

Bachelor's Thesis

Business Administration

2020

Jani Nevaranta and Aleksu Turunen

MOBILE GAME DEVELOPMENT FOR BLIND AND VISUALLY IMPAIRED AUDIENCE

– Case: AudioWizards

BACHELOR'S THESIS | ABSTRACT

TURKU UNIVERSITY OF APPLIED SCIENCES

Business Administration

2020 | 44 pages

Jani Nevaranta and Aleksi Turunen

MOBILE GAME DEVELOPMENT FOR BLIND AND VISUALLY IMPAIRED AUDIENCE

- Case: AudioWizards

The objective of this thesis is to convey a clear idea which methods and actions are needed to create a working game product for the blind and visually impaired audience. The methods in practice are shown through the case game called AudioWizards. AudioWizards was developed by myTrueSound Oy together in cooperation with students from Turku University of Applied Sciences.

The knowledge base used is composed of product and game development models and theories and public market research surveys about video game players. In addition, an internal company market research survey was used to confirm the target group characteristics.

The product development model used was agile software development model in iterations. The iterative method was used as game development differs from normal product development with perceived goals and customer needs changing during the testing phases.

Based on collected data the target group are blind and visually impaired, under 35-year old males with high proficiency in English and want of challenging playing experience. The target group plays games actively, at least on three days in a week.

The agile software development model used in the development provided to be successful and the game was finished in a satisfactory manner on time for the launch on September 1st. Although the goal sales were not reached, the customer feedback was positive especially from the blind and visually impaired audience. In summary, removing some unnecessary outsourcing, changing the game's type from an audio game to a video game and changing the pricing model to be closer to other mobile games are the most impactful as the outcome of the process.

KEYWORDS:

product development, game development, accessibility

Jani Nevaranta ja Aleksi Turunen

MOBIILIPELINKEHITYS NÄKÖRAJOITTEISELLE KOHDERYHMÄLLE

-Tapaus AudioWizards

Opinnäytetyön tavoitteena on esittää selkeä kuva siitä, mitkä keinot ja toiminnot ovat tarpeellisia toimivan pelin kehittämiseksi sokeille ja näkörajoitteisille. Tuotekehitysmallit tuodaan esille käytännössä AudioWizards -nimisen pelin kautta. AudioWizards kehitettiin myTrueSoundin ja Turun ammattikorkeakoulun opiskelijoiden välisessä yhteistyössä.

Tietoperustana käytettiin tuote- ja pelinkehitykseen liittyviä malleja ja teorioita, sekä julkista markkinatutkimus dataa videopelejä pelaavista. Näiden lisäksi yrityksen sisäistä markkinatutkimusta käytettiin vertailussa kohderyhmän piirteiden varmistamiseksi.

Tuotteen kehityksessä käytettiin iteraatioissa toteutettavaa ketterää ohjelmistokehitysmallia. Iteraatioissa toteutettava malli valittiin yleisien tuotekehitysmallien sijaan, koska tavoitteet ja kohderyhmän oletetut tarpeet voivat muuttua pelinkehityksen testausvaiheiden aikana.

Kerätyn datan perusteella kohderyhmäksi muodostui sokeat ja näkörajoitteiset alle 35-vuotiaat miehet, joilla on hyvä englannin kielen taito. Kohderyhmään kuuluvat pelaavat aktiivisesti videopelejä, vähintään kolmena päivänä viikossa.

Ketterä ohjelmistokehitysmalli osoittautui toimivaksi ja peli saatiin valmiiksi tyydyttävässä muodossa ajallaan ennen pelin julkaisupäivää, ensimmäinen syyskuuta. Vaikkei myyntituloksia saavutettu, asiakaspalaute pelistä oli positiivista erityisesti sokeiden ja näkörajoitteisten keskuudessa. Johtopäätöksenä merkittävimmät kehityskohdat ovat tarpeettomien ulkoistamisien poistaminen, pelin tyyppin muuttaminen pois audiopelistä ja pelin hinnoittelumallin muuttaminen lähemmäs mobiilipeleissä yleisesti käytettyjä malleja.

ASIASANAT:

tuotekehitys, pelinkehitys, saavutettavuus

CONTENT

1 INTRODUCTION	7
2 PRINCIPLES OF PRODUCT DEVELOPMENT	9
2.1 New Product Development and Game Development	9
2.2 Traditional and Agile Product Development Models	10
2.3 Product Development Strategies	14
2.4 Understanding the Risks and Stakes	16
3 TARGET MARKET	18
3.1 Demographic	19
3.2 Blind and Visually Impaired Target Group Characteristics	22
3.3 Conclusive Thoughts on the Target Group	26
4 THE DEVELOPMENT PROGRESS OF “AUDIOWIZARDS”	27
5 CONCLUSION	40
5.1 Sales Results	40
5.2 Customer Feedback	41
5.3 What Could Have Been Improved	41
REFERENCES	43

FIGURES

Figure 1. Visualization of the Waterfall Development Model (Hughey 2009).	10
Figure 2. Visualization of the Iterative Development Model (Powell-Morse 2016).	12
Figure 3. Gantt chart of the game development phases of AudioWizards	13
Figure 4. Mytruesound.com visitor data from January 2019 to September 2019 by age.	20
Figure 5. Strongest age groups in key European markets (ISFE 2018).	20
Figure 6. Percentage of individuals using the internet to play or download games by age (Eurostat 2018).	21
Figure 7. Top 10 percentage of mobile game users by country (allcorrectgames.com. 2019).	22
Figure 8. Video game playing activeness per day by individual from the myTrueSound market research survey (Internal company survey, Gwock 2018).	24
Figure 9. Average spend on games per consumer (Economic Study on Consumer Digital Content Products, EU Commission 2015, 118).	25

Figure 10. Fair price for a game that suits the player's needs (Internal company survey, Gwock 2018).	26
Figure 11. A screen capture of the blog used by the group.	28
Figure 12. AudioWizard's planned tutorial loop used by the team.	30
Figure 13. AudioWizards elemental affinity cycle.	33
Figure 14. Forest and Village environments from AudioWizards.	35

TABLES

Table 1. Risks and their consequences AudioWizards faced during its development. .	16
--	----

LIST OF ABBREVIATIONS (OR) SYMBOLS

AR	Augmented Reality. Defined by Cambridge Dictionary (2020) as “images produced by a computer and used together with a view of the real world”.
B&VI	Blind and visually impaired.
VR	Virtual Reality. Defined by Cambridge Dictionary (2020) as “a set of images and sounds, produced by a computer, that seem to represent a place or a situation that a person can take part in.”

1 INTRODUCTION

This thesis consists of the new product development progress of an audio game called AudioWizards, released on 1st of September 2019, from its initial creation to the game's launch. The game was initially screened as a capstone-project for a university course in Turku University of Applied Sciences by the company myTrueSound Oy, an audio game developer start-up company based in Turku, Finland. The writers of this thesis have been part of the game's development since the beginning.

MyTrueSound Oy as the project owner has set up itself on the path to become one of the leading developers in the audio game industry. Majority of their target customers are blind and visually impaired people living all over the world with an access to a mobile device and/or computer. According to myTrueSound, there exists about 20 million blind and visually impaired people with such access to a varying degree across the world. One of the myTrueSound's value thus is immediate accessibility in their products for blind and visually impaired users. Other values company aims to accomplish are to make high quality audio game's, to give equal opportunities to the players playing their games and to be trustful game studio that is recognized industry wide.

MyTrueSounds goal as a joint-stock company is to make a profitable business. The company has set up as their goal to turn from an audio game manufacturer to an audio game publisher. This has been planned to be accomplished within the next three to four following years as the company develops its audio game engine and generates trust and recognition in the industry by their self-published games.

MyTrueSound is a small indie game company operating in Turku, Finland. The company had as of the start of the project four to six employees and was mainly funded by several investors from different technology advocating funds. The company was working on another game project, GoldGun, at the start of the project.

The working group for the project and product development was a group of nine students from the Turku University of Applied Sciences. From the group, seven students were studying game development and two students were marketing students. The skills within the group varied from the game design and programming to arts and sales. No one in the group had worked in a project of this scale before. All members in the project were participating in the project as a part of their studies as a part of the Innovation Project - course, also known as Capstone.

The goal of the project was setup as the following: "Develop a New Audio Game Utilizing 'IMAGE'-Audio Game Engine for the Blind and Visually Impaired Audience". The project was set to run for about seven months with a handful of students from the group continuing the project as trainees for myTrueSound Oy. The project had no clear set budget expect the funds that went into paying the Capstone course.

2 PRINCIPLES OF PRODUCT DEVELOPMENT

2.1 New Product Development and Game Development

In the new product development, the process of moving from an idea to a sellable product is a phased progress to reduce uncertainty in different problem-solving stages that can be visualized in a form of gates (Tidd & Bessant 2013, 407).

Commonly presented model for the new product development can be seen as the following: (Trott 2017, 489)

1. Idea Generation
2. Idea Screening
3. Concept Testing
4. Business Analysis
5. Product Development
6. Test Marketing
7. Commercialization
8. Monitoring and Evaluating

According to Kotler (Kotler et al. 2017, 271-272), a successful new product development should also be centered to be customer orientated. It is crucial that the customer is understood throughout the whole product development procedure. From this we can conclude that the product should be constructed in relation to the customers' values and wishes.

Game development is software development with art, audio and gameplay. Understanding the key elements in software development helps the game development to stay on budget and on time (Bethke 2003, 4). From this, we can conclude that models used in software development should be favored when compared to traditional product developments models. However, this does not mean that elements from traditional product development should be left out in their entirety. This includes methodologies used to build customer orientated models and when visualizing the product development models. The common new product development model presented by Trott (2017), for example, can be utilized as a general product development process model but should

not be used literally when applied to the game or software development which differ even drastically from the more traditional product development.

2.2 Traditional and Agile Product Development Models

Waterfall model, as seen in the Figure 1, is an example of a traditionally popular product development model. However, it is unsuitable for game development due to the nature of game development. In the game development, changes can and will happen throughout the development process as the game changes after testing and feedback. In waterfall model, the budget used in the development process is directly used in order to attain the goal set in the model. Setting that goal in game development may mean the game misses the optional path during the development and the end result, that was initially set, turns out to be a dissatisfying product. For an example, if a game development followed Waterfall model accordingly, it would mean no code would be implemented before the all of the decisions would be made (Cohen & Bustamante 2009, 100-101). This could be fatal for the new product's development and would result in a lot of stale time where only part of the group is working.

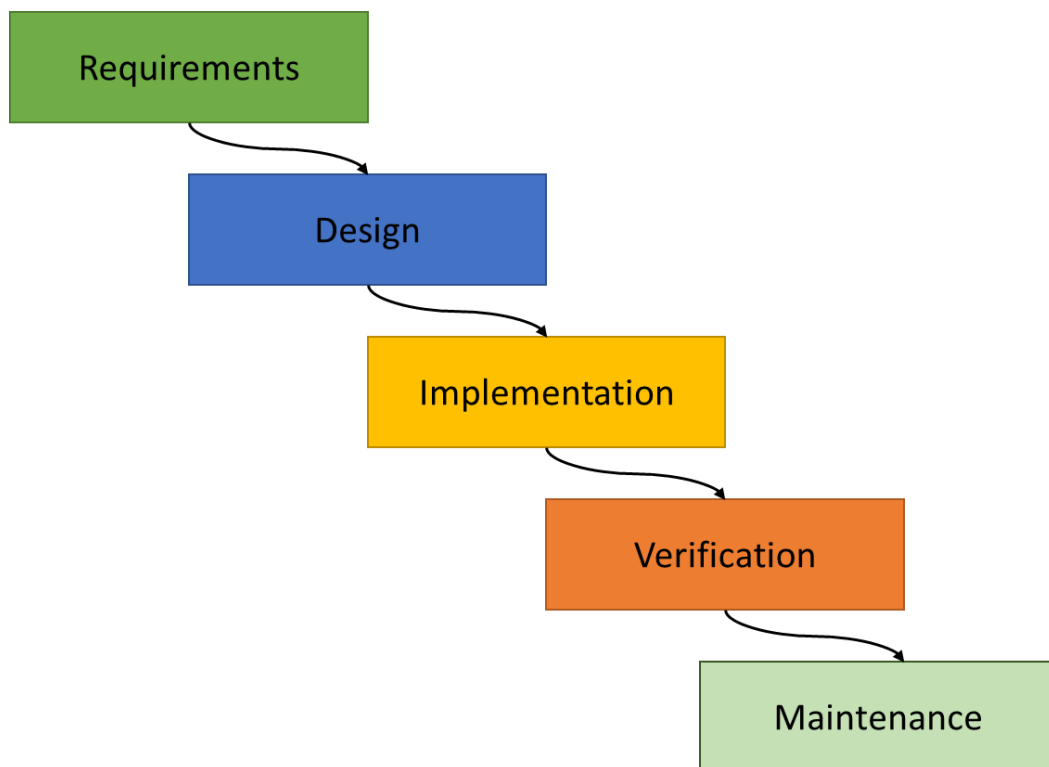


Figure 1. Visualization of the Waterfall Development Model (Hughey 2009).

Thus, waterfall model is usually not suitable for software or game development. However, agile models are used in this type of product development to create fast iterations in a short span of time. This is done in a process where the goal for the product development is set again after a certain period of time (Ferrara 2018). Each iteration in the agile product development is like its own project (Ferrara 2018).

Agile software development models and methods can be described in short by following principles where items on the left are valued more than items on the right: (Beck et al. 2001)

- Individuals and interactions over processes and tools
- Working software over comprehensive documentation
- Customer collaboration over contract negotiation
- Responding to change over following a plan

The main point in these four values is to value teams of individuals and to welcome change (Beck et al. 2001). This can be seen as a contrast to the traditional product development models, such as the waterfall model, where the goal is set as an absolute ending point with no alternative paths.

As the product is worked in agile iterations and incrementally, the development team has time to learn from its mistakes from last iteration and adapt during the development process. These changes can occur in response to the different factors such as tester feedback, competitor response and discovery of new technological advances (Trott 2017, 502-503). This suits well in the game development where the goals and targets set by the developer in the beginning can change according to the feedback given by the testers.

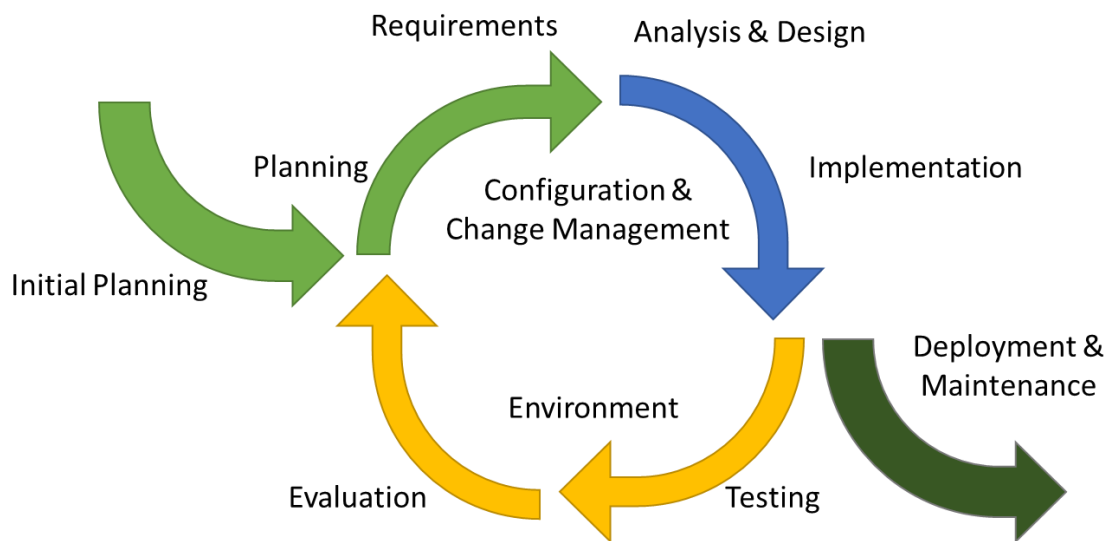


Figure 2. Visualization of the Iterative Development Model (Powell-Morse 2016).

In practice, the product will go through a similar iteration process as seen in the Figure 2. The first step is to go through the planning and setting the requirements for the iteration. Once planning is finished, an analysis and design stage is conducted to establish the technical and business requirements. Implementatiton is the process of implementing all the planned material and design after which the testing procedures can be started. After the testing is finished, the iteration goes through evaluation where it is decided whether another iteration is needed. The iterative cycle can be done as many times as need until the product reaches its satisfactory state and is ready for deployment and maintenance. (Powell-Morse 2016.)

In iterative and incremental development, it is typical to finish each iteration with a demo for stakeholders (Farcic 2017). As the working model is available earlier than in for example waterfall model it is much easier to notice the problems in the product and fix them (Farcic 2017). In AudioWizards case during the Capstone period, each iteration lasted for a long time and the demo was only shown if any major changes had occurred. This changed during the later stages of the development however, as the the iterations got more frequent. During the last three months of the development, a demo was showcased for all stakeholders weekly. The stakeholders in that time were the owner of myTrueSound and the five developers included in the development and marketing.

Game development usually follows the following general phases before the launching of the game (Prystupa-Rządca & Starostka 2015):

- Concept development – decision about type of the game and targeted segments.
- Preproduction – strategic plan of implementation, division of responsibilities, demo version.
- Production.
- Testing phase:
 - Alpha: development of basic structure of the game.
 - Beta: tests of a fully playable game.

In AudioWizards case, these phases can be assigned to the respective periods in the year the game was in the development as seen in Figure 3. Capstone period was used for the concept development and preproduction and the last three months during the practice period consisted of the production and testing phases.

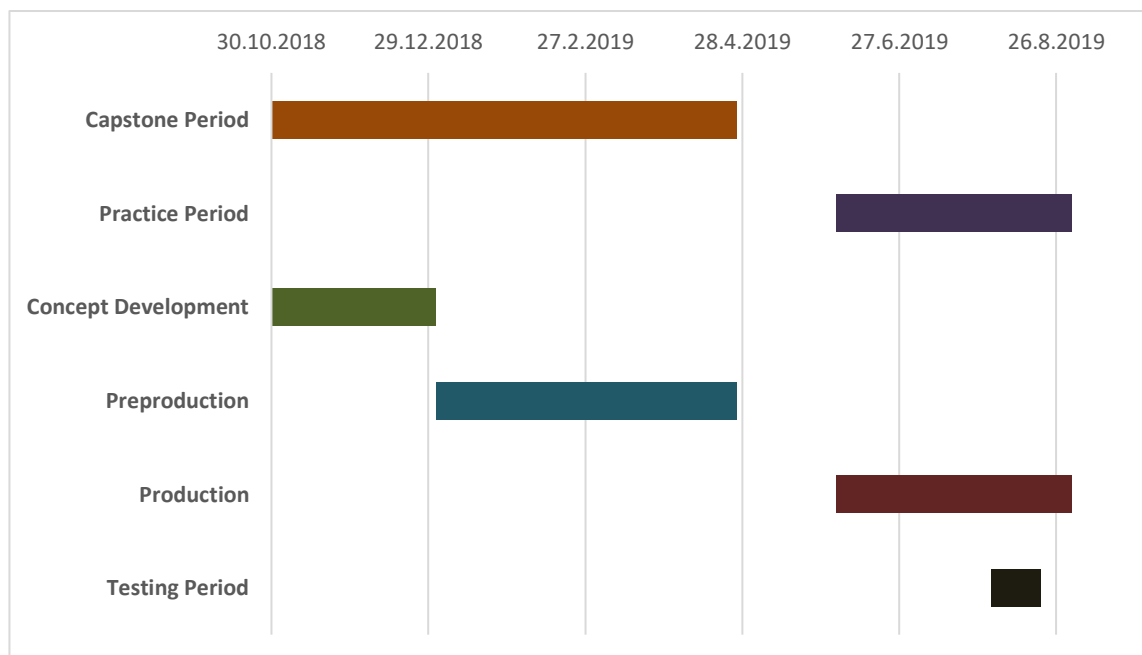


Figure 3. Gantt chart of the game development phases of AudioWizards

Concept development during the Capstone period consisted of brain storming the game's concept and marketability. The preproduction stage was used to create the game's first playable demo and to finalize the game concept. During the production

phase, the final game was made. AudioWizards spent last weeks of its development in testing where we added last bits of content from the feedback we got.

2.3 Product Development Strategies

Product development strategies are used to minimize the risks in product development. By constructing and following a proper product development strategy the intended goal of the product development can be reached leanly and with a minimized effort of a setback.

The development of AudioWizards should follow the following strategies in order to gain an advantage against its competitors. The competitors AudioWizards should be compared to are the other audio games and some mobile games with accessibility features, to an extent.

Competing through Proliferation

Competing through proliferation, also known as “trial and error marketing”, is a competing strategy where the product competes against its competitors through variety and product proliferation (Baker & Hart 2007, 30). Using this strategy, the product is catered to a certain audience through research or trial and error. In a way, using this strategy the product is made according to the customer’s needs, wants and wishes. The proliferation of AudioWizards comprised of the studies and research conducted through the user discussions in different audio game forums and social media.

Competing through Value

When a product competes through the value it brings to the customer the product aims to maximize relation between the cost and the value the product brings when compared to the competitors (Baker & Hart 2007, 31). While many improvements increase the products immediate value, most of the time they also increase the costs for the customer. In AudioWizards this can mean adjusting the cost of the game to the customer to be on par to the most games of its perceived value.

Competing through Design

Competing through design means the product is perceived by the customer to be “pleasantly designed”. The design should also be in parallel to the product developer’s

values and brand. We aimed AudioWizards to be “pleasantly designed” by making it easy to operate and use, appealing, safe, easy to install and easy to be understood. Successful design is a combination of aesthetic and engineered design (Baker & Hart 2007, 31-32).

Competing through Innovation

To compete through innovation the product has to be innovative in some way or another. Successful innovation can be derived by filling the empty spots left in the current market. Innovations can also be improved by the previous, unsuccessful innovators who did not have sufficient marketing resources or position (Baker & Hart 2007, 32). This is why most of the successful innovators are the fast followers that come after the original innovator (Baker & Hart 2007, 32). For AudioWizards, the game could utilize some already familiar gameplay elements that already exist from other games but improve them. These improvements include better incorporation of the gameplay sounds, greater focus on difficulty and logical, easy-to-use navigation.

Competing through Service

When a product competes through a service, the product and its related subjects are given a good customer orientated service in a form of quick, quality response to a call of service in the time of need. When compared to its competitors, the product has a superior service given to the customer when the customer compares it to the alternatives (Baker & Hart 2007, 33). The customer or the user of AudioWizards should be given access to a quick contact and response by the developers. This was conducted through a daily email, social media and forum response checkups by the marketing personnel once the game’s marketing started.

2.4 Understanding the Risks and Stakes

Understanding the risks and stakes is an important part of new product development. The existing risks and their consequences for the project at the start of the AudioWizards Capstone project can be identified in the Table 1.

Table 1. Risks and their consequences AudioWizards faced during its development.

Risk	Consequences
Lack of safe funding.	Limited budget. Risk of losing business.
Lack of proper, devoted time.	Uncertain deadlines. Time is hard to manage.
Bare informative resources.	Research has to be made by the company or developers.
Lack of experience from the stakeholders.	Uncertain or bad decisions.
Missing the clear, defined goal and purpose.	Lack of motivation. Lack of proper way to manage time.
Unrefined team composition and jobs.	Absence of management.

While many of the mentioned risks were overlooked at the start of the product development, some of them were recognized immediately. One was the lack of funding which was also one of the main reasons to outsource the product development to the student group in the university Capstone course. Other limiting factor that was originally realized quickly was the lack of time given to develop the game. The project was started with these two limitations which is why the project was limited very fast in scope to be a single-player, arcade type of game which could be developed quickly relative to the cost

and time given. Majority of the risks, such as the lack of experience from the stakeholders and unrefined team composition, had consequences to the project during the Capstone period but the risks diminished as the team got smaller and more confident. The remaining team also had more devoted time for the project during the practice period.

Many of the later risks were realized, unfortunately, only later during the course of the product development which further stressed the first two limitations, the time and funding. Thankfully, the chosen development model in the form of iterative, agile model gave the development some leeway to adjust to these mistakes as the project could easily be adjusted in accordance to the model. Thanks to the chosen model, the team could adjust their time and resources to the problem they were facing. If the chosen model would have been the waterfall model, for example, focusing the most prominent problem at times would have been difficult as every resources would have been aimed towards the end goal.

3 TARGET MARKET

Our primary target group is blind and visually impaired English speaking-audience worldwide. The target group was previously defined by myTrueSound based on previous research. Our work focuses on comparing the blind and visually impaired target group to video game players in general.

Because of the nature of our product AudioWizards which is an audio game, the choosing of the target group was fairly obvious. For proof of concept myTrueSound conducted a market analysis survey in 2018 studying the B&VI audience.

The survey was conducted with users from a forum dedicated to audio games called Audiogames.net and Spanish B&VI Facebook groups. In total 186 people participated in the survey. Although the survey group is rather small, it gives a good overview of the target demographic. We will be comparing the survey results to two different market surveys one based in the USA and one based in Europe.

The three surveys used are “2019 Essential Facts About the Computer and Video Game Industry by the ESA (Entertainment Software Association)”, “2019 Key Facts by the ISFE (Interactive Software Federation of Europe)” and the internal company survey by myTrueSound. The ESA’s survey was conducted in May of 2019, with data from over 4000 Americans. The ISFE’s survey uses data extracted from GameTrack covering France, Germany, Spain and the UK.

3.1 Demographic

Gender

The general view is that most video game players are male, while researching this topic the evidence points to it being partly false. According to a targeted survey done by the ESA conducted in May 2019, 54% of American players are male while 46% are female. The same numbers (46% women and 54% male) can be found on a survey conducted by ISFE (ISFE 2019).

Based on these surveys we can see that males are in fact the major demographic, but globally the gap is much narrower than we expected. We can further confirm this by looking at myTrueSound's visitor data from Google Analytics. Compared to global data, our Google Analytics data shows that the clear majority was male, close to 70%. The result were similar in our internal company survey closer to 70% male.

Age

The survey by myTrueSound did not ask the age of the participants, so the age group of our customer base is compared to myturesound.com website visitor statistics obtained from Google Analytics.

The myTrueSound Google Analytics data is shown in Figure 4 which shows that the largest age group is under 35-year olds. Compared to ESA's survey the strongest age group in American households is also under 35-year olds with a 40% share among participants. (ESA 2019).

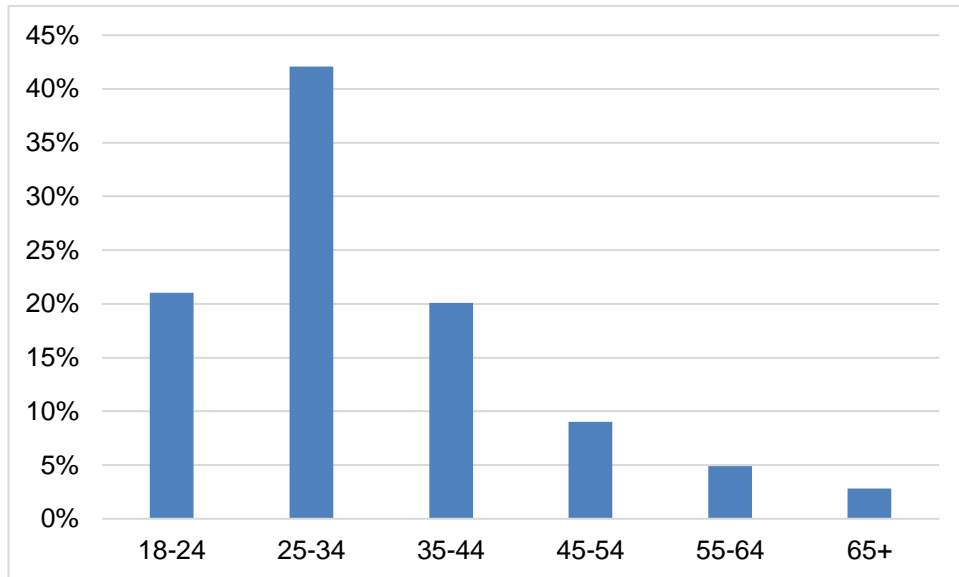


Figure 4. Mytruesound.com visitor data from January 2019 to September 2019 by age.

Comparing myTrueSounds's Google Analytics data to the ISFE study is more difficult as the age group data is based on total population rather than individual participants. The largest groups in Europe are 11-14 with 86% of the population answering that they play games. Similar to the myTrueSound Google Analytics and ESA survey under 35-year olds were the second largest group. In Europe the strongest growing age group is 25-34 as seen in Figure 5. (ISFE 2019).

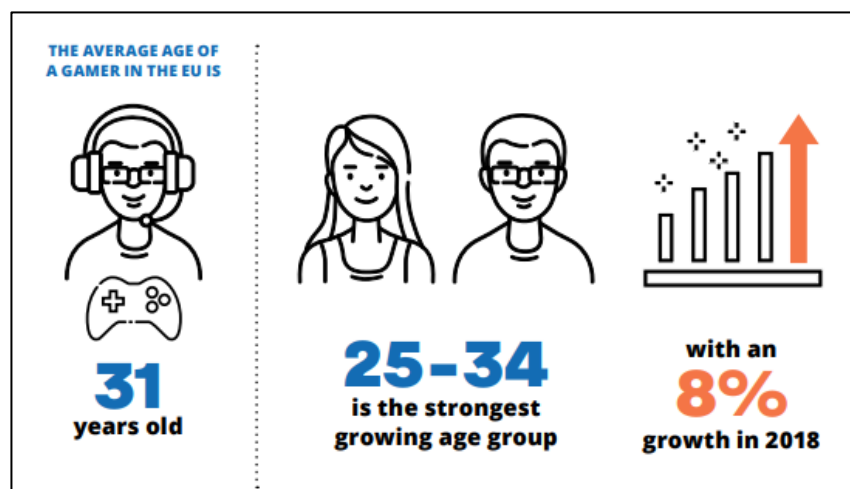


Figure 5. Strongest age groups in key European markets (ISFE 2018).

We also compared the data to Eurostat statistics seen in Figure 6 and found many similarities. Here 16-19 seems to be the largest group compared to the ISFE data where 11-14 was the dominant one, even though both are based on European data.

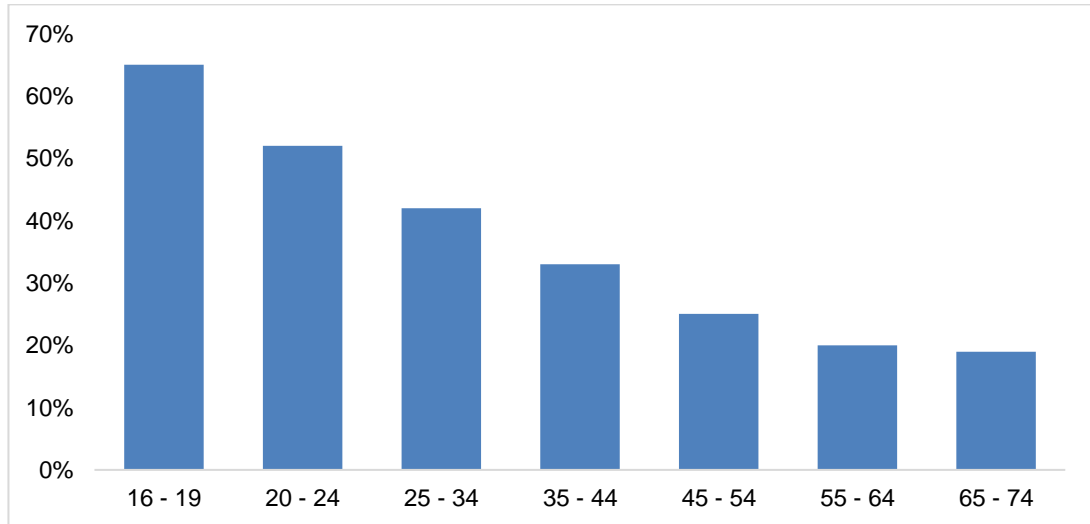


Figure 6. Percentage of individuals using the internet to play or download games by age (Eurostat 2018).

Compared to myTrueSound's Google Analytics and the ESA survey it seems that in Europe the larger age groups peak at under 25-year olds rather than under 35-year olds. (Eurostat 2018).

Geography

Geographical location was not a part of the research questions in myTrueSound's market research survey, so we made decisions based on market size and the level of English proficiency.

China holds the largest mobile game market by far. The USA and India are the second and third biggest markets as seen in Figure 7. (allcorrectgames.com. 2019).

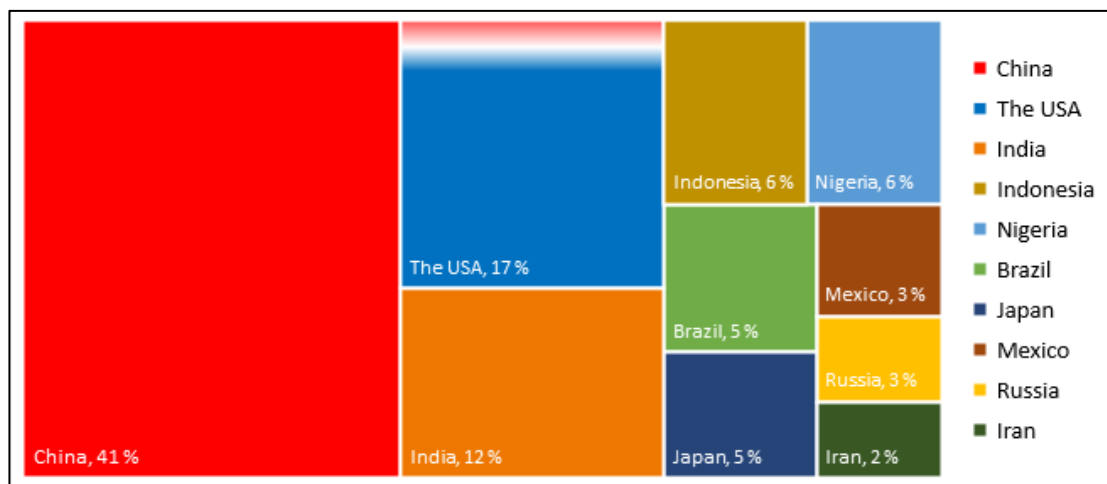


Figure 7. Top 10 percentage of mobile game users by country (allcorrectgames.com. 2019).

Even though the biggest mobile game market is in China, we focus more on the USA and English-speaking European countries because AudioWizards is fully in English. We chose to focus on these countries because the easier reach was more important than the market size. Additionally, Google services, including the Google Play Store are not available in China limiting availability and increases needed resources for the game. (Bloomberg 2018).

According to the EF English Proficiency Index the 10 most English proficient countries in order are Sweden, Netherlands, Singapore, Norway, Denmark, South Africa, Luxembourg, Finland, Slovenia and Germany. (EF English Proficiency Index 6. 2018).

On the other hand, limiting our operations to English speaking countries removes the need for translation thus lowering production costs, as the company already has limited resources. AudioWizards had all game dialogues and game text only in one language, English.

3.2 Blind and Visually Impaired Target Group Characteristics

Challenges In Gaming For The Blind And Visually Impaired

According to a survey done by the University of Melbourne (Andrade etc. 2019, 12) people with visual impairments tend to have similar gaming habits when comparing to

sighted players but confront a series of barriers regarding to games. Some of these barriers were limited self-representation, perceived lack of complexity in games and fear of missing out more specifically new technologies like VR and AR. One modern example is the highly popular mobile AR game Pokémon Go which was completely inaccessible for low vision players.

Playing games on devices like game consoles can be difficult to B&VI players but technological advances like the Xbox Adaptive Controller have opened up a lot of way for accessibility. Using devices is a necessity nowadays and B&VI people find ways like screen-readers to use devices like smartphones. Screen-readers are widely used on computers too which ables the B&VI players to play on computers too. The technology and ways exist but accessible games are rarely developed, perhaps because developers don't know how or because it is assumed to add costs.

Based on this data we can deduce that the B&VI target group have a need for more complex games and a desire for a sense of community. We consider a niche market to be easier to reach and that a game providing both a sense of community and high quality entertainment would bring more value to the audience. This would make the B&VI audience a good choise business wise. These aspects were some of the deciding factors when developing AudioWizards as shown later. AudioWizards aims to be both challenging and as accessible as possible for low vision players. We wanted to add the visual layer to the story telling as a way to make AudioWizards appealing for both B&VI and sighted players. In principle, a community including both sighted players and B&VI ones, is gapless and larger than only the B&VI or sighted ones.

Playing Habits and Purchase Behaviour

In the survey conducted by myTrueSound there were some research questions regarding the playing habits and purchasing behaviours of the target group in addition to demographic question.

Shown in Figure 8 almost all participants answered that they play games at least once a week, with seven days being the highest group.

The results of the ESA and ISFE surveys only show the number of hours played per week. 77% of Europeans playing at least one hour per week (ISFE 2018) and 60% of American playing at least 1 hour daily (ESA 2019). Based on this it is not possible to

determine if the B&VI target group is more active compared to sighted players because of the different measurement methods.

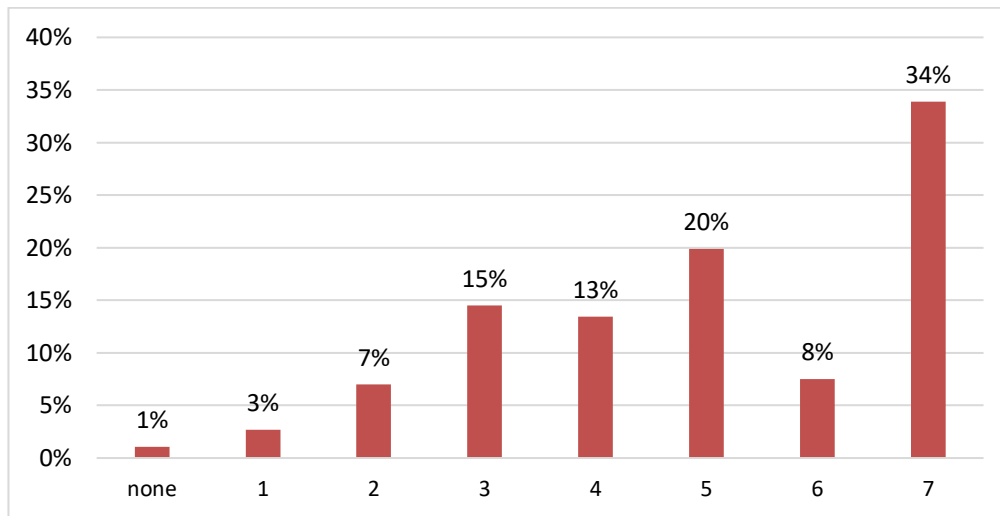


Figure 8. Video game playing activeness per day by individual from the myTrueSound market research survey (Internal company survey, Gwock 2018).

The B&VI target group are also active spenders in games. From the myTrueSound survey over 74% of individuals answered that they had spent at least one to five euros on games in the last 12 months. Between individual who had spent at least some amount of money 24% answered that they had spent 20-50 euros in games. What we found interesting was that almost 10% of individuals answered that they spent over 100 euros.

Compared to Eurostat data shown in Figure 9, Europeans spend about 79 euros in total on games on average per year with the UK having the highest average per consumer 132 euros per year. (EU Commission 2015). Something worth noticing is that the countries that have higher English proficiency are mostly at the higher end of average spendings.

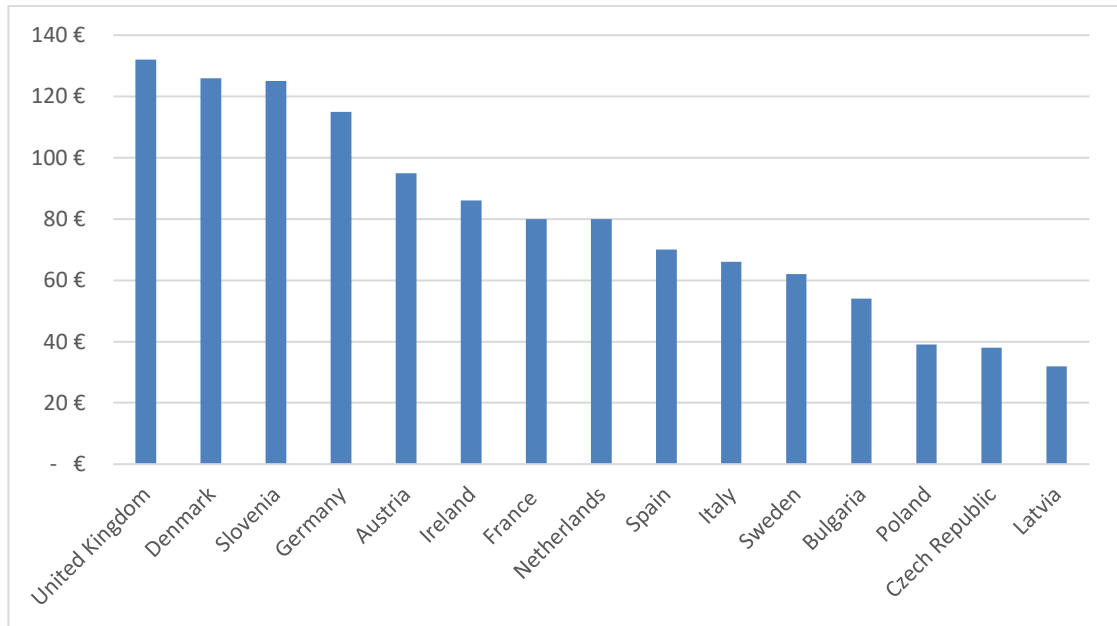


Figure 9. Average spend on games per consumer (Economic Study on Consumer Digital Content Products, EU Commission 2015, 118).

We used the average spending data to justify our pricing of five euros which is clearly higher than the average app price. The average app price is somewhere around 0,85-1,00 euros depending on the region (pocketgamer.biz 2012).

Our choice for a higher price was partly based on development costs which needed to be covered. From the internal company survey shown in Figure 10 we can see that for the majority of B&VI players price is not a problem.

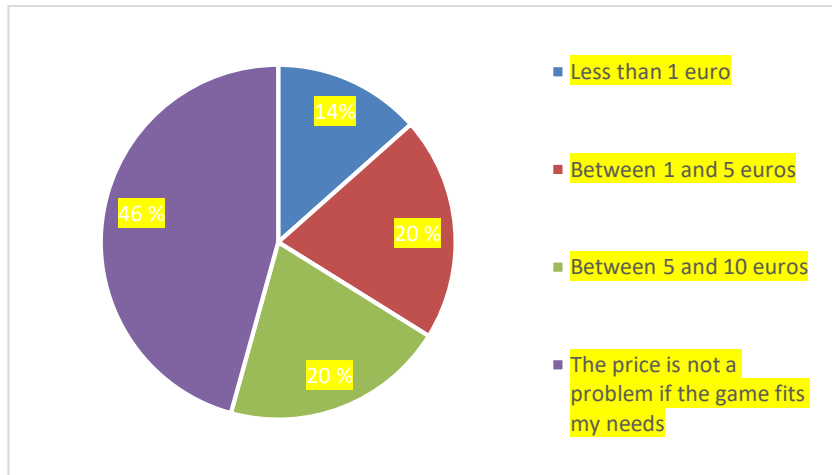


Figure 10. Fair price for a game that suits the player's needs (Internal company survey, Gwock 2018).

Like seen in Figure 10, 46% and 20% answered that anything above five euros is suitable for a game that fits their needs. This reinforced our choice for the pricing.

3.3 Conclusive Thoughts on the Target Group

Main demographic characteristics are blind and visually impaired Americans and European males, ages under 35 years, with high proficiency in English. We also aim to reach sighted players as well, but our actions are more focused on the B&VI audience. In addition, the target group consists of people who play games actively, at least three days a week, and have on average spent over 50 euros on games in the past 12 months.

As mentioned before the B&VI players are looking for a more challenging experience and a sense of inclusion in games. AudioWizards is developed directly in that way. In the end AudioWizards is a casual game fitting a broader target group but also has challenging tasks for player that are looking to test their skills. The inclusion of graphics makes the game appealing for both sighted and B&VI players. This opens up a way for the two communities to intertwine and grow the target group.

4 THE DEVELOPMENT PROGRESS OF “AUDIOWIZARDS”

The new product development progress of AudioWizards consist of the time the game was worked from the start of the Innovation Project -course in October 2018 to the launch of the game in September 2019. The methods, events and results are reported as they were perceived by the writes as a part of the group that worked on the game from the start until the finish.

The Game’s Development During the Capstone Period

The capstone course in 2018 started with a few weeks of idea screening sections where the group working on the “new audio game” started looking for interesting ideas to start developing. In this point the group had no real established roles expect one of the students was mostly dealing with the communication between TUAS and the project leader. The group had decided together with the project owner to report once a week what the group had worked on. Some day after that the group would work independently essentially making the working schedule weekly scrum. At the start of the project the group consisted of nine students with additional help from the project owner’s company in some things such as music production. The project owner also had an internal person to test B&VI features in the developed games.

The first half of the project during the Capstone was devoted to shaping and generating ideas. Many ideas were presented during this phase but ultimately the group ended up choosing an idea about wizardly combat where the player would use different elements to defeat enemies. This idea was chosen due to the majority vote. Other minor reasons were the scalability of the idea and the limited scope the group had to work in due to the time constrains set for the run of the Capstone course. At this point the game was already decided to be on the mobile platform as per request by the project owner which further attributed to the decision to make a game in small scale. The game was also intended to be made utilizing the project owner’s work-in progress audio game engine, “IMAGE”, and help the company to develop the tool.

After choosing the “magic game” idea the group started to work on shaping the game’s idea further. At this point the group still did not have a solidified working methods or theory but rather the group worked on according to the curriculum that was created by the Capstone staff. This did come with a cost to the group who had several group members standing by without anything to do. Despite the group holding weekly meetings but the group only had few members who were doing the majority of the conversations. However, the different mandatory “tasks” the Capstone staff assigned to each group gave the group something to work on together. The tasks were related to different stages of product development and they were supposed to help each group advance their ideas to be more coherent in their structure. The tasks varied each week and had an approximately one week of a deadline per task. These tasks included a shareholder map, idea tree and project owner meeting diary. The tasks were uploaded to the group’s blog, seen in Figure 11.

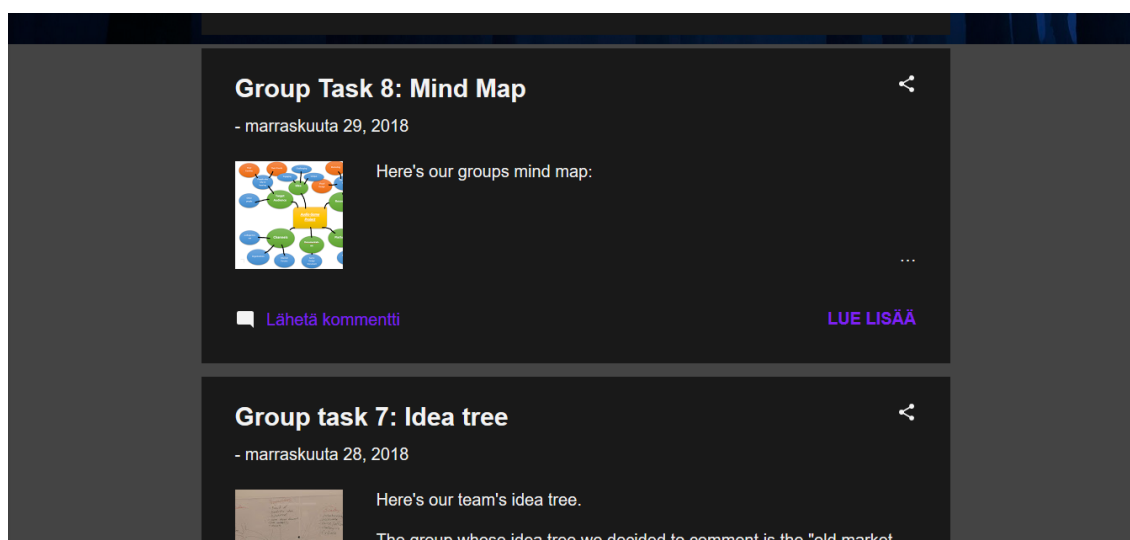


Figure 11. A screen capture of the blog used by the group.

Before moving forward to the next phase in the next year the group had to pitch their idea for the Capstone audience. The pitch would have no real impact regarding the project but there would have been a chance to win a minor price for excellently made pitch. The stress of the pitch however made the group more motivated to shape the idea to its final form before everyone would start their holiday season. The pitch was held in December but unfortunately the group did not win the competition. The idea however was generally praised for its value of generating something “good” for an audience that

does not have an equal access to things such as entertainment and its unique approach to gaming. After the pitch the group decided what would be their plan for the rest of the year and what should they do, starting next year. Ultimately, the group decided that a minimum viable prototype should be made before the New Year. The demo was made and had only the minimum controls and functionality to demonstrate the core behind the idea the group had worked on.

At the start of the 2019 the group returned from the holiday and started work on the project again. At this point, however, some of the group members started to see some faults in the way they worked for the project and how the things were being handled by the project owner. The group essentially felt like the current goal of making a launch-ready game for the Spring would be impossible and the way they had worked on the project was lacking a proper composition and plan. The idea the group had worked was still liked but the working methods and targets were not properly thought. After some internal discussion between the group members, the project owner and the Capstone staff from the university, the group decided to reduce the initial goal of a fully playable game to a demonstrative game with a built-in tutorial and some test levels. The group also decided a role for each member according to their interests and strengths unlike in the beginning where anyone was working on pretty much anything at hand. A timetable and timeline were set-up to further solidify the group's working schedule and deadlines.

The next milestone for the group to tackle was the "ICT-Showroom". In the ICT-Showroom the IT-related projects present in the Capstone course, and from other universities in Turku-region, had a chance to present their ideas and plans to a larger audience in a form of a stand. There would be judges going through the presented projects and prizes for different categories would be given to the best presented projects. The showroom set up a clear deadline for the group as by then the demo version of the project should be in its most presentable form.

The demo version of the game had a tutorial that lasted approximately 5 minutes and gave the instructions for the player how to play the game. The tutorial had a voice acted character that gave the instructions. The test level that was intended to be played after the tutorial and lasted for about five minutes. The game had really simple graphics at this point with only the approaching enemies being properly 3D-modeled. Placeholder sounds were used to represent the sounds of enemies and spells. In the demo, the player had to defend themselves from approaching enemies using magic spells with the instruction given by an instructor character we called "Saundaman". For visualizing this

the group created the Figure 12. The game was presented in this form during the ICT-Showroom with two available test devices and headphones.

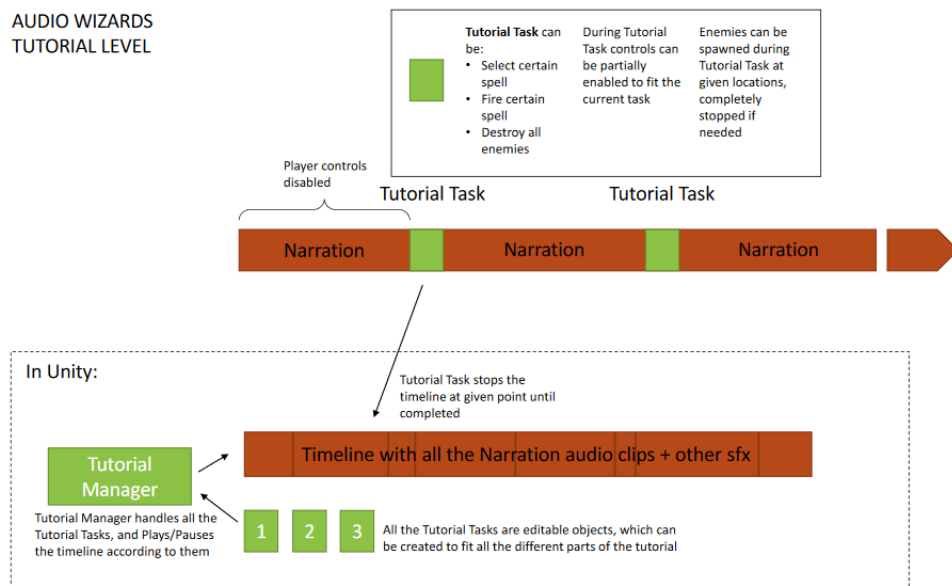


Figure 12. AudioWizard's planned tutorial loop used by the team.

In accordance with Figure 12, the game's tutorial was planned to have a narrative description that would instruct the player what they should do in the Tutorial Task - sections. These tasks would teach the player the mechanics they would later need to play the game. Task would be repeated as long as the player successfully completed the required task.

The general feedback the game got during ICT-Showroom was promising for the group. Many people who tested the game gave constructive feedback how the game could be improved and how they felt about the idea. One of the major feedbacks given by the people who tested it was about the sounds in the game, but the group had already figured at this point the sounds were only placeholders. The tutorial was also deemed quite long and tedious with only a few players patient enough to finish it. Albeit the Showroom was the first time the game was tested publicly, no one who tested the game was a part of the intended target group. The game also caught the interest of the judges and thus AudioWizards won an award for the most unique game idea in the ICT-Showroom.

With the feedback given during the ICT-Showroom the group started to prepare for the Capstone Showroom, a separate showroom event from the ICT-Showroom and the ending point of the Capstone course in 2019. The group made some minor upgrades to

the prototype such as adding an environment to the gameplay scene and improving some sounds in the game. A third-party sound producing company was also appointed at this point to produce sounds required for the game.

Some problems quickly arose from the decision to outsource the sounds. The lack of clear communication between the group and the sound producer led to the sounds being stuck in many repeated iterations, going back and forth between the team and the sound company. This also led to some personal quarrels which made the interactions awkward and more difficult.

Despite the difficulties, the team successfully made a slightly improved demo for the Capstone Showroom. The team once again gathered useful feedback but despite their efforts the game failed to gain any recognition and notion from the Showroom judges as the pitch and presentation might have been lacking compared to the ICT Showroom. After this Showroom the Capstone course was concluded and the project went to a month lasting hiatus. The game received a teaser trailer that was distributed during the hiatus on Youtube and some audio game related forums.

Progress after Capstone

After Capstone was finished and we had a working prototype of AudioWizards, members of the group were offered a position to continue working with the game during the summer. Four members of the original team agreed to continue and decided to conduct their professional practice work in myTrueSound from June 3rd until 3rd of September.

In May 2019 a few weeks before the practice work started, we had already created the first trailer for the game. The trailer was aimed to be the first officially revealed piece of information about the game's idea and story while also creating excitement for the release also known as a teaser trailer. In addition to the trailer we had recorded footage of the voice-acting session which could later be used as marketing material. The trailer was the first official reveal of the release date for September 2019 which meant we had around 3 months to complete the game.

June

We started our practice work in June of 2019. On our first day we had a meeting with our CEO and the continuing members of the Capstone team.

During the first meeting of summer we made plans for the development timeline of AudioWizards. We agreed to have weekly meetings regarding the development and marketing of the game, each week we would view on previous week's tasks and come up with new ones. We found that this method was the most effective for us, since we would have clear goals each week and we would be able to effortlessly find tasks that needed prioritizing. We also decided that the game's focus should be on individual levels that tell the player a story set in the game's world. This decision was backed up by a thought that the game would not have enough content to justify a premium pricing model without a comprehensive story for the player to enjoy. We however also decided to include an arcade type of game mode where the player could compete for the highest score to increase the replay value of the game.

In the first month of our practice work we continued where the development left off in the Capstone project. The first major task was to update and re-design the main menu of the game. Since the game is built for the B&VI audience, we needed to make sure that all elements, buttons and navigation of the menus work with screen reader tools. The way we achieved this was to use Unity Accessibility Plugin or UAP for short. The UAP allows the screen reader tools like the iOS's VoiceOver and Android's TalkBack to read aloud all elements and text that is included in them. In addition, the UAP enables navigation between the menu elements by swiping, thus removing the need to tap or see the elements on the screen.

Our second task was to redesign the tutorial levels of the game. The original tutorial which we made during the capstone was very thorough and it taught the player all key aspects of the game but in contrast it was clearly too long with over seven minutes of constant gameplay. Additionally, all information about the gameplay was given all at once which turned out to be very overwhelming and, in some ways, the length of the tutorial made it too boring

In order to properly describe the improvements made to the tutorial we will briefly explain how the game worked at this point. In AudioWizards the player combats enemies using spells. Each enemy and spell have their own elemental properties. The properties are

Fire, Earth, Lightning and Water, these properties counter each other in a cycle shown in Figure 13. A simpler way to explain it is that it works in the same way as an expanded Rock, Paper & Scissors.

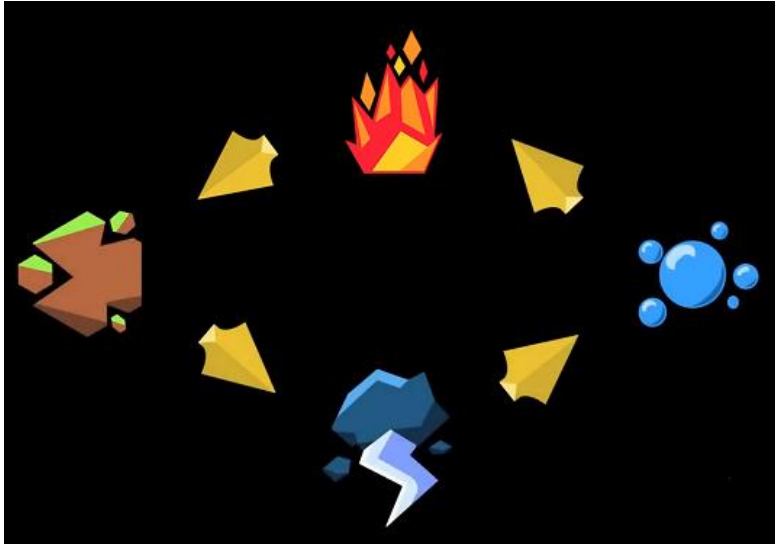


Figure 13. AudioWizards elemental affinity cycle.

The player combats enemies and these enemies approach the player from three different directions; left, middle or right. We chose to call these directions “lanes” as it is a common term used in other games with similar mechanics.

All enemies and elements have unique and describing sound effects so that players can differentiate them without needing any visuals. The enemies have additional footstep sound effects to indicate the distance between the player and the enemy, thus again removing the need for visuals.

Rather than having all this information all at once we chopped the tutorial into four different levels, one for each element. Each level started and ended with a voice-line giving the player all the information in bits. The key difference in this new tutorial was that the player got to actually play the game straight after the voice-lines rather than waiting for minutes between doing nothing. This made the tutorial a lot less boring and the general user experience better.

In the development process of AudioWizards we had somewhat active collaboration with the B&VI community. In June our first larger collaboration was to have a competition to compose music for the game. Music is a key important component for any game because

it can improve the sense of immersion, enhance narrative elements of the story, overall enrich the experience and gives a sense of quality. (Zhang & Fu 2015, 1-2).

Like previously mentioned the sound effects of the game quickly arose to be a problem. The co-operation with the company creating the sounds was getting more difficult each time we made contact. The sound effects were okay, but it was not something we would approve for the game and we had some troubles explaining to the company exactly what we wanted or how the sound effects should be improved. Additionally, there was some unclarity about the contracts and after we received all the sound effects, we had agreed on we decided to end our co-operations. Because the problems with the sound effects wasted a good amount of time, we made it one of our priorities to fix them and do new ones in-house. We learned quickly that we should've done the sound effects by ourselves from the start, because the sounds were exactly what we were looking for and we were really happy with them.

At the end of June, we had a meeting where we discussed how to make the game more re-playable to increase to length of the game. We came into the conclusion that we would implement a star system into the game. At this time the player had to complete all the levels only once and there were no additional rewards for doing it. The star system changed that aspect of the game, now every time a player finished a level, they would get one, two or three stars based on their performance on each level. The star system allowed us to make the game more challenging without actually changing the game mechanics and it added value to players who wanted to master the game completely. The star system also allowed us to make the tutorial levels clearer. Instead of getting stars the player now got awarded one spell after each level. Like mentioned before the tutorial consisted of four levels that taught the player how to use all the spells and unlocking them one by one made it seem that the player is already progressing even though it is just the beginning of the game. At this time the game started to have its core completed, we were only missing story level designs and the full script for the voice acting.

July

At the beginning of July, the development of the game was still heavily focused on the story mode, so we wanted to add some features to balance the endless mode as well. In one of the first meetings of July we came up with an idea that one of the main characters Saundaman would appear on one of the lanes randomly and bring the player

tea that replenishes one of their health points. This idea was a great way to add some balance on the endless mode since the difficulty rises constantly based on the time. This way the endless mode could last a bit longer, increasing user retention and overall playtime. The way we implemented Saundaman into the game started the same way as making the normal enemies. We created a 3D model and animations for the character and, additionally, we created some voice-lines so the character announces itself approaching the player so that the player can differentiate it from the enemies.

Like mentioned the game was heavily focused on the story mode at this time but we had some issues since we only had one 3D modelled stage for the game, the Cave, which was done by one of the original group members before the Capstone showroom way back in April. The group members all agreed that additional levels would give the game more life and make the scene changes and story livelier. Since none of the group knew how to 3D model environments, we outsourced the modelling to a third party individual known by the company CEO.

After a few e-mails we received levels we were all happy with. We received four new environments: a village and a forest with three variations which were normal forest, snowy forest and a dark forest shown in Figure 14.



Figure 14. Forest and Village environments from AudioWizards.

With the new environments added we updated the story script to include some change in scenery based on the new levels. In total the original story included 20 levels which all were to be fully voice-acted. The voice-actor we contracted during Capstone had been on board for the whole project. Before finishing the script, the tutorial was the only part of the game that had its voice acting done fully. In July one of our main tasks was to contact our voice-actor and finish the script so we would have all the needed voice-lines recorded.

Nearing the end of July, we were still in the middle of getting all the voice-lines ready, which would eventually continue into the middle of August. In the meantime, we thought of additional ways to improve the arcade mode, called endless mode. What we came up with was “Wizards Hats”, hats that are only usable in the endless mode and they all have unique effects that change some of the fundamental aspects of the game. Since the endless mode is all about achieving the highest score possible, we chose some effects for the hats that would either change of limits of the playstyle for the players. Such as the “Jesters Hat” which randomly changes the orders of the spells and gives a sizeable score bonus of 50%. Few other examples include: A “Hard Hat” which increases health points and gives a small score bonus and a “Tea Dispenser Hat” which increases the chance of Saundaman appearing during gameplay.

We were thinking about various ways to introduce these hats but in the end, we agreed that they should be collectables and they would be unlocked by doing various tasks in the game for example get all starts from every stage. The hats acted as a way to again increase the total playtime of the game and give players that have mastered it something to do. Additionally, it added a lot of variation to the endless mode which was considered by the group as fairly boring in the stage it was then.

August

August was by far the busiest month of the development process because there was only four weeks until the planned release date. At the end of July, we had a meeting where we discussed additional possibilities to add some difficulty to the game. We decided that we would create two new enemy types to add some variation to the gameplay. These enemy types were the “Tank Elemental” and the “Trickster Elemental”. The Tank Elemental is more or less the same as a normal enemy, but they take 5 hits to defeat instead of one like the normal enemies. Trickster on the other hand was a

completely different type of enemy. The Trickster takes three hits to defeat but after each hit the Trickster changes its element and the lane it moves on. These two new enemies added a lot of challenge especially in the later levels where enemies approach the player much faster.

In addition to new enemies we came up with boss fights, a common trope used by almost every video game made (Cockshutt 2015). Video game bosses are usually unique enemies whose encounters are more grandeur and dramatic, acting as a significant proceeding points in the story. Boss battles usually have different iterations like mini-boss or mid-boss and final boss. Mini-bosses are often a stronger enemy that appears as a way pace the story telling and divide the games chapters. Final bosses like their name conveys are the climax point of the story, the last obstacle for the player often appearing at the very last point of the game.

We created two boss fights a mid-boss and a final boss. The boss battles were a way for us to experiment with the game and change the mechanics a little. Instead of fighting enemies the player faces another wizards who send their spells along the lanes. The boss fights are similar to normal enemies in the way that all spells the bosses use are certain elements and the player need to counter them.

We wanted to differentiate the bosses from enemies and have them have voice-acted lines like one of the main characters Saundaman. Our mid-boss “Mezafort” appears on the 15th level, where the player starts to learn the reasons behind the Distortion invasion adding progression to the story. The bosses in AudioWizards don’t have any visual models, they only announce each spell they use, and these spells are the only visible part of the bosses. This was chosen mostly due to the limited time left in the development. Our second boss is the final boss “The Principal”. The Principal uses the same mechanics as Mezafort but has added difficulty and more health making the battle last longer making it more epic and dramatic. The Principals voice-acting was done by another third party individual who had worked with the company before.

After the boss battles were done and working we moved on to testing. We sent a stripped down version of AudioWizards to 15 beta testers. The version had all four tutorial levels and two normal levels, one easier from the beginning of the game and one from later on with Trickster Elementals. We were looking for feedback about the gameplay mechanics and menus since the game was not fully ready at this point. We received feedback from 10 of the beta testers. After receiving the feedback we made changes to various features

within the game. The first one was menu navigation. When UAP read all the elements on the screen it goes through them in order but this order can be changed, which we did. After completing a level the UAP moves directly to a “Back to menu” button, we changed it so that it moves to “Next level” button making the level transition easier for B&VI players.

Additionally, when a player starts a level there is always an intro voice-line first followed by a gameplay phase then an outro voice-line. Based on the feedback we received we made a “skip intro” button so that in an event that the player restarts or re-plays the level they don’t have to wait through the voice-line again. One of the most important parts of the feedback for us was all things related to sounds, because the game relies on them to work properly for B&VI players. We added a volume slider for music volume and an option to turn on “Narrow stereo field” which limits the width of the sound distribution helping players that have damaged hearing. Only a few bugs were found during the testing phase which were related to music continuing to play in the endless mode after restarting. No other major bugs were found. Overall the feedback was very positive and nothing about the core gameplay mechanics or controls needed any changing. The game was considered challenging but not too difficult once you learn the controls, just as we hoped.

Last Improvements and Launch

After testing we had received all the missing voice-lines and the story mode was considered complete. Our final part of the development was to fix the endless mode. Our new system for the endless mode was to make the enemies appear in “chunks”. Enemies still appear randomly but the chunks made it easier to add features to the endless mode. For example after the player defeats a chunk of enemies they have a chance for Saundaman to appear and give them more health points. The chunks also act as a way to pace the endless mode. Despite its name we designed the endless mode to last around five minutes after which the difficulty is so high no-one will be able to keep up with the speed. We also included the boss fights in the endless mode. After clearing three chunks the player faces a boss, this repeats for as long as the player lasts.

With the endless mode updated the game was finally finished. We made final testings within the development group and agreed that everything worked as intended and it was time to move on to the release.

The release phase was fairly straight forward, we made accounts for Google and had one already for Apple because of the previous project GoldGun. We filled out all necessary company information submitted the game and waited for approval. We also created all needed screenshots, promotional texts and catchy descriptions to make sure all store page visitors had a clear idea about the game.

From Apples side the approval came within a week, this was a few days before the launch date on September 1st. Within the first week on iOS we already received a good amount of positive feedback and did not find any major bugs. Unfortunately from Google's side we had to wait a bit longer due to the approval criteria having been changed just around a week before our submission. The Android version launched on September 9th. After that the game had successfully been released for both platforms.

5 CONCLUSION

5.1 Sales Results

The sales were much lower than expected although when compared to many new games launched in recent years, the game did relatively decent. However, the launch was not sufficient enough to deem the game monetarily successful. The expected turnover of 10 000 by the end of the year was only reached by 10%. When compared to the cost of the project the game did in theory pay itself back but not enough to warrant the development of the other games and projects in the company or to warrant the long-time support for the franchise.

Most of the sales were made in the English-speaking countries or in the countries where people have high proficiency in English like Germany. In App Store, the game has sold 590 units (1.9.2019-15.1.2020) in the United States alone with United Kingdom coming in as the second most sold area with 100 units (1.9.2019-15.1.2020). This is no surprise as both the game and the game's marketing were done fully in English. The game might appear to be unplayable to the audience with little or no proficiency in English which makes the market in many countries seem inaccessible. Unfortunately translating the game to another major language like Spanish or French was not possible due to the lack of time and funding but was one the aspects that was realized in the development as a possible inclusion.

Majority of AudioWizards sales came from the Apple's App Store. This was to be expected as iOS devices have better accessibility features according to the study. iPhone is also the phone of choice for majority of the English-speaking audience in the United States. Android and Google Play sales were about 1/6 of the App Store's sales.

AudioWizards has gained approximately 1,9 million impressions, 36000 product page views and has sold 1119 units (1.9.2019-15.1.2020). Out of the 1,9 million impressions, about 1,8 million of them were gained during the first two weeks after the game's launch on the store. This was most likely due to the fact that Apple had the game featured on the App Store's "New Game We Love" -section for a week. Product page views and sold units are also heavily weighted to those first two weeks. On Google Play, the game has sold 143 units with no data on the impressions gained (1.9.2019-15.1.2020).

5.2 Customer Feedback

The major feedback channels for AudioWizards were the reviews on the store sites, AppleVis forums and Audiogame.net forums. As of today (15.1.2020), the official released threads of AudioWizards in the forums have gained 166 and 89 answers, in AppleVis Forums and Audiogame.net forums respectively. The game has 37 ratings and 24 reviews in App Store with the average user score of 4.6 out of 5.0 and on Google Play the game has 14 ratings with the average score of 4.5 out of 5.0.

The reviews of the game have been mostly positive. The game has been praised by the overall quality, especially the sound design. The gameplay has been called fun, addicting and challenging. Users have expressed their love for the story and cast. The game's price has been suggested to be fair and "worth it".

The game, of course, is not without any critique. Some users have experienced difficulties playing the game despite the available accessibility options. The game's gameplay has been said to be nothing new or special and the challenge for experienced audio game players was lacking. There have also been some critiqueless comments on how the game is "waste of money".

AudioWizards was also reviewed by the National Federation of the Blind, the largest and oldest nationwide organization for the blind in the United States (nfb.org -website. 2020). The review is the longest written review of the game the game has gained so far. In the review, the game was highly recommended and praised for its light-hearted story, fair difficulty curve and accessibility.

5.3 What Could Have Been Improved

From the B&VI community the ratings were all quite positive and we received a lot of praise. Unfortunately, we haven't seen much feedback from sighted players, at least that we know of. We think that focusing too much on the B&VI market and limited experience releasing a game combined was one of the factors that affected the lower than expected sale numbers. From a product standpoint the game might have also been too expensive, since most mobile games have moved to the Freemium/Free-to-play models or cost

around 1 euro or less (pocketgamer.biz 2012). The game was also not made with longevity in the mind as the products value for the customer and for the company deteriorates eventually with no updates or customer loyalty benefits. Although the game's pricing model was generally liked it was a poor business model for the company. There are currently no ways to generate additional revenue from the existing customers, for example.

From the development side, our common thoughts revolved around all the third-party participants we had along the way. The final product turned out good but in terms of time and cost of some outsourced parts could've been better handled in-house. Focusing on the game design earlier could have been improved as well. Overall the plans and layout of the game were decided early on but along the way we added a lot of featured that were not in the original plans. Adding features is definitely not a bad thing since it improves the overall quality of the product, but it adds some development time since the plans are not 100% clear at the time of development. Using the iterative development model especially later on however was a very satisfying decision as we could review the game in-between each iteration. This helped us to keep a track of the things that needed to be improved or things that seemed unnecessary.

Overall, we are happy that we selectively used the agile and iterative game development approach during the development, especially in the later stages. The agile model helped us to keep improving the game often and, at the same time, it made us stay on the schedule without any major delays. Profiling the needed product development strategy helped us fare well against the competitors with most prominent of them launching only few weeks before our game. Unfortunately, we did not have enough time to test the game as much as we would have liked and some of the last feedbacks before launch were got only few days to spare. Thankfully, the game did not receive any vital critique which reassured that we could launch the game on time. Asserting the risks and stakes in the beginning helped us maintain the limitations that these risks created and to not go over them. Some of the risks were even resolved along the development as the team got smaller and more confident in their ideas and decisions. We were also satisfied with our definition of the target group and focusing the marketing for this specific audience helped us to budget the marketing resources and time accordingly.

REFERENCES

- Andrade, R. et al. 2019. Playing Blind: Revealing the World of Gamers with Visual Impairment. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (116). ACM. Cited 20.11.2019 <https://dl.acm.org/doi/fullHtml/10.1145/3290605.3300346>.
- Baker, M. & Hart, S. 2007. Product Strategy and Management. 2nd edition. Prentice Hall.
- Beck, K. et al. 2001. Manifesto for Agile Software Development. Cited 10.12.2019 <http://agilemanifesto.org/>.
- Belanger, K. 2019. Accessible Gaming: AudioWizards Review. National Federation of the Blind - web blog. Cited 27.1.2020 <https://www.nfb.org/blog/accessible-gaming-audiowizards-review>.
- Bethke, E. 2003. Game Development and Production. Wordware Publishing, Inc.
- Bloomberg - The Great Firewall of China. 2018. Cited 19.11.2019 <https://www.bloomberg.com/quicktake/great-firewall-of-china>.
- Cambridge Dictionary. Cambridge University Press 2020. Cited 27.1.2020 <https://dictionary.cambridge.org/>.
- Cockshutt J. Where the Heck Did the First Video Game 'Boss' Come From?. 2015. Cited 4.1.2020 <https://geekinsider.com/heck-first-video-game-boss-come/>.
- Cohen, D.S. & Bustamante, S.A. 2009. Producing Games: From Business and Budgets to Creativity and Design. Routledge.
- Education First 2018. EF English Proficiency Index. Education First. Cited 14.12.2019 <https://www.ef.co.uk/~-/media/centralefcom/epi/downloads/full-reports/v8/ef-epi-2018-english.pdf>.
- Entertainment Software Association. 2019. 2019 Essential Facts About the Computer and Video Game Industry. Cited 28.10.2019 <https://www.theesa.com/wp-content/uploads/2019/05/2019-Essential-Facts-About-the-Computer-and-Video-Game-Industry.pdf>.
- European Commission. Economic Study on Consumer Digital Content Products. 2015. Cited 21.11.2019 https://ec.europa.eu/info/sites/info/files/study-consumer-digital-content-products_en.pdf.
- Eurostat. 2018. Purpose of mobile internet use. Cited 21.12.2019
- Eurostat. 2019. Individuals – internet activities. Cited 22.12.2019
- Farcic, V. 2014. Software Development Models: Iterative and Incremental Development. Web-Blog Writing. Cited 10.12.2019 <https://technologyconversations.com/2014/01/21/software-development-models-iterative-and-incremental-development/>.
- Ferrara, F. 2018. Agile Game Development process for Indies. Web-Blog Writing. Cited 10.12.2019 https://www.gamasutra.com/blogs/FabioFerrara/20181218/333112/Agile_Game_Development_process_for_Indies.php.
- Hughey, D. 2009. Comparing Traditional Systems Analysis and Design with Agile Methodologies. Website. Cited 20.2.2020 <https://www.umsl.edu/~hugheyd/is6840/waterfall.html>.
- Interactive Software Federation of Europe. 2019. Key Facts 2019. Cited 7.11.2019 <https://www.isfe.eu/wp-content/uploads/2019/08/ISFE-Key-Facts-Brochure-FINAL.pdf>.

- Kotler, P. et al. 2017. Principles of Marketing. 7th European edition. Pearson Education Limited.
- Määrittäminen - Näkövammaisten liitto ry. (2020). Cited 10.10.2019 <https://www.nkl.fi/fi/etusivu/nakeminen/maaritys>.
- Pocketgamer.biz. "App Store Metrics." 2019. Cited 10.12.2019 <https://www.pocketgamer.biz/metrics/app-store/app-prices/>.
- Powell-Morse, A. 2016. Iterative Model: What Is It And When Should You Use It? Web-Blog writing. Cited 20.2.2020 <https://airbrake.io/blog/sdlc/iterative-model>.
- Prystupa-Rządca, K. & Starostka, J. 2015. Customer Involvement in the Game Development Process. Journal of ENTREPRENEURSHIP, MANAGEMENT and INNOVATION, Vol 11, issue 3.
- Tidd, J. & Bessant, J. 2013. Managing Innovation – Integrating Technological, Market and Organizational Change. 5th edition. Wiley.
- Trott, P. 2017. Innovation Management and New Product Development. Sixth Edition. Pearson Education Limited.
- Youngim, G. 2018. Market Research for myTrueSound. Company's internal, unpublished market research.
- Zhang J, Fu X (2015) The Influence of Background Music of Video Games on Immersion. Journal of Psychology & Psychotherapy 2015. Cited 2.12.2019 <https://www.longdom.org/open-access/the-influence-of-background-music-of-video-games-on-immersion-2161-0487-1000191.pdf>.