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Game development for museums

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ABSTRACT

Digitalisation in museums is visible through different strategies, use of 3D scanners for preservation purposes, designing of interactive exhibitions and creation of various digital solutions.

The objective of the thesis was to study of the game development for museums. The research analyses good practices of creating games for museum exhibitions. Games are used on exhibitions to help the visitor to immerse in the story, but it can be used to as preparation before the visit or to reinforce the memories later. This research aims to solve common communication problems between curators and digital solution providers.

Qualitative research has been made in a form of case studies, project works, observations during workshops in projects. For the theoretical part of work literature review has been created.

The study showed that there are communicational issues between museums and developers over developing games and other digital solutions. Some problems are the results of the lack of appropriate terms that are understandable to both parties, because of shortcomings in understanding digitalisation and specifications of both industries. Those issues can be at least partially, solved by creation of best practice models and development of existing tools for museum purposes.

Keywords: museum, game, design, digitalisation

CONTENTS

ABBREVIATIONS & GLOSSARY

ACMI	Australian Centre for the Moving Image.
AR	Augmented Reality.
BCE	Before Current Era.
CE	Current Era.
DSP	Digital solution provider.
Exhibition scenario	Freeform document, which is describing how the exhibition will look like, what artefact and how those will be displayed. The scenario might have concept drawing of the exhibition and text descriptions.
ICOM	International Council of Museums.
NFC	Near-field communication, short-rage technology which uses tags with read only data.
MUD	Originally multi-user dungeon, a multiplayer real time virtual world with storytelling in this game is text-based.
PEGI 3	Pan European Game Information. The content of games with a PEGI 3 rating is considered suitable for all age groups. The game should not contain any sounds or pictures that are likely to frighten young children. A very mild form of violence (in a comical context or a childlike setting) is acceptable. No bad language should be heard.
POLIN	Museum of the History of Polish Jews.
RPG	Role-playing game is a game where players immerse in a fictional world by taking the role of the character.
UI	User interface.
WebGL	JavaScript application programming interface to build interactive solution for the Web.

1 INTRODUCTION

Development of hardware and software in recent years has changed people´s everyday lives. Nowadays technology accompanies societies in almost every aspect of life. It is also used in modern museums to a great extent. Creating different digital solutions for exhibitions, especially games, is a challenge, there is a lot of problems which developers and curators might face.

The purpose of this thesis is to highlight encountered issues and possible explanations for overcoming possible complications for both digital solution providers (DSP) and museum teams. Interactive games, devices, and applications are becoming more widely used by the museum on the exhibition but also before or after the visit. Those are used as a tool for memorising facts or to preparation for the sightseeing by the visitors.

The idea of this thesis came from discussions with different museum employees and digital solution providers over problems with communication, expectations, and results of creation of digital layer on the exhibition. Through the work in the project "Utility game development and game entrepreneurship in the context of working life: Case Rajamuseo" and "Doors Digital Incubator for Museums", it was clear that there is a communication problem between developers and museum employees. Museum curators sometimes have wrong idea of how games are made, they hope for spectacular amounts of downloads and popularity. Game developers, on the other hand, sometimes forget about space, proper sources, museum mission and vision and the role museums have which is to teach and popularise the past. Both usually have no or very little understanding of the visitors and non-visitors of the museum and their needs.

The thesis aims to research good practices of developing games for museum exhibitions to help solve common communication problems between curators and digital solution providers. The research methods for the thesis include case studies, project works, observations though workshops in various projects.

The first part of this paper aims to help the designers to understand a museum is and how it is operating from the point of view of the museum staff. Showcasing the history of evolution of collection displays and their purpose is especially important for creating more inclusive environment on exhibitions. Often the designers are confronted with difficult terms and concepts which will influence their design choices. The presented information forms the basic structure of communication between the DSP and the museum cadre.

2 BRIEF INTRODUCTION TO MUSEUMS AND MUSEOLOGY

Museums are changing through time; their goals and tasks are constantly evolving. Deep understanding what a museum is and how it works helps to create better designs.

International Council of Museums (ICOM) is a non-profit organisation which is affiliated to United Nations Educational, Scientific and Cultural Organisation (UNESCO) and has consultative status with the United Nations Economic and Social Council. It is operating under French law and has over 44 000 member in 138 countries organised in 119 national committees. (International Council of Museums (ICOM) 2021.)

ICOM General Conference held in Prague on 24th of August 2022 has established a new museum definition. According to it, "A museum is a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets and exhibits tangible and intangible heritage. Open to the public, accessible and inclusive, museums foster diversity and sustainability. They operate and communicate ethically, professionally and with the participation of communities, offering varied experiences for education, enjoyment, reflection, and knowledge sharing."

Nowadays, museums are becoming more democratic institutions which create a space for dialog. Museums developed the Code of Ethics, an important document

with set of rules and standards, which every museum, associated with the ICOM or not, should know and respect. The ICOM Code of Ethics with internal rules complete the statute of the organisation. It describes how museums take care of the collections, how they maintain it, how it is showcased, kept and expanded. The Code of Ethics is also mentioning how creation of copies, making of facsimiles, and publications must be done. It establishes basic cooperation rules between museums and different institutions. (Code of Ethics 2017.)

Museology is an ancillary branch of history, and it researches functioning of the museum, and collections in a context of human society. It is relatively new branch of science approximately 80-100 years old. There is not just one definition of museology. The creator of modern museology is Georges Henri Riviere, founder, and long-time director of the ICOM. He has connected a museum to the society by showing the educative role of museums and how ideologies and social theories are used on exhibitions. (de la Rocha Mille 2011. Robbins et al., 2021.)

Museology is a science which tries to research museums. The definition of the museology varies in different countries. The main interest of the science is practical work and functioning of the museums, how they preserve, showcase, collect materials, but also wide range of museum impact on society, relationships between people and objects, types of exhibitions etc. (Robbins *et al.*, 2021, 63-70.)

2.1 History of museums

The history of development of museums in Europe, has almost two and a half thousand years. At the beginning, according to Greek mythology, there where Muses, daughters of Mnemosyne, goddess of memory and Zeus. Nine daughters were supposed to create an order to different sciences. The myth has been established after writing The Histories of Herodotus, which has been divided into nine parts, each named after one Muse. (Kowal and Wolska-Pabian 2019. Folga-Januszewska 2020.)

Another important name is Musaeus. This name relates to two different people, first one was mythical. His mother was Selene, and he could have been a son, a friend, or a student of Orpheus. He was a poet and could heal with music. It is believed that the name of the hill in Athens came from his name. In the fifth century CE the same name has been given to Greek poet, author of a poem Hero and Leander. (Kowal and Wolska-Pabian 2019. Folga-Januszewska 2020.)

Between the fourth century BCE and establishing Mouseion of Alexandria in approximately 280-year BCE, museums had been different things like: festivals, hills, caves where people were meeting and staying to compete in music and poetry. Later Mouseion was established in Lyceum in Athens. This was also a place where different collections were kept, shown, and discussed. Mouseion of Alexandria included the Great Library of Alexandria and has been important place where scientists were creating most important works of Mediterranean civilization. (Kowal and Wolska-Pabian 2019. Folga-Januszewska 2020.)

Through medieval times term "museion" has been used as synonym of library. From fifteenth to eighteenth century places where collections had been created and research had been made were called differently, but synonym for each has been a word "musaeum". According to Folga- Januszewska (2020), Samuel Quiccheberg published first description of a typology of the museum collection. It has been the manual of perfect museum, where people could learn and experience. The biggest museum before the seventeenth century was Musaeum Kircheriarum in Rome. The museum then had the style of "cabinet of curiosities". Some artefacts from collections are still available to see at different museums in Rome. Probably the most significant museum of that time was "Museo di Ferrante Imperato". The owner Ferrante Imperato had published the illustration of his collection in Dell´Historia Naturale that can be seen in Figure 1. (Kowal and Wolska-Pabian 2019. Folga-Januszewska 2020.)

Figure 1. Engraving from Ferrante Imperato, Dell'Historia Naturale (Naples 1599)

The crocodile hanging on the ceiling has quickly become the most well-known "curiosity" and every aspiring collection had to have one. It was a mark of well-designed and serious collection. Museums have influenced the publication of "Encyclopédie" edited by Diderot and d´Alembert (Kowal and Wolska-Pabian 2019. Folga-Januszewska 2020.).

In the nineteenth century, rich families started to collect "souvenirs" connected to countries, symbols, and important documents. Later, smaller museums were closed, and collections were confiscated to create large national museums. Different nationalities were searching for their own identity. For example, museums like the Hungarian National Museum, the National Museum in Prague or the Slovenian Museum of Natural History and many more have been created in times, when those nationalities did not have their own countries. (Kowal and Wolska-Pabian 2019. Folga-Januszewska 2020.)

The narrative accompanying those exhibitions made displayed items become "sacred". Displays were presenting history from the stone age till the present day to prove the existence of the nation. A museum from a dynamic institution became a static exhibition, with collections were the main purpose was to preserve memories. Eventually in the twentieth century a new idea of museum approaches – new concept of "community museum" is made. It is supposed to

become public and social. Different types of museums are created, often very specialized and open. Education and popularization of knowledge starts to become more important. (Kowal and Wolska-Pabian 2019. Folga-Januszewska 2020.)

2.2 Types of museums

Some of the typical terms that designers will encounter while working with museums scholars, are classification and typology. According to the place in Europe and the type of study, those terms might be used interchangeably, or might have slightly different meanings. Classification is a study of sets, which might sometimes be called objects, or collections, which can show the results of research, theories or hypothesis in a visual way (Minta-Tworzowska 2012.). Typology is a classification and ordering of collections according to the type, which might be the ideal construct (Minta-Tworzowska 2012.).

The usual classification of museums is based on the types of collections. In this classification there are general museums, archaeology museums, history museums, art museums, science museums, ethnography museums, industrial museums, natural history museums, geology museums etc. Other classification for example, might be based by the area they serve like national museum, regional museum, ecomuseum, open air museum, city museum, local museum. There are a lot of different classifications of museums. These classifications usually are more useful for the audience and museum employees, than for the digital solution providers to understand the needs of museums. (Ambrose and Paine 2018.)

Rapid development of technologies, computers and the internet has created new type of visitor at the museum. New media – dynamic, innovative, digital media give the opportunity to access information on almost every place and time (Siapera 2017.). This change has made museums rethink museum exhibitions and ways of communication with visitor. To improve communication between the museum staff with different types of designers a new type of classification needs

to be proposed. The classification is based on the use of new digital technologies. According to this, there would be three main types of museums: classic museum, narrative museum and multimedia museum.

A classic museum is a museum very similar to those from the twentieth century. The main goal of the museum is collecting, preserving, and exhibiting. This type of museum is very static, the exhibition mainly showcases and explains to the visitor what is shown in the cabinet and why it is important. The exhibition is linear, and visitors are supposed to walk on one path from one artefact to another. There might be a possibility to see a video, or a presentation, an audio guide, sometimes even touch a screen with information about the artefacts. The technology might be included in the exposition, but if it was replaced with poster, flyer, or other printed text the museum would not change, the exhibition would look and feel the same.

The opposite of a classic museum is a multimedia museum. The use of new digital technologies in this type of museum is very high. Physical artefacts are not needed, those are replaced by digital visualizations like 3d models, photographs, drawings, recordings etc. This type of museum can have a physical location but operates mainly online. The visitor or the audience might be presented with a raw and objective database or some form of gamification, story-driven games and sometimes special programs might be applied. The most important aspect in this type of museum is digital copy of the artefact or showcasing the story of the historical event, a fact, or a problem with use of new media and new technologies.

The third most balanced museum type would be a narrative museum. According to the definition made by Dorota Folga-Januszewska and Pawel Kowal (2019.), the narrative museum has been created on a change which occurred in the end of twentieth century and the beginning of twenty first century. Narrative museums, besides the classic goals, must fulfill additional ones. Through the exhibition museum wants to tell stories, ask visitors to discuss with the proposed view of the event or a fact. Visitors must fully immerse themselves in the museum

exhibition, feel emotions, tastes, smells, sounds, interact. This can be done through great exhibition design, with the use of new technologies and multisensory experiences. The technology in narrative museums is equally needed as the physical exhibition and the message which museum would like to share. Those museums have a so called "wow" effect, as named by some scholars. Typical examples of narrative museums would be the Budapest´s House of Terror Museum, United States Holocaust Memorial Museum, Australian Centre for the Moving Image, Museum of the History of Polish Jews Polin, the Porta Posnania ICHOT and many more.

2.3 Exhibition design

The idea of what is a museum has been changing drastically from antiquity till now. Museums became an important part of culture, and it made people think about museums in more scientifical ways. Historical sciences have been developing research techniques and methods, often multidisciplinary scientifical projects has been held. A new science – museology has been developed to understand and analyse collections, exhibitions and learning process behind them. Technology and computerization and digitalization became new standard.

The exhibition design process might look different according to the type of museum (classic, media or narrative), but also preference and style of work of the museum team, as well as the budget for the exhibition. Classic and narrative museums as well as multimedia museums if they are placed in a physical space must think how to build an exhibition through architectural point of view. The form, function and utilities have major role in good design. In the ideal situation the first thing which will be done is a feasibility study. The audience segmentation and the audience needs should be researched. This data is needed for establishing a strong foundation of successful design of the exhibition. (Monti and Keene 2013. Kowal and Wolska-Pabian 2019.)

The second part of the exhibition design is to create a team of experts from different fields. Curators, architects, developers, designers, should together

create the exhibition scenario. It is most optimal if all this process is done together. This ensures that everyone understands the subject, principles, mood, and the story of the exhibition. The process might be much longer in this case but at the same time most creative ideas and unbiassed views can be created. This happened in Polin where designers with the curators have made a very popular and creative narrative exhibition where the most important was the story (Figure 2) but also visual interpretation of history of Jewish people. Their scenario has been called "masterplan". At this time all other important issues will be discussed, also multimedia. (Kowal and Wolska-Pabian 2019.)

Apps and games must be designed in a way to support the exhibition and learning process. All technological implementations must become a serving tool in a process of experiencing museum by the visitor. A lot of museum curators are worried over screen time people spend every day and raise a discussion if museum should contribute to it. Well-designed solutions can connect people and make them to spent time together in a meaningful way. (Tallon 2008. Monti and Keene 2013.)
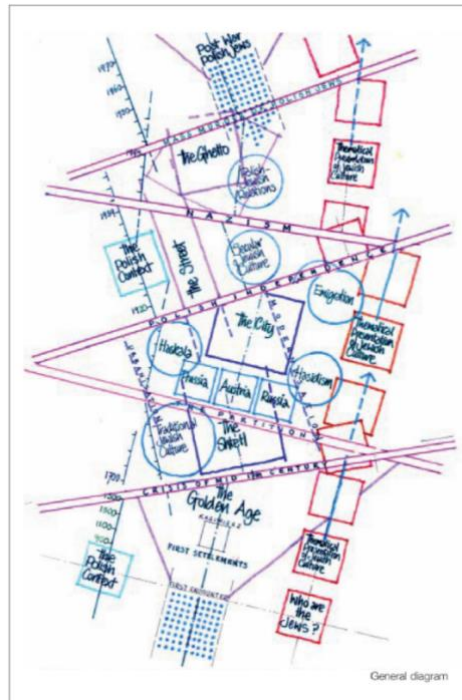

Figure 2. Blueprint of the exhibition in the Polin museum. Drawn by Steven Lumby, Event Communication

3 "LOW TECH" OR "HIGH TECH" IN MUSEUM

Based on previously mentioned definition of the museum one of the main functions of the museums is education, sharing of the knowledge and enjoyment. A museum is a space of informal education. Visitors like to use different resources while sightseeing the exhibitions. They benefit from having labels and wall texts, brochures, videos, graphics, interactive kiosks or walls, and books. Everything what contains the interpretation of the space, fact, art or artefact is used by different visitors.(Tallon 2008.)

Since the first use in 1952 of handheld technology in the Stedelijk Museum a steady development of different digital solutions in museums took over. Audio guides have developed technologically and now are the most popular tool used by millions of visitors yearly. The same has happened with the use of different screens, mobile technology and interactive devices. Technological change creates a fear in curators and museum staff. Curators are afraid that with the introduction of handheld devices and screens, visitors´ attention will be driven away from objects, social interactions will stop and some groups will be excluded from experiencing museums. (Tallon, 2008)

Different studies have shown that well designed digital solutions can help to create intercultural and intergenerational dialog, provoke cooperation between people and teach in easy effortless way, through experience and fun activities. Depending on the type of the museum some activities like games can be done "low" and "high" tech, sometimes simultaneously. One very popular example of game working well on museum exhibition as "low" tech is a simple sandbox with copies of bones or artefacts like flint flakes, pottery pieces or iron artefacts. The same idea is used in commercial games like ARcheology or MyMuseum and showcase the "high" tech approach. When a digital solution at the museum is well designed, it might help to catch interest of people usually not interested in this subject. This problem is especially visible in science museums where girls tend to get frustrated by different objects due to problems with labelling and accessibility

(Dancstep (née Dancu) and Sindorf 2016.). Children under the age of twelve years are sightseeing in a different way than teenagers, teenagers on school visits tend to explore museums in groups of three girls, or two boys, a mother with children usually spends more time at the museum than a father (Dancstep (née Dancu) and Sindorf 2016. Kowal and Wolska-Pabian 2019.). The game designer who would like to design for museums has to take all of those things into consideration.

Museums usually think about adding digital and interactive layer to their exhibitions under few circumstances – when a museum is created, which does not happen often; when a new exhibition is planned, but only when budget allows it; or when a museum applies for different funding and the museum needs to invest (Paardekooper 2019.). This creates multiple problems for developers and museums. Usually time framing is challenging and there is no money for proper audience segmentation research and there are no funds for updating and upkeeping the solutions (Paardekooper 2019.).

Museum staff have also different understanding of the sources. Most of historians and archaeologists learn about the past from different sources in a linear way, they speak about the past in a form of linear organised narration (Mol et al. 2017.). While trying to generate ideas for game concepts archaeologists and historians often struggle to challenge their way of thinking about processes in the past, but they often face problems with understanding technology behind games and applications and generally have false ideas of the impact the game or application will have for their museum (Mol et al. 2017.).

Visitors at the museums have been researched many times. It seems that every museum should know their visitors very well, unfortunately when a developer starts to ask questions to understand the target group, very often the answers are general and imprecise. Typical knowledge about the visitors which museums have is number of visitors per year, number of groups, average group age.

Basic and most popular taxonomy of visitors used in museums is created according to the number of visits per year. There are three categories: frequent participants, occasional participants and nonparticipants. Even though frequent participants are just 20% of the population, they tend to create about 50% of the visits at the museums. Occasional participants visit museums less than 3 times a year, usually they come with other people and treat museums as place where it is worth to show as a status symbol. Nonparticipants and Occasional participants have equally 40% of population each. Usually museums do not make a research over nonparticipants, and often museums think that they know why those type of people do not come. (Hood 1983.)

There has been a lot of different research done over frequent and occasional participants. People visiting museums have been well researched and different models have been created. The Audience Agency has created research over United Kingdom population where different types of people has been selected with different needs and preferences (Audience Spectrum n.d.). Probably the most interesting for this study is the model that divides visitors by their self-motivation.

Visitors have been divided on five categories: Explorers, Facilitators, Professionals/Hobbyists, Experience Seeker and Recharger (Falk, 2016). This model seems to share a lot of similarities with the Bartle taxonomy of player types. Explorers, in Falk´s study (2016), are curious and want to learn something, while Explorers in Bartle's model like to immerse themselves in the world, learn it and understand. Facilitators just like Socialisers tend to cooperate, like to be in community, interact with people. Experience seekers and Bartle´s Achievers prefer to establish goals and being proud of them, this type of visitors are happy that they have been somewhere and did particular activities. Professionals/Hobbyists and surprisingly Killers are people who like to shine, show the knowledge. At the museum they will interrupt the guide and tell the "proper" truth, or they will show how much they know. The only type in Falk model (2016) is not getting similar pair from Bartle taxonomy is Recharger. Rechargers, seems to come to museum, gallery or park mainly to rest or get

spiritual feelings. Unresolved question with this type is, why somebody chooses to rest in museum instead of swimming pool or for example forest? As explained those two models share similarities, but those resemblances should be researched further, as with the digitalisation coming to museums it might be beneficial for both sciences to have similar language. (Bartle: Players Who Suit MUDs n.d. Falk 2016.)

The PreHistorisch Dorp in the Netherlands is an Open-Air Museum located on an outskirt of Eindhoven. The museum showcases reconstructed buildings from prehistory till medieval times. It is visited by groups and individual guests. Often school chooses the option of "camping" for two or three days at the museum. This place offers a lot of "low" tech activities, like throwing spears to points, medieval games, jewelry making, etc. During the visit in 2014, the museum offered an activity sheet for children, who were searching for tasks and answers at the entire museum and at the end of the visit could get a small coin as a gift. In 2016 a new VR application has been introduced for visitors on less busy days. Unfortunately, it turned out that the system was loading too long, signals were lost very often and visitors complained about the need of using VR glasses. The application has been redesigned into a treasure hunt style mobile game. (Paardekooper 2019.)

Ping! The Museum App is an app designed for Bandisches Landesmuseum. It is a mobile application which can be at the museum and at home. The game uses Tinder mechanics where the player is paired with objects and can decide whether to speak with some of them or not. In this app, an object might not be interested in speaking with some types of visitors. This creates a fun experience, where objects are personified. When the chat starts some object can be funny, some very nostalgic or in need of help. The app is creating a map where visitors can see where the objects are at the museum exhibition. This builds connections between the visitor and the object, makes the learning experience easy and fun and helps to navigate around the museum. The application has been downloaded over thousand times since the publication. (Ping! The Museum App n.d.)

Lenses is a project created by ACMI. Visitor is given a "Lens" at the beginning of sightseeing. It is a paper circle made from cardboard paper and NFC tag, which can be removed for easy recycling. Dyes used for the Lens are plant based and fully recyclable. While sightseeing the visitor can collect tags by touching their lens to the reader. All digital activities made at the museum can be stored and viewed again at home on the computer. The Lens makes people collect tags and create own digital exhibition. It can be used multiple times, or a new Lens can be connected to the account. The solution is dedicated for ACMI exhibitions and as for now there is about 200 tags. The project was very well received. (The Lens n. d. Chan 2022.)

4 DESIGN OF URAJÄRVEN KARTANON MYSTEERI MOBILE GAME.

Urajärvi Manor Museum (Urajärven Kartanonmuseo) is one of the oldest historic site museums in Finland. The mansion has been established in 1653 year by lieutenant Berent Möller, who has sold it to lieutenant colonel Jurgen Heideman. Since then, the history of Urajärvi Manor has always been connected to Heideman family. (Kuurne et al. 2018.)

The last owners of the house were siblings Hugo and Lilly von Heideman, who have lived together and never got married. At some point of their life, they had decided that they would like to donate the mansion to state for museum purposes. After death of Lilly in 1917, the building and surrounded land has been given to the state in testament. The museum was opened in 1928. (Kuurne et al. 2018.)

The museum has one permanent exhibition inside the ground level of the mansion, and another permanent exhibition in outbuilding nearby, which has been planned as museum exhibition through Hugo´s and Lily´s life. (Kuurne et al. 2018.) All exhibits are original mementos of Heideman family and those have a great historical value. Interiors feels like last owners has just left the house. Visitors can sightsee the place with the guide in small groups, which helps with better immersion to the history. (Kuurne et al. 2018.)

Museum is open usually from May to the end of the September. The number of visitors is approximately 5.000 people, at the time of pandemic-related restrictions number of visitors dropped to approximately 3.000 people. Most of visitors are adults, sometimes families with children, exception is "Children Day at the Manor" ("Lasten kartanopäivä") where most of the visitors are children. Very popular are ghost themed evening guided tours, where more families and friends are attending. The museum understands that there is a need to add new digital layer to their exhibition to attract new audience and be able to connect with it in the time when it is closed.

4.1   Game analysis

The game is supposed to show the history and artefacts of Urajärvi Manor Museum. All the items and scenes are possible to sightsee in real life. The game can be used as an advertisement for a real visit to the museum or fun review of things which have been seen on place. The game will have gamification elements, which will encourage people to visit Urajärvi Manor Museum after playing the game.

Each level takes place in a different room in the main building of the manor and buildings in the surrounding area (Figure 3). The player is supposed to collect different artefacts or things presented on the screen to be able to unlock another level and unveil another part of the mystery. Every level has three difficulty levels marked by white magnifying glass. After winning, the easiest level player automatically unlocks the second level. Passing one difficulty level gives the player one red magnifying glass and an artefact to his collection to his collection as seen in the Figure 3.
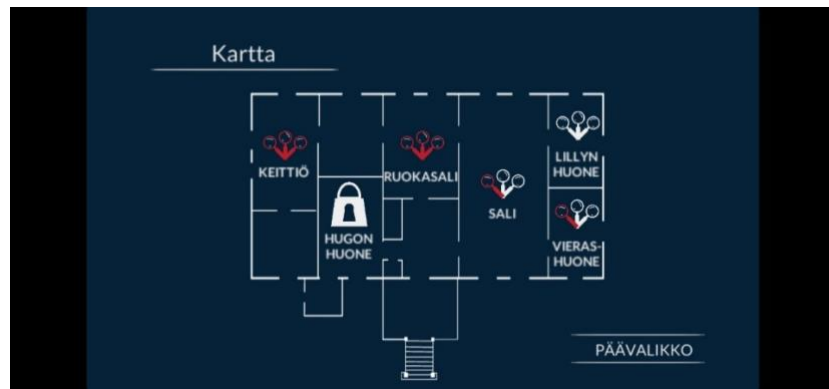
Figure 3. Screenshot from the Urajärven Kartanon Mysteeri game, showcasing the map of the museum and levels with different icons used to present the progress of the player

Passing all levels on all three difficulty levels fills the whole collection of artefacts. If a player wants to finish the game, he/she needs to come to the museum and find all the artefacts inside the museum. The first 100 visitors who find all the artefacts at the exhibition will be granted a small prize.

4.2   Target group

The game should add innovative value to the sightseeing of the place. A typical target group will be in this case young adults and families with children. The game is ranked as PEGI 3, which means it is suitable for all age groups. The gamification elements like searching for real artefacts from the game on exhibition can be done with very little children with the help of parents. Families can also play the game together with small children. The museum provides guided tours for individual visitors and groups. Other groups of visitors are coworkers or groups of friends who came for a trip. Most of the visitors are adults. The game is designed to be satisfying and pleasing for adults but also for children.

4.3   Storyline and characters

Lilly and Hugo von Heideman are living in their mansion in Urajärvi. They are happy and wealthy people, who have been able to travel to Europe and even to Egypt or Jerusalem. They both share the love for the music, and they love Richard Wagner´s operas and Jean Sibelius music. Every year in summertime

they invite friends from the whole world. This year siblings are having a lot of guests, so they are very busy with preparations. Lilly and Hugo are preparing a nice dinner for the whole group of friends, but Lilly´s cookbook with receipts has been missing. Luckily it has been found very fast. Meanwhile comes a letter from Wagner with notes from "Lohengrin" new opera. Hugo gets an idea that they could make a small theatrical performance at the manor with their guests, as one of the visitors is a singer. Lilly wants to invite her friends from Heinola Woman Association, where she is a chairman. The guests agree and they start preparations.

Lilly and Hugo decide to make their play based on "Lohengrin" opera, with some poems written by Hugo. Notes from Wagner´s letter, are missing and there is a possibility that the group cannot make a rehearsal on the evening. Thankfully, it has been found, and Lilly suspects that Hugo, her dreamy brother has been reading the letter, when the window was open, and the wind has blown it off the floor. Next day, one of the guests, Elsa af Klinteberg, who was supposed to play the main role in the play, notifies Lilly that she has seen a ghost in her room. Elsa´s beautiful white gown, which she was planning to wear on the performance is gone.

The siblings try to help Elsa to find the gown, but the only thing they could find was a small piece of ripped lace. Lilly starts to be suspicious about this whole story and she decides to keep an eye on people, to see who might want to destroy their small theatre play. Lilly and Hugo are getting stressed and sad. Suddenly the nice idea of creating a theatre at their manor is not so nice and fun anymore. While they speak, some horrible sound comes from Hugo´s room. Siblings go to the room to investigate. They notice that an inkwell fell on Hugo´s papers. Lilly thinks that they might have an unexpected companion in the shape of a ghost. They suddenly see a shadow and Lilly understands that she knows the ghost. They go to outbuilding upstairs, where Sophia´s rooms were before her tragic death. Sophia is there waiting. She is wearing Elsa´s white dress and smiles. Lilly is terrified, but Hugo is fascinated. He starts to speak with the ghost, who is their father´s first wife. Sophia is just lonely and sad. She reveals that she

would like to take part in the play. After first shock they agree to change the scenario, so that Sophia could attend. The play turns out to be successful and a nice experience for everyone. Sophia, now called a "White Lady", is still showing up in the mansion even on these days.

4.4   Gameplay

Urajärven Kartanon Mysteeri is a mobile game on Android systems and iOS. The main genre is a hidden object puzzle game, with a mystery story behind it. There are few very popular examples of this type of games, for example June´s Journey or Mystery Manor: hidden objects.

The game is loosely based on historical facts from Urajärvi Mansion Museum. The whole location is based on the existing interiors of the manor. The player is passing levels and gets badges, which are one of the most fascinating artefacts from that room and collects them in his own gallery. After having filled the whole gallery with artefacts, the player can visit the museum and find them in real life at the exhibition (Figure 4).

The game has gamification elements that connect the game world with the real world. All the levels are based on real interiors. The game is free to play with no typical monetization elements. The player´s gallery is a form of monetization, as one of the goals is to make players to come and visit Urajärvi Mansion Museum (Figure 4).

Figure 4. The "gallery" mode of the game Urajärven Kartanon Mysteeri with drawings of artefacts possible to find at the museum exhibition

4.5   Game design approach

Urajärven Kartanon Mysteeri game has a realistic 2d look, with vibrant colors.
The game has a warm and chilling feeling. The story is linear, and all characters
are non-playable.

UI is simple and does not take attention away from the game. The user can view
in the gallery all items he or she has collected. List of items which need to be
found on the play screen is shown on the side of the screen and screen is in a
horizontal position. The player can use thumbs to pick up objects or hold the
phone in one hand while tapping with one finger.

After launching the game, the player will see the main menu with five buttons:
play button, Asetukset - options, Museon tiedot – museum information, Kerätyt
esineet – found items, which is also called gallery in this thesis and Tekijät –
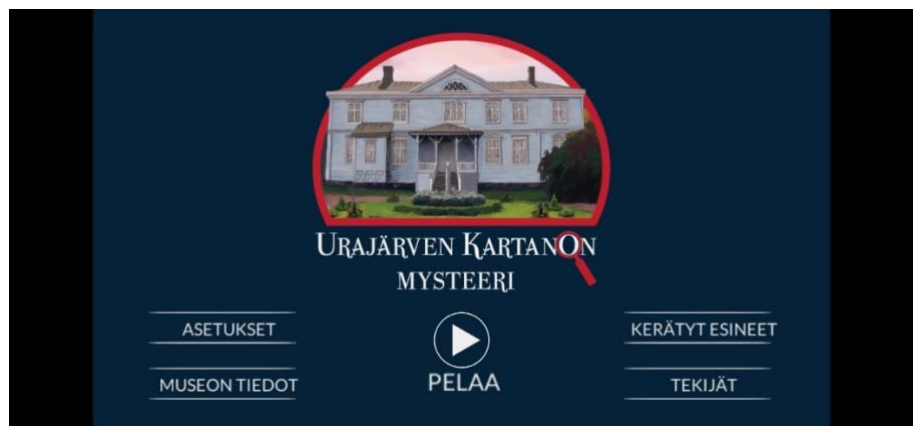credits (Figure 5).

Figure 5. Screenshot of the main screen of the Urajärven Kartanon Mysteeri game

While designing the logotype of the game it was very important to use drawing of
the museum building, to underline that the history presented at game is held
inside the iconic mansion. People, who play the game before visiting the museum
can easily recognise the place just by having interactions with the game.

After tapping the play button, the player will see a map of levels (Figure 3).

The player can tap on a new level or replay one of the old levels. Play screen will have pause button, which will display pause screen with buttons: Päävalikko - main menu, Jatka – continue, Asetukset – options, Kartta – map.

At the bottom of the gaming screen there is a banner with a timer, silhouettes of objects they need to find and a magnifying glass (Figure 6).
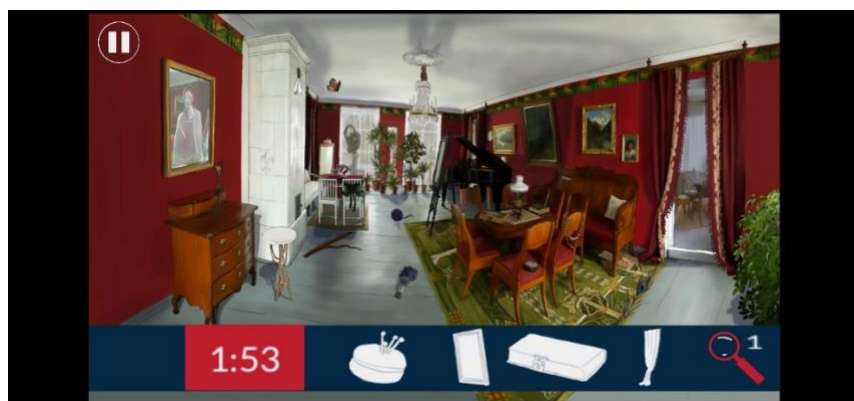

Figure 6. Game screen

A very important aspect of the game design in this case, was to create an art, which will be easily recognisable by the player while visiting or just after the visit to the museum. A lot of care was given to recreate interiors of the museum (Figure 7). Some important artefacts had to be drawn bigger or in different position than those which are on the exhibition. This decision has been made due to making the level more balanced, as all hidden objects were equally spread through the screen. Bigger objects were drawn when the real size did not enable the player to find it or tap on the object precisely enough for the app to mark it as found. Additional hidden objects had to be added to scenes. The main idea was to add as much hidden objects which are typical for hidden object games convention, and those have been added in surprising places. Additional hidden objects were for example: sticks, bones, flowers, necklace, yarn, petals, butterflies, ribbons (Figure 6). Due to very rich museum exhibition, some of added objects might be still hard to recognise as non-existing on exhibition.

Figure 7. Comparison of the in-game art with panorama picture of the actual interior

4.6   Museum experience and the game

Urajärven Kartanon Mysteeri was launched in September 2021. This was a good time to test how the game works and how it is received. The last month of the season is usually not busy, so it gives perfect testing conditions.

The game has been advertised by social media channels and a few small articles in local newspapers. There has been a poster hung with QR code to download the game. It has been downloaded almost 200 times now and has good reviews. It has also been published for IOS devices. The main problem which has been noticed is that the guides are not advertising the game. Visitors have little or no idea that the game exists, and posters should become more informative.

Overall, the Urajärven Kartanon Mysteeri creates nostalgic feelings and people are interested in to playing it. Even visitors on retirement who usually do not play games, are curious about it, and often try to play with their children or grandchildren, as was observed on the promotion day at the museum. This creates very interesting conversations and allows families to spend more time together. It helps to raise digital skills level for elderly people, which was an additional impact of the game.

The game became an inspiration for further development of digital solutions. In February 2022 the Urajärvi Manor Museum has been selected to the first stage of the project "Doors Digital Incubator for Museums" with pilot proposal "AR Quest: Urajärvi Manor". In November the pilot got fundings and began developing a new web site and AR experiments. 3D scanning has been held by students at LAB University of Applied Sciences, with Artec Leo scanner. The museum team and DSP have been participating in lectures and workshops throughout the whole project span.

5 DESIGN OF RAJAMUSEO GAMES FOR EXHIBITION

Rajamuseo – Border Museum is located in a small village near Finnish and Russian border called Immola, which is a part of Imatra. It was built due to the existence of an important army airport. The airport was open in 1936 and it was much in use for Finnish air force and Immola was built in thirties of the 20th, century. The museum was opened in 1989. The owner of the museum is Rajavartiolaitos (Finnish Border Guard). It was designed to serve as a teaching and learning place for the visitors and to serve as a teaching place for new recruits. The museum serves now as a place of promotion of the work of the Border Guards through exhibition, publications, and educative events. Other very important tasks for the museum are digitalization, documentation, and conservation of the artefacts. The museum guides are usually members of Kaakkois-Suomen Rajamieskillan ry, the Border Guards and employees of the museum. The Kaakkois-Suomen Rajamieskilan ry is an organization which is

helping with running the museum. The organization´s main purpose is to bring new interest in the Border Guard service, popularization of knowledge and taking care of the veterans.

At the time of writing this research Rajamuseo was redesigning and moving their exhibition to a new building. The old exhibition showcased different types of work done by the Border Guards. There have been a lot of figures, arranged scenes with different figures and stuffed animals, other important artefacts, and light weapons (Figure 8). Visitors could read texts and learn the history hidden behind the showcased objects. The main interest of the old exhibition was a war time.

Figure 8. Realistic figures at the old exhibition, showcasing the work of the Border Guards

Different screens and touch screens installed at the exhibition have been showing presentations. Even though special signs were indicating that the object can be touched, visitors have been confused about what was allowed to touch and interact with. The most interactive part of the old exhibition was a place where visitors could wear hats and clothes used by the Border Guards and make pictures of themselves (Figure 9).

Figure 9. A place used for taking pictures at the old exhibition

The museum is usually open in the summertime. Every year it has about 3000 guests. Most of the visitors are seniors, middle aged people, and families. Group visits, especially from schools, are random. There is no entrance fee.

The Border Museum is moving to a new building. It is a functionalism style office building. The new museum exhibition will be opening at this place in 2022 - 2023 (Figure 10) while the old exhibition will be closed.

Figure 10. The new museum building. The exhibition will be located on the ground floor

The new space is located on the ground level of the building and is smaller than the previous exhibition space and is challenging to create fun and interactive exhibitions. The building is a typical office building, with a corridor in the center, and different size small rooms on sides. On the right side of the corridor looking from entrance another very tight corridor is located, with entrances to rooms (Figure 11).
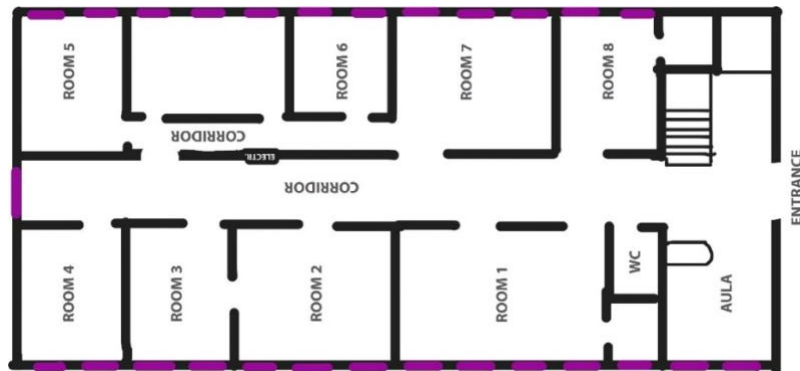

Figure 11. Plan of the new building where the exhibition will be built

After opening the exhibition, the museum hopes to have about 10 000 guests per year. Games for the museum exhibition are designed within the project "Utility game development and game entrepreneurship in the context of working life: Case Border Museum" (Hyötypelikehitys ja peliyrittäjyys työelämäyhteydessä: Case Rajamuseo).

5.1 Game analysis

During the project a team of four designers has been developing two digital games "The Border Gods" and "Caesarin Passit" and an additional card deck has been designed and printed. "The Border Gods" game is designed as a single player for a Samsung Smart Singage QM32R-T touch screen display. The player takes the place of a border guard on his first day at work which happens at Finnish Midsummer. In just two minutes the player must check as many passports of different magical entities as possible. Some passports have multiple mistakes in them, as ancient gods, do not have a good understanding of nowadays papers. All mistakes must be marked and carefully checked. At the end the player gets a rank according to the score he or she got. Possible ranks are "Bear Cub", "Wolf Nose" and "Parrot stamp" (Figure 12).

Figure 12. Designs of three ranks to the game "Border Gods" made by Emma Seppälä

The second game "Caesarin Passit" is made for 10-inch Windows tablets, which allows the player to make pictures and print. The two-minute game is mixing interactive elements, like application with different aesthetic choices to make and reality, like rubber stamps which visitors will search over the exhibition, or printed sticker of a passport made by the player.

At the beginning of the sightseeing the visitor will be asked to create own "passport". Four Windows tablets located somewhere near the entrance of the museum will present the game. The player will design own first page of the passport by choosing different backgrounds, adding own name, taking a picture of himself, etc. and when done print it. The print of the of size A6 on the sticker paper with color. When the sticker is placed on prepared base of the passport player can search for hidden rubber stamps of the Finnish fauna hidden on the exhibition. "Caesarin Passit" is compatible with "Border Gods" game, the rank system has three different stamps included in the game. This means that the visitor can stamp their rank (but probably visitors will stamp all of them) in the passport.

5.2 Target group

The old exhibition has been visited mainly by seniors, veterans, and the Border Guard students on various levels of education. The target audience of the new exhibition is much larger. The museum would like to extend their visiting groups into school children and students, enthusiasts of the subject and families with

children. Games should attract young audience but at the same time should be interesting also for adults.

There have not been made real visitor and audience research at the museum. For better understanding the team of designers had to use different research made in various countries.

According to the research made by Marilyn G. Hood (1983), there are three types of people who show different interest in visiting museums as a free time activity. As mentioned in the previous chapter, frequent participants, occasional and non-participants are basic audience segmentation for the museum purpose. Since 1983 the percentage of participant groups has been stable, according to different research. Frequent participants` way of sightseeing is not much connected to the way how the museum exhibition looks like. Occasional participants and non-participants showed higher interest in visiting museum if family activities have been held and advertised there. Family-centred activities like interaction with a family or friends, relaxation and comfortable surroundings were most important for those groups of people. (Hood 1983. Kowal and Wolska-Pabian 2019.)

School children are frequent visitors of the museums. School excursions to museums can largely increase the number of museum visitors. There are differences between sightseeing museum according to gender. Boys are more often choosing exhibits which need physical strength, or are about competition, while girls liked puzzles. Twelve-years-old girls were sightseeing in groups up to 3 people, while boys do not show such a need. (Kowal and Wolska-Pabian 2019.)

5.3   Storyline and characters

Both games have a very simple story which supports the museum exhibition. The main character in game "Border Gods" is Border Guard Teddy Bear. The teddy bear works at the border crossing and gives feedback to the player after every passport check (Figure 13).

Figure 13. Screenshot from the tutorial of the "Border Gods" game

Different ancient entities travel to Finland for the Midsummer. The player might see ancient gods from Egypt, Japan, Korea, Ireland, Māori, Mesopotamia, Greece, Hawaii, Slavic and Nordic countries including Finland (Figure 14).
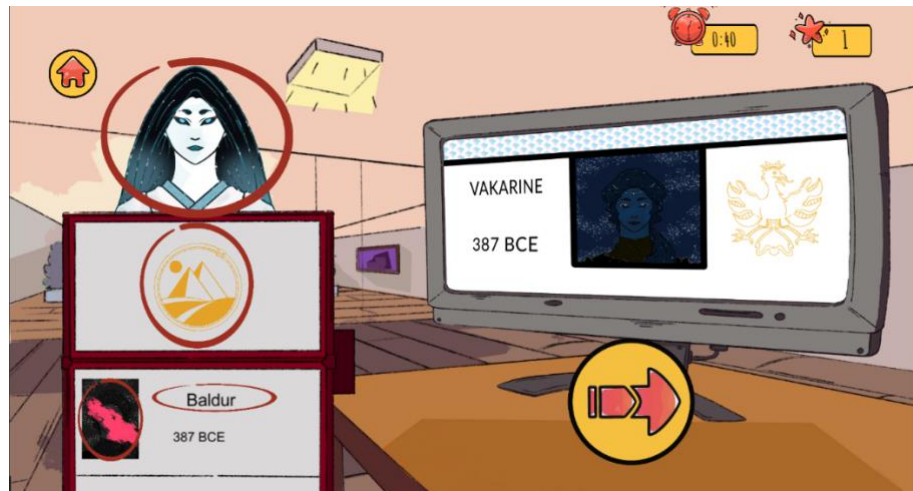

Figure 14. Screenshot from the "Border Gods" game showcasing the gameplay screen with marked "mistakes" in Goddess´ identity

The main character in the game "Caesarin Passit" is the first Border Guard dog called Caesar. The design of the character is based on pictures and taxidermized exhibited Caesar (Figure 15). The dog is helping the player to create and print the first page of the passport.
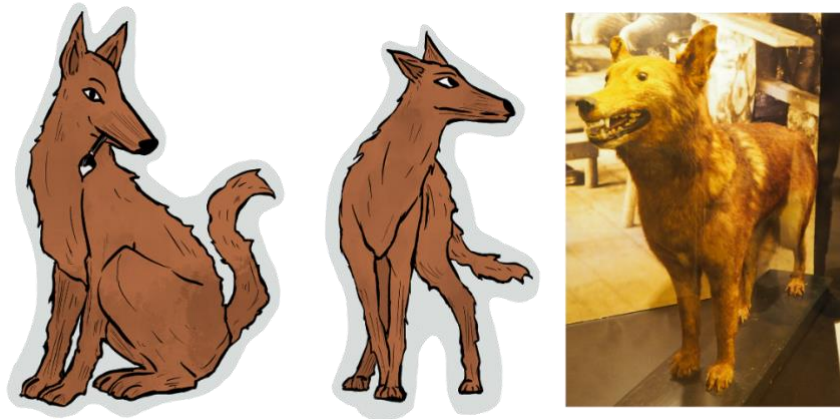
Figure 15. Caesar character design made by Emma Seppälä and a picture of taxidermized Caesar at the museum exhibition

5.4 Gameplay

Gameplay for museum exhibition games should be fast and interesting. There are two games designed for Rajamuseo. The first is "Border gods", which is fast and highly competitive and the second "Caesarin Passit" is idle, design game. "Border gods" game is single player game designed in Unity for a large touch screen. The touch input works as a mouse click and it is possible to click only once at a time, but considering the size of a screen the game could be played in small, organized groups of visitors. The approximate time of the whole game, played without tutorial, is about two minutes. The game is supposed to create a feeling of stress and uncertainty. The player needs to check passports of different gods and find mistakes, at the same time, if the player decides to play against the game by fast clicking next button, the game will slow down, and the player will never get better rank. Good choices will affect the game too, the player is granted with a "combo" which is multiplying the score and the game shows the next passport faster. The game shares some similarities to other publications like "Papers please", "Death and taxes" and "Orwell Reign".

"Caesarin Passit" game had a different approach to the gameplay. It is a very easy creative game which is appropriate for every age group. This means that even very small children, with the help of an adult, can play it. The game is designed for Windows tablet devices, single player. The player creates their own

passport page, by choosing a background, an emblem, taking a picture and inserting the name and age. Then the player prints it on a sticker, which can be placed on the premade passport. The important part here is to search for rubber stamps in shapes of animals at the museum exhibition. There is no time pressure and no need to gather all stamps or put real data. At the end the player has own passport as a souvenir. This shares similarities with games from simulation, lifestyle, and casual genre like "Chibi dolls", "Fashion show" or "Covet Fashion".

Both games do not collect any information or data about the visitors. Pictures and names are deleted just after printing from the device.

5.5   Game design approach

Creating a game for the museum exhibition is a challenging experience. To ensure how the museum space will look like after the renovation, an excursion has been organized. The old museum exhibition and new museum building have been showcased. The museum staff has been speaking about museum exhibition design, history, and relationship to local community. The project manager then created a brief and gave basic propositions of games based on museum needs and suggestions. Due to COVID-19 restrictions the design of games has been held remotely.

The team of four designers (two game designers, one coder and one person who is a game designer with high coding skills) and project manager started the design process. Throughout the whole process the museum and the Border Guard employees have been involved. The team has been meeting every week and showcasing the work progress and the discussion has been made. The first phase of the project was focused on understanding what the museum is and how it works. The team has been learning how museums have been changing through time, what philosophy is held behind the exhibition, what is Code of Ethics at the museum. The team has been analyzing plans and exhibition scenario to choose best solution for visitors flow and work organization. Every time a few different options have been discussed and the museum has been choosing what is best

for them. The cooperation with Vellamo Merikeskus in Kotka and EXARC, international network of Open-Air Museums has been established. Every week meetings on Teams have been very effective and established a connection between the designers and the museum.

The second phase of the project was developing games. Creating the paper mockups and intensive testing allowed to improve the "Border gods" game very much (Figure 16).

Figure 16. An example of a paper mockup created while testing and ideation of the game "Border Gods" on the early stage of development

The purpose of the game was to simulate the work of the Border Guard in an engaging way. The main educational objectives were to teach different elements of the passport like picture, name, date of birth, emblems, colors and that those elements can be different in different passports. The player is also taught that a passport cannot be reaped, stained, or painted. Mechanics are simple and gameplay is fast and competitive. Designers wanted to obey ICOM Code of Ethics, and they have been searching for a way to fulfill small educational goals and not to provoke negative feelings or behaviors of the visitors. The player never decides who will cross the border, he or she simply checks passports for errors and presses an arrow button for next passport without distinction if the passport is good or has some mistakes in it. The use of mythological creatures gave the opportunity to switch the attention to passports instead of ethnicity or citizenship

of the characters. This also added extra value for the game and exhibition itself, by creating an intriguing experience for people who are observing the gameplay. Testing on this stage has shown that the game is playable, engaging and fulfills the designers´ goals. The game was supposed to be played once or twice by one player at the museum sightseeing. Testing has shown that most of the players play it from one to three times. People who were waiting for their turn or were just observing were interested and engaged.

"Caesarin Passit" game was designed first as a tutorial for "Border Gods". Testing showed that players liked the game, but all together the game became too long and over complicated when combined with the "Border Gods" game. The team decided that it could be used as a stand-alone game. The museum employees and the team of the designers decided to develop this game further to create another game for the museum exhibition. The main purpose of the game is to create bonds between the museum, the visitor, and the exhibition. Therefore, it is combining digital solutions like simulation and an art game with real life objects. The game underlines the connection between the work of the Border Guards and the environment. The rubber stamps, which players can search on the exhibition, are representing Finnish animals. This gives extra topics to speak about for guides, or to create special events for families. Younger children can also develop further precision movements by stamping their own passport. This game supports the exhibition in different ways and is easy to play for children of every age.

The development of this game turned out to be hard due to different issues like time pressure, technological problems, and a smaller team. Combination of kiosk mode game and making pictures, typing words and printing turned out to be challenging. Finding a solution that would work became a long process of experimentation and testing on devices which will be used in the exhibition. The designers´ team wanted to be sure that users were not able to accidentally get out from the game to the main tablet screen. The only way to execute this was to export the game from Unity as a WebGL game and create a local server on every device so those will not have the need to connect to internet to run the game.

Testing with a real audience after the end of the project showed that the game needs small design changes, as with any game design project. The arrows, which the player needs to press after every choice he or she makes should be on the bottom of the game screen. The position of the arrows turned out to be very important for user experience, as some players have been complaining that positioning them on the top of the screen is counterintuitive. The devices have problems with the connection to the printer after jamming. The "punch" gesture done multiple times on the device allows the player to access the main tablet screen. The "Caesarin Passit" game needs more testing and small changes, which is typical when designing a game for the museum exhibition.

Though the time of the project a simple card deck has been designed. The designs of the cards were made according to the museum request. The subject of the Finnish fauna has been explored further (Figure 17). The deck has been printed in the amount of 500 copies.

Figure 17. Card deck designed for the Border Guard Museum. The card layout design: Katharina Hauer and Emma Seppälä

6   DESIGN OF "ARKEOSYSMÄ" AUGMENTED REALITY MOBILE GAME AS MULTIMEDIA MUSEUM

Sysmä is a municipality in Finland located in Päijänne Tavastia region. The west border of the municipality is the shore of Lake Päijänne, which has a highly developed coastline. Lake of Päijänne is the second largest lake in Finland. It relates to the Gulf of Finland by Kymijoki river. The coastline of the lake of Sysmä municipality has a lot of bays, islands and peninsulas. Sysmä nowadays has a lot of forests, fields and hills. There are two most famous glacial erratics in Sysmä: Kammiovuori and Onkiniemen liikkuva kivi. Glacial erratics are rocks carried by glacial ice. (Korhonen 2003.)

Municipality of Sysmä as well as Sysmä village has a lot of inventoried archaeological sites. There are finds dating from the Stone Age till historical times. Sysmä village has exceptionally many finds. (Seppälä 1999.)
There have been found about 130 archaeological remains of human activities in Sysmä. Even though Sysmä has an important place in the Finnish prehistory not many excavation works have been done. There is very little information published in scientific books. The first excavations were held in 1919 at the Supitu stone cairn. Another bigger excavation happened in mid-1990. Most of them were connected to the Iron Age. (Malinen n.d.)

The basic game concept was created with the help of AVEK DigiDemo Concept Design funding. Further development of the game is unsure.

6.1   Game analysis

ArkeoSysmä is an AR treasure hunt game. The game showcases the prehistory of the village of Sysmä situated in Päijänne Tavastia region. The main purpose of the game is to visit the village and search for special markers located on a path. Every time the player scans the marker an additional artefact and history connected to it appears. The 3D AR artefacts were found in the village or in the nearby surrounding area. In some cases, there will be a possibility to make souvenir picture of the player wearing the artefact.

There are three main periods showcased in the game: stone age, bronze age, iron age. The player searches the markers and unlocks them. This makes the game become a virtual museum with clear narration about the past for local communities and tourists. The trail is easy and accessible without any hills or hard to walk pathways.

The route on which markers will be located goes around the village and passes different points like coffee shops, shops with handmade souvenirs from local artists and UNESCO Salpausselkä Geopark path in Sysmä. This way the game also supports the local community and other previous projects, when played by tourists.

6.2   Target group

The target audience was divided into few categories:
-              School children from Sysmä and surrounding municipalities
-              Families with children.
-              Young adults and adults

The game is designed to serve mainly the local community. The local community is not getting enough of easily accessible knowledge about their prehistory. Young school children will be able to learn about their cultural heritage in a way that they understand the best – interactive and fun. Nowadays a lot of children aged 12-17 own a smartphone and the game is designed in the way that students might use one smartphone or tablet while sightseeing in a bigger group.
The game will be designed to appeal to children, young adults and families with children.

The last group is represented by young adults and adults, who are visiting Sysmä for short trips in the afternoons or weekends. There are not many cultural attractions in the village, especially in the winter season. The game might be interesting for tourists who will see more of the village and stay there longer,

which gives the possibility that they would want to visit coffee shops and other dining places.

6.3 Storyline and characters

The main character of the game is the player. He or she needs to become a treasure hunter, scientist on a secret mission to unveil Sysmä´s prehistory timeline. The player is guided by mysterious narrator "The Voice" of the game. Nobody really knows who it is, but it is helpful and sometimes funny. It gives the player the feeling of being on a secret mission.

The Voice has been living in the world since the beginning, but like every human he is forgetting the past. He has left signs of his memories like crumbs of bread, that when he needs then he can always find them. He asks the player to find all the missing elements.

6.4 Gameplay

ArkeoSysmä is a treasure hunt, AR, simulation, mobile game. It is mixing AR with real life experience and education. It is also a type of virtual museum. The game should be played on a smartphone or tablet, and it should be possible to download it from Google Play Store and Apple App Store. The game is single player, but it can be played with family and friends together on one device. ArkeoSysmä will have different 3D scans of real archaeological objects from Sysmä made in photogrammetry technique, mark spots, which will show the artifacts or real places in Sysmä, which are important for prehistoric and historic narration to game, combined into three levels.

6.5 Game design approach

ArkeoSysmä is supposed to be a safe and fun game for all users. It will serve educational purposes and because of that it should not have any advertisements in the form of pop-up windows, banners, or other advertisement solutions. There should not be any additional monetization elements, as access to educational

content is already hard for a lot of children whose families are struggling financially.

The game will have 3D models of archaeological finds made in photogrammetry technique. It is a non-invasive technique of scanning artefacts. Either the artefacts are fragile, and it is not recommended to even transport them or the viewing of them is restricted. It is in the biggest concern of the developer to secure the safety of the artefacts while making the procedure. There might be changes to the list of artefacts used for scanning according to recommendations given by the Finnish Heritage Agency. In case the object planned will be on exhibition abroad then the object needs to be changed, if waiting to for the return would be changing the schedule of development of the game. Texts and stories presented in the game should be on highest level of scholarship, but still presented in an easy and fun way with the use of good but rather simple language. All possible terms should be explained.

7 GOOD PRACTICES IN MAKING GAMES FOR MUSEUM

Through the "Doors Digital Incubator for Museums" phase one, different DSPs have been presenting themselves and speaking about typical problems they have faced while working with museums as partners. The biggest issue DSPs have been rising is the lack of communication. Museums often do not answer emails or answer them very late, sometimes after a few weeks or months. The communication channels are not established, or the chosen channels do not work. In that case DSP will not get proper feedback and materials to work with.

Developers need to be very active and flexible in finding solutions which work for both sides. The change in museums and turn into digitalization creates tensions between museum curators, experts and other employees. Projects often have a lot and different stakeholders, creating a kickoff session with all of them is useful. On that kickoff session milestones, deliverables and success indicators should be presented.

DSP should try to educate the museum about the production pipeline, make the museum a partner and respect historical source material and ways of interpreting the past. Developers must speak about possibilities and technological options with delegated people from the museum in a simple way. Museum experts understand the museum´s values, mission and vision and try to showcase the fact, problem or phenomena on the museum exhibition. Those experts are assets and quality knowledge providers. DSPs can create new technologies, systems and games for museums which are innovative and risky compared to commercial products. The Museum Code of Ethics should be always taken under consideration while developing any digital solution at the museum. (Tallon 2008. Giannini and Bowen 2019.)

Developers need to think about sustainability of the technology, the price of production or replacement of tools, devices, and equipment in the project. The cost of subscriptions and plugins or licenses might be too high for the museum. Vendors ought to sign contracts with museums. Small museums might not have many staff employed, so sometimes projects with companies are held with a simple invoice system, which might become problematic after some time. It is advised to create all assets and software with open source license, although not every asset needs to be free of charge for visitor. (Tallon 2008. Giannini and Bowen 2019.)

Museums approaching digital transformation through creation of gamified, fun, experiences for their audience should consider starting this process from writing a document called digital strategy. The important part of becoming a great partner for DSP is to learn and successfully communicate the change to museum employees. Only when the whole museum understands meanings, needs and the process, the project will be supported. Good digital strategy for a museum should showcase digital skills level of the whole group, weakness and strengths and goals. The success of the activity must be declared and ways to measure it should be defined. Not always simple analytics like number of downloads or sum of interactions, likes or comments will truly measure the goals. A long-term impact, sustainability of the solution and inclusion could be more important.

The research about the audience segmentation for the museums is crucial. This is not a simple process, but it is the only way to create meaningful experiences for the museum guests. (Case cards n.d.)

Some museums might need to create the idea and choose technology before they will be able to choose DSP. In that case the idea generation phase is partially or fully omitted by the developer, who could still make a lot of changes in basic idea. The artistic style, technical approach and UI would be adapted to the needs of target groups. To help visualize the game or application special documentation should be made. Good practice for museums would be to fill a one-page design canvas. For museum needs most of templates are not well fitted and might be hard to understand for some less digitally skilled people. Appendix 1 showcases the proposition of a special digital solution canvas for museums. The proposal is based on a game design canvas made by Huhtikalio, J. (2016). The canvas should help with shaping the idea of a digital solution.

Every game, interactive device or application ought to be tested as early as possible. The DSP is responsible for making paper or simple digital prototypes with interactive placeholders and UI. The test results on target groups are important to share over whole designing group which includes museum. This approach to testing and critical thinking over feedback makes changes to the design understandable by everyone. (Giannini and Bowen 2019.)

Digital technologies by themselves will not make new visitors come more often to museums. Those can become "hooks" for some groups, but only if new the audience learns about them. Understanding that games, applications etc. needs to be constantly advertised, allows the museum to secure funds and create the strategy. (Tallon 2008. Kowal and Wolska-Pabian 2019.)

Even the best designed and tested games or other digital solutions would need redesign. Such situations could happen when the main target group would be young people, and the solution would be designed for them, while seniors are the main visitors. Through careful observation and feedback small changes could

open the solution to wider target group. (Tallon 2008.) The main points learned though development of different solutions and games are visible in the following table (Figure 18).

For museums	For digital solution providers
Answer emails, calls, check approoved communication channels	Choose easy and well known communication channels, make meetings
Speak about your needs and ideas, but with normal language, educate!	
Do not fall in love in first idea, it might not work with museum or exhibition, or it needs to be simplified etc.	
Treat your DSP as a part of the team, not as subcontractor	The museum curator is not your enemy
Do not fear to risk – new technologies are fun and can bring positive change	Do not fear to make game which is not "fun" here you can play against commercial rules
Write Digital Strategy, even if you think that it is not needed	Write game design document, or application design document and show it to your museum
Discuss the project thogether with every involved and not involved employee, everyone has to be onboard and has to understand why? what? and when?	

Figure 18. Table showcasing good practices for both museums and DSPs

8 CONCLUSION

The purpose of this work was to create foundations for a successful cooperation between museums and developers who face communication issues while creating various digital solutions. The researched topic was concentrating particularly on the development of the games which can be used on different platforms outside and inside of the exhibition. This is a particularly important issue because museum curators with the DSPs will be creating more digitalization projects in the future as the technologies develop.

The theoretical part of the work presents definitions of terms important from the museum´s point of view, museum development through the ages from antiquity till now and modern exhibition design approach. The proposed new classification of the museums gives a new approach in terminology and possibly will help developers and museums with creating their own inclusive language. The practical part of this thesis tests the hypothesis of the need for new terms and in those cases made the DSP and curators understand each other faster and better through the creation of different games.

Based on case studies, the conducted research showcased that open communication and explanation of the project improves the production pipeline and helps with communication. The subject needs to be researched further, for usability of different digital solutions and more visitor centered research needs to be done. Further research into audience segmentation and similarities between them and gamers should be done to create links between game development and museology. Development of new terms, classifications and tools useful for both parties should be held.

Deeper understanding of both sides by developers and museums is crucial to create sustainable and well-designed digital solutions. Communication problems and misunderstandings over the ways of showing historical sources and fast development of technology make projects hard and often disappointing.

Museums in the future will concentrate on sustainability and the impact of digital solutions on their visitors, education and exhibitions. The connection between a real object and human will not disappear, there will always be visitors wanting to see original objects. Digital copies, gamification and possibilities to explore collections through computer, mobile and other devices open museums to different audiences and an opportunity to explore. Importance of the preservation of the cultural heritage and sharing the knowledge in new innovative and playful way changes the approach to game design by museums. Exhibitions are interactive, engaging and concentrating on storytelling and dialogue with the visitor. This makes them look more like a RPG game, where all digital devices and solutions help to keep the visitor immersed in the story (Giannini and Bowen 2019. Kowal and Wolska-Pabian 2019.).

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LIST OF FIGURES

Appendix 1

Digital solution canvas for museums
Title of the project:

Name:

Platform	Pitch	Features
What platform your digital solution will be designed for. (For example: Android, iOS, Windows, Linux)	Short, one or two tenses description of your digital solution.	Describe what else is important in your solution. What else the user or visitor need to do or get after using the solution? Here you can describe gamification elements or other important tasks in which your solution is supposed to help.
Target group	**Mechanics and technology**	
Describe who you are designing for. Think about gender, sex, age etc.	Describe what tools you or users will need to use the solution. (For example: smartphones, tablets, touch screens etc.) Describe how the solution will work and what will the user need to do to achieve the goal of your solution? (For example: the player must to press the touch screen every time the character needs to jump, or the player have to put their hand under the projector to dispaly a pattern on skin etc.)	
Uniqueness	**Goals**	**Storyline**
What makes this idea new, fresh and different? What will make people want to use this solution? What special values does your solution have for your visitors?	Describe the goals that your visitor should achieve when using your solution. What are the long-term goals that the visitor should achieve (after the visit or after the use of your solution)? What are the short-time goals that the visitor should achieve?	Briefly describe what story, fact etc. you would like to present with your solution.
Other similar solutions		**Visual style**
Search for similar ideas, applications or games which have features you would need.		Describe how you would like the solution to look like.
Advertisement	**Sustainability**	**Ethics**
Decide how you will advertise your solution. How big budget you will need to have, to make people use you solution? How you will communicate with your audience about the solution? Who will take care of the advertisement? Will you need any in game advertisement?	Think over the sustainability of your solution. Will you need paid subscriptions, buy new devices or keep the solution up to date? What will you do if the solution breaks or is no longer supported? How will you develop this idea in the future?	Think about ethical side of your project. How you will use collected data, who owns the assets, art? How the solution will affect the behavior of players? What type of advertisements you will have in the solution and how will they be displayed?
Impact		
What kind of effect in a long and short term will have your solution? How will it influence your visitors?		

This proposal is based on a Game Design Canvas made by Huhtikalio, J. (2016) Avaliable at: https://edugametion.fi/canvas.php