TALLINN UNIVERSITY

Institute of Digital Technologies

Digital Learning Games

Virtual Game Museum: Gamified E-learning Environment for Learning Digital Games History

Master Thesis

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INTRODUCTION

The scope of digital games and their influence on modern society is significant, Paris et.al (2017) points out, they (digital games) are seamlessly embedded into multiple areas of entertainment, there are movies (e.g. *Assassins Creed (2016))*, television shows (e.g. *Mortal Kombat: Conquest(1998))*, books (e.g. *The Umbrella Conspiracy* by S.D Perry (1998)) that are based on games (and vice-versa), (p.p. 4). Other examples include live orchestra's playing digital game soundtracks (e.g. *Skyrim* concert in London *(2016)),* numerous toys, board games, clothing wear and theme parks such as *Mass Effect (US, 2016)* and *Angry Birds Land (FI, 2012)* as well as other interesting examples like gaming-themed restaurants (e.g. *Metal Gear Cafe* in Japan), and all of which are built with digital games in-mind, creating one of the most diverse modern cultures by the year of 2017.

Williams and Smith (2007) write that people play digital games on their computers, laptops, gaming consoles, handhelds, personal digital assistants, cellphones and other mobile devices and in environments such as bedrooms, family rooms, on the way to the meetings, at home, at school, at work and with new communication technologies, it allows gaming communities to be established, where players can share their experiences from anywhere around the world (p.p.1). In the year 2017, people also play games on their wearables (e.g. *Doom (2015)* on the *Apple Watch*). Paris et. al (2017) informs that there are 1.2 billion players worldwide (p.p.4) - making it one of the biggest cultural communities around (in the year 2017). Williams and Smith (2007) also mention that the study of gaming, although not new, has seen a vast growth since late 1990s and only in the recent past, scholars have started researching social and cultural aspects of digital games. (p.p.3).

According to Melissinos (2015), digital games are one of the most important art forms in history, being a fusion between art and science, it let's artists to express forms of traditional art with the use of technology: 3D modelling as sculpting, creating stories (narratives), illustrating and composing dynamic music that can react to player interactions and with the help of technology, it provides the possibility to combine and transform each other. He also mentions that it is the only art medium that allows people to personally experience artist's creations - digital games employ these three components: *developer*, *game*, and the *player*,

and *the player* can personalise his experience by making different choices in-game, albeit following the developers rules. One example of this activity is the implementation of *choices & consequences (2011)* design principle, where players can advance the game story by making their own decisions (*choices)* and later experiencing the *consequences. D*igital game *Mass Effect (2008)* gives players a choice to *kill* or *save* a specific non-playable character (*Wrex*) and the game narrative progresses either way. What is interesting, is that the game (*ME1*) creators provide players with an option to transfer their saved data (*choices*) prior to playing the the game sequels (*Mass Effect 2, Mass Effect 3),* and by doing that, players can experience the *consequences* in the later games, consequently making it a personal experience. Melissinos (2015) writes that if a person can examine others creative work and personally connect with it - art is achieved. According to the *Computerspiele Museum,* oldest connection between games and art can be traced to the start of dramatic theatre, where sounds and projected images were manipulated by two performers during public performances.

Analysing the vast growth of digital games (and gaming) as a culture and their (digital game and gaming) contribution to it's (culture's) forms (e.g. contemporary art), means that there is a history behind it, like there is with any other culture and it's forms (e.g. art, literature). Lowood and Guins (2016) write that game history is an emanating field of study but essential concepts of game design and development, technology, and play have seldom been researched in their background of historical, etymological, and conceptual structures. Consequently, they (mentioned authors) composed a collection of game historical studies written and carried out by scholars and practitioners from a variety of study fields, such as game development, curatorship, media archaeology, cultural studies, technology studies and others, meaning that it is a very multi-disciplinary field of study.

Concepts of game are integrated into non-gaming or entertaining contexts as well, such as classroom and coursework design, described by Sheldon (2011) in *The Multiplayer Classroom: Designing Coursework as a Game,* or games used for military (e.g. *America's Army (2002)),* or for medical training purposes - *RCSI Virtual Reality Medical Training Simulator (*2016*),* which are classified under *serious games*. A gamified lecture was carried out by Dr. Martin Sillaots (2015) during *Basics of Game Theory and Design* course in *Tallinn University* on the topic of *game history,* where students had to form teams, compete by

answering questions and earn points. The lack of student engagement was evident while observing this activity, even with the game elements employed into the exercise and one student (2015) reflected, that “it is not possible to learn game history just by the means of competition, there should be theory learning beforehand, and only after that - playing the game”.

Arpsen (2013), described game historical studies as a *premature field* and stated that there is a scarcity of categorised mediums for learning digital game history: such as archives, museums, journals, conferences and international networks. The **need** for a new game history structure and the lack of student engagement to learn game history in *Tallinn University* heavily reflected upon the formulation of the main thesis idea - to introduce a new medium for learning game history that could be used as a new educational tool (exercise) for *Tallinn University* in the course *Basics of Game Theory and Design.*

Main **objective** of *Virtual Game Museum* thesis is to create a prototype of a virtual game museum, a gamified e-learning environment for learning digital games history.

Current thesis follow these **research questions:**

1. What are the most important milestones in game history?
2. What are the previous attempts for introducing game history?
3. What is a suitable format for introducing game history?

These **research methods** in order to answer the **questions** are utilised:

1. Literature review (online and offline), and a visit to the *Computerspiele Museum* in Berlin.
2. Literature review (online and offline).
3. Paper prototyping, documenting, concept mapping the e-learning environment, concept mapping the structure of learning content, implementing game elements, developing (using a game engine) and using a *developer diary* to keep notes of the process.

1. THEORETICAL OVERVIEW

In this chapter, author of thesis will overview central concepts, virtual museums, learning environments, game history mediums, virtual game history mediums and lecture on game history.

1.1. CENTRAL CONCEPTS

Central concepts are key elements that this current master thesis is concerned about.

1.1.1 Digital Game

Martson and Kaal (2016) defined digital games as interactive software programs that lets single or multiple players to interact with it's (program's) content, mainly for entertainment purposes and Ilomaki and Kankaaranta (2009) addressed another purpose - that digital games can emphasise learning. They (Ilomaki, Kankaaranta (2009)) also mentioned that digital games are created to be played on a computer, video game console, mobile device or other systems using computing technology.

Regarding the terminology, *Computerspiele Museum* stated that there is a clear distinction between terms *videogame* and *computer game:*

1. *Video games* are created to be played on video game consoles (e,g. *PlayStation 4*, *Nintendo 3DS)* and are chosen by their producers (e.g. *Sony*)
2. *Computer games* can be developed and sold independently for any kind of a home computer (e.g. iMac)

As both of the terms are utilising computing technology - *digital game* can be used as an umbrella term when referring to both videogames and computer games, and also encompassing mobile and other type of games, e.g. made for smartwatches.

Adams (2009) provided a definition "A game is a type of play activity, conducted in the context of a pretended reality, in which the participant(s) try to achieve at least one arbitrary, nontrivial goal by acting in accordance with rules". It means that games do not have to be

based on extrinsic motivations (e.g. *points)* or competition. Addressing this particular definition Sillaots (2016) provides digital game examples of *Sim City* (2011) and *Minecraft* (2011) as the mentioned game titles do not have any winning conditions.

1.1.2. Virtual Museum

Shumaker and Lackey (2016) have written that a "virtual museum is a complex environmnet that according to the choices of the design team, determines the visitors' final experience" (pp 125) - meaning that there can be different types of virtual museums, and consequently authors with team of four interaction design scientists and the implementation of *Information and Communication Technologies* in culture and education structured the wide range of existing online museums according to their visual representation methods:

1.Panoramic Images (QTVR).
2. Scalable Images with text
3. Searchable databases
4. 3D environments
5. Videos

1.1.3. Gamification

Sillaots (2016) collected these definitions of *gamification:*

Gamification is the integration game design elements in a non-game context" (Deterding et.al, 2011), the process of it (gamification) was first mentioned by Pelling in 2002 (Penenberg, 2013). On the other hand, execution of game elements in non-gaming contexts has been practiced long time before (Coonradt, 1984). (p 123). Sillaots (2016) writes that gamification can be used to increase student's involvement if applied in a classroom context (pp 25).

One of the examples is the implementation of *reward* game element, which according to (Hsu. et. al, 2013), satisfies the player (learner) and motivates him (her) to achieve more.

Referencing Adams (2009) *reward* game elements can be extrinsic (e.g. *points*, *badges*) or intrinsic - which are satisfying by their nature.

Antin and Churchill (2011) have written that b*adges (*component of *reward)* are visually depicted *virtual goods* and they are awarded to players (or learners) after completing certain tasks (*challenges)* or reaching achievements. Sillaots (2016) pointed out that badges can be used for sharing the *badge* information, representing the player (learner) status and supporting the identity within a community and that they are used in education as well (smile *badges*).

Another form of *reward* game element are *points,* which according to (Antin & Churchill, 2011) are rewarded for solving challenges and this is evident in many games, they can be added or subtracted and might be represented with a help of numerics or *badges.* Sillaots (2016) writes that they are similar to grades in education systems and the players (students) can be listed on a *scoreboard* in both games and educational contexts, and according to Kapp (2012), Hamari et. al (2014) this particular reason is why *points, badges and score systems* are the most often used game elements in the process of *gamification.*

Sillaots (2016) similarly to others Deterding et al. (2011), have stated that a game can be structured by game elements, that are similar to building blocks, for creating the game experience and that according every element in the game is a *game element.* Hamari et. al. (2014) have found that game elements are motivational factors and Sillaots (2017) has written that the use of game elements can create game patterns, such as intrinsically motivating experiences (p.15).

Gamification is important in current thesis context because museums apply this approach in order to engage visitors.

1.1.4. Game-based learning

Sillaots (2016) found that *gamification* is used as a synonym for *game-based learning* and noted that they are essentially different, as *game-based learning* is the utilisation of games (digital and non-digital, commercial and non-commercial) as learning tools (concept defined by Simões, Redondo & Villas (2013) as the usage of every kind of digital games as learning

tools and he (Sillaots, 2016) has written that *gamification* is different from *game-based learning* because it is focused on implementing a small number or just even one game element but not the entire game, although he mentioned that there are examples when the difference is gone when a higher number and different game elements are integrated.

In order to engage visitors, museums are applying game-based learning principles, meaning that there is a connection between learning and museums, as learning environments.

1.2. VIRTUAL MUSEUMS

Mirzoeff (1999) has stated that virtuality is "an image or space that is not real but appears to be" (pp. 89) and mentioned that cyberspace, internet, television are phenomenas of virtuality. He (Mirzoeff 1999) also stated that a telephone conversation is a subject of virtuality, because when a person is having a conversation with another human being - it seems that they are sharing a physical space, but in reality they are not.

1.2.1. Virtual Museum of Canada

Canada's national virtual museum repository is holding entries with over 2.500 Canadian museums about topics of history, art, science, nature and others. One of their exhibits is *Getting Better,* a game-based learning virtual hospital museum where a visitor can *enter* rooms to learn about them and *meet people* - play games. The museum in question is gamified as game elements (such as) are utilised, visitors can play short games related with Canadian hospitals e.g. *Hospital Architect* (see **Image 1)** - at first, the player is instructed to read the descriptions (learn).

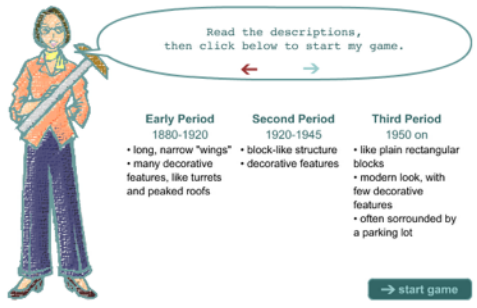


Image 1. Learning process about the style of hospital buildings in Canada

Consequently, when the game is launched, player has to look at pictures of Canadian hospitals and drag them into their respectable places that reflect the mentioned time period, doing a factual knowledge challenge (see **Image 2)**. Player has the ability to read the descriptions again.

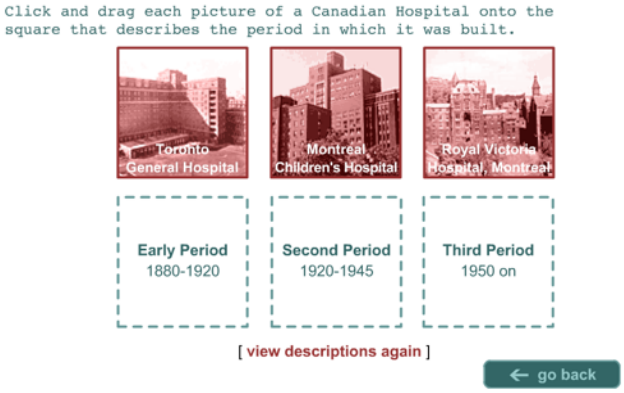


Image 2. *Hospital Architect* gameplay, player has to drag the images into boxes according to their descriptions

Finally, when the player wins - he/she is rewarded with a fictional ID card (*badge) (s*ee **Image 3**) for the player to print out and write his name to be *acknowledged* as the *Getting Better* hospital staff. Author finds this museum a successful result on game-based learning, utilising several game elements - providing *challenges* and *rewards* (*badge*). As a virtual museum - *Getting Better* falls under *images and text* category but also incorporates a collection of digital learning games. The games are built in 2002 using Adobe Flash technology.

Image 3. Fictional card given out as a reward (*badge*)

1.2.2. VR3D

Vietnam's first virtual museum with 3D scans of ancient relics. Kira (2015) writes “the ability to document and preserve precious artifacts in their current state, including distinctive marks, surface textures and coloration all in the finest of detail, means that even with the passing of time, natural disasters, or damage, future generations can appreciate and learn from the past.”. Visitors can interact with the 3D models by zooming in/out, rotating them in 3D space, reading about them (see **Image 4**) and some of them have a feature where it is possible to measure the distance from a selected point and to remove parts from them. The museum is web-based and can be categorised in the *3D Environments*. Kira (2015) writes that “order to capture the most detailed and realistic 3D models possible, he (Nguyen) uses custom-built 3D

scanning hardware that combines structured-light, laser, and photography to reach the best results in terms of both mesh and texture quality". Student was very impressed by the attention given to detail of VR3D museum. Museum is classified as a "3D environment" category.

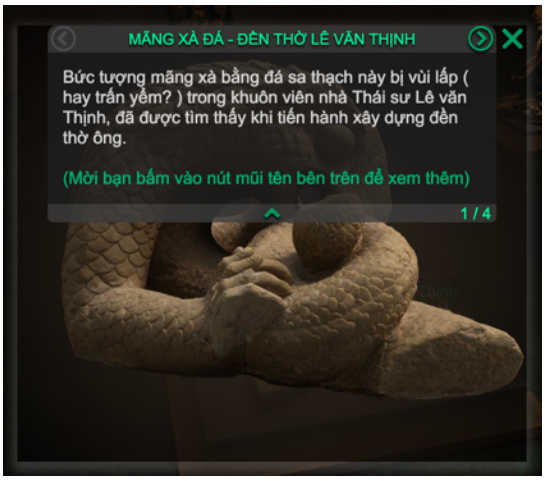


Image 4. Ancient dragon statue that visitors can

1.2.3. E-learning

Defined by the *University of Tartu* (2016) as a learning activity that takes place partly or fully with the means of technology. These are the examples that the *University of Tartu (2016)* provide:

1. E-courses (e.g. *Coursera, Moodle)*
2. Web-based learning materials (e.g. audio and video lectures)
3. Using digital communication (e.g. forum)
4. Using social media (e.g. wikis, blogs)

One functionality of a museum is to provide a learning environment, and a virtual museum is an example of e-learning and e-learning environments.

1.2.4. Learning environments

Glossary of Educational Reform (2014) defines learning environments as different physical locations, contexts and cultures in which the students (learners) learn. There might be different settings, such as exterior environments and the term is preferred to be (and often is) associated with an alternative to traditional classroom and it's standards (e.g. room with desks and chalkboard). It is also mentioned that a learning environment is concerned about the school culture - about human-human interactions (between students and teachers e.g.) and the approaches for the educator to organise the learning setting in order to aid the learning process.

This model is introduced by *The British Stammering Association* to showcase the central focus of a learning environment. Analysing the figure (see **Figure 1**)

Figure 1. *Central focus of a learning environment introduced by the British Stammering Association*

Community - a learning environment should be be evolved around a community, which is usually consisting of students (learners) and teachers - it supports learners, and community-based learning.

Learner - learning environment should emphasise learner and his (hers) learning goals, contexts and other characteristics, Bates (2015) written that "work and home context, learners' goals, and students' prior knowledge and skills (including their competence with digital media) are some of the critical factors that should influence the design of teaching."

Knowledge - referencing Bates (2015), content data, content design, structure and activities (e.g. reading, writing, painting) are one of the main concepts of creating a learning environment.

Assessement - assessing learners cognitive outcomes by means of tests, essays, providing feedback and other methods.

1.2.4.1 iCampus

Virtual learning environment used by *Tallinn University* where learners can create their own profiles, participate in groups (courses), submit posts in group discussions, upload and download files, send and receive messages, collect friends (see **Image 6**). Course assignments are written in the descriptions field of group discussion, where students later can post their work as comments.

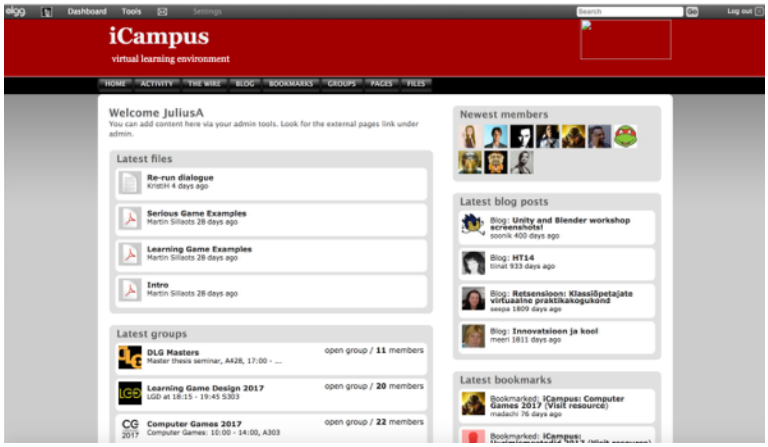


Image 6. iCampus user interface, showcasing groups, latest uploaded files, blog posts, newest members and other information.

iCampus is gamified by M. Sillaots, and the groups have progress boards (*reward* game element) implemented (see **Image 7**), where students get points after doing exercise, also it allows them to can see each others work and compete - making the learning process more engaging.

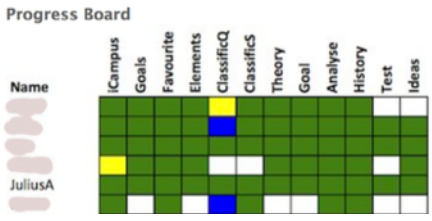


Image 7. iCampus progress board, columns show the assignments and the rows are depicting student progress in completing the assignment tasks

1.2.4.2 Blog-based Learning Environments

Tallinn University implemented a blog-based course system as a learning environment and according to Poldoja (2015), blog-based environment format include a course blog, student's personal blogs, web tools integration (eg. *youtube),* assignments given out (and sent) through blog posts and feedback (discussion) taking place in the comments section of the course, or in the personal blog. Some of the courses using this method were *Interaction Design Methods, Evaluating the User Experience* and *Foundations of Human-Computer Interaction.*

Benefits of using blog-based courses are described by Poldoja (2015): supporting learners to create and express their ideas, supporting group work activities, receiving feedback, encouraging new educational practices, personalising the learning environment, motivating learners.

1.3. GAME HISTORY MEDIUMS

Arspen (2013) stated that the problem in game history is not the lack of written material (about the topic) but the scarcity of different mediums on how to approach it (the topic). Nevertheless, he expressed some positivity on the subject of matter and mentioned that number of game history structures is increasing and provided readers with these examples:

1.3.1. *The Strong - National Museum of Play*

Museum situated in New York, US - owner of the largest collection of toys, dolls and games (digital, board, electronic, etc.). Museum is active in hosting innovative exhibitions involving robot artifacts and is emphasizing research and publications. The online collection will be reviewed in the following paragraphs of this current thesis.

1.3.2. History of Games Conference

It is an international conference dedicated to gaming history and held in Toronto, CA. Conference proceeded with an extensive three-day programme with topics ranging from computer game pre-history up to "Interactive Objects: 3D graphics in the History of Games" (Jacob Gaboury, New York University), *The Development of Videogame Cities* (Bobby Schweizer, Georgia Tech) and history of game studies with E.Arspeth (IT University of Copenhagen) and B.Perron (Universitete de Montreal).

1.3.3. Computerspiele Museum

Current thesis author travelled to *Computerspiele Museum (Berlin, GER)* in April 2017 to do his research for the *Virtual Game Museum* thesis. Museum is sectioned into these different parts: play culture, game machine history, gaming inventors, coin-operated computers, game milestones, game market, dimensions in games, sound, rhythm (in games), input devices (controllers), using human body as an input, mixed reality, gamer as an author, moral ethics

Image 8. Vectrex, a single gaming platform with a built-in vector monitor

(in games), history of connectivity, virtual reality, game development history, independent games, simulations, educational games, E-sport, healthcare, addiction to games, virtual economies, modding, democracy (in games), game storage mediums, game art and gaming platforms. To see the complete research (overview and photographs) of the mentioned topics, please see the appendix nr.1 section. Student added his own contribution to the appendix as well, such as gaming platforms that are not mentioned in the game museum (e.g. *Nintendo (JP) Switch (2017))*. One visual example of historic platform *Vectrex* manufactured by *Milton Bradley (USA)* in 1992 is given in above the current paragraph (see **Image 8**). For full system overview - see appendix.

1.4. VIRTUAL GAME HISTORY MEDIUMS

Author states that websites and a web-games developed for the purpose of game history education belong to the international networks and extra attention is given to them because they are more similar to the *Virtual Game Museum* project - both of these mediums are digitally interactive and easily accessible via internet. Digital mediums for learning game history will be reviewed in the following sub-section (previous projects).

1.4.1. The Strong. National Museum of Play. Online Collections

Website accompanying a popular game museum that holds information about games, toys and has a catalog of 29552 objects (2017-03-17) with sections for arcade games, computer

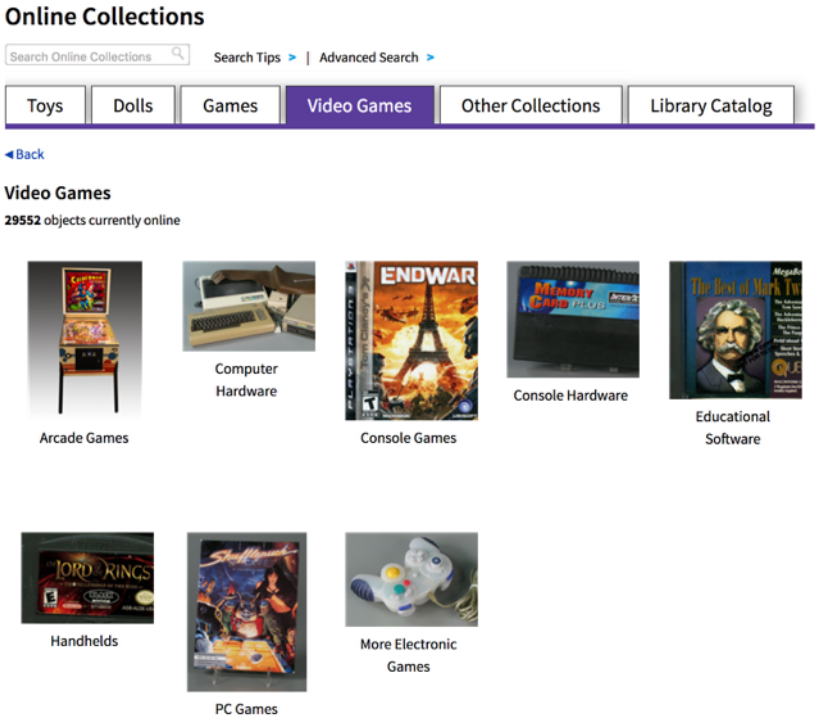


Image 9. User interface of *The Strong. National Museum of Play*

hardware, console games, PC games, educational software, handhelds, etc. Website emphasize school education and research (publications) regarding game history. Section *Hall of Fame* section is created for the most important games in game history. Museum is categorised under *images and text*. The other categories as seen from the image above (see image) include computer hardware and computer games separated from console games and console hardware, arcade games, handhelds and educational software. There are errors in the content structure because computer hardware and PC games, that presumably should be titled *computer games* are under the category of *video games*, which, according to *Computerspiele Museum* are developed for video game consoles only

1.4.2. System 16 - The Arcade Museum

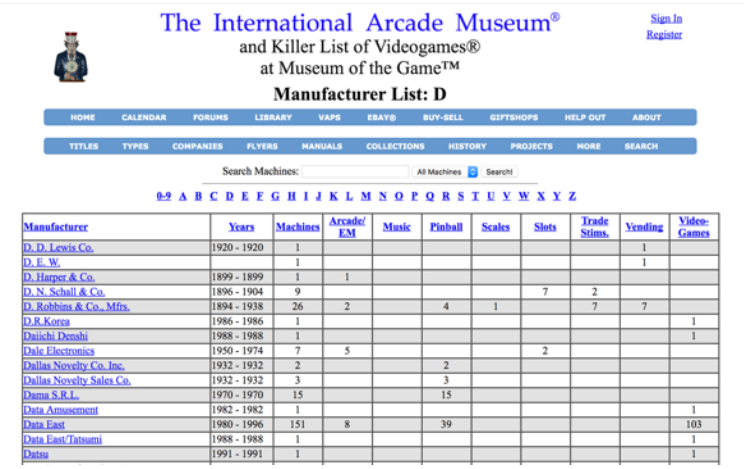
Online museum for showcasing arcade machines and their games featuring products from *Atari*, *Capcom*, *Konami*,, *Midway*, *Sega*, *SNK*, etc. Website has a an extensive collection of hardware information about rare arcade machines, exploring both higher-level and lower-level (individual components). In the image example below (see **Image 10**) is a visual representation of an *ATARI 6502* system board with a hardware description section, e.g. this particular system could only represent black and white colours - the museum states this

information and describes that arcade games (machines) that were using this system board had to use plastic coloured overlays to display colours. Below the hardware information, a list of games is given, and also with visual examples. This virtual museum is categorised under *images and text.*

Image 10. User interface of *System 16. The Arcade Museum.* A high quality picture that shows system board (Atari 6502 Black & White Raster) is presented and also a list of games

1.4.3. The International Arcade Museum

Online platform for the biggest list of arcade machines and their games. People are able to select an object and see it's details such as images, name, manufacturer, year made, type,



Manufacturer	Years	Machines	Arcade/ EM	Music	Pinball	Scales	Slots	Trade Stims.	Vending	Video-Games
D. D. Lewis Co.	1920 - 1920	1							1	
D. E. W.		1							1	
D. Harper & Co.	1899 - 1899	1	1							
D. N. Schall & Co.	1896 - 1904	9					7	2		
D. Robbins & Co., Mfrs.	1894 - 1938	26	2		4	1		7	7	
D.R.Korea	1986 - 1986	1								1
Daiichi Denshi	1988 - 1988	1								1
Dale Electronics	1950 - 1974	7	5				2			
Dallas Novelty Co. Inc.	1932 - 1932	2			2					
Dallas Novelty Sales Co.	1932 - 1932	3			3					
Dama S.R.L.	1970 - 1970	15			15					
Data Amusement	1982 - 1982	1								1
Data East	1980 - 1996	151	8		39					103
Data East/Tatsumi	1988 - 1988	1								1
Datsu	1991 - 1991	1								1

Image 11. Virtual museum's *International Arcade Museum user interface with alphabetical and a search field search options*

subtype, cabinet styles e.g. upright/standard. This museum lists *Ebay* auctions of the arcade games (machines). This particular museum belongs to the category searchable databases but also has images and text descriptions for the machines (games). The website has a table that visitors can search alphabetically or can search for a particular model using the search field (see **Image 11**).

1.4.4. Atari Museum

An online museum and community for the preservation of Atari history, providing information about Atari systems, games and supporting numerous former and current Atari employees and is intended to provide images and information on all areas related to Atari - images, personal stories for individuals interested in learning game history. This particular website has been created in 1998 and still has low-quality pictures and an old design (see **Image 12**).

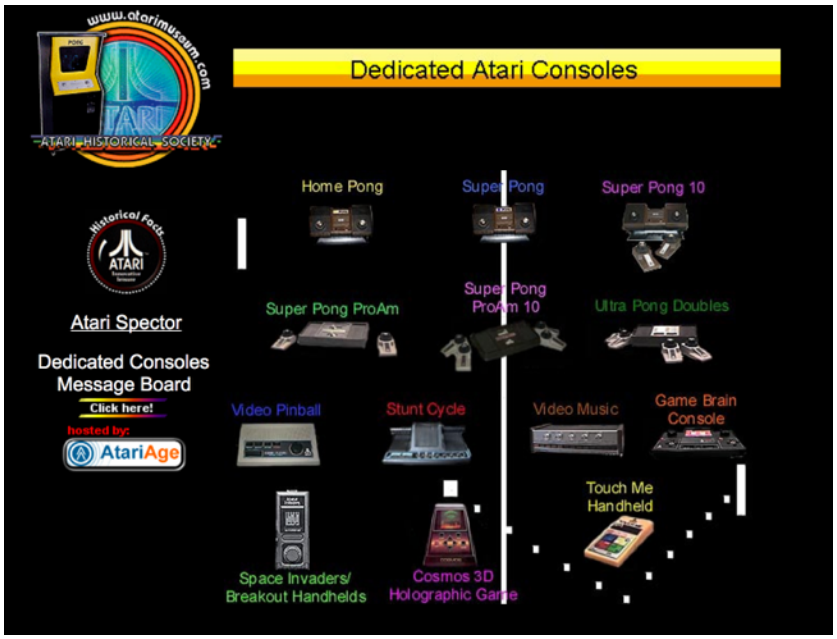


Image 12. Atari Museum's user interface, having an old design and an uncosistent (uneven) layout.

1.5 LECTURE ON GAME HISTORY

Lecture about the game history topic was carried out by Dr. Martin Sillaots in 2015 during *Basics of Game Theory and Design* course in Tallinn University. It was interesting because it had game-based principles implemented - students had to form teams, answer questions and earn points. The quiz game was carried out with the help of slide presentations. There were 14 questions and one of their example is given below with a sequence of question (see **Image 13**), the correct answer (see **Image 14**) and a visual in-game example (see **Image 15**).

Image 13. Question in the quiz game

Image 14. Slide containing the answer

Image 15. Slide containing the

Image 16. Post by current thesis author contributing to the

At the end of the class, a crowdsourcing element has been used by giving students a task to provide their own questions and answers (about game history) by creating a post in a virtual learning environment (iCampus). By using this method, it was possible to get ideas and to update the existing content, which in this case is the slide presentation (quiz) about game history. A total of 12 by posts have been submitted by students, below is a visual example of a post composed by the current thesis author with a sequence of question, answer, reference

(see **Image 16**). In the end, student was rewarded with a point on the progress board, making the submitting process a gamified experience.

Although the classroom had game-based learning elements implemented, judging by the current author's observation, students still lacked engagement in the mentioned topic and one student expressed that it is not possible to learn game history with a competition without having prior knowledge.

1.6 CONCLUSIONS

Based on overview of previous attempts to introduce the history of computer games and based on expectations of the game design students and gaming communities in general, learning environment about games history is needed.

Expected outcome is to design (and develop) a virtual game museum that could be used as a gamified e-learning environment for learning digital games history, categorised as a museum under *images and text* category, with gamification elements implemented into the learning process (reading text, and seeing images) and utilising a game-based principle (quiz) for carrying out the assessment process. Referencing Bates (2015), he mentioned that a learning environment should have different learning activities and the current author expects to provide learners a space to play a game sample for understanding (learning) basic functionality (gameplay and core mechanics) of a 2D platformer game genre.

Virtual museum can be used as an e-learning environment if a **community** (educators and learners) can utilise it, meaning that the content (**knowledge***)* could be structured, updated by the teacher, and accessed by the learners from different contexts (***learner centred*** element (e.g. working students)), followed with an assessment procedure, assessing the learners (e.g. using a *test)*. In order to make the learning and assessment processes more engaging, - gamification and game-based learning principles can be implemented.

Using games as tools (game-based learning) for introducing game history through play is not a new concept, one interesting game example is *Uncharted 4 (2016)* where players could play a *PlayStation 1* game *Crash Bandicoot (1996),* a historical 3D game, while playing a

PlayStation 4 game titled *Uncharted 4 (2016)*. Both of them were released by the same company *Naughty Dog* (US) and prior to starting the *Crash Bandicoot game*, *PlayStaion 1* loading screen appears, followed with an accurate graphical representations of the *PlayStation 1* system and it's controller - an example of digital games used to teach about game history and more specificaly, introducing a historical game *(Crash Bandicoot)* through play - a similar concept to the current thesis level with a 2D platformer game.

2. METHODOLOGY

Current author of thesis will overview the research strategy and methods used in this particular chapter in order to design and develop the gamified virtual museum.

2.1. RESEARCH STRATEGY

Kothari (2004) writes that a research goal is to find answers to questions, to gain knowledge about a phenomenon and (or) to generate new insights about it (the phenomena), through the application of scientific procedures (p.p.2). One of these procedures is a design-based research which according to the *design-based research collective* (2003), is a mixed method procedure where theory is linked with practical integration. According to Ley (2016) one of the principles of a design-based research is a theory applied to inform designs and develop them further with an inductive process.

Gasparski (1989) defined design methodology as "a philosophy of science applied to practical disciplines or to applied; or artificial sciences" (p.143)". As the current thesis is not only a research project, it's main outcome is a software artefact - means that a set of procedures must be applied to deliver it, so the author has selected to combine a design-based research (current thesis research part) and a design methodology model for software development (and delivery process).

Author will apply the 4-stage user-centred design approach for research, design and development and add the last "*Game Development Process"* stage for the delivery of the prototype. Rogers (2012) defines this (see **Figure 2**) cyclical methodology stages as: "1. Problem formulation; 2. Design 3. Deployment; 4. Observation 5. Reflection and then re-definition of the problem " (p.66).

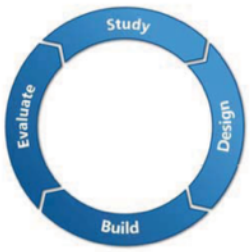


Figure 2. The 4-stage user-centred design approach.

1. Study - doing literature review (theoretical overview), on-site research (Berlin museum), understanding main concepts, analysing previous studies, projects, finding connectedness, problems and and informing the design process to improve the later stages of design and development. During this phase, these **research questions** will be answered**:** *What are the most important milestones in game history?; What were the previous attempts for introducing game history?*
2. Design - implementing theory (from the research part) in the application design, paper prototyping, documenting (designing) actions and interactions, levels and creating a concept map and mind map (data visualisation) for the general structure of the learning environment and for the structure of the learning material. This phase will provide answer to **research question**: *What is a suitable format for introducing game history?*

Author would like to extend the previous model by adding a phase from a similar (cyclical) design methodology approach introduced by Adams (2009) (see **Figure 3**) to reach the **main goal** of the current thesis: *create a prototype virtual game museum, a gamified learning environment for learning digital games history*. *Adjustment* phase will be added to extend the *evaluation* stage. Analysing the *Game Development Process,* these are the connections that student has found (with the previous model), that are sharing similar theoretical and practical activities:

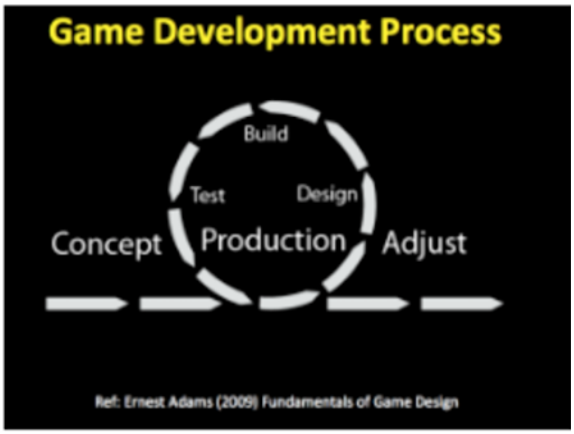


Figure 3. Game development process methodology

1. Study phase - concept phase.
2. Design phase - design phase.

3. Build phase - build phase.
4. Observation - early test phase
5. Evaluation stage - later test stage

Consequently, if the product does not need problem rethinking (restarting the cycle), means that there are no apparent (or relevant) software defects - then update is followed by *adjustment* phase , otherwise known as *delivery* stage. No new features can be added and the main focus of this (stage) is to get the software released, but in this context, building and uploading the prototype for the review of current master thesis.

Student has chose to use these methods because if applied, they can serve as both theoretical and practical approaches for researching, understanding and providing information to the later design, and then designing, developing, reflecting and delivering the digital artefact in question.

2.2 METHODS

This chapter is about the research process and methods used.

2.2.1. Study Phase

Doing literature review and research on-site, keeping notes for collecting information and ideas related to current thesis. Also emphasising thoughts on the overall game concept and of the next steps (of the methodology).

2.2.2. Design Phase

Composing a concept document using digital text editors *Pages.* Designing learning content by using the knowledge gathered during *study* phase. Composing a concept map with CMAP tools visualising the learning environment and a concept for the learning content structure. CMAP has been chosen because data visualisation, according to SAS, leaders of business intelligence, is a fast and effortless way to understand concepts, giving the opportunity to experiment with different options, and to easily change them during this process. And Mickey

(2015) told that one the most important aspects of data visualization is that it provides people with a visual entry to big amounts of data which is easily understandable (concept connections, see **Image 16**).

Sketching UI prototype with pen and paper because creating sketches (or paper prototyping) holds a similar advent as concept mapping - changing features during the design phase of the software development process is easier than making changes during the production phase, when software is being developed, and in order to save time and energy it is recommended to have constructed guidelines, and in this context - executing the activities stated and visualised in the design phase.

2.2.3 Build Phase

In order to develop a digital game (software) - a game engine is required and student has chosen Unity 3D because it is free (personal edition), it is multi-platform, has stayed on the market for 12 years (as of 2017-03-27) and has an established community concerned about user-generated content. *Unity 3D* is used by both indie and AAA companies - e.g. *Red Thread Games* (indie) developed *Dreamfall Chapters* and Square Enix (AAA) has developed popular games such as *Hitman GO*, *Lara Croft GO*. Target platform is chosen as mobile because it is easily accessible and widespread. *Developer diary-based* method will be used to document the development process, although there is no academic definitions for this method, it is widely used by game development companies such as *Electronic Arts* for big budget games like *Star Wars Battlefront* - it is a method used to showcase the process of game design and development, usually accompanied by videos but for this thesis, author will describe this process with documentation and visual examples. These Unity 3D plug-ins will be used for developing the e-learning environment: UI Builder, Visual Novel Engine,

2.2.3.1 UI Builder

UIBuilder - an editor extension for designing and developing user interfaces in games. Student has chosen this extension because it provides a library of tools for building modern

Image 16. Library of user interface elements provided in the *UI builder* repository

flat design user interfaces (see **Image 16**). It provides useful user interface elements such as inputs, buttons, custom panels, sliders, toggles, switches and even data analysis tools such as pie charts. Typography elements such as different fonts can be used as well. All of the elements are pixel perfect which means that the quality of the images are preserved with different resolutions

2.2.3.2 **Visual Novel Engine 2D Cutscene engine**

Editor extension used for creating Visual Novels providing controls for Text: such as Mute, Auto mode, Speed, Advance (**see image 18**) and similar controls for Images and sound.

Image 18. *Visual Novel Engine* user interface with provided text controls for *Mute, Auto, Fast, Hide, Next.*

Author chose this particular plugin for the gamification of the text material, implementing visual effects and sound.

”Visual Novel Engine” has the ability to import text (TXT) files and to use them as conversations. As it is evident from the editor screenshot below (see **Image 19**), Visual Novel Engine provides users with a comprehensive set of tools, such as animations for *actor positions*, or voiced conversations. Creating a *Items and Iffs conversation* - developer can build a conversation where a player can use items acquired during it (conversation) in order to advance the story. In the this image (see **Image 20**), in the scene manager view (Unity3D) we can see a sequence that is applied to game object (*starting conversation)*: at first a background is set, then music starts playing, screen fades to black, etc.

When a game object in the scene manager is selected (Enter Actor e.g.,) it is possible to see it’s detailed information, all attached components, their properties and allows to edit/add functionality to the game object in question. *Enter Actor* game object’s inspector view can be seen on the image on the right (see **Image 21**) - here developers can specify the actor they want to add to the scene and from which side, actor has properties such as image component (for visually depicting the gameobject in the scene) and the *actor* script can be used to

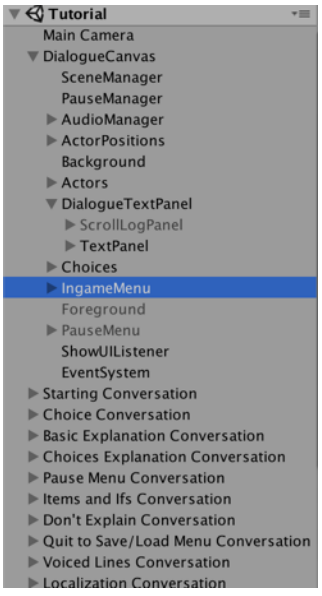


Image 19. Scene manager view with game objects such as camera, canvas,

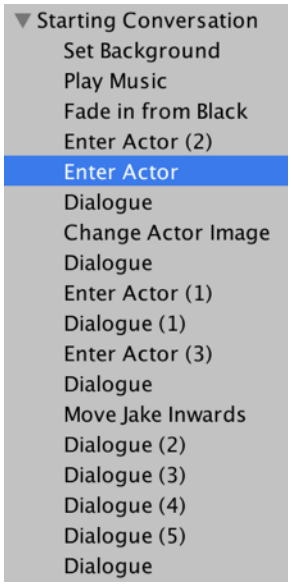


Image 20. Sequence of a game object *Starting*

Image 21. Inspector view of the *Enter Actor* game object with *image* and

execute scripted commands, such as identifying the game object by it's given name, by which it can later be simply added in the scene during the conversation (at a specified time).

Regarding the dialogues, when selecting a dialogue in the scene view, it is possible to control the game object values in *Dialogue Node* script (see **Image 22**) such as *Actors*, text (rich or standard, written in the editor or imported from a TXT file), adding sound that would be played during every word, record text in a log and to execute other game logic.

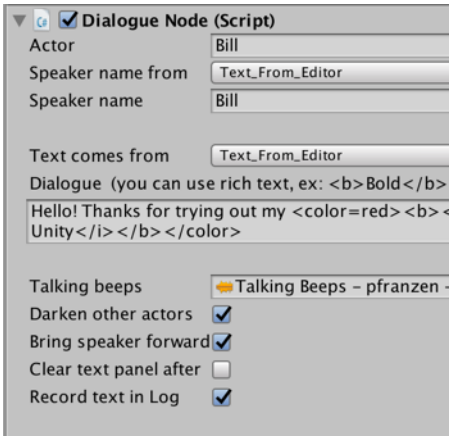


Image 20. *Dialogue Node* script

Author will remake the user interface that is provided with the *Visual Novel Engine* from horizontal to vertical, intended for one-hand smartphone use, and also worth mentioning that this decision is heavily inspired by *Phoenix Wright: Ace Attorney* released for *Nintendo DS* on 2004 by *Capcom* (JP) "Phoenix Wright" (see **Image 23**) because it is played in vertical

Image 23. *Phoenix Wright Ace Attorney uses a vertical playing*

mode - released for Nintendo DS (2004) and iOS platforms (iPod Touch, iPhone, iPad) in 2010. It is a visual novel adventure game with comfortable text controls for playing, fast forwarding the text. The visual novel engine have more options built-in and student will decide which ones to use, and present them in the results section of master thesis. Author will implement royalty-free sound effects and music (soundtrack).

2.2.3.3 Easy Touch 5

Unity asset, made by *Hedgehog Team* will be implemented for creating controls using touch input. It provides a library of joysticks, directional pads, touch areas and a button. The controls are similar to controllers to those controlling older platforms, thus giving it a classical gaming feel. Directional pad (see **Image 24**, second from the left) will be utilised, as well as the red button (see **Image 24**, far right) for actions such as jump, shoot, etc.

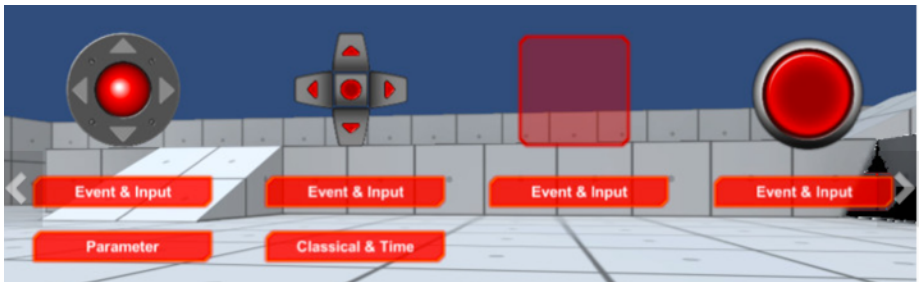


Image 24. Touch-screen controls in the *Easy Touch 5* library.

2.2.3.4 2D Platformer

A sample game made and distributed for free by *Unity Technologies* named *2D Platformer* (see image) is selected to be played in the digital game's level to give players, learners a look and feel (visuals and functionality) of this particular genre (see **Image 25**) in practice.

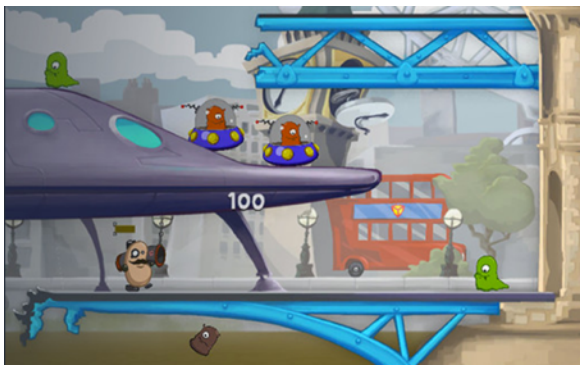


Image 25. Visual style of the platformer genre game to be implemented into the

2.2.3.5. Quiz Game Template

Unity asset used for a quick creation of quiz games. Author of *Virtual Game Museum* selected this plugin because one of the levels (assessment) will be based on mentioned game genre. This plugin provides developer with an audio-visual feedback and genre specific elements: animations, sounds and a score system (see image 26). This plug-in is simple to use because developers can import their questions using an XML script template provided by the asset's developer *Pupeteer.*

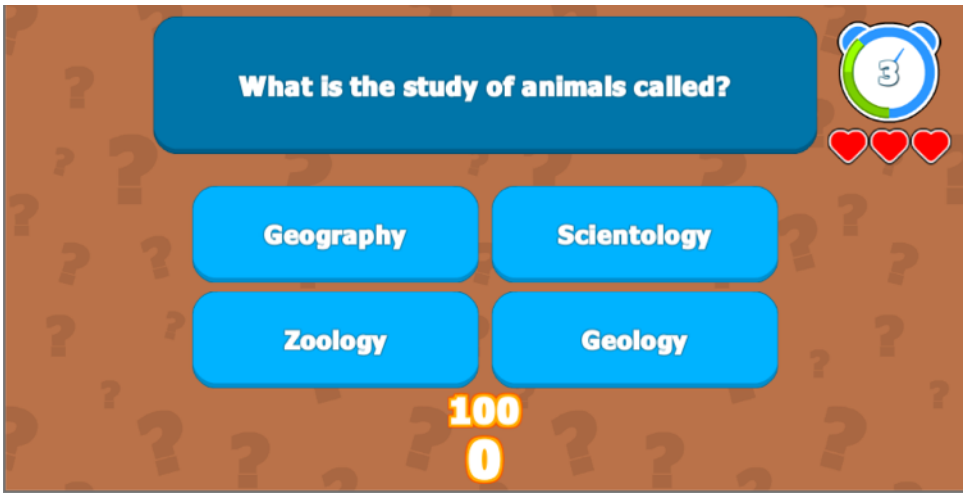


Image 26. *Quiz Game Template user interface with a question box and answers, score, timer and lives.*

3. RESULTS

In this chapter, author will present his results of the current thesis.

3.1 CONCEPT

Concept document is created to have a general idea of what the software will be in terms of content, functionality and visual style.

Description: *Virtual Game Museum* for learning digital game history and also about game genres. Level progression is non-linear as the learner can choose what he wants to learn first.
Learner's role: Learner can read about their selected platforms/games, play 2D platformer genre example, and take a quiz for testing their knowledge.
Learning goal: Learning goal is learn and repeat information about game history; and the level of goal is classified as "Knowledge" (Bloom's Taxonomy).
Levels: Three levels (scenes) are designed: *Discover* - game/platform history learning, introduction to influential game genre; and finally - a quiz test. Goal for the player in *Discover* level is to to read in order to learn about game/platform history; to play in *Play* level a provided game example (walk, shoot, pickup objects) to learn about game genre characteristics and to answer questions *Test* level - for assessing learning outcomes.
Target audience: students
Target platform: mobile (iOS/Android), WEB.
Visual style: Minimalstic (flat-design); retro (*Play* level)

3.1.2. Concept map

Concept (see figure) has been composed to showcase the overall structure of the virtual game museum (VGM) and the relationships between content, design elements and the levels:

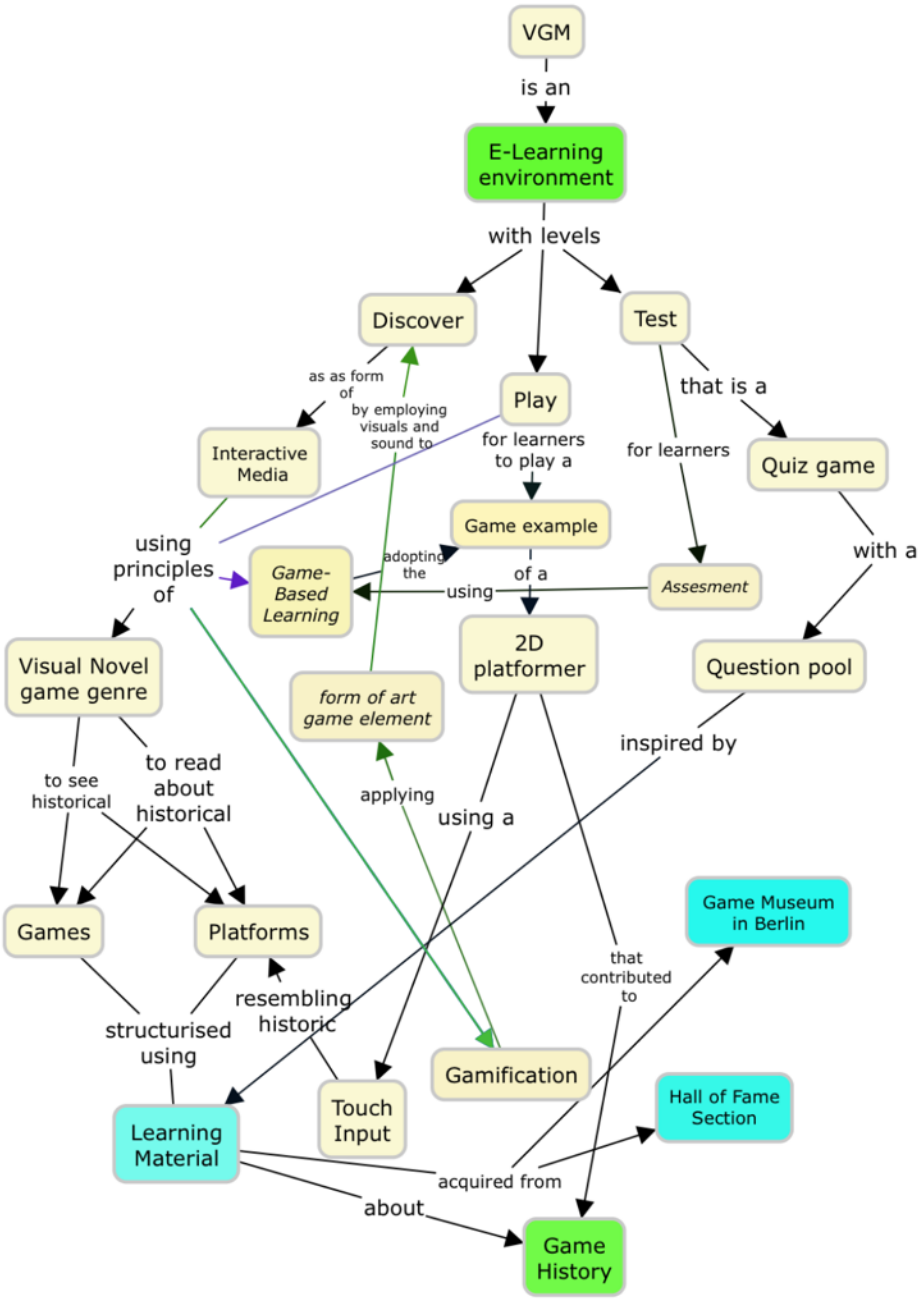


Figure 4. Concept map showcasing the general network of the virtual game museum as a gamified learning environment

3.2 LEARNING CONTENT DESIGN

This chapter holds information about the learning content design of *Virtual Game Museum*

3.2.1. Discover Level

In order to create a learning environment, learning content has been designed. For creating the first scene (level), *Hall of Fame* section from The Strong. *National Museum of Play* and the current author's research at the game museum was used for selecting the important historical games in game history (milestones).

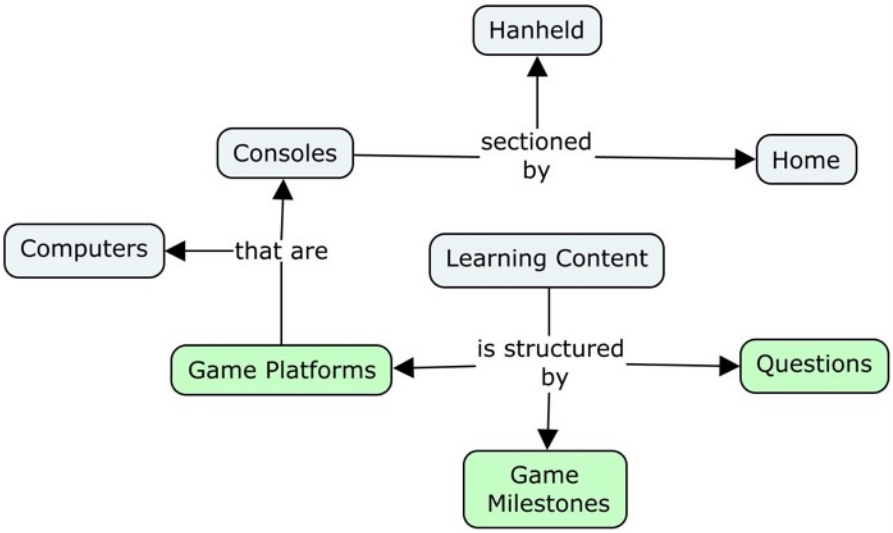


Figure 3: Learning Content Structure

Both games and platforms are implemented using *Visual Novel Engine* plug-in, working with Unity 3D software. The level is based on a visual novel game genre, which incorporates a style described by Galbraith (2011), when the environments are static and change only with a new location, and the environments are often reused. Text visually depicted on-screen describes the location and situation. The example of the content format can be seen in page nr 23, which is an image (of the game or platform) followed with a text description.

In order to create a gamified experience, game element that is *a form of art* based on aesthetics (Costikyan, 2002), the definition was found in a collection of game elements (used in gamification) compiled by Sillaots (2016). The *form of art* integrated into this level is

Digital Art defined in *Oxford English Dictionary* an art composed or modified using a computer or other digital system. In this context, sounds are played during the conversation and the animated text resembles a *typewriter-like* effect, and ultimately both of these artefacts can be acknowledged as forms of *digital art.*

3.2.2 Play level

In this current thesis, learning content for this particular level was selected to be a *2D* platformer genre game that could be played within the software prototype (mobile and web). 2D game genre is defined by Klappenbach (2017) as a digital game where players have to control their character, running and jumping onto platforms or other objects visually presented on a single or scrolling (horizontal or vertical) game screen. Principle of game-based learning is used, as the game is a tool by itself.

3.2.3 Test level

A digital quiz game was utilised and as it is defined in *Oxford Living Dictionary*, *quiz* is a test of wisdom, usually a competition between people (single or teams) and in an entertaining form. The assessment form is carried out by giving learners questions, 16 questions are integrated from the authors research and 9 from the National Museum of Play, Online collections. Each question has four answers with a possibility to make two mistakes prior to losing a life. Players have 4 lives.

It is a digital game with an extrinsic reward system that is *score*. Feedback element is also utilised because the player immediately see's if his answer was correct or not. If used as an educational tool, students can compare their high scores, which is a form of a competition - a game element that might make student's learning (assessment) experience more engaging.

3.3. LEARNING CONTENT STRUCTURE

This map (see **Figure 5**) visually depicts how the learning content is structured and from where it was acquired in the current thesis. Categorising the learning content into *platforms* and *games* has been decided after doing the reserach on-site, and based on author observations, game history structured by it's *games* and *platforms* to can be presented as format reflecting the game history and still maintaining simplicity.

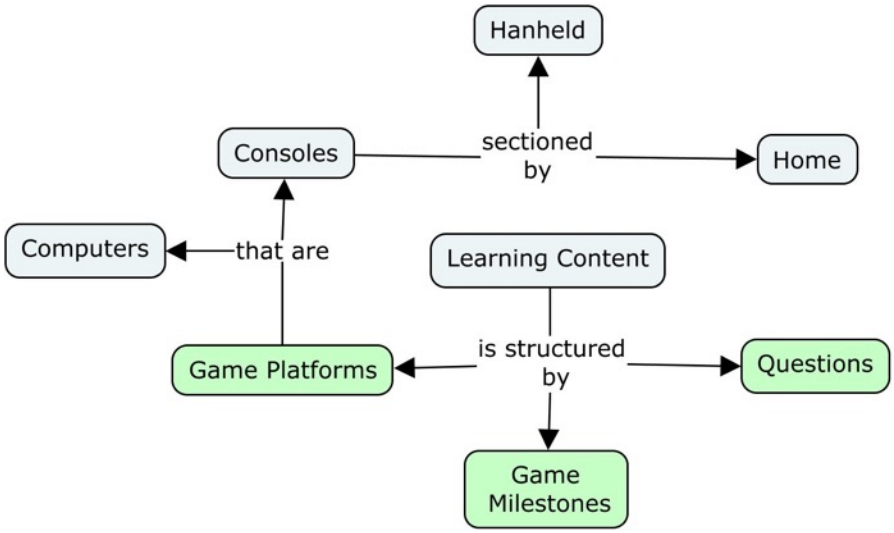


Figure 5: Learning Content Structure

The table below (see **Table 1**) has examples of important moments (milestones) listed. More important and historical content can be seen in the appendix (appendix research at the game museum). The table is structured into columns of different categories (from 1 to 5, from left to right). The full table can be seen in the appendix nr.1

Table 1. Important game milestones

Name	Date	Type	Company (Person)	Relevance
Brown Box	1969	Platform	Ralph. H. Baer (US)	Prototype of the first home video game console
Dungeons & Dragons	1974	Game	N/A	The first time a narrative, could be rewritten each the game was played. Game was not digital.
Maze War	1973	Game	Greg Tompson (US)	First game to introduce the subjective perspective - a new spatial perception in gaming environments.
Moon Patrol	1982	Game	Irem (US)	Introduced parallax scrolling - element background plains are moved across the screen (horizontally or vertically), Usually dependent on the player movement.
Zaxxon	1982	Game	Sega (JP)	First game to use isometric perspective.
Empire	1973	Game	Iowa State University (US)	Firs multi-player network game - 8 players could play simultaneously.
Alpha World	1995	Game	World Inc (US)	One of the first 3-D internet environments, using web browser and voice communications software, in addition to the 3D game.
Habitat	1986	Game	F. Randall Farmer (US), Chip Morningstar (US)	First graphical game where thousands of people could play at the same time and first one to use graphical representations of players titled "avatars".
Bradley Trainer	1981	Platform	Atari (US)	Frst computer that has been adapted for military training. Based on the Battlezone machine, capable of representing three-dimensional battlefield.
Beginning Grammar	1978	Game	Texas Instruments (USA)	It is of the first learning games for computers (home), for learning grammar.
Quake	1996	Game	ID software (US)	Started the modding era, with it' sourcecode voluntarily disclosed. One of the modding examples is QuakeRally (1997).
Microvison	1979	Platform	Milton Bradley (US)	First programmable handheld gaming system.
2600	1977	Platform	Atari (US)	The leader of video game systems in the 1970s and early 1980s.
Vectrex	1982	Platform	Milton Bradley (US)	The only video game system with a built-in vector monitor.
PC	1981	Platform	IBM (US)	Computer with operating system (*DOS, Microsoft)* started era of other manufacturers selling *IBM-compatible* titled clones with standard components.
LYNX	1989	Platform	Atari (US)	First handheld with colour LCD screen.

3.4. USER INTERFACE

Sketches made early into the design phase (see **Image 27**): node-based screen is designed for the *Discover* topic selection and the frames with a headers *VGM* have been designed for the *Discover* level learning scene and the *Play* level scene. User interface for *GM3* has been designed only to be played on a portrait mode, instead of a landscape - but the actual UI components won't be changed from the template (visual novel plug-in). UI is designed for mobile (iOS, Android) but the learning environment will be also usable on WebGL for the review purposes of this current thesis.

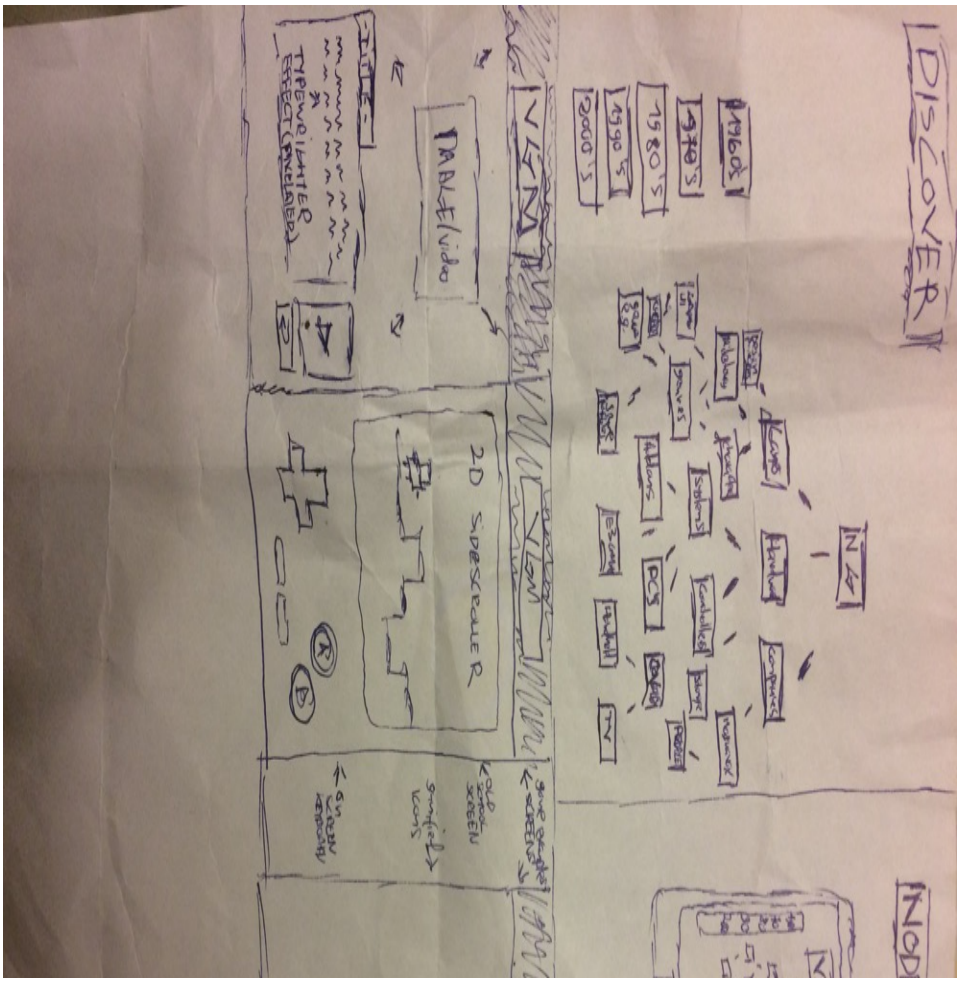


Image 27. User interface sketches made in early *Design phase*

3.5 DEVELOPER DIARY

In this paragraph, author will overview the development process.

3.5.1 UI

Author of thesis started working on building the UI for *Discover* topic selection screen and *Play* level. *Discover* screen has two menu's" - *Games* (see image) and "Platforms" (See figure) are designed, and they can changed with a switch button. A scroll view has been built in order to navigate through topics in the sliding area (up until down, and vice-versa). The main goals of building this UI was to make it simple, easy to navigate and during this process an idea came to author's mind - changing the layout of the topics by not building it according to the design sketch (see **Image 27**) (network-based nodes) but to arrange it in more simpler style - similar to the one that that is evident when navigating through a smartphone home-screen. (see **Image 28**). Each topic button has an icon with 120 x 120 pixels in size.

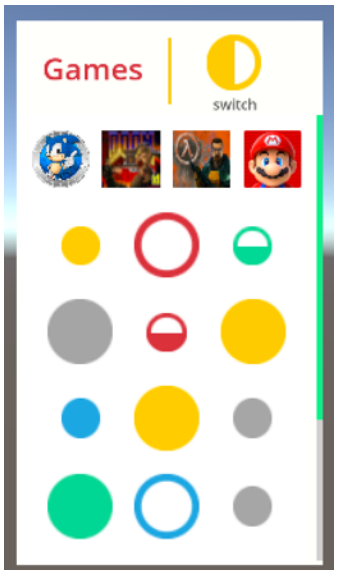


Image 27. Topic

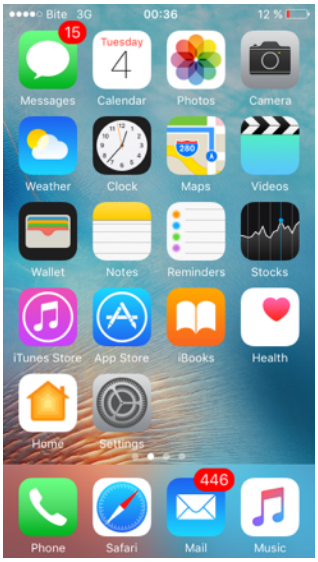


Image 28. Reference to the topic selection

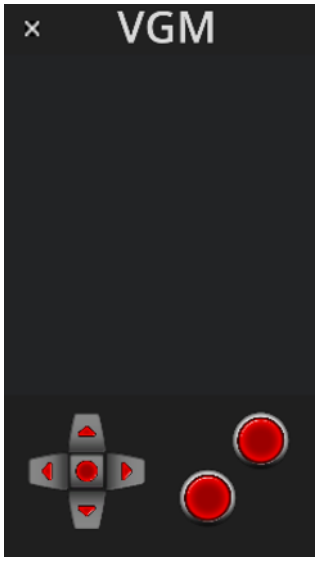


Image 29. *Play* level screen, resembling

Building the user interface for the *Play* level (see **Image 28**) was process that involved following the design sketches that were composed during the early design process. Touch controls and more specifically directional pad, and three buttons - two of them action (red colored, bottom panel) and one *exit* (on the top) were created. First development day is

considered complete and author is satisfied with the functionality outcome working with Unity 3D

3.4.2. Creating Visual Novel

Next development stage was dedicated to recreating the user interface of the *Visual Novel Engine* to make it vertical. These Unity tools were used:

Using the navigation menu (see **Image 30**), author resized text panels and images, and then edited their colour attributes. Consequently, author of thesis added a background image in the *background* game objects script (see **Image 31**).

Image 30. Navigation panel

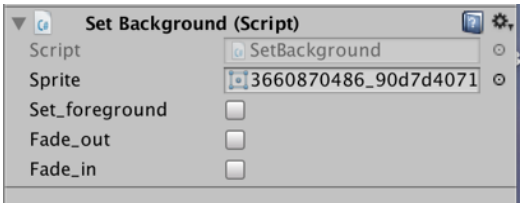


Image 31. *Set Background* script component for choosing a background

After this process, Author utilised the *Dialogue Node* script and entered text for the *actor* Xbox 360. End result is evident in the image below (see **Image 32**) and rich text was achieved using this particular command:

Image 32. *User interface of Discover levels* second

“<color=red>Xbox 360 manufactured by Microsoft</color>” - whereas font style choices such as colour red, bold and italic has been specified.

Student reflects that developing the framework for the *Discover* level was a simple and satisfactory process, although style changes are planned in the future, such as changing buttons and text panel image. *Visual Novel Engine* is a quick and efficient way of creating visual novel games with many customisation capabilities.

3.4.3 Play level stage

Author of thesis decided to work on the *Play* level and more specifically o integrate *2D platformer* and the user interface that was composed in **April 1.** After the *2D paltformer* project has been imported into *Unity 3D*, student edited the attributes of the *Main Camera* game object, by changing it’s size so that it would fit the canvas of the *VGM Play* level and also shrinking user interface fonts (eg. *score)*. When the scaling was done, author of thesis began working with touch controls (see **Image 33**).

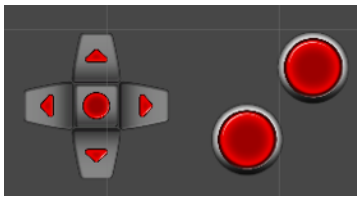


Image 33. Touch controls

This process included inspecting the scripts *PlayerControl, Gun* and modifying the inputs for movement (see **Image 34**, upper line) , jumping (see **Image 34**, middle line) and firing (see **Image 34**, lower line) functions with adding extra letters *ETC* to the *Input* command because then the script of *Easy Touch* Input is accessed.

```
float h = ETCInput.GetAxis("Horizontal");

if(ETCInput.GetButtonDown("Jump") && grounded)
    jump = true;

if(ETCInput.GetButtonDown("Fire1")
{
```

Code 1. Script lines for renaming the controls for

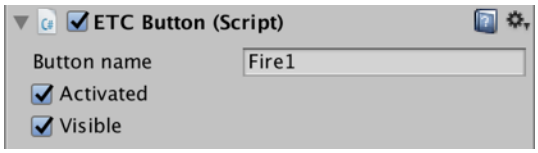


Image 34. *Easy Touch 5* script

Later author renamed the inputs for the on-screen buttons with the ones stated in the script: Directional pads horizontal axis (left and right) were named *Horizontal* and the lower button was named *Fire1* and the upper - *Jump.* Renaming was done in the *input* script components - one visual example is given (see image). The end result is visible on image below (see **Image 35**).

Image 34. *Play level user interface with 2D Platformer* implemented

3.4.4 April 28th, 2017

Prototype development for the quiz part began with creating an XML file and inserting questions created by the current author of thesis. Author had to create wrong answers (See **Image 35**). The other options are: points - for the right answer and time limit in seconds (see **Image 36**). Later when the questions have been entered, Author imported them into Unity 3D

```
<record>
  <Question>First multi-player network game?</Question>
  <Image></Image>
  <Video></Video>
  <Answers>
    <Answer correct="true">Empire</Answer>
    <Answer correct="false">Counter-Strike</Answer>
    <Answer correct="false">Ultima Online</Answer>
    <Answer correct="false">Asteroids</Answer>
  </Answers>
  <Bonus>100</Bonus>
  <Time>8</Time>
</record>
```

Image 35. *XML* script for questions and answers, bonus points and time

Other activities included working with a *Game Controller* script - adding player lives (see image) and also manipulating the questions. Using this controller, it is easy to add pictures and video - to accompany answers.

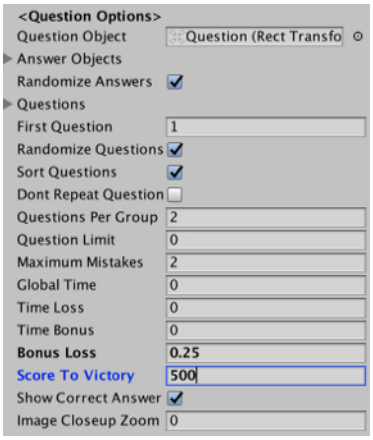


Image 36. *TQG Game Controller* script for controlling the game logic

Main

Author began working with scene management and created a user interface for main menu (see **Image 37**) and then used a button script that transforms game objects into buttons, in this case it was a graphical image (panel) and with an added *Button* (see **Image 38**) it was possible to access *SceneManager* script and manage scenes. The empty space on the main menu user interface is a placeholder and left for future design's of the prototype.

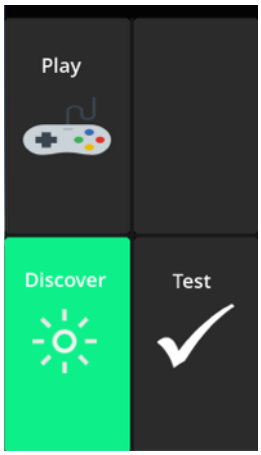


Image 37. Main-menu of the learning

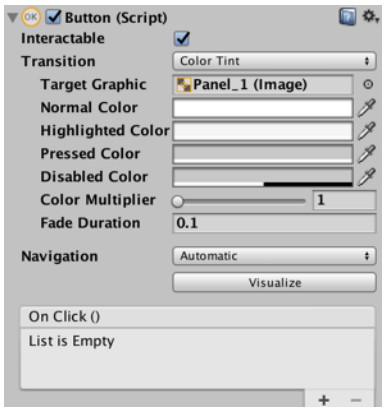


Image 38. *Button* script component used for scene

3.5 CONCLUSION

The **process** of answering ***research*** **question** *what are the most important milestones in game history?,* - included activities of doing literature review (online and offline), online game museum overviews and visiting the game museum in Berlin. The **result** for the question is composed as a table (see table) of platforms and games that were influential to game history. Overview of other important moments in game history can be in found the appendix. Author of thesis states that a more profound **answer** would have been provided if an on-site visit to *The Strong: National Museum of Play* in New York was done as well. In conclusion - this **research question** has been answered.

The procedure of answering the **research question** w*hat are the previous attempts for introducing game history?,*- was carried out by doing an in-depth literature review on the fields of virtual museums, learning environments and game history (online, offline), finding and analysing the previous projects (online, real-life context) that related with the topic of game history. Author states that the **research question** has been **answered** and seven examples belonging to four different mediums are presented below:

1. *History of Games* international conference and the museums *The Strong National Museum of Play* in New York (US) and *ComputerSpiele Museum* in Berlin (GER).
2. Gamified lecture utilising two learning environments - classroom and a virtual (digital) learning environment.
3. Four virtual museums in the categories of *Images and Text,* S*earchable Databases, mixed.*

The final **research question** *(What is a suitable format for introducing game history?)* required the implementation of theory gathered during the *Study* phase in the methodology into the design of the learning environment. The research process informed author that a virtual museum that can be used as a learning environment, with included gamification and game-based learning elements implemented, can be used to introduce game history. **Research question** is acknowledged as answered.

Main concepts as derived from the thesis title:

Virtual museum, classified in the *images and text* category about game history is the *Discover* level, designed and developed using *Visual Novel Engine* plug-in with *Unity 3D*.

E-learning concept was utilised because the learning process is executed by the use of technology (web, mobile).

Gamification principles utilised are the implementation of a game element into the *Discover* level that is *a form of art,* and that was done having a visualised text (colours, *type-writer effect)* with sound-effects played when letters are typed, with a soundtrack implemented also.

Using **Game-based learning** is evident in the levels *Play* and *Test* - to learn about the game genres, a method was provided that an example of game can be played by learners. *Test* level is using a quiz game to test learner's knowledge (**assessment**) with a score system (a *reward* game element).

3.5.1 Use of the learning environment

A learning environment should have a connected **community** and in this sense, the target community are the students and teachers in the programme of *Digital Learning Games (Tallinn University)* that could use this as more engaging educational tool to learn about game history. Learning environment must be learner-centred, meaning that it can be accessible from multiple contexts (out-of-class), and as the learning environment is a software program - this can be achieved. Another component of a learning environment is **assessment** which is carried out by an automated feedback playing the *Test* level with the previously mentioned score system. The gamification and game-based learning principles implemented might engage students more in both learning and assessment processes. Another element of a learning environment is the **content** (knowledge) and an important aspect of it is that the learning content should be flexible and customisable in the future by the educator, so access to the prototype is possible with a simplified process because ready-to-use user-generated plug-ins are implemented: XML script with questions and answers can be imported and it is provided in the appendix directory as a template, together with instructions how to use it. *Unity 3D* is a multi-platform game engine so the teachers (lecturers) could export the e-

learning environment to multiple platforms, including *Android*, *Windows*, *Mac* and a number of others, such as *Facebook Games* and even *Samsung TV's*. Information in the learning (*Discover)* level can be done by importing a CSV file (as *converstations*).

3.5.2. Problem

Reward game element was not employed yet but it is a plan in future development but in the context of gamified (or game-based) e-learning environment, one important aspect might be *extrinsic reward* and there is no possibility to share the score on a scoreboard directly at the moment (2017.05.01). While it's still possible to share the results (e.g. taking a screenshot and sending, showing other people the score physically (on-screen), writing it down or just comparing the scores orally).

3.5.3 Further studies

Addressing the **problem** that was stated in the paragraph before (*problem* section), it would be possible to share the score using a *Facebook SDK (*software development kit) for *Unity 3D*. Then students and lecturer could create a *Facebook* group (open, or closed) where the students could share and compare their results. Another option to share the results would be to use a *Unity 3D* plug-in made by *White Dev,* titled *iOS Post to Twitter/Facebook/Mail* to share the results on the mentioned (in the title) mediums, but using only an iOS (iPhone, iPad, iPod) device.

The final suggestion would be to develop a virtual game museum in 3D space using 3D models of gaming platforms acquired from a popular repository *Turbosquid* - one of their

Image 39. *3D model collection of game devices*

collections is titled *Game Consoles Collection* sold by 3D_molier (2017.04.30) (see **Image 39**). In combination with a *First Person controller* such as *Pure FPP controller* plug-in (made by *Fireballed)* sold in *Unity Asset Store* (2017.04.30) and (or) other plug-ins for object examination, could serve as a solution for an interactive 3D game museum, where players (learners) could navigate in 3D space and interact with (visually inspect and manipulate) various realistic game platforms and their input controllers, it would be an innovative solution for a virtual game museum and an e-learning environment.

SUMMARY

Main goal of the current thesis was to create a virtual game museum that would be a gamified e-learning environment for learning game history. Main needs of the thesis were the lack of different mediums (structures) introducing game history and the lack of student engagement and also negative student feedback regarding the lecture on game history that was carried out by Martin Sillaots during Basics of Game theory of Design course in Tallinn University. Author of thesis conducted an in-depth research in the field of virtual museums, learning environments and game history and then designed and built a virtual museum as an e-learning environment by combining central elements of the learning environment (content, community basis, different contexts of a learner, assessment) with virtual museum elements - presenting historic information in digital format. Learning environment display gamified (visual novel genre-based) historic digital game information, with a follow-up game-based learning assessment - a quiz game about game history. Also, author of current thesis designed and developed an additional game-based learning activity, that lets learners try (play) a 2D platformer genre game to familiarise themselves with the basic functionality (of the game genre). Usefulness of the project is that it could be used as an educational tool during *Basics of Game Theory and Design* course in Tallinn University. Future studies would include making a 3D virtual game museum.

Summary (foreign language)

Käesoleva magistritöö eesmärgiks oli virtuaalse mängumuuseumi loomine, mis omakorda looks mängulise e-õppekeskkonna mänguajaloo õppimiseks. Magistritöö kirjutamise vajalikkus tulenes sellest, et puudusid meediumid (struktuurid), mis tutvustaksid mänguajalugu ning üliõpilaste negatiivsest tagasisidest Martin Sillaotsa loengutele mänguajaloost „Mänguteooria disaini põhialused“ Tallinna Ülikoolis.

Magistritöö autor tegi põhjaliku uurimistöö virtuaalsetest muuseumidest, õppekeskkondadest ja mänguajaloost, misjärel autor disainis ja lõi virtuaalse muuseumi.

Virtuaalne muuseum on e-õppekeskkond, mis ühendab õpikeskkonna kesksed koostisosad (sisu, kogukond, õppija erinevates kontekstides, hindamine) ja virtuaalse muuseumi koostisosad - esitades ajaloolise teabe digitaalsel kujul. Õppekeskkond kuvab mängulise (visuaalselt romaanipõhise) informatsiooni digitaalse mängu ajaloolistest aspektidest, andes ühtlasi tagasiside ja hinnangu õppeprotsessi kohta, milleks on viktoriin mänguajaloost.

Täiendavalt disainis ja arendas magistritöö autor veel ühe mängul põhineva õppetegevuse, mis laseb õppijatel proovida 2D platvormil rollimängu, et mängužanri põhifunktsioonidega tutvuda.

Magistritöö kasulikkus seisneb selles, et seda saab kasutada õppevahendina Tallinna Ülikooli loengutsüklis „Mänguteooria disaini põhialused“. Edasine uurimistöö võiks hõlmata 3D virtuaalne mängumuuseumi loomist.

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Appendix

Link to the **prototype** and **appendix** repository:

https://drive.google.com/drive/folders/0B3OQ-Saosqm5bG5kb282UnRVeTQ?usp=sharing