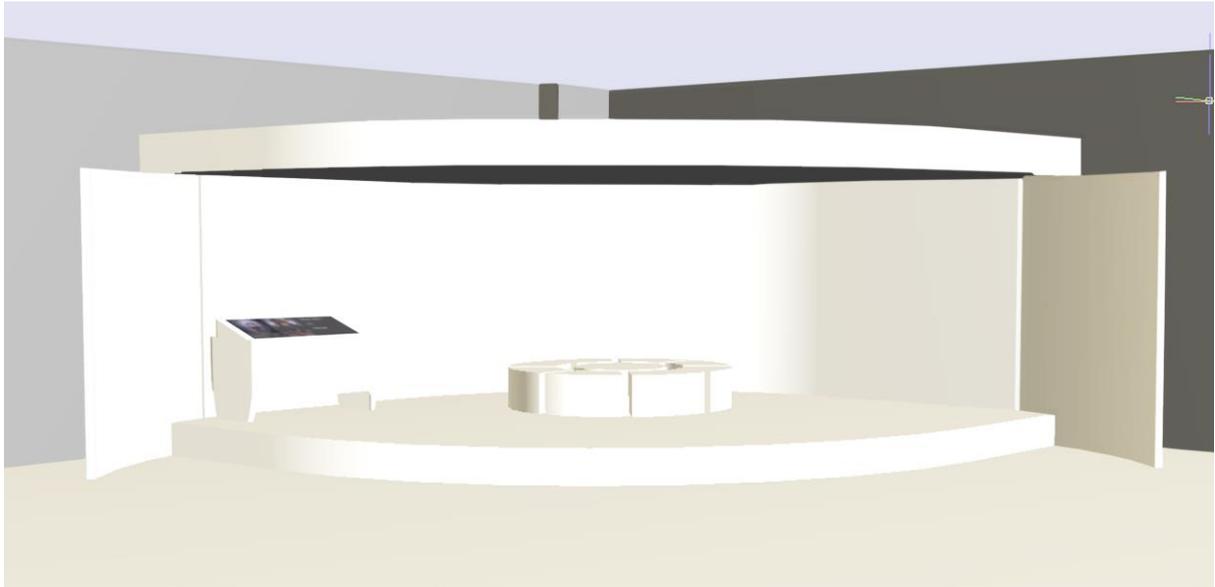


Image 4.2.2 - 03 – Result of the second step of the concept generation: general view of the open space.

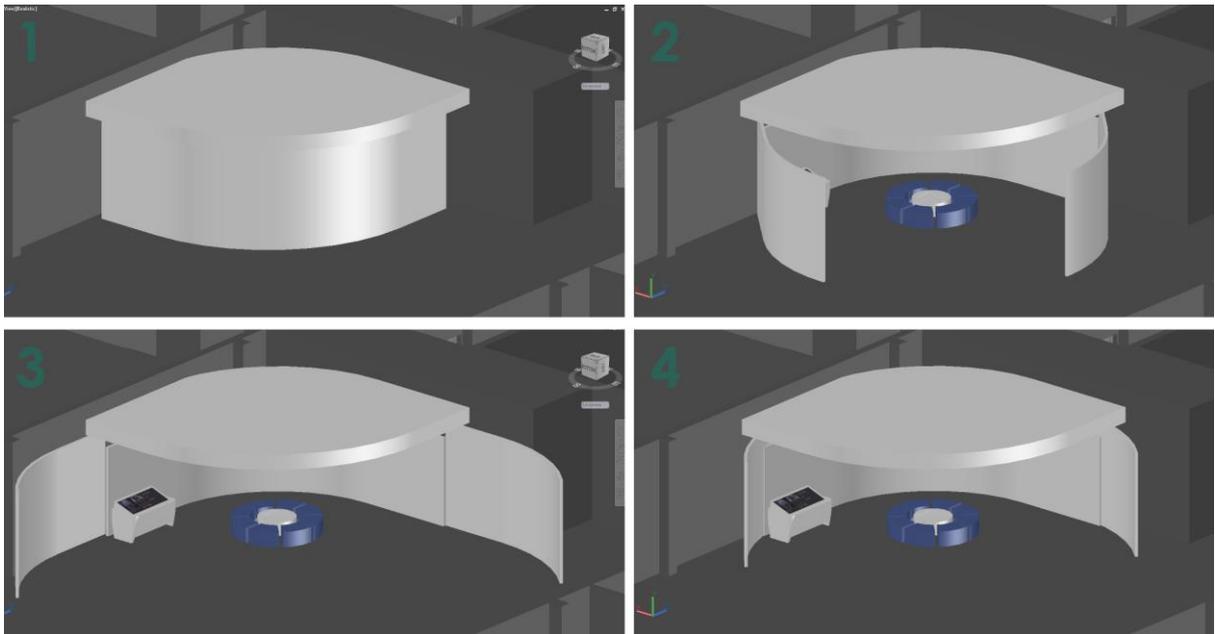


Image 4.2.2 - 04 – Result of the second step of the concept generation: movement of the doors.

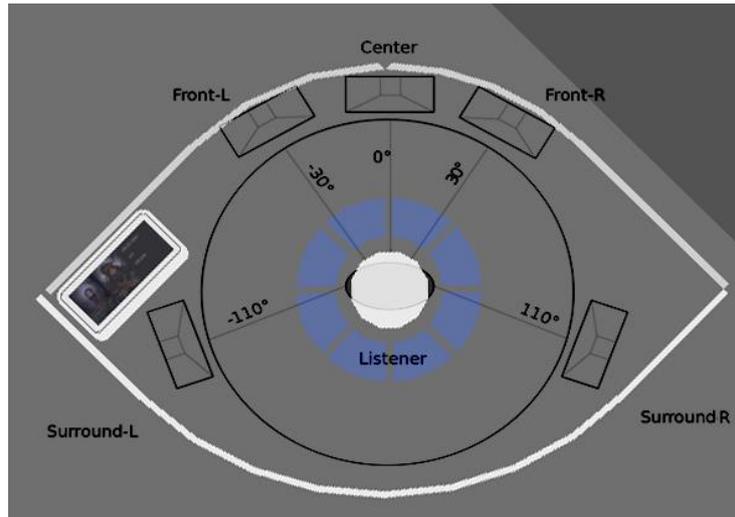


Image 4.2.2 - 05 – Position of the speakers: Round inner space

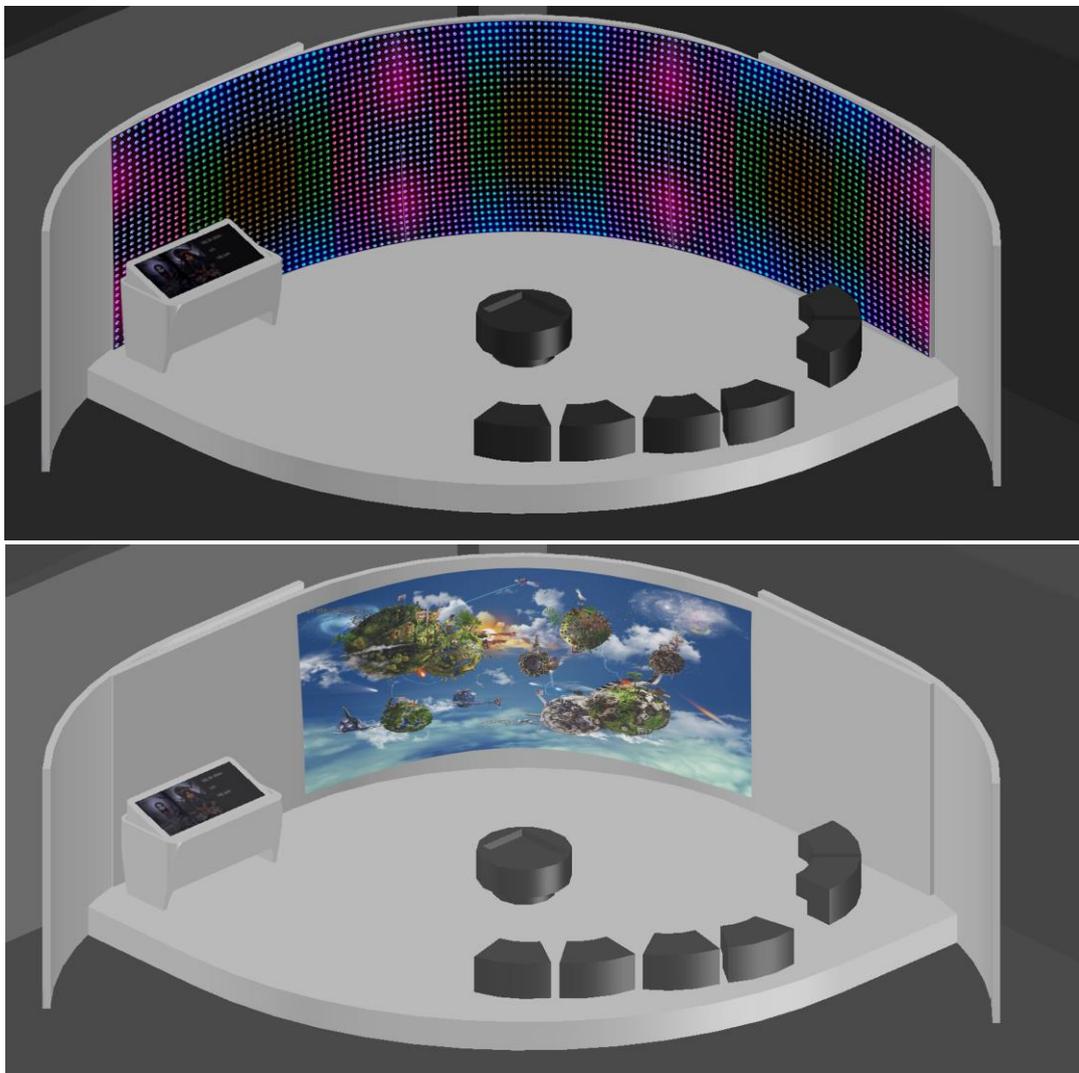


Image 4.2.2 - 06 and 4.2.2 - 07 – Projection in an immersive space.

4.2.3 Third step of concept generation: PROTOTYPE

A prototype was presented as a result of the first and second concept generations, this was presented along with some questions in the interviews done in the next step.

What has been acquired here is:

- Surround/immersive space (*Images 4.2.2 – 06 and 4.2.2 – 07*)
- Open/Close space – mobile walls (*Images 4.2.2 – 08 and Images 4.2.2 – 09*)
- Selection of input and output devices
- Mobile walls

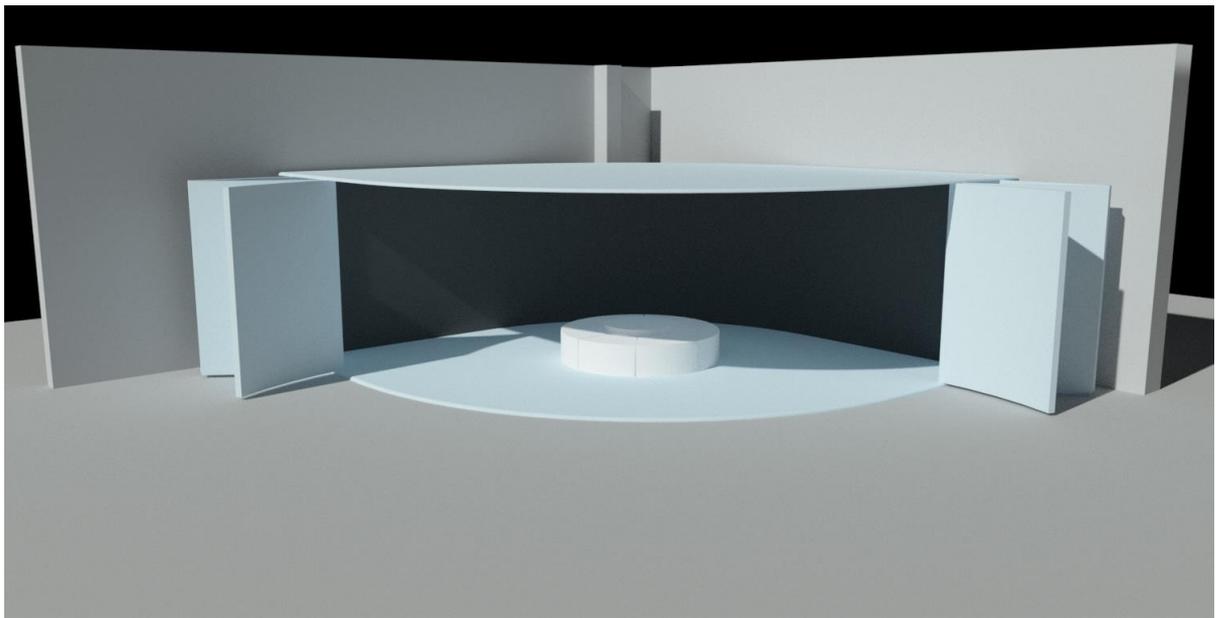


Image 4.2.2 - 08

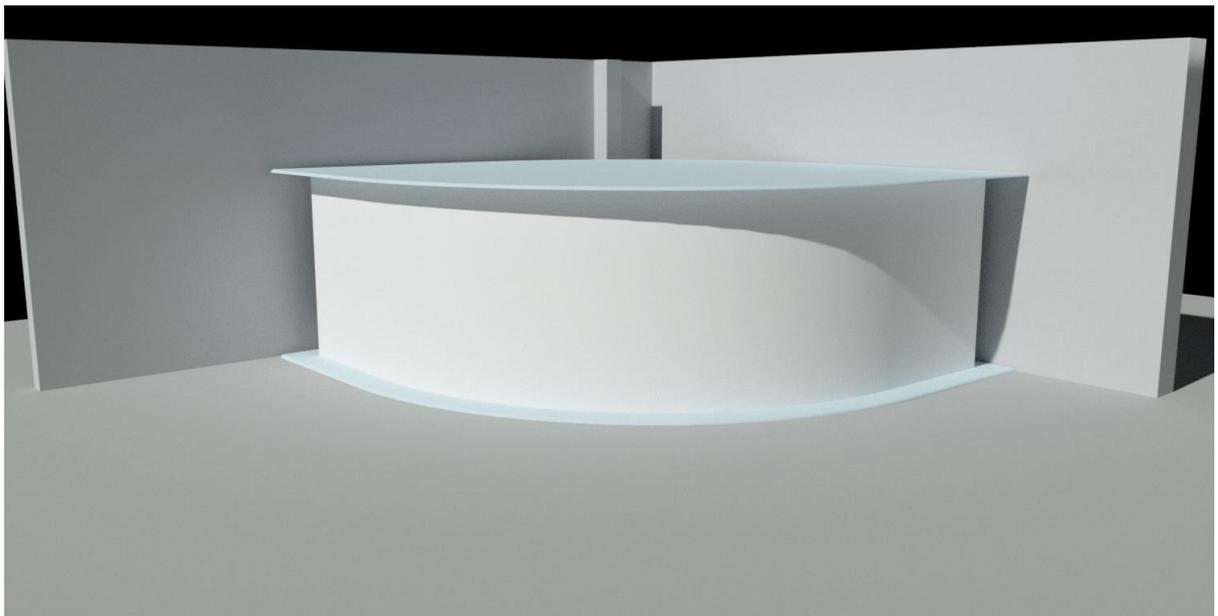


Image 4.2.2 - 09

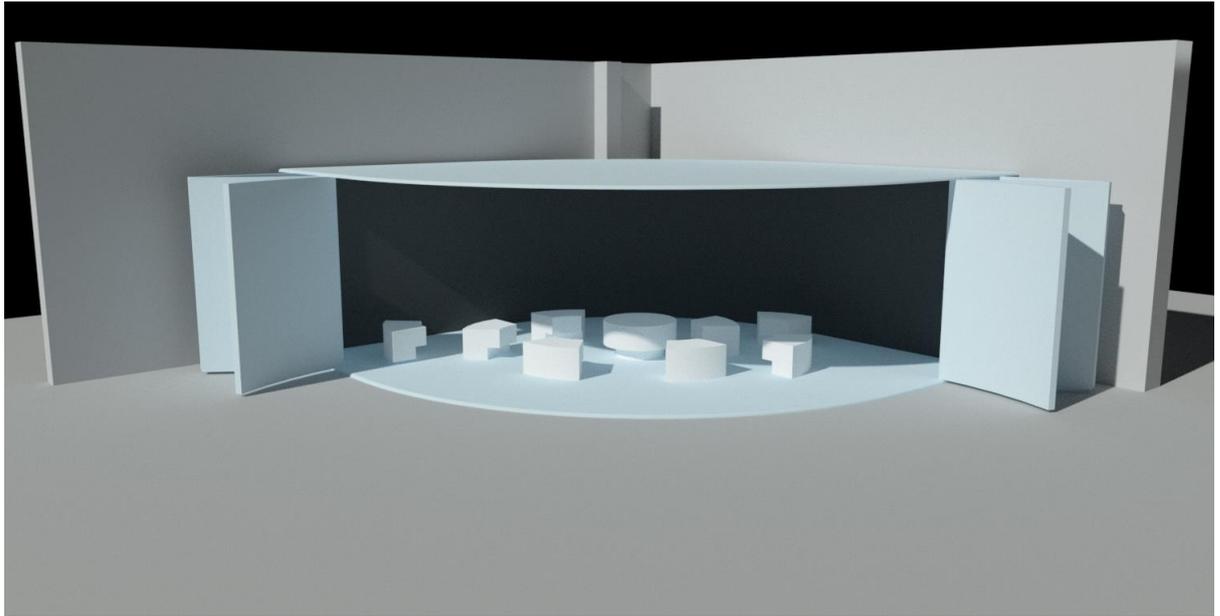


Image 4.2.2 - 10

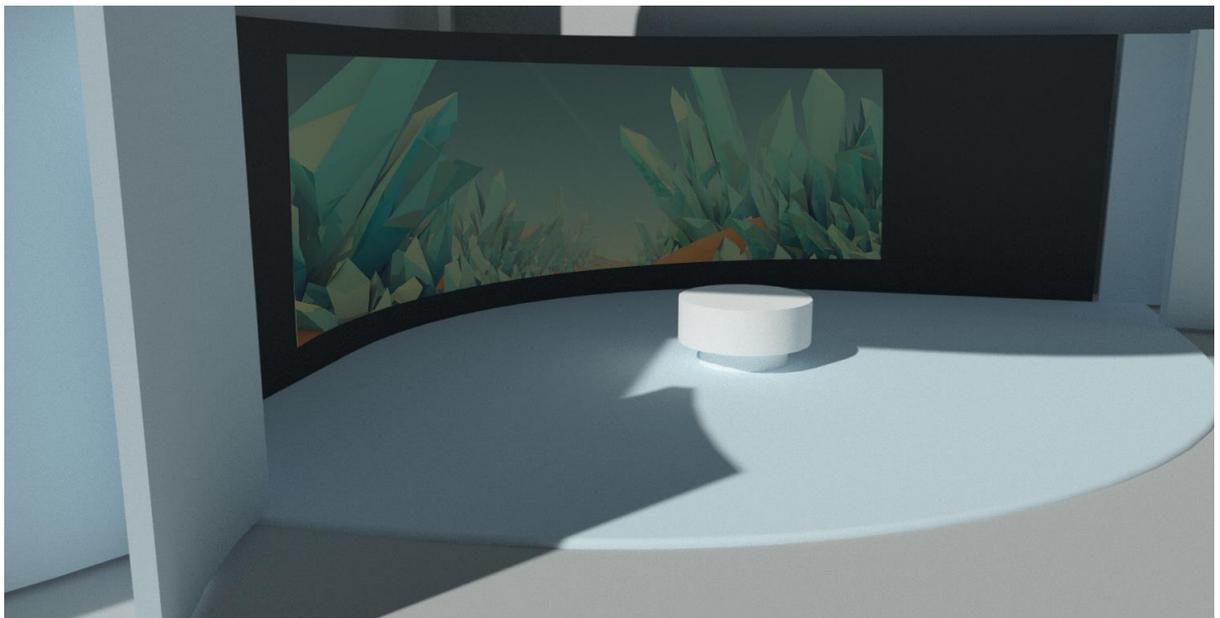


Image 4.2.2 - 11

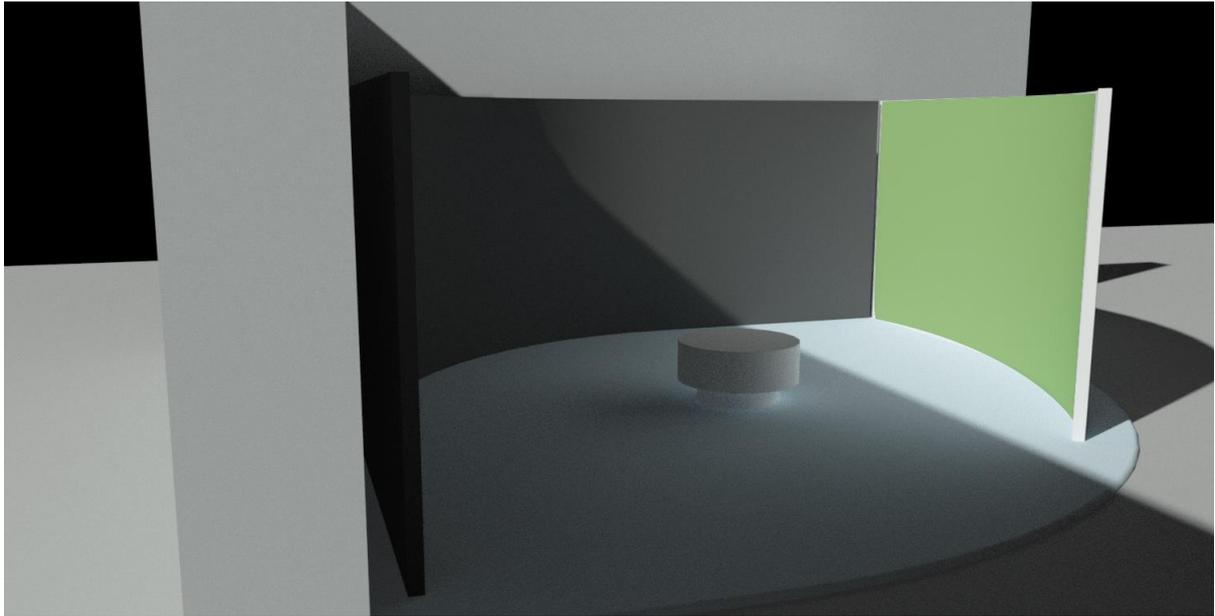


Image 4.2.2 - 12

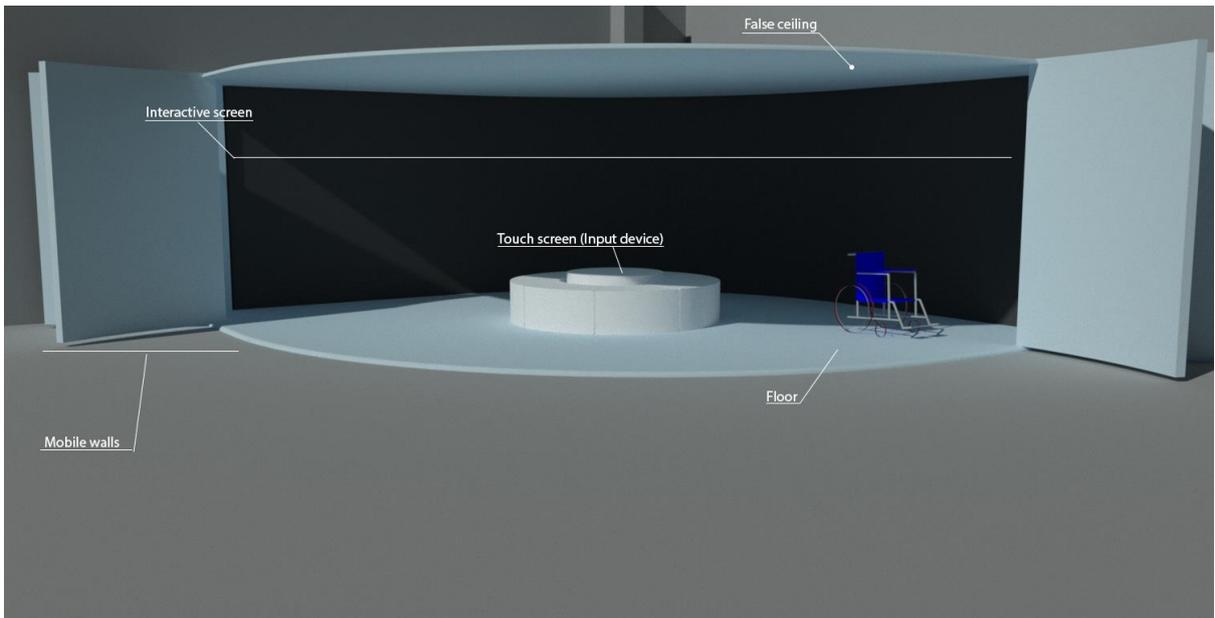


Image 4.2.2 - 13

4.3 Focus group interviews

4.3.1 Interviews

Five participants have been interviewed in this process. Each person answered depending on the group to whom he/she is related.

The questions are related with museums and interactive applications, how often they use them, and if they find difficulties using them. I used open questions and each question can be modified depending on the persons. And following their answers, different questions can be asked. The main questions used to open the conversation are:

1. What are the main difficulties you find when you visit a public place?
2. What are the main difficulties you encounter when you visit a museum?
3. Are all exposures/exhibitions accessible?
4. What are the least accessible exhibitions?
5. How do you think that these difficulties can be resolved? - For example, when an object is in a glass case
6. Which proposals would you give to improve museums and make them more accessible?
7. What difficulties you encounter when playing video games or any interactive platform.

After that, the prototype of the conceptual design is shown and the interviewee is asked what they think and to make suggestions about how it can be upgraded in a better way.

8. Do you think that having an interactive – multimedia room will attract more people?
9. Would you visit a museum more often?
10. Can the visitor experience be intensified through the interactive applications?

4.3.2 First participant

The first participant is a person who needs a wheel chair every day. He is student in his last year of the university and therefore, he needs to go there very often to assist with classes and work with his classmates. He does not have any cognitive problems, so basically it is the movement with his chair that makes him more dependent.

When asking him the first two questions, he replied that the main difficulties that he found when he is visiting a museum are the architectural barriers such as:

- Slopes between the levels instead of steps: the ramps must be of 10 degrees' incline maximum.
- Elevators, if there are different floors.
- The difference of levels in the floor; no more than 10cms, so the chair can pass by them.
- Limited free space under a table allowing him to stay in a comfortable position.

- Lack of automatic doors (Or someone who can help them opening it).
- Maximum and minimum reach grab, both height and depth.
- Inclination of 45 degrees in the information tables (not in the horizontal position).
- Enough space around the object.

He said that he sometimes visits museums, and he explained that in Sweden he never had problems with the architectural barriers and the museums are always good adapted. Related with exhibitions, he said sometimes you find some objects from the exposition that are not easily accessible, like for example, when there are objects in a glass showcase or cabinet, and poor sight fails to appreciate the displayed object.

He suggested that the seats can be an obstacle in the Lab and therefore, that having the space free is more practical. In a small person cannot reach the top of the interactive exhibition, a little bench can be used to solve this problem.

Even though this person is not a very active game player, he is interested in new technologies, but the reason is because he has not so much time left after the studies. He would be more interested and might have some curiosity in the museum if there were an interactive installation because it would make the museum more active and interesting for young people, and also that the visitor's experience will be intensified.

The interviewee also gave some extra ideas to incorporate to the lab:

- The use of a joystick for people with limited mobility in their limbs.
- making objects easy to move, to make them more accessible
- Wi-Fi, the use of Internet in the museum to make more the information more accessible, and in case that the visitor is not able to reach the table.

4.3.3 Second participant

This participant oversees a project called *Music Passion*. This project work was intended to create a working method through the music to promote health, social participation and active leisure for people with a cognitive disability. They want to be part of “a strategy for implementing disability policy” and the way they do that is changing the approach and content of care activities to fulfil the desire and interests that the young adults have. Especially for those with cognitive disabilities, it is necessary to change the working method, to lead them to a rich, active and stimulating life and leisure. The goal is to motivate a person with cognitive disabilities to have better health, a higher quality of life, communication and participation. They work using music as a base and cooperate with the Music Factory in Skara because they can provide good facilities and knowledge.

After this presentation, the participant started explaining more in detail how the working method is used in the Music Factory. They work with a group of people with cognitive disabilities of different types: every child/youth has a different activity into the music group, some of them sing and other play instruments, for example. They reunite two times per week, and from time to time, they present public performances. The time occupied in each group is two years, and after that, new members will take part in the music group. When the group

finishes the second year, the level of each participant has increased positively in relation with the values that they want to instil. The values and objectives are:

- The members need to feel in a professional environment.
- The members need to feel in education; they are doing a real progress learning music and expressing themselves.
- The feeling that they are doing something for real, and this is done with the public presentations in the shows. Convey the feeling that they can do that better every time.
- Build self confidence in every member.
- There is a wide range among the participant, and everyone will do that in their way.
- There is a strong connection between the music and the form. This led them to create a mental connection with the visual and the audio perception.

During some sessions, the group members are recorded, and they can see themselves singing and acting. This is a curiosity that they like watching them because can see the image of them expressing themselves and they can get the attention of other people by their artistic expression, and so this fact can create more confidence in the participants.

As there are different levels of disabilities in the group, the instrument used in the group can be different: there are basic keyboards, bass guitars, etc. but they can use also a type of instrument that is without hands, or also a type of guitar that just need to be pressed in two precise parts, and gives two notes.

The participant in the interview gave some tips to use in the design process of the lab:

- The use of camera.
- The use of Chroma key

4.3.4 Third participant

The third participant is visually impaired by 90%, and deaf impaired at a high level. He is always walking with his guide dog, and he is using a deaf/blind cane which helps him to have freedom when he is walking outside his home. Also he is using a hearing aid in his ears. However, this person has a very active life. He likes listening and making music with his guitar. He is the President of the *Visually Impaired Association (SRF)*, an organization for the blind and the visually impaired that rejects all forms of discrimination and is characterized by the openness and democracy.

SRF is based on the idea of human equality and to jointly enforce the visually right to participation and equality in all areas, create social community and support each other, so that it is possible to live and active and independent life.

SRF has a Museum in Enskede, Sweden, called “Synskadades Museum” which is a small specialized museum with collections reflecting the history of the visually impaired in Sweden, exposing visually impaired conditions in the society, education, social relationships, professional life, etc. The museum counts with a cultural and historic library in braille, and this collection shows examples of different writing systems, such as Latin writing in relief,

stachelskrift, Moons writing, Fahlgrens writing Braille and Braille. The exhibition of the museum has a lot of objects with very limited viewing activities.

The way that the room was presented to this person was though a model made of cardboard, inspired by 3D printed maps that recently have been incorporated in some public places. This helped provide an explanation of the project and how it is supposed to look. The suggestions regarding the Lab from this participant are:

- The use of yellow lines in the floor because this colour cannot be easily confused with others.
- The use of a spoken board with the information about the activities.
- The use of voice talking and headphones.
- The use of spoken voice at the entrance to the Lab explaining what is happening: information for the visually impaired.
- The use of Personnel helping people to learn about the exhibition.
- the use of extra seating in the Lab for resting.

This participant does not visit museums very often, except when someone invites him to do something special. He said that the place will be more interesting if there is some interactive installation adapted for the blind. Apart from these suggestion, he also gave more tips to make the Lab and the museum more interesting, including:

- The use of spoken books, for both children and adults.
- The possibility to read/listen the newspaper, this can create a habit to some people for visiting the museum more often.
- The use of music from different style and decades. (As described before, this person is very interested in music, and he likes to discover new sounds).
- Regarding the audio, he suggested the use of vibrations and the bass tones to feel the rhythm music through the sense of touch.

4.3.5 Fourth participant

The fourth participant is the President of the organization *FUB (För barn, unga och vuxna med utvecklingsstörning, for children, youth and adults with developmental disabilities)*. FUB is an organization working for children, young people and adults with developmental disabilities to live a good life. Its principal objective is to give support and advice to people with learning disabilities and their families, giving information about law and justice. They keep the community active by arranging activities during the year, such as meetings, excursions, and seminars.

At the beginning of the interview with this participant, she explained in depth the characteristics of this group. They are dependent on other people taking care of them, which make their life limited. There are different cognitive levels, not everyone has the same limitations, and every case is different from each other: for example, some of them cannot read, but some can do that in some level or some can present multiple disabilities. She also added that they have a cognitive level similar to children. They do not learn English, and this

makes their lives narrower. This is one of the reason they do not visit museum very often, because there is nothing interesting for them.

After showing her the pictures of the conceptual model of the Lab, she gave some suggestions to take into consideration: The use of **touch screen**, for example. Most of them are users of tablets and they like to interact with easy applications. Sometimes they need help using them, but it can be done in an intuitive and easy way.

4.3.6 Fifth participant

The fifth participant works as *personal assistant* through a private care company offering services in personal assistance to individuals with disabilities. The goal is to improve the quality of life for all those people, and giving them the opportunity of living a good life.

The interviewee has been working with persons who have limited movement in different levels, from people who have cerebral palsy to people who just have a limited movement because they are wheelchair users.

The main every day challenge for them is that making everyday activities requires much more effort and is more energy consuming than people without this condition. They get tired easily, have problems in their muscles, and/or their hands cannot stop shaking.

Also in this group, everyone is different from the other, and cerebral palsy can affect both the body, but also the brain. But normally, this group presents normal cognitive conditions. So, the work she has to do with them is to help them with the everyday activities to make it easier, and sometimes is just sit up with this person, and go for walks, or just sit in a coffee house. Sometimes they need to think about new activities to do, and creating activities for this group can be an easy way to attract more under-represented members of the public to the museum.

After showing the pictures of the conceptual Lab, she gave some suggestions:

- Make things movable. One of the characteristics that they have, is the limitation of movement, and the reach to grab things is sometimes very limited.
- Create enough space for movement between the objects. Some wheelchairs that are used by those people have more appliances in the front part.
- Create activities easy to use for both the user and the assistant.

4.3.7 Summary from the focus group interviews

As we can see, each participant has helped with their interviews in a very different way.

Some are giving ideas related with measurements and shape, especially from the person related with the mobility group and the person with visual and hearing impairment. This is because those people do not present any cognitive disabilities, so the way the design is needed to be adapted to them is by adding some extra details to make it inclusive.

On the other hand, we have the other three participants: the group from Music Passion that belongs to the cognitive; the person working with the organization that helps to improve the life of people with dependency, and this can be a mixture of different groups: cognitive and

mobility, and cognitive with hearing impairments; and the last participant who is an assistant for people who just need help in their everyday life, that includes mobility issues but at a higher level than just a typical wheelchair user.

This can make a difference of data in two groups: the tips that apply to measurements or just to physical adjustments in the design, and the tips that can serve the general concept of the Lab. The suggestions and observation given by the participants in the interview are going to be used for the next step of the concept generation. Here we are taking into consideration those that can be more useful in the creation of the Lab. Nevertheless, the others are also interesting for incorporation in the rest of the museum.

First participant

Most of the tips and suggestions given by this person are related to the architectural barriers. The museum is a public space so that all those details are already solved in the building. But the things to consider related to the Lab are:

- Do not use any steps or use of slopes. If there are changes of levels, no more than 10cms.
- Create free space under a table.
- Design according to maximum and minimum reach grab.
- Create an inclination of 45 degrees in the tables.
- Create enough space around the objects.

Extra ideas that can be useful:

- The use of a joystick, or something that can make input of the interactive room more interactive for visitors.
- Create things easy to move, to make them more accessible
- Establish Wi-fi and the use of the Internet in the museum to make information more accessible, and in case that visitor is not able to reach the table directly.

Second participant

The information collected from this participant is more about ideas to make the Lab more inclusive for people with cognitive disabilities. Giving equal conditions to them and presenting the Lab also as a creative place that can be used as a stage. Also it is best to have the option to see themselves creating and participating in the exhibition, and this can be done with a camera as suggested by the participant. We must make it possible to have different options and participation from more people, so they can all interact with each other.

Third participant

The participant suggested the use of a spoken board at the entrance of the lab that can help to identify the user about what is happening inside of the Lab at this moment. The use of headphones was also suggested as something interesting since there are some people with impaired hearing. This person think that the use of seats is important because some people get tired easily and can enjoy the exhibition better when they rest at times. They also suggested

to listen to different audio elements: for example, newspapers, audiobooks and music from different styles and decades. And, something also suggested that can be very interesting is the use of vibrations and the bass tune to feel the rhythm of the music.

Fourth participant

From the participation of this interviewee we can get some tips regarding the way the interactive exhibition will be done in the future, and how to change the shape of the room.

The interactivity needs to be easy to understand, and the way the things are placed should be very intuitive. We need to have enough space to use it for at least two people, because the user usually goes with an attendant.

Something interesting to consider is that those people normally use a table because for them this is something to understand.

Fifth participant

The most interesting thoughts to take from the interview with this participant was to make the space adaptable for them. And the best way to do that is to make the room the most flexible and open as possible.

4.4 Working method - Final design

The final design of the product was created as the last step of working method. In this part of the process, there were not used methods like in the first step of the working method: check list, bench marking, etc. since now, we have a concise idea after the meeting and the interviews, and the only thing to take into consideration was to create the most appropriate product, in terms of space, shape, material, and also adapting the result to the budget that was designated for its creation and maintain all the measurements and features for the elimination of barriers for an inclusive design.

Meeting with the museum were done from the beginning of this project, but it is important to mark that the museum technician started working at this point, and her vision of the content of the museum was more accurate about the space, the measurements, materials, etc. This new information was transferred to the design, with the material and the final shape.

Also, one requirement was suggested by the museum, making the design difference from the prototype: the room must be **mobile**. Even though the main characteristics was kept, the design of the room was adapted to suit this mobility, this was simply done adding wheels to the bottom of the Lab, but other measures changes were needed as, making the room foldable, to make easier its mobility, in the doors and the roof. Also, this featured affected in the way to place the electricity.

Physical room

The adaptation of the new design to all the requirements have this change in the physical room were:

- The shape of the room should follow the aesthetic of the other stations that will be designed in the future for the museum. These stations have a **shape based in straight lines** mainly and all of them are made out of **wood**.
- The room, beside of the requirement of been mobile, should have a maximum horizontal measurement of **1.80m**. This requirement is to assure that the mobile room has enough place to move it to another part of the museum in case it needs to be stored.
- The room mobile, adding wheels and adapting the shape to the movement.
- As the room is mobile, the electricity should be adapted to keep everything inside and easy to plug/unplug when it changes position.
- Walls and roof are foldable, for its storage and its mobility.

Peripherals and electrical components

To ensure a good interactivity between the product and the users, there should be selected some specific products that are suitable for this project.

The content of the room and the peripheral that have been selected with this product are:

- **Projectors (x3)** – output method
- **Xbox One Kinect 2.0 Sensor** – input method

- **Touch screen** – output/input method
- **Speakers** – output method

The way to interact with the content is done through the input methods: Kinect for the movement of the body, and touch screen. The content reacts with the output: projects, touch screen and speakers.

- **Screen arm mount** – this is essential for the adaptability of the touch screen for people with lack of mobility, children, etc. This creates an adaptation that leads everyone use the product.

Everything is connected through the computer. In the *Appendix: Technical equipment selected and used for the project*, there is a specification of the connectivity.

Presented here is **the final design** given to the museum:

The physical room of the Lab is composed by 5 walls and an open space, and the roof which is also divided and has a little mobile part. There are 3 fixed walls, and 2 that are mobile. It has two positions: The **closed position** when nobody is using it, or if it needs to be transported to another spot of the museum and/or to be stored, folding inside the two mobile walls. And the **open position**, when the installation is in use by the public, and the mobile walls are open, and they also have the function of keeping the roof in the open position, folding outside the two mobile walls and keeping the roof in the horizontal position.

The cabinet in the left is storing the PC, sound card, amplifiers, etc. also, it serves as support for the touch screen and its mobile arm. Placing it in a corner, lets a lot of free space inside of the room, eliminating of the barriers or obstacles for the users, and having all the free space for the center of the room which is the place where is more immersive.

When the room is in use, there is capacity up to 5/6 person to be inside with no problem of space (*Image 4.4*). The position of the projects is keeping the immersive feeling, but with the straight lines, that have an angle of 140 degrees between the walls that project the image. The speakers are describing a circle, and they are having the required position for the surround sound system.

All the cables that connect each electrical component are placed in a tunnel that is still making the place aesthetically nice, but also not creating any problem when the mobile walls are folded. Everything is connected to a cable that is going outside and connect with the electricity. This feature makes the room easy to transport and plug to another place if required. In order to prevent any heating problem, there are installed some fans in the cabinet, that are running meanwhile the Lab is in use.

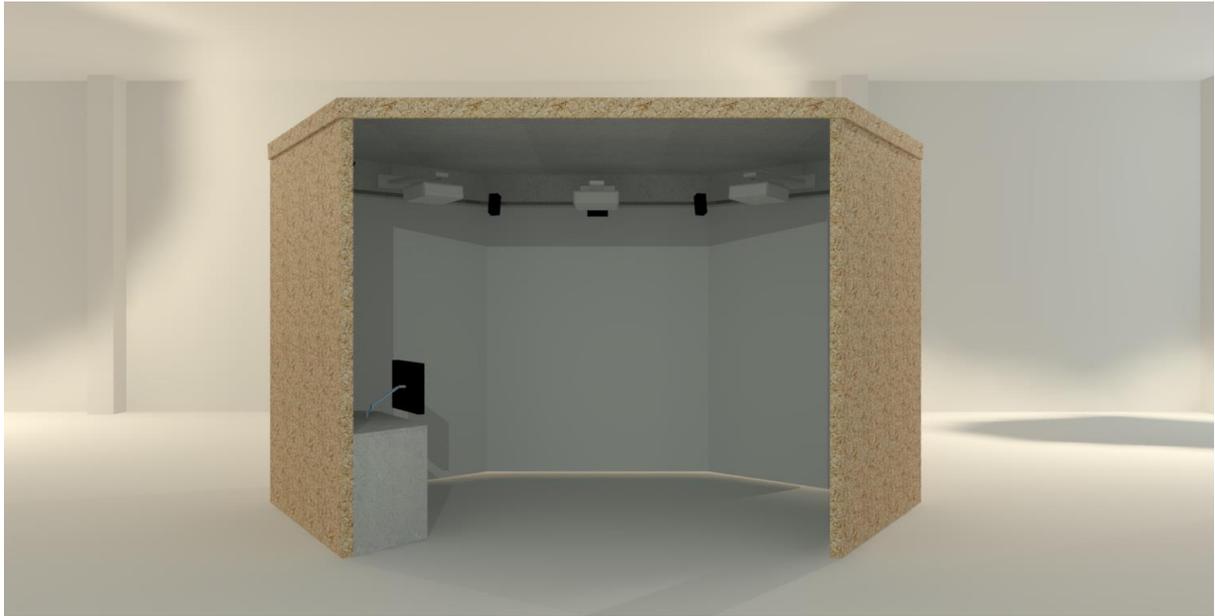


Image 4.4 - 01 – Open position



Image 4.4 - 02 – View of the sides

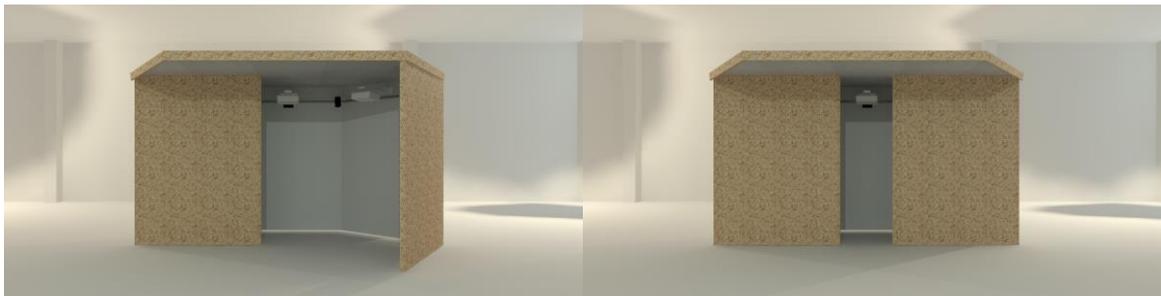


Image 4.4 - 03 – Movement of the mobile walls



Image 4.4 - 04 – Closed position

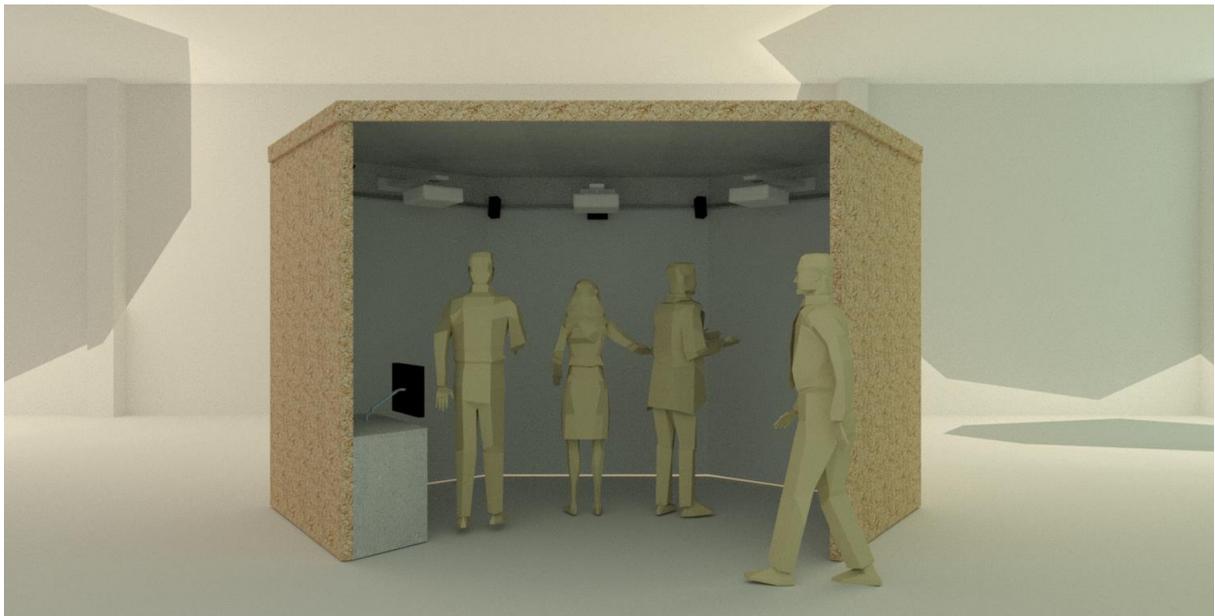


Image 4.4 - 04 –Lab in use

Materials

The three walls are composed by two boards and an internal structure. The material selected for the external board is the OSB. This needs to match with the other furniture that will be placed in the museum. The external board will not have any future process, if the material selected is OSB.

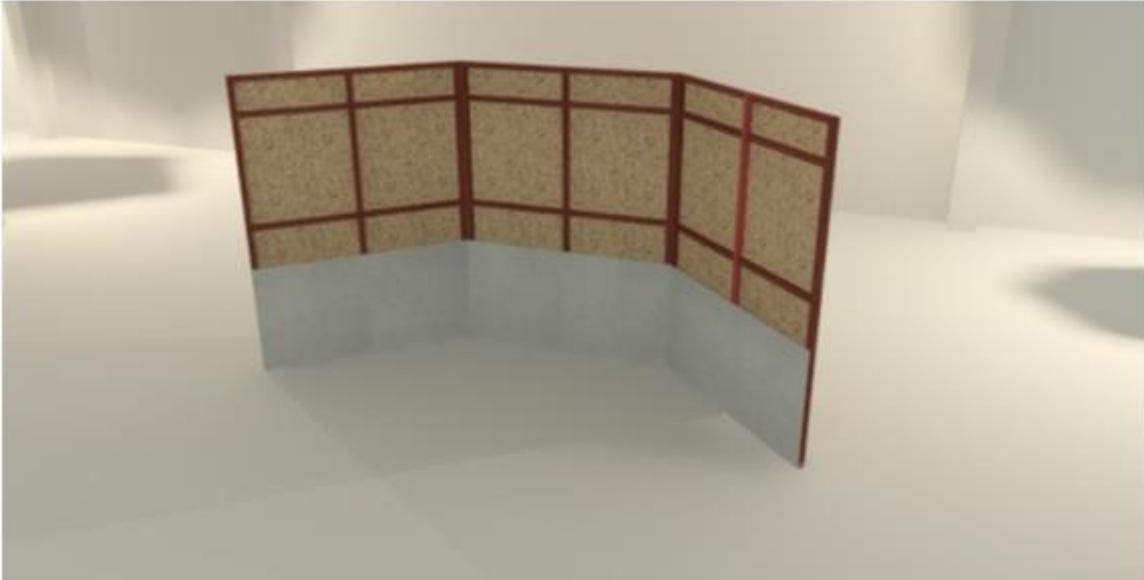


Image 4.4 - 05 - Detail of the construction material



Image 4.4 – 05 - Detail of the projectors held by the structure

The internal board can be from another material, and it needs to be painted after the construction of the installations and/or some projection cloths will be installed. After all the wooden structure is done, the electrical part is installed with all the peripherals.

4.5 Project summary

This project has been carried out from different perspectives. From the academic point of view, it has been interesting to combine the knowledge from product design in combination with the knowledge acquired during my Master's courses, which is focused on digital narratives. The key part of the process was to find a methodology that can provide a solution from the two different sides and that leads the developers to incorporate all the needs in different approach; and to achieve this goal, it was necessary to have a combination of working methods and analysis methods. This has been achieved through the following primary focal points:

- A series of interviews with organizations in charge of assisting people with disabilities.
- Research developed throughout my Master's courses.
- A strategic research process developed to achieve those objectives.
- Collaborative meetings with key people and an exchange of ideas with museum workers.

The product was actually implemented in the museum space, and it was presented in the first opening day of the Culture Factory in Skövde, and also it has been operative the following days as part of the exhibition of the museum. Some technical documents were redacted with all the information needed for its construction with detailed plans of the measurements to the carpenters and the electricians. The result from what was initially projected to what was ultimately achieved in terms of the design, was very accurate, as it is shown in the following pictures (*Image 4.5 – 01 & 02*):



Image 4.5 – 01 - Projected



Image 4.5 – 02 – Result

Content of the Lab

As this project serves as a platform for interactive-multimedia projects. During this process, a group of students created an interactive musical exhibition for the LAB as part of their summer course. This exhibition has been the only exhibition during the opening of the Museum and the visiting hours in the museum schedule, serving as a form of learning entertainment for the visitors of the museum and the school of music.

This musical interactive exhibition was created with two different software: Arena resume for the graphics, and Unreal for the programming. The idea of this project was to present a space where people can interact with the music, being themselves the creator of the piece of music using their body, that was tracked with the Kinect, and it involved creating new instruments and four different sequencers, that were patching different parts of the song as drums or the principal melody. The user coming inside of the Lab was able to feeling inside of an instrument part.

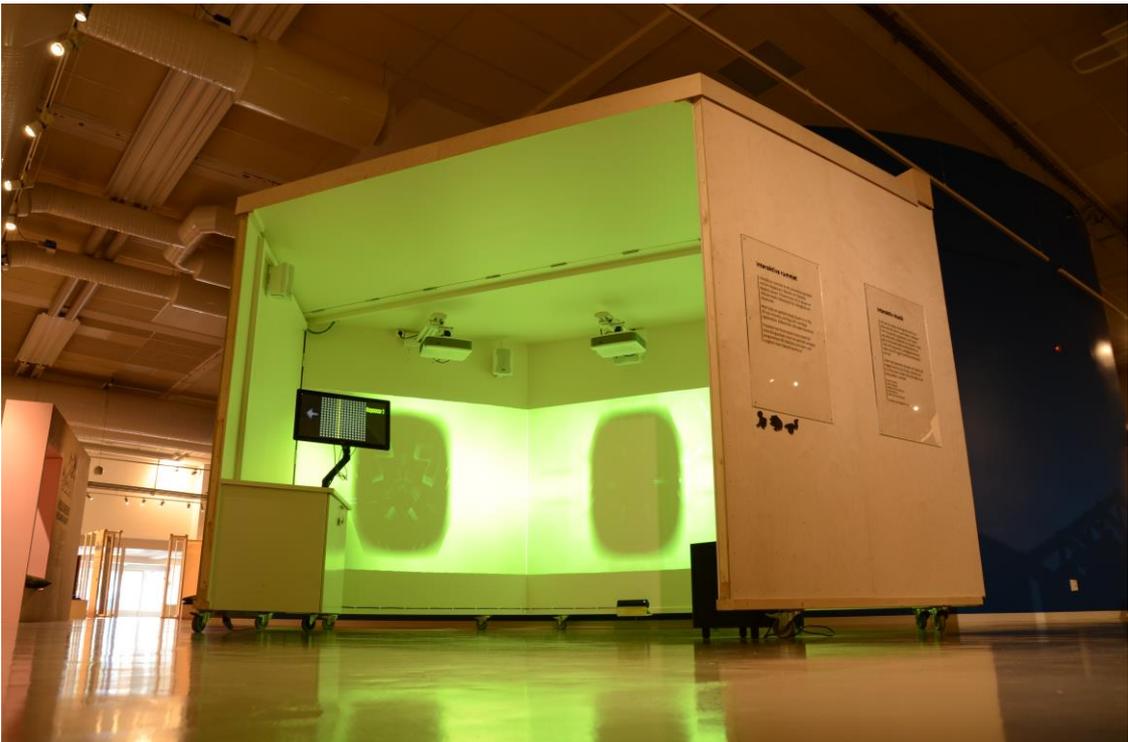
In this case, as there were no other presentations or exhibitions for the Lab, this was the only use for the it. In the part of future work (6.3), ideas of content for the future of the installation will be outlined that can be carried out with different objectives (musical, cultural heritage, space visualization, etc.)

In the future, it will be easy to create interactive-multimedia content for the Lab, since this is already placed in the museum, and the new creators just have to go there and test it. This platform can be also part of their project in the future. Having a PC as a main part of the platform makes it easier, as it is flexible and people can create something new, because any software can be used and it is not restricted to a specific code or software.

Problems that needed to be addressed, in terms of software, was a software to map the projections. As the room is mobile, every time the room is moved, there were a problem with the projectors, and it was necessary a new adjustment. This problem can be solved with a software that is not incorporated in the programing itself, or in the software where the multimedia exhibition was created.



Images 4.5 – 3 – Lab in use



Images 4.5 – 4 – Lab in use

5 Analysis: reflection upon process and final design

The research question that were presented at the beginning of the project were:

Which methods are useful to create a design of a mobile interactive lab that includes a surround sound system in an immersive space inside a culture house setting? The design should also include people with various kind of disabilities.

As an analysis of all the process of creation of the physical room, taking into account all the requirements from the museum and the features have been incorporated in the design. The way to achieve this final design has required an iterative methodology with the combination of working and evaluation methods. The working methods were directly focused in the creation of the product, meanwhile the evaluation methods were a mixture between interviews to the different focus groups and interviews and meetings with the museum personal. It has been a long process but it was interesting to gather all this information to get a more accurate and specific design.

Finding a particular type of methodology has been very important, because the different approach in combination with the development of the product, required an iteration process going to different stages of the conceptualization of the product, with stops that were needed in order to gather important information. The result of this was the final product, and the shape of the concept to the final design has changed a lot in the different phases. This means that the use of a methodology completely adapted to this project was a key part to achieve the purpose, and finally the product accomplished the main characteristics wanted from the research and from the museum.

After the Lab was presented to the public it was placed as a part of the exhibition in the museum. In the opening day of the museum Kulturfabriken, the Lab also was presented for the first time, and after that, it was also a part of the exhibition. This event was very interesting because it helped to observe people reactions, as well as have some feedback from the visitors to gather information that offer the possibility to analyze the research questions.

5.1 Characteristics of the Lab

The main characteristics that were achieved in the development of the product are:

Interactivity – This product is interactive as it contains different features that make it possible the users be part of the exhibition and modify the content. This has been done with the incorporation of input devices that send data or instructions to the computer:

- The Kinect as an input device tracking the body movement in the space with the gesture recognition.
- The touch screen as an input device tracking the touching surface with hands.

These interactions give a response and react to the output devices:

- The projectors are reacting to the instructions in a visual way.
- The touch screen can also serve as an output device in visual way.
- The speakers are reacting with audio.

It is important to create reactions that can be clearly seen by the user, so the user can feel it as s/he is in the part of the exhibition. When the reaction is not correlative or not very clear with the interaction, then it is a problem to be addressed. This fact is more related with the content and the programing, but the design of the space should be prepared to give the public the optimal space to the interaction to be performed.

Usability – Another goal was to make this product usable for the user as well for the workers of the museum. In general, the product is very easy to use from the point of view of human interaction. There were so many features that were discarded as for example, the use of chairs,

In the concept generation, there were so many features and characteristics that were selected depending on usability, and it was, the shape of the doors, finally, there were no close doors, but the movement of the doors and the roof is easy to do by a person, just the use of small stairs are needed.

Flexibility was another characteristic that was addressed with the doors and the roof. The mobility of them provide the easiness of folding them and keep everything inside, in case the workers of the museum are going to storage the room or change the position of it. And therefore, the Lab can be easily in an open or in a closed position.

Accessibility from the perspective of the design of the physical product and position of the peripheral, was present in the process of the working methods when the position of the touch screen and other features were discarded because of the possible problem that can create to the user with special mobility or lack of vision. This is why the inner space is completely empty, avoiding any obstacle for circulation.

Specially in the third step of the concept generation, the measurements that should be required to fulfill the requirements to make a universal design, were implemented in the product design, as part of the final product. These measurements are directly related with height and width of the space (4.1.1 – Elimination of barriers), providing enough space for the circulation to everyone and not creating any obstacle at the moment of using the room, making it an *inclusive* design.

Other feature that is making the Lab *Inclusive* is that when it is in the open position, there is no intimidation or obstacles that can make someone to hesitate to enter and interact with the artifact, as for example: columns, closed doors, object in the middle of the space (as subwoofer of the touch screen), etc. This is presented in five walls with a very big open space, that when you are inside you can feel involved in a different space, but when you are outside you can feel invited to enter and test it. This feature is very important for the museum, as we want everyone to feel part of the exhibition.

There were **two main features** needed in the development of the product, *a surround sound system* and *immersive space*. Those characteristics were an essential part of the design because in the research it was important to analyze how a person is feeling inside of the space being surrounded by visual and aural reactions.

From the first step of the concept generation, a rounded shape was selected because it was more favorable to create an immersive feeling, while the square space was not giving that nice feeling. Even though, finally the space was done with five walls, but they are displayed

following an oval shape, and giving the immersive space. The five walls also are inscribing a circle, where the speakers are placed, providing a perfect space for a surround sound system.

In the process of the concept generation, requests from the museum were given to be incorporated in the final design, as for example, some special measurements in the dimensions of the Lab, when it is in the closed position, this is due to the dimensions of the door where the Lab is going to be stored in case nobody is using it. Also, as a design attribute, in order to have a correlation with the rest of the stations of the museum and the Lab, the material selected was a specific type of wood, this affected directly to the shape of the Lab, as described before, because it was converted from an oval shape, to a 5 walls shape with an open space serving as a door.

Because of the need of movement, it was requested to make the room mobile. This was incorporated in the final design, providing the Lab with wheels and creating a foldable room that can be in the closed or in the open position, and that when it is in the closed position, it can be perfectly transported from one place to another by two persons.

5.2 The Lab and the inclusivity

One of the most important keys in this project was inclusivity, with a special focus on people with disabilities, and making this product suitable for everyone, not allowing for the possibility that someone does not feel as part of the exhibition.

When the term inclusivity is used in this project, it is not just related with people with disabilities, as described in the background (2.6 – *identifying disabilities*), but also it entails additional features such as age, gender, language, culture, etc.

Presenting the Lab as an open space, as well as an immersive space, was done with the idea of not making people feel afraid of coming inside and interacting, as we wanted instead to create an inviting place. It is very interesting that even when you are inside of the Lab you feel like you are in a different place, and looking to the Lab from outside, you still feel like an open space with the lights coming out and the sound is inviting for the users, encouraging them to take part in the experience.

In the case of the elderly and also some young/middle age people that are not familiar with the use of new technologies, it is not very comfortable for the user VR-headset for them, because they can feel dizzy very easily and not feel comfortable with the interaction, and also the experience may not be positive then, they may like to feel like they are trapped somewhere. The space in the room gives the feeling to be in another place, without being a completely closed space, but also having the feeling of freedom of not having anything attached to you, and it is easy to leave in case of not feeling comfortable in the exhibition.

The content of the Lab is based mainly in a multimedia interaction, and with the aesthetics as the main part of the exhibition, this attribute is interesting when the content is being created. Then it is possible to create absorbing games with the use of not much text; instead the focus is the graphics and audio.

In the case that the text is incorporated, then it may be interesting to have different translations for it, which can be displayed in the projections, the touch screen, or even in additional cartels placed in the 2 walls of the Lab that are empty.

A special feature that has been incorporated in the museum, since the museum has been also adapted to the inclusivity, is the addition of symbols near to the stations. In the case of the Lab, the ear and the hand, pointing out a place where you listen and touch. The use of symbols can be interpreted universally with no restriction of language or culture.

On the opening day of the museum, there were a lot of visitors testing the room. The range of age was big, from small children to elderly people. Most of the young people were students from the music school, and their relatives, but also there were people who were not connected with the museum school and they came a museum visitor. Some people with physical disabilities were there, and they took part of the interactive exhibition. There were, in summary a huge range of people and this was very interesting for my analysis and research.

6 Conclusions

6.1 Summary

The Lab has been presented as a platform for content that can be interesting in a cultural area. As we saw in the presentation day (*Appendix 2*) and on a 'normal' day that the museum has been open, the attention that the artefact had was interesting, attracting people of different ages and conditions. Even though the exhibition presented until now is just about interactive music, it is important to think about different options for it.

The museum has a focus in the history of the city of Skövde, and so many objects are placed all over the wall showing to the public how those objects are. But this exhibition of objects is missing one important element. When the user is watching the object, there is no more information about it. Also, all the visit through the museum is done but there is no a storytelling that is connecting the different exhibition of the objects creating a more engaging experience to the visitor.

The idea of the interactive Lab in the future is to create content that can help to address this problem at the same time that is offering an engaging experience. It can be, for example, offering information about those objects or placing the objects in a context to understand the history of this object, that would intensify the experience giving a better overview of the object in its ambience and time.

Through the process of the interviews and the meeting with the personal of the museum, I have gained a lot of understanding of how to adapt a product into a culture house setting, the information and the different opinions were crucial to understand the differences between creating a commercial product and a customized product for a specific reason in a public area. Along with the information gathered in the interviews with the focus group, the customization of the product was done with the requirements of an inclusive product with perceptual and/or physical disabilities.

The most important measurements, that were taken into consideration are the one described in the Table 4.1 - *List of measurement for the elimination of the architectonic barriers*. All of them have been used in the construction of the Lab.

6.2 Discussion

This project had as a primary goal to make a product easy to be used by people with disabilities. But as it was explained before, during the process, not only this group was taken into consideration, but also many other kinds of people as: the elderly, children, people from different cultures and different language speakers.

My goal with this project is to provide technical information and knowledge related with product design in a public area taking into consideration aspects like: space distribution, recommended measurements for visibility, accessibility, minimum and maximum space and distances, etc. Also, other characteristics that enrich the product as immersion and interactivity.

Those characteristics can be applied to any other product that is going to be placed in a public area. Actually, some of the features that was thought for the Lab, was also implemented in the museum, in order to create integrity with the idea of an inclusive space in a public space.

6.3 Future work

This work has been done from a very technical point of view due to my background, but the idea is to incorporate different projects in the Lab, that can satisfy the needs from the museum, and keep in touch with the museum, for these future content projects, as it is needed. It is important to find interesting and educational uses of the Lab for the future, the different uses that this platform presents are very and very interesting, and it is necessary to explore the different options that this artifact offers. It can be done for educational uses, such as cultural heritage, where it would be very interesting for a museum, including these possibilities for use:

- Visualization project for 3D models of spaces and or object.
- Musical galleries, interactive space to learn about different style of music through the time.
- Photography galleries, presentation of old pictures of
- Etc.

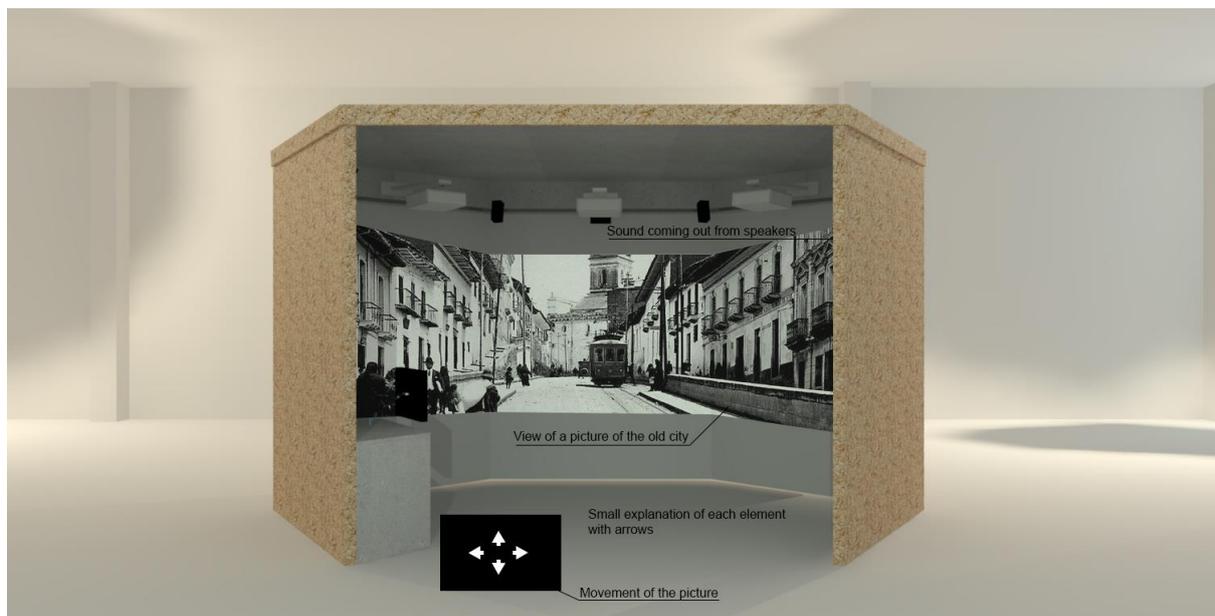


Photo 6.3: example of the use of the Lab for a Cultural Heritage project.

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Appendix 1: Technical equipment selected and used for the project

Description of the technology used

- Projectors (x3)
- Computer
- Xbox One Kinect 2.0 Sensor
- Microsoft Kinect Adapter
- Touch screen
- Screen arm mount
- Audio interface
- Speakers



Image: Connexion of the technology used

Appendix 2: Photos of the final product in the Museum presentation





