NTNU
Det skapende universitet

Sosiale Spill-baserte klasseromsapplikasjoner

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Abstract

The purpose of this research was to find out how game elements and features from modern popular games fit into an educational environment. Earlier research describes that all players can be divided into four player types: Killers, Achievers, Socializers and Explorers. These types are defined as having different preferences in terms of game elements and features. In order to find out if features adopted from modern games have an effect on various player types, we made a social game-based classroom application with some of these features implemented. The game itself is a multiplayer quiz game which includes features such as a leaderboard, experience points, levels, collectible bonuses, unlockable cosmetic items and character customization. We assessed whether these implementations were successful through user experiments, where we calculated each participant's player type and their feedback to the various features. We found that there was a large diversity among player types where some had high scores in specific types and others were more of a hybrid with even scores. Some participants enjoyed the competitive aspects of the game while others preferred the more individual aspects, in which we also found some correlations between features and player types. This thesis provides an insight in modern popular games and how their features affect various player types. It also gives an example of how such features can be implemented in an educationally focused application and assesses the effects of it. We think that having a better understanding of how to appeal to all types of players is important for further development in educational games.

Sammendrag

Hensikten med denne forskningen var å finne ut hvordan spillelementer og funksjoner fra moderne og populære spill passer inn i et læringsmiljø. Tidligere forskning som vi har sett på beskriver at alle spillere kan deles inn i fire spillertyper: Killers, Achievers, Socializers og Explorers. Disse typene er definert slik at de har ulike preferanser når det gjelder spillelementer og funksjonaliteter. For å finne ut om funksjonaliteter som er hentet fra moderne spill har en effekt på ulike spillertyper, har vi laget en spill-basert klasseromsapplikasjon med noen av disse implementert. Spillet i seg selv er et flerspiller spørrespill som inneholder blant annet en toppliste, poeng, nivåer, bonuser, kosmetiske samleobjekt og karaktertilpasning. Vi vurderte om disse implementeringene var vellykket gjennom brukereksperimenter, hvor vi evaluerte hver deltakers spillertype og deres erfaring med spillet. Vi fant ut at det var et stort mangfold blant spillertyper hvor noen hadde høye resultater innenfor bestemte typer og andre fikk mer jevne resultater. Noen deltakere likte konkurranseaspektet av spillet, mens andre foretrakk de individuelle aspektene hvor vi også fant noen sammenhenger mellom funksjoner og spillertyper. Denne avhandlingen gir et innblikk i moderne og populære spill og hvordan deres funksjoner påvirker ulike spillertyper. Den gir også et eksempel på hvordan slike funksjoner kan implementeres i et lærings-basert spill og vurderer effekten av den. Vi mener at det å ha en bedre forståelse av hvordan vi kan appellere til alle typer spillere er svært viktig for den videre utviklingen av lærings-baserte spill.

Preface

This is a master thesis in Social Game-based Classroom applications at the Norwegian University of Science and Technology as part of the study programme Informatics. It was carried out over a year from autumn 2015 to spring 2016. The project goal was provided by our supervisor Alf Inge Wang, which was to create a prototype for real-time social and game-based classroom applications and run experiments in a classroom. The task was fairly open, which gave us freedom to come up with our own ideas for the prototype in order to engage and educate students.

The reader of this report is assumed to have basic IT knowledge.

Acknowledgment

We would like to thank Alf Inge Wang for this assignment and for his help and guidance throughout this project.
 We would also like to thank everyone who participated in the conducted experiment and interviews, and provided us with valuable feedback.

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Trondheim, 1. June 2016

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Part I

Introduction and Research

This part gives an introduction to the thesis, describes the research questions and how they will be answered.

Chapter 1

Introduction

This chapter covers the background and motivation behind the project, the problem description, objectives, limitations, approach and a readers guide.

1.1   Definitions and abbreviations

The definitions and abbreviations of this document are listed in Appendix A.

1.2   Background and motivation

In this section, we present the problem that we are going to investigate, why this problem is of interest, what has been done so far to solve the problem, and which parts of the problem that remain unsolved till now.

Motivation

The technologies available today enable us to connect everyday activities of ordinary people to technology and software. Some applications are intended to make activities easier and provide an enhanced experience, e.g. running apps and shopping lists. Some provide a more important utility, such as medication reminders or work related apps. While others have the sole intention of entertaining the user with games or multimedia. The application world has grown for several

years and the possibilities seem endless as development continues and people's lives keep improving, using these tools and features. However, we think some areas are still far from optimal, especially when it comes to the area of education.

Gamification is a increasingly popular phenomenon in work and education environments. By applying some kind of treat, reward or other game-based feature to an activity that is otherwise considered tedious, an increase in motivation and attitude can be observed. This can in turn increase productivity, provide better results, improve learning and create a positive work/learning environment (Hanus and Fox, 2014). Our motivation is to achieve these benefits in the classroom by using social game-based applications.

Problem Formulation

Current popular games use various elements to attract players, such as competition, rewards and achievements. However, people have different preferences as to what interests them about the game (Bartle, 1996), and not all players have the same amount of competitive spirit or need to collect items. Some prefer collecting or exploring over competition, which gives a whole new interpretation of the game, and it is important to stimulate these kind of players as much as the competitors. It is already established that these game design principles work well in modern games, but how would they perform in a learning environment such as a classroom? The main problem of our thesis will be to test out and measure how well specific gamification techniques affect students with different preferences. If it has a positive effect that will result in more productivity and motivation in the classroom, then teachers can use this as a tool for livening up the classroom situation.

Literature Foundation

This section covers the main findings of existing literature that treats similar problems to the ones explained above.

As mentioned in the problem formulation, (Bartle, 1996) developed a model for distinguishing four types of players. He named them Killers, Achievers, Explorers and Socializers. Figure 1.1 shows a graphic view of the model. (Kyatric, 2014) defines the four types as follows:

- *Killers* like to provoke and cause drama and/or impose them on other players in the scope provided by the virtual world. Trolls, hackers, cheaters, and attention farmers belong to this category, along with the most ferocious and skillful PvP opponents.

- *Achievers* are competitive and enjoy beating difficult challenges whether they are set by the game or by themselves. The more challenging the goal, the most rewarded they tend to feel.

- *Explorers* like to explore the world - not just its geography but also the finer details of the game mechanics. These players may end up knowing how the game works and behaving better than the game creators themselves. They know all the mechanics, short-cuts, tricks, and glitches that there are to know in the game and thrive on discovering more.

- *Socializers* are often more interested in having relations with the other players than playing the game itself. They help to spread knowledge and a human feel, and are often involved in the community aspect of the game (by means of managing guilds or role-playing, for instance).
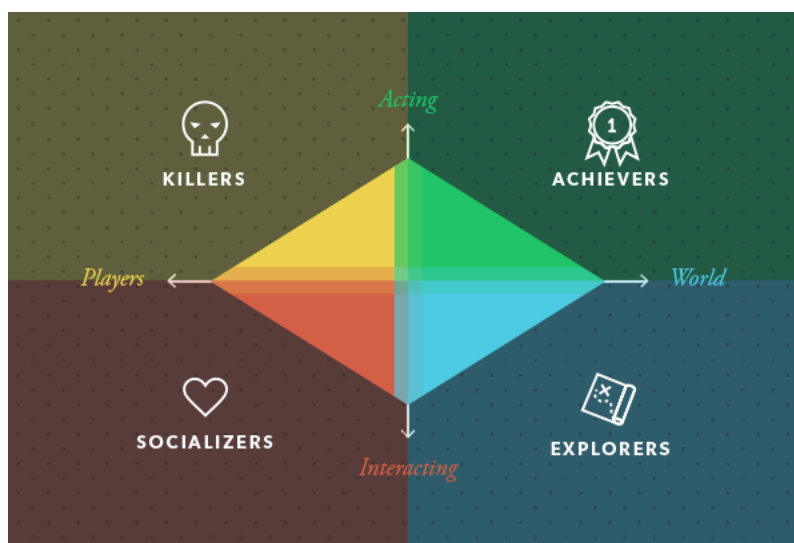
Figure 1.1: Bartle's taxonomy of player types (Bartle, 1996)

Having such a detailed psychological depiction of various player types helps the creation of a game design that targets a large diversity of users. An example of a system that has already tested out this model on students is the "Quiz-a-tron" by (Trong Hoang, 2015). The experiments

that were conducted here show that the player types had very little effect on the experience of that particular application. A reason for this could be that the application lacks some depth and customization that could potentially further stimulate these player types, which is an important topic in our research.

What Remains to be Done?

The research that has already been done helps us to identify different player types, and be aware of research conclusions from experiments that took a more general approach to gamification in the classroom. What remains to be done to reach a sufficient understanding of possible game-based improvements to education is applying specific techniques that we already know succeed in modern games. Techniques and elements that stimulate specific player types need to be identified, interpreted and implemented as features. The desired result is an educational game that contains a combination of the most prominent features that are identified. These features will then need to be tested out to achieve research conclusions.

1.3   Project description

The assignment of this thesis is to create prototypes for real-time social and game-based classroom applications. The development of the prototype is going to be done in HTML5, JavaScript and known server-technologies. The researchers are free to come up with their own ideas for motivating and educating students.

1.4   Objectives

The main objectives of this Master's project are

1. Construct an overview of specific elements and features in modern games that are known to achieve motivation and excitement among various players.

2. Develop a social game-based classroom application with game features and elements that are inspired from the games discussed in the first objective. Supply an overview of the

technology used.

3. Conduct user experiments with the developed application to find out whether the system is sufficient in terms of user friendliness and has an effect in terms of motivation and education.

1.5   Approach

Each project objective will be approached in the same order as listed above. The approach will be in a "waterfall" fashion, where will we will complete an objective entirely, before moving on to the next.

The idea behind applying more comprehensive gamification elements that originate from modern games is something that we, the authors, came up with as a thesis project. Thus, it is natural to approach the first project objective by including games and game elements that are already known to us. Our goal is to use the four player types described by (Bartle, 1996) as a base for constructing an overview of techniques that is supposed to appeal to each type.

After the game features and elements are documented, a game design and requirement document will be created, and the development will start. Some research will need to be done to find the most suitable technology for developing the application. The source code architecture will also be documented.

The user tests will be conducted on university students. A questionnaire will be made and handed out to the students after they have used the system. We will also ask questions and take notes during the process to observe user experiences. The analysis will be carried out using the user test results. This part of the approach is further covered in Section 2.2.

Chapter 2

Research questions and methods

This chapter covers the research goals we want to achieve in this thesis and the methods to achieve them.

2.1 Research questions

One goal of this thesis is to identify, depict and translate game elements from modern games into an educational game. The idea is to stimulate various player types by including these features in a comprehensive manner. However, we must first set some goals for our research in the form of research questions. The following are the research questions of our thesis, which are further explained below.

- *RQ 1*: What is the diversity of player types in a typical Norwegian classroom?

- *RQ 2*: How well do game elements adopted from modern popular games fit in a social game-based classroom application?

- *RQ 3*: Is there any correlation between player types and the effect from the features in our game?

2.1.1   RQ1: What is the diversity of player types in a typical Norwegian class-room?

The target audiences of the final product are students in classrooms, and since the researchers are situated in Norway, the focus will be on Norwegian classrooms. As mentioned in Section 1.2 people have different preferences in game features, and thus there can be various player types in a single game. Before a test of features can be conducted on the students, it would be an advantage to see the distribution of the different player types in a class of students. To achieve this we will employ the Bartle test, which is further described in Section 2.2.1. In addition, we would also like to see if the students agree with the player type allotted to them. We end up with the following underlying research questions:

- *RQ1.1*: What is the distribution of player types in a Norwegian class?

- *RQ1.2*: What is the attitude of students in a Norwegian classroom toward the player type result they receive from the Bartle Test? What is the reason behind them?

2.1.2   RQ2: How well do game elements and features adopted from modern popular games fit in a social game-based classroom application?

We want to investigate how game elements and features from popular modern games can be implemented in a social game-based classroom application. The goal here is to see what kind of impact the various elements create when applied to a learning environment. We want to look into which features that do and do not fit well in our game.

- *RQ2.1*: What specific game elements and features fit well in our game?

- *RQ2.2*: What specific game elements and features do not fit well in our game?

2.1.3   RQ3: Is there any correlation between player types and the effect from the features in our game?

Another interesting aspect of this research would be to look for correlations between player types and what kind of game elements they prefer in social game-based classroom applications.

- *RQ3.1*: Can we link player types to specific game elements in our game?

- *RQ3.2*: Do certain game elements appeal to all player types in our game?

- *RQ3.3*: Do certain game elements have a positive impact on some player types in our game?

- *RQ3.4*: Do certain game elements have a negative impact on some player types in our game?

2.2 Methods

All research questions are entirely based on user opinions and feedback to our system. Therefore it is necessary to apply research methods which aid the field study and provide results that can be further analyzed. (Creswell, 2013) depicts two types of methods for data gathering and analysis: quantitative and qualitative methods. An example of a quantitative method is a questionnaire survey. These will often contain multiple-choice questions that provide data that is easier to construct statistics and graphs from. Qualitative data is often gathered using interviews with one person at a time. This allows the participants to express opinions that they might not be able to in quantitative methods, as long as the questions are open-ended and unbiased. A typical approach is to use both types of methods in conjunction, also known as "mixed methods". This might involve using the results from one type to analyze and plan the other part (Explanatory Sequential Mixed Methods Design).

2.2.1 Answering research questions

In order to answer the first research question, which focuses on player types, we will initially have the subjects perform the Bartle test (Andreassen and Downey, 2006). This test was created by Erwin Andreassen and Brandon Downey, and is based on research done by Richard Bartle in 1996 (Andreassen and Downey, 2006). As of October 2011, this test has been taken over 800.000 times, making it the most prominent tool for performing a test regarding this subject. The test prompts the user with a series of multiple choice questions that are related to a player's experience within an MMO. The results will be used as a base for the further process of the experiment

and the discussion of the research. However, some skepticism must be raised towards the use of this test, as it was not created by the original researcher of this study. In fact, it seems Richard Bartle himself has commented on the validity of the test in the comment section of the website. He quotes some figures on player types from his book from 2003 and makes some arguments towards why the split among players in this test do not reflect those figures. His reasons include:

- Participants in the test are self-selecting. Most don't hear about it until they've played a virtual world for a while, therefore they are not representative of the general user population.

- It is clear from the nature of many of the questions what is being tested for, which means players can give the answer they believe will lead to a cooler rating (e.g. explorer or killer) rather than the truth.

- There is no 'neither' answer. A socializer being asked to choose between defeating an enemy and exploring an area may as well flip a coin to answer, given that they don't particularly care for either.

- Some answers favour two or more types. Killers and achievers would probably both prefer defeating an enemy to exploring an area, but the questionnaire can't disambiguate them.

- Ties aren't handled very well. If you choose achiever and socializer answers with equal frequency, you will be recorded as favouring A over S.

Bartle provides some valid points, and some people seem to agree with him. However, other people also express that their results were accurate and that the test itself has sufficient validity. To save time and effort spent creating our own player type test, we have decided to use the already existing Bartle test as an initial indication of the subjects player type, with a more specific questionnaire as supplementary support. Hopefully, this will create a general impression of each subjects player type, which will be saved and used in the discussion and analysis of the results. Some criticism will be kept in mind during this analysis, due to the diversity in feedback that this test has received. After the test is completed by all participants, a questionnaire survey will be handed out to each person. The content of the first part of the questionnaire is listed in

Chapter 10. The second part of the experiment, which addresses the second research question, will be conducted by letting the subjects try out the thesis project. They will be asked to log in to the system using their own devices and join the game. After the game is finished, each participant will receive a questionnaire containing feedback questions to the system. These include specific questions about the quality and user-friendliness of the application as well as thoughts about and impressions of the application features. A random sample of people will then be selected for a qualitative interview. The questions for both the questionnaires and the interview are listed in Chapter 10. The third research question will be addressed using analysis of both the Bartle test results, the questionnaire data and the interview data. We must make sure to identify each participant in each test in order to study a possible correlation between the results from the first and second phase.

2.2.2 Quantitative data collection

We use the questionnaire survey as the primary tool for collecting quantitative research data. The goal is to collect tangible, measurable information on the participants, the bartle test, application usability and application features. This is further discussed in Chapter 10, where we will describe the empirical approach of the experiments and specific survey questions.

2.2.3 Qualitative data collection

In this section of the data collection, we want to obtain as detailed information as possible from the participants' opinion. It is therefore important to choose the right procedure for the conducting of the interviews and what questions to ask. Considering the topic of this research, which revolves around user opinions regarding fun and games, it is not considered as very sensitive or serious by the participants. Hence, the researcher does not need to worry about being very cautious about the wording during the conducting of the interview, and the questions can be fairly prodding without being perceived as too inquisitive. The researchers can act naturally and enter the role of a fellow student, considering the similar age and study programmes of both the researchers and participants. However, people respond differently depending on how they perceive the person asking the questions. (Oates, 2005). Acting too much as a fellow student can

therefore lead to the participant giving biased or dishonest answers because they want to please the researcher. Hence, the role of the interviewer should be a more journalist-like fellow student that will react neutrally to both positive and negative feedback to the system.

We have decided to use a semi-structured interview (Oates, 2005). The interviewer will prepare a list of questions, but be willing to add, remove or change the order of the questions depending on the flow of the conversation. The reason for the semi-structured interview is to allow the interviewee to raise opinions or aspects that the interviewer might not have prepared for, and speak more in detail about them. The prepared questions will address the various aspects of the application we want feedback on, but some new ideas or thoughts might also emerge using this method.

2.3   Readers guide

In Part II, we initially look at and review existing solutions that are similar to the product of this thesis and what we can utilize from them. Then we look more into specific modern games and discuss the gamification techniques used in these games. We also describe the software technologies that we will use for the development process.

Part III covers the requirements, architecture and gameplay design of the thesis project.

Part IV describes how we planned, prepared and conducted the user experiment. It also describes and discusses the experiment results and experiences.

Finally, in part V, we provide a conclusion of the thesis and make suggestions for further work.

Part II

Prestudy

This part provides information about existing learning platforms and game elements and features from popular games that we will use as inspiration for creating the thesis project. It also describes software technologies that we will use for the development process.

Chapter 3

Student Response Systems

This chapter examines and reviews existing student response systems and assesses what we can utilize from them.

3.1 Kahoot!

Kahoot! is an example of a game-based application that has found its way into many classrooms already. A "Kahoot!" is essentially a multiple-choice quiz that users create themselves. The quiz may contain text, picture or video questions, and all questions are multiple-choice. A common usage of Kahoot! is to summarize/check learning outcomes after a lecture or class, but can also be used for pure entertainment. Since users create the quizzes, the subject matter varies.

The game was originally inspired by the PS2 quiz-game series called Buzz! which is described later in this chapter. (Wang et al., 2008) state that at the time of writing the article (2008) there were some examples of how video games could be used in higher education, but they believed that this area needed to be explored more extensively. This project has the same goal: To find game elements which can increase students' motivation and enthusiasm. (Wang et al., 2008) states that the students claims that the use of such games might lead to higher attendance at these lectures. In addition, such games also provide useful feedback to the teachers about how much the students actually have learned from a lecture.

A Kahoot! is typically played in groups. A PC running the Kahoot! online is displayed to the group, preferably on a big screen/projector. This screen displays the questions and the leader-

board between the question rounds. The participants connect to the quiz on their own devices(PC/mobile phone/pad) using a unique game-pin, and answer questions using the device. Players receive points based on whether they answered correctly and how fast they answered. After each round of questions, the top-5 leaderboard gets updated and presented to the group. The players' current rank is also shown on the device and how many points they are behind the player in front of them. When all questions are answered, the Kahoot! is finished and the winner is announced. Figure 3.1 shows a game of Kahoot! on both the game screen and the answering devices of the players.

Figure 3.1: Answering a question in Kahoot! from various platforms (Kahoot!, 2015)

One of the key aspects of Kahoot! is the ability to motivate the students with an interactive approach to learning. Once students are motivated, they become engaged; for this reason, their attention increases (Glover et al., 2005). In addition, Kahoot! is a very intensive learning platform. The players have relatively short time to answer the questions (5-120 seconds) and short breaks between the questions. Another important aspect is feedback that the players get from the game. When the players are not answering questions, they are presented with the latest cor-

rect answer, updated scores and rankings. The competitive aspect of this feature maintains the excitement, but will also aid the learning aspect of the game. (Randall and Zundel, 2012) agreed that feedback improves learning because it gives students the opportunity to learn from their mistakes.

Kahoot! has many advantages and the creators have succeeded in designing a type of simple game show for both learning and entertainment. The simplicity and intuitiveness of the game is probably an important factor. It is easy to join a game without registering as a user and sticking to only multiple-choice questions. No registration for users means less hassle for the players, but prevents the possibility of tracking and rewarding players between game sessions. Keeping it simple is however definitely an important aspect in Kahoot!.

(Wang, 2015) discussed the wear out effects of a Game-based Student Response System DEF(GSRS). He conducted an quasi-experiment which tested the wear out effects of Kahoot! over a five months' period. The experiment tested how students' attitude developed as regards user-friendliness, motivation, concentration, perceived learning, classroom dynamics and enthusiasm. Wang maintains that Kahoot! managed to increase the students' learning and motivation even after using it repeatedly for several months, and that the competitive nature of Kahoot! is the main factor behind this. However, Wang concludes that he can predict wear out effects if the same GSRS is used in several courses. There are ways to avoid these effects though, for example by adding more content through new games, game modes, ways of asking questions and ways to give response to the users.

3.2 Socrative

Socrative is another student response system tool that has many similarities with Kahoot!, but also contains some distinct differences. Socrative does not require synchronous answers from the players. Players answer in their own tempo and finish at different times. Socrative also offers more flexibility in both how to make quizzes and how to answer them. For example, you can create a "quick question" just to see how many are paying attention in the class. Another feature is the "space race"-quiz. The players can track their progress in an animated space race, where each player or group has its own spacecraft that moves when they answer correctly. Figure 3.2

shows a screenshot of the Socrative game.
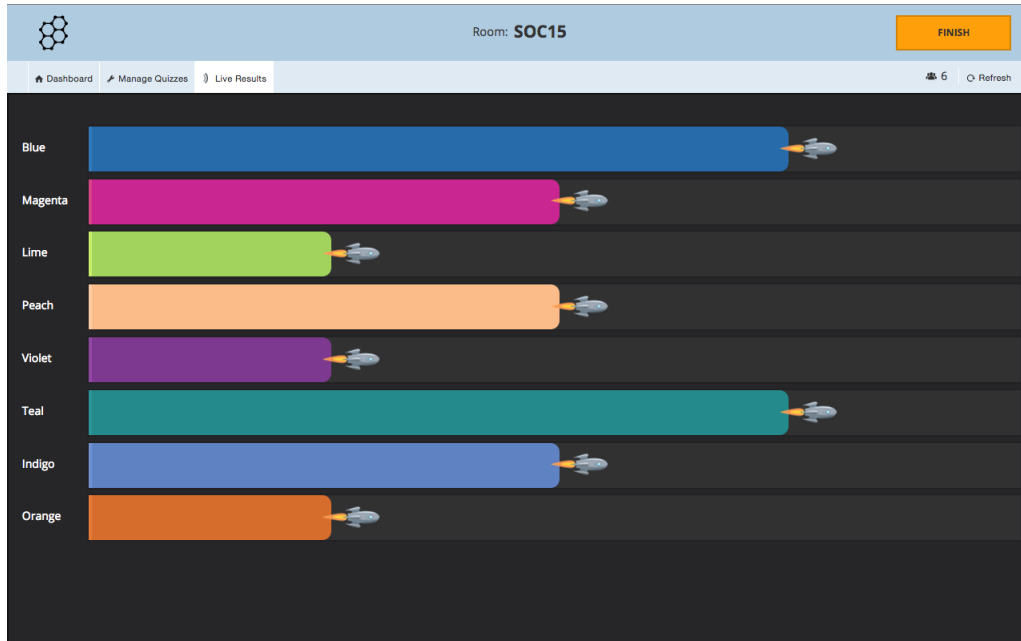
Figure 3.2: Socrative space race (Socrative, 2015)

Tracking progress is a well known feature in many games. Players want to see that their actions and accomplishments are recognized and given the appropriate feedback. Even though the game mode is named space race, you can still change the avatars to other themes, such as bears or unicorns. One drawback we see here is that all players have exactly the same avatar. As described in (Vasalou and Joinson, 2009), avatars are not just the interface which the players use in order to control the game, but also conceivably represent the players' own or created identity. It is difficult to identify with an avatar if everybody has the same one. This topic is further described in Section 4.1.4. The space race gives players the opportunity of seeing the progress of the other participants as well. This gives the game mode a broader competitive dimension. Another possible addition is some kind of consumable or perk that could give the player an advantage in the game (Trepte et al., 2010). This is further discussed in Section 4.1.3.

3.3 Khan Academy

Khan academy is a non-profit educational organization which provides short lectures and exercises for teachers and learners. The organization offers these resources through a website called khanacademy.org which in 2013 had ten million unique visitors every month (Fast, 2014). The website had five thousand free instructional videos, and four million exercises are completed on the site's adaptive coaching platform every day. In later years, Khan Academy has implemented several gamification features in their exercises. Users can for example collect emblems and observe their progress as they complete assignments.

(Morrison and DiSalvo, 2014) describes the different game elements used in Khan Academy. One feature, i.e. The Knowledge map is a traditional game element that is used to give the users a guide to accomplishing the next task. The map consists of several dots that represent a type of skill. Decimals can for example be a dot, which can be broken down into several other dots consisting of new subjects. Only the math content is currently represented in the Knowledge Map, but according to (Morrison and DiSalvo, 2014) computer sciences can easily be included and be provided with a special knowledge map. Figure 3.3 shows a screenshot of the knowledge map in the game.
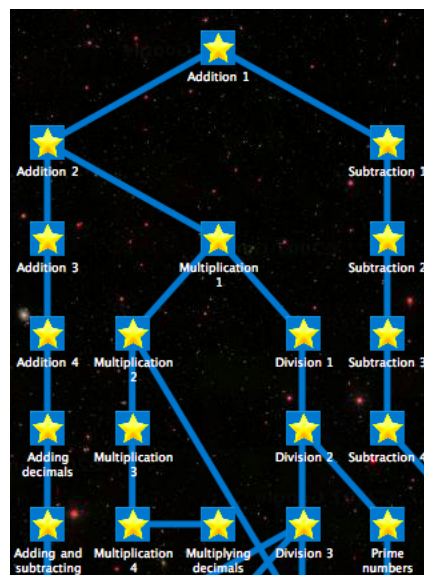
Figure 3.3: Knowledge map at Khan Academy (Kamens, 2010)

3.4   Relevance to our work

Kahoot!, Socrative and Khan Academy are all good examples of student response systems. Not only because of their popularity, but also their ability to implement gamification techniques in textbook fashion.

The information about these systems will aid us in the creative process and implementation of our thesis project. It will help us recognize favorable features for making the application intuitive and user friendly as well as fun-based features that create excitement and motivation. This is further described in Chapter 9.

Chapter 4

Game Features

Modern online games use techniques and features to engage, motivate and attract players to try the game and keep playing it. This chapter describes some of these games and describes how they are relevant to our work.

4.1 What techniques do modern games use?

This section describes the game concepts we are going to use as a base for creating our thesis project. We discuss games such as DOTA, Mario Party, Spore and World of Warcraft. Some of their specific motivational features and their effects on various player types will also be explained.

4.1.1 Competition

Rank

Hearthstone is an example of a game that uses modern game techniques in a textbook fashion. It is a turn-based card game developed by Blizzard Entertainment. The goal of the game is to gather cards, create your own combination of 30 cards, called a deck, and compete against opponents. The opponent can either be the computer or other players. The cards in each player's deck can either be a minion, which can attack other minions or the other players, a weapon which enables the player to attack others, or a spell which can affect the game in many different

ways. When a game starts, each player draws his starting hand from their decks, which are three or four random cards (depending on whether they start or not). Each player draws a new card at the start of each turn, and a turn ends when a player has used up all his mana crystals. The available mana crystals increment each turn, starting at one, and the mana costs of each card are indicated in its top left corner. A game ends when one player has lost all his health points, which starts at 30. Figure 4.1 shows a game of Hearthstone.

Figure 4.1: A game of Hearthstone. Each player has a hand of cards and in the middle is the board for creatures (Jacinto, 2014).

The ranking system of Hearthstone is not very complex. Ranks go from 25 to 0, where the 0 is called Legend rank. From rank 25-20 you can not be downgraded even though you lose a match and you need two wins, represented by stars, to reach a new rank. From 20 to 5 you need three, four and five stars, based on your current rank, to achieve a new rank and you lose one star if you lose. In the range of 25 to 5 you can also get winning streaks for winning three games in a row. This will give the player an additional star for each consecutive win. Figure 4.2 shows a screenshot of a player reaching a new rank after winning a game.

Figure 4.2: Hearthstone: A player reaching rank 5 with winning streak (pcklamer, 2014)

On rank 5, the game becomes a lot harder. You meet the top 2% best players in the game and winning streaks do not count anymore. If you manage to reach the Legend rank, a new ranking system is introduced. This system is a high score list of all Legend ranked players in a geographical region. The player on top of the list is the region's best player at the moment. The whole ranking system is reset every month, so players need to return to the game to reacquire their position.

Matchmaking Rating (MMR)

MMR is a popular way of ranking players. DOTA 2 is an example of a game using this type of ranking mechanism. DOTA is a competitive game of action and strategy, played both professionally and casually by millions of passionate fans worldwide. Players pick from a pool of over a hundred heroes, forming two teams of five players. The two teams fight each other on a battleground with npc's for levels and items for their characters. The objective in the end is to eliminate the opponents' base and if your team succeeds, you gain MMR. The concept is seemingly simple: If you win a game, your MMR increases, if you lose, it decreases. But there are some special cases in this system. For example how should a new player be rated when many players are already rated? The solution to this in DOTA is that players have to go through a trial

period before entering ranked games. This means that the new players want to perform well in this trial period, in order to be calibrated into a high starting rank.

MMR is a big deal in the DOTA community. One of the first questions you would receive when meeting someone who also plays the game is what MMR you have. It is an easy way to determine your skill level. The accuracy and importance of this feature is one of the reasons why many people return to the game every day. The initial excitement can be felt when the game begins and all ten players in the game know what is at stake. This can often lead to conflicts and arguments in the team when something goes wrong and people start blaming each other. This is of course a negative outcome, but it shows how much people care about their MMR. Figure 4.3 shows a screenshot inside the game where the game is over and the final scoreboard is displayed with the MMR change.

Figure 4.3: Scoreboard at the end of a game in DOTA 2. The MMR change is shown on the rightmost column. The winners gain 18 points, the losers lose the same amount. (Supplied by present authors).

Head to head

Head to head is one of the more classic and simple ways of competing in video games. By head to head games we mean arcade games like Pong were you do not progress from completing games. Every game played has one simple goal and that is to defeat your opponent. You will not

get points like in the MMR system or make progress in your rankings. A head to head game can be between two players like a duel or between several players.

Buzz! for Playstation 2 is a game that we have mentioned earlier as the inspiration of Kahoot!. Buzz! is a typical head to head game where the player who won the last game is the current champion. The game has been released in several different version like Buzz! The mega quiz and Buzz! Junior: Jungle party. The buzz! concept has been developed throughout all these versions, but we will just describe the basic concept of Buzz! The mega quiz. It is supplied with controllers shown in the figure below.

The game tries to simulate a game show with the a game host called Buzz. After configuring the duration of the game etc., Buzz will introduce the first round and his sidekick Rose will explain the rules. A round could for example be the "point picker". In this round you choose a category and receive a question from this category. The players answer by pressing one of the colored buttons on the controller. As the game progresses, the players collect points and the player with most points in the end, wins. Figure 4.4 shows a question prompt in the game.
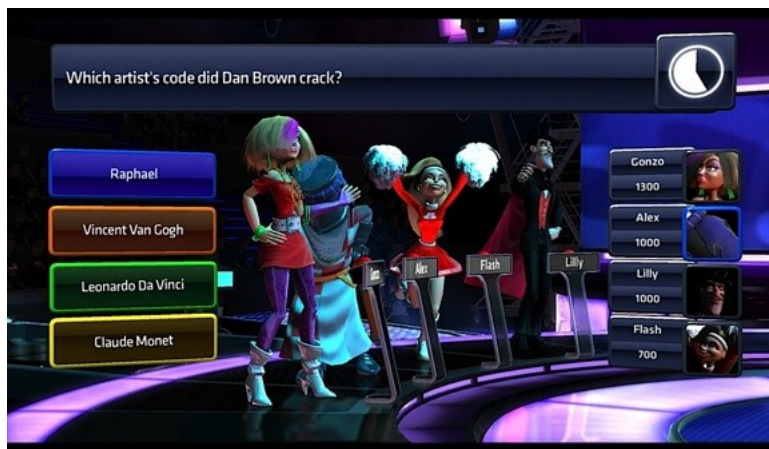
Figure 4.4: A round in Buzz! (WishStudios, 2016)

4.1.2 Special events and randomness

Mario Party (Nintendo, 2000) is a classic example of how one can create more excitement and sudden changes in standings between players by adding special events throughout the game. The main game timeline works as a board game, where players take turns throwing a dice and moving across the board collecting coins in order to purchase stars, which can only be bought

at a specific location on the board. The player with most stars at the end wins. After every player has completed a turn, a special event will occur. They call it a mini-game where the players will compete against each other in a randomly selected challenge. The winners receive bonus coins which brings them a large step closer to purchasing a star. Other events can also occur if the players land on certain spots, such as stealing coins, teleporting to other areas of the board or even stealing stars. Figure 4.5 shows a portion of the game board in Mario Party and the position of a player. Each players status is shown in the corners of the screen.

Figure 4.5: Mario Party game board (MarioPartyLegacy, 2016)

These events are often severely luck-based. The most skilled player may not be the one who wins the coins in the end, solely because of luck. This leads to excitement since the events are unpredictable and random, but can also create a feeling of unfairness. The study of Educational Games done by (Gredler, 1996) describes various requirements towards the deep structure of academic games. One requirement mentioned is that chance or random factors should not contribute to winning.

4.1.3   Unlockables and collectible items

The first element we want to look at is the collection of cards. Hearthstone contains 566 unique cards with different values and effects. A full collection is worth around 1300 dollars (Marks, 2015) and can be unlocked by either buying or playing the game. One might wonder why thousands of people want to collect these virtual cards at the expense of money and time. Collect-

ing is basic in human social behavior, but not much research has been done to understand it. In (McIntosh and Schmeichel, 2004) it is postulated that collecting is an attempt to fulfill self-needs, and that different aspects of the collecting process fulfill self-needs in different ways. The "Explorer" type of player (Bartle, 1996) might see this as an opportunity to explore new cards and use them in new deck combinations. Collection also creates a sense of completeness and uniqueness. To complete a collection, whether it is marbles, movie effects or virtual cards, gives the "Achiever" type (Bartle, 1996) a feeling of satisfaction. Uniqueness is the feeling of standing out from the crowd of other players and collectors. More cards also means more possibilities when it comes to deck building, and can give an advantage in the gameplay, which appeals to the "Killer" type(Bartle, 1996).

Another example of unlockables in Hearthstone is the solo adventures. An adventure is a PVE based game mode, where the player participates in matches against computer-controlled opponents with different themes and identity. When the player defeats a challenge, a new challenge is unlocked and ready for play. The reward for each challenge is special cards that can only be obtained through these challenges, which are attractive to the "Achiever".

In Mario Party, all players have an inventory where they can keep items they collect throughout the game. Examples of items are the Golden Mushroom, the Bowser Phone, the Dueling Glove and the Magic Lamp, which affect the game in different ways (most often to bring the player a step closer to obtain a star). They can either be purchased from a store for coins or collected randomly through special events or mini-games. Because of the competitive impact these items can have, the Killer and Achiever would supposedly be attracted by these features.

4.1.4 Customization

(Gee, 2003) describes how players feel that they invest in a game character on a deep, personal level by being able to manipulate the character and make decisions which have an impact on the game. Hearthstone uses this technique by allowing the player to choose the design on the back of the cards. A new design is collected for each new month that the player is active in the game. The card back is visible both to the player and the opponent. Special card backs can also be collected, e.g. the "legend" card back which can only be collected by reaching the "legend" rank. This feature primarily appeals to the "Achiever". Figure 4.6 shows a sample of card backs

which can be obtained in the game.

Figure 4.6: Hearthstone card backs. The center card has the "Legend" card back (Jacinto, 2014).

Spore is a multi-genre single-player god game. A player starts the game as a cell in a two dimensional plane in a water environment. The player designs the cell himself with a customizing tool. The cell has to adapt to the environment and evolve by feeding on weaker cells and at the same time stay away from predators. When the cell has evolved enough, it grows legs and swims up to the surface. This is one of four phases in the game, where each phase changes the game. Upon each phase change, the player has to customize the creature again with more possibilities, since the creature becomes larger. Figure 4.7 shows a screenshot of the gameplay when creating a creature in Spore.

Figure 4.7: Spore: The creature editor (Maxis, 2008)

(Lin and Wang, 2014) bases avatars to be digital self-representations of participants in the virtual worlds. In this study they define an avatar as any form of representation that marks a user's identity. This could for example be symbols, creatures, emoticons or pictures. Despite of this broadly adopted definition, (Lin and Wang, 2014) focuses on avatars as digital self-

representation of participants in the virtual worlds. The study tries to understand why players spend time customizing avatars. Through a questionnaire, they found three contributing factors: (a) idealized self, (b) standing out, and (c) following a trend. It is important to remember to separate character creation in virtual worlds where you can create characters that for example look like yourself, from character customization in Spore where you can only create creatures.

World of Warcraft, also known as WoW, has been one of the most popular multiplayer games during the last ten years and is currently the world's most-subscribed MMORPG. In WoW, a player creates a character by customizing its appearance and assigning a nickname. Then the player spawns in the world as level 1 with only basic equipment and abilities. The goal is to level up to max level by acquiring experience points through completing quests and killing creatures. When obtaining new equipment and gear, the appearance of the character changes. The player can also choose which ability to acquire next when leveling up. This opens for a lot of possibilities, since there are huge amounts of items, areas, abilities, dungeons and cities to explore. World of Warcraft is a a perfect game for the "Explorer" (Bartle, 1996) because of size of the world and the almost endlessly possible places to visit.

Whether they have unique equipment, appearance, companions, titles or achievements, the interesting thing here is that the diversity in these elements attracts millions of players. Some players want everything that the game has to offer, while more casual players can find their niche. (Ducheneaut et al., 2006) argues that the attractiveness of the game could have a lot to do with its fine-tuned incentives and rewards structure, reminiscent of behavioral conditioning. Rewards are always in sight and in combination with fun gameplay, this may be the reason of WoW's spectacular growth. A typical feature in MMO games such as WoW is player guilds. A guild is essentially a group of people organized in a hierarchy of members, class leaders, officers and a guild master. It is a social community that has their own chatroom in the game and members will often complete quests together, cooperate in raid dungeons or organize world PvP battles with other guilds. The Socializer player type would supposedly enjoy this feature a lot.

4.2   Relevance to our work

The information gathered in 4.1 provides an overview of specific features that are known to at-
tract and keep players in the game. This was the goal for objective 1 in our project objectives,
Section 1.4. For the second project objective, some of these features will be interpreted and
translated into a feature that fits the game and serves the same purpose as it did in the original
game. The adaptation of the specific game features is described in Chapter 9. With so many fea-
tures and games to choose from, implementing all of them is impossible. There are concerns to
keep in mind such as synergy between features, intuitiveness, avoiding redundancy and creat-
ing as little confusion for the players as possible. The researchers will have to determine which
features that are the most favorable to implement. Each selected feature and the reasoning be-
hind the choice will also be covered in Chapter 9.

Chapter 5

Digital Game Based Learning Systems

We have all probably been in a situation where we need to learn something dull and do not feel motivated. The result is that we maybe remember some of it temporarily, but do not really learn anything. Learning is not equal to memorization (Trybus, 2009). Learning is to acquire skills and thought processes that is needed to perform tasks under pressure, in different situations. We do not need more time in classrooms with focus on a chalkboard or on a book. What we need is interactive experiences that actively engages us. Digital game based learning, or DGBL tries to offer this kind of learning environment by taking the users into a virtual world where they feel familiar and relevant.

> "Tell me, and I'll forget. Show me, and I may remember. Involve me, and I'll understand."
>
> *Benjamin Franklin*

DGBL, is a learning environment that addresses various levels of learning needs. The positive effects of DGBL seen in experimental studies can be traced, at least partially, to well-established principles of learning (Gee, 2003). By combining these principles optimally, DGBL might be expected to show more and stronger positive effects.

(Van Eck, 2006) divides DGBL into three approaches for integrating games into the learning process:

1. Have students build games from scratch

2. Have educators and/or developers build educational games from scratch to teach students

3. Integrate commercial off-the-shelf games into the classroom

The basis of approach two fits the description of this project, but it is important to point out that the developers in this project are not experienced in DGBL. This approach is said to have the biggest potential of the three, because they are professionally designed games. The downside of this is the resource requirements. To address educational needs and entertainment equally and on top of that combine them is not an easy task. In addition, the determination to gather these kinds of resources for a concept that has not yet materialized is also needed. Institutions which want to use DGBL face several challenges (Van Eck, 2006):

- Documentation and training support

- Technical support

- Financial support

- Infrastructure support

- Research and development support

Documentation and training support acknowledge the needs to gather experiences and information about DGBL design, development and implementation so that everyone can share and learn from it. In addition, people involved in the process have to get proper training on DGBL and how it is supported and implemented.

Technical support involves challenges in connection with instructing and assisting development and implementation of DGBL. This includes institutions and the students themselves. Financial support is a familiar issue. The different approaches to DGBL differ a lot in financial requirements. If a game has to be developed from scratch it could cost from hundred thousands

to millions of dollars (Aldrich, 2008). Hence such games might prove too expensive for most institutions.

Infrastructure support is also an important factor. Computers with up to date specifications and equipment like headphones have to be available in computer labs. Optimally the students should be able to play the game outside the lab too. This requires that students have computers that meet the same demands, which is difficult.

The final challenge is research and development support. As mentioned earlier in this chapter, institutions need to collect and disseminate research and examples of successful DGBL from inside as well as outside the institution. Databases should be created for examples and guidance for application and extension to additional domains. Through this collaboration it would be possible to define and redefine DGBL locally and abroad.

5.1 Relevance to our work

We do not aim to create a heavy DGBL system in this project, but we will follow the guidelines on how to make the system a optimal learning environment. The information regarding DGBL systems helps us to understand the needs and possible issues that is connected to integrating it with for example a school.

Chapter 6

Technology

This chapter describes our choices of technology used for developing and using our application.

6.1 Software

Kahoot!, Socrative and other games with a similar gameplay style to ours, use web technology frameworks in their applications, which seems like a favorable solution. Our supervisor suggested that we used these frameworks. They provide portability, platform independence and setup convenience. The users do not have to install or be dependant on any software other than a Internet browser, which is a standard feature on pretty much all modern devices today. Although this is a fairly normal solution, what still remains to be decided is what languages and frameworks we want to use.

In addition to using the standard web technologies (HTML, CSS, JavaScript), we need a framework that supports synchronous connection between players and database storage to meet the requirements specified in Chapter 7. The technologies we have decided upon are described below.

6.1.1 Node.js

Node.js also known as Node is a serverside JavaScript environment. Unlike most other modern environments, a process in Node does not apply multi-threading to support synchronous execution of business logic. Node is based

on an asynchronous I/O eventing model (Tilkov and Vinoski, 2010). Code built on the Node platform does not follow the traditional model of receive, process, send, wait, receive. Node processes incoming requests in an event stack and sends small requests without waiting for responses.

Node also contains a build-in library that allows its applications to act as a web server without any software such as an HTTP server. As an asynchronous event-driven framework, Node is designed to build scalable network applications. In addition to providing event-driven architecture it also includes a non-blocking I/O API that makes it perfect for data-intensive real-time applications that run across distributed devices (NodeJS, 2016).

Node package manager

Node package manager or NPM is a tool that Node uses for handling dependencies to various libraries and modules. NPM makes it easier for developers to share packages between each other. The concept of NPM is that these packages are small building blocks for many applications. Each building block takes care of a certain problem and does it well. In addition, several other tools have been added to NPM, like for example testing frameworks and analysis tools (npm Inc., 2016).

6.1.2   Angular.js

AngularJS, also known as Angular, is a framework that came to support the development of productive, flexible, maintainable and testable web applications. In terms of concepts a typical Angular application consists primarily of a view, model and controller, but there are other important components, such as services, directives and filters. The view is a standard HTML template developed by web designers. The controller is connected to the view and contains all business logic implementation needed by the view. From the controller the JavaScript developers can do various types of refactoring activities like moving the code to other components. The model directly manages the data, logic and rules of the application (Branas, 2014).

6.1.3 MongoDB

MongoDB is a non-relational database, also known as a NoSQL database (MongoDB, 2016). It is document-oriented with a JSON-like structure and dynamic schemas. Instead of storing information about a user in distinct relational structures, all the information about a user can be stored in a single document with indexed fields and nested arrays. This makes the storage of objects and values on existing documents much more flexible, which is more suitable for a game-based system. If we want to save an unlocked item etc. on a specific user, it can simply be saved in an array called "items" on the user object. Queries can also be executed using server-side javascript, which suits well with Node.

6.1.4 Socket.IO

Socket.IO is a real-time framework for mobile and Web applications. It leverages Node and features an engine module reliability and supports bidirectional, event-based communication (Krill, 2014). Socket.IO primarily uses the WebSocket protocol with polling as a fallback option, while providing the same interface (Rauch, 2014). It can be used only as a wrapper for WebSocket, but it can also be used for many other purposes, for example storing client data and broadcasting to multiple sockets. Socket.IO can be added to a project through NPM.

6.1.5 HTML5

HTML5 is the fifth revision of the standardized markup language HTML (Mozilla, 2016b). HTML is used for structuring and representing content on the world wide web. It is also a collection of features, technologies, and APIs. It includes better web application features like <video> and <canvas> into the language so one does not have to use Javascript or Flash. In addition, HTML5 includes consistent defined error handling. HTML5 supports the ability to write malformed code and corrects it into a valid document. This ends up in many malformed pages, which are not represented as the developers want it to. HTML5 tries to discover these errors so

that developers can reduce their time spent on displaying content consistently.

6.1.6   Cascading Style Sheets

Cascading Style Sheets (CSS) is a stylesheet language used to describe the presentation of a document written in HTML or other markup languages (Mozilla, 2016a). CSS describes how documents should be rendered on the screen. The stylesheet is separated from the markup language which makes it possible to share them across unlimited sets of web pages. The core functionality of CSS is supported by all web browsers, with some exceptions in newer, experimental features. There are a lot of downloadable finished CSS-files online which can give a web page a distinct look. Developers can also further customize these CSS-files, to make a unique style for the website.

Material design for AngularJS applications

Material Design is a specification for a unified system of visual, motion, and interaction design that adapts across different devices (Burleson, 2016). The purpose of the system is to offer a lean, lightweight set of AngularJS-native UI elements that implement the material design specification for use in Angular single-page applications. We have used several components from this library which form the ground layout for the whole web page, for example buttons, inputs and lists. Each of the mentioned components contains animations which give everything a playful look. This fits well with what we are trying to achieve.

6.1.7   Relevance to our work

We have chosen solid and modern frameworks that has been proven to work in other similar applications like Kahoot!. In addition to this, as mentioned earlier, our supervisor gave us guidance that pointed us in this direction. This influenced us heavily in the direction of choosing these frameworks. It also helps that we as the developers have experience with the frameworks from earlier work.

Part III

Framework

This part gives a full description of the thesis project. It covers the requirements, architecture and gameplay description.

Chapter 7

Requirements

7.1   Introduction

7.1.1   Document purpose

The purpose of this document is to provide a logical description of the application that we are going to develop. It reflects the requirements that the user will expect to the application.

7.1.2   Delimitation

This document will not cover any specific technical information. The content is limited to the description of the main features of the application, and how the system and its users interact.

7.1.3   Overview of contents

The second section provides a user story diagram which provides the reader with an overview of the user stories that are relevant for the application to come to fruition. In addition, assumptions and dependencies of the system will be discussed. The third section contains all the requirements of the system. The functional requirements are described as user stories and associated system sequence diagrams. These will provide an insight into the messages sent between system and user.

7.2 Background and Overview

7.2.1 Users

The target users for this application are students and teachers at teaching institutions or similar. There are no distinguished roles in the application. A user can use the system in two ways; create a game or play a game. There will be two separate areas for creating and playing a game. When creating a game, the creator will receive an identification number. The users will then be able to join the game by submitting this number into the game page.

7.2.2 User story UML-diagram

Figure 7.1 shows the user stories for the admin, and Figure 7.2 shows the user stories for a regular user. For documentation of the user stories, see Section 7.3.1.
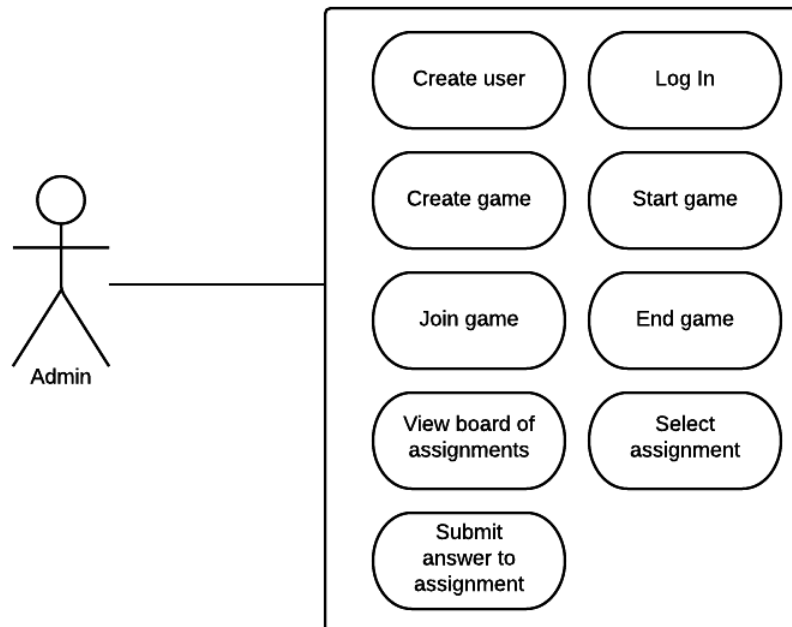
Figure 7.1: Admin stories
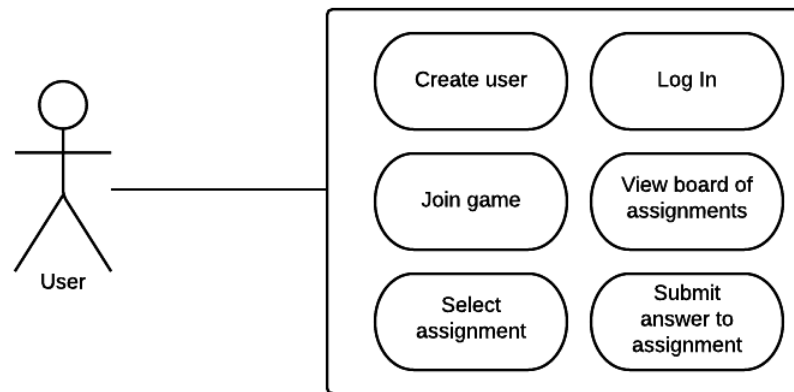
Figure 7.2: User stories

7.2.3 Assumptions and dependencies

- The application requires an Internet connection to be used.

- The user of the system will need an iOS or Android device, or a desktop computer with a
  HTML5 compatible browser to run the application.

7.3 Detailed requirements

7.3.1 User stories

User story 1 - Create user

As a user I want to create a user, so that I can use the application.

Acceptance criteria

- Chosen username and password fields must be provided.
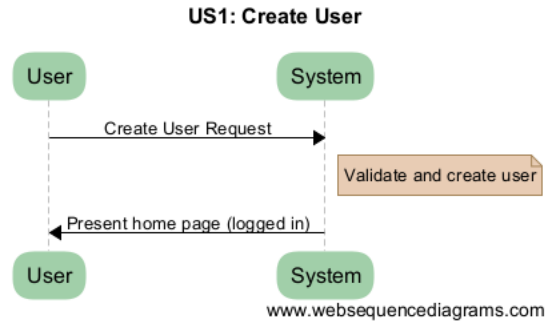
Figure 7.3: User story 1 - Create user

User story 2 - Login

As a user I want to log in to my account, so that I can use the application.

Acceptance criteria

- Username and password fields must be filled in.

- User must be registered in the system.

- Username and password must correspond.
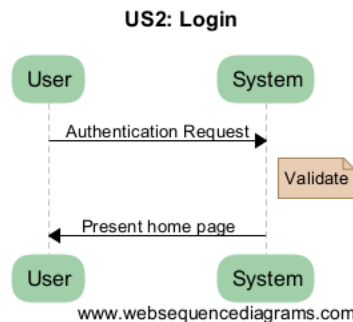
Figure 7.4: User story 2 - Login

User story 3 - Create Game

As a user I want to create a new ladder game.

Acceptance criteria

- User is logged in

- User has the admin role

- Assignment details are provided
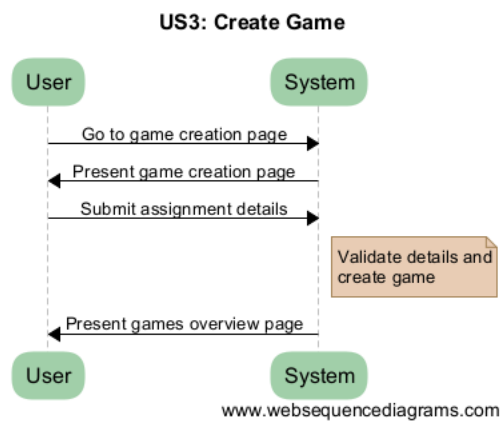
Figure 7.5: User story 3 - Create Game

User story 5 - Start game

As a user I want to start a game that I have created.

Acceptance criteria

- User is logged in

- User has the admin role
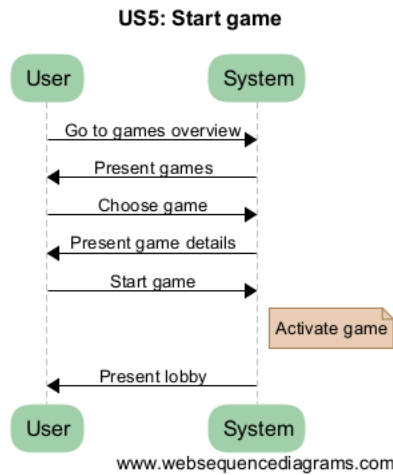
Figure 7.6: User story 5 - Start game

User story 6 - Join game

As a user I want to join a game.

Acceptance criteria

- User is logged in

- A game has been started
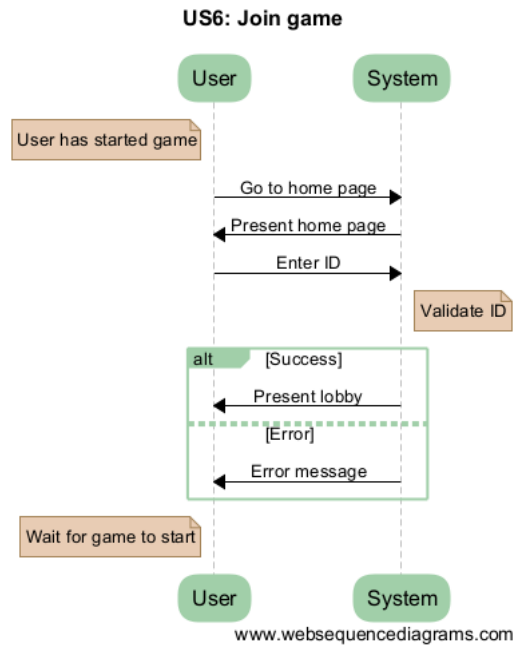
Figure 7.7: User story 6 - Join game

User story 7 - End game

As a user I want to be able to end the game when I want.

Acceptance criteria

- User is logged in

- User has the admin role

- A game has been started
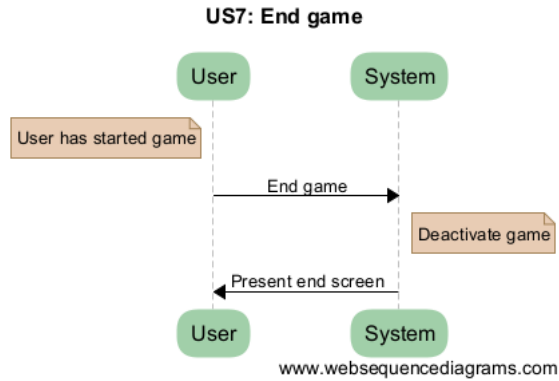
Figure 7.8: User story 7 - End game

User story 8 - View board of assignments

As a user I want to see an overview of assignments so I can make a decision on which one I want to choose.

Acceptance criteria

- User is logged in

- User has joined game
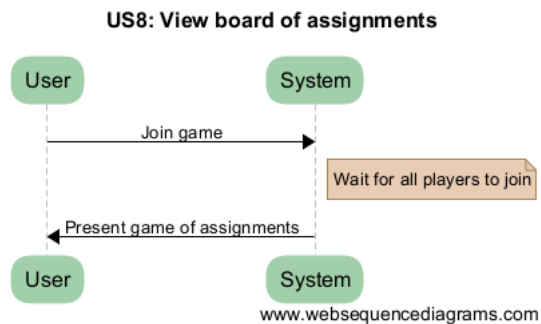
Figure 7.9: User story 8 - View board of assignments

User story 9 - Select assignment

As a user I want to select an assignment in the game which I can complete.

Acceptance criteria

- User is logged in

- User has joined game
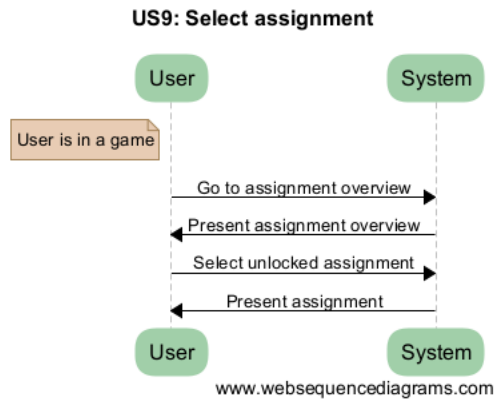
Figure 7.10: User story 9 - Select assignment

User story 10 - Submit answer to assignment

As a user I want to submit my answer to an assignment and receive feedback.

Acceptance criteria

- User is logged in

- User is in the game

- User has provided answer in input field
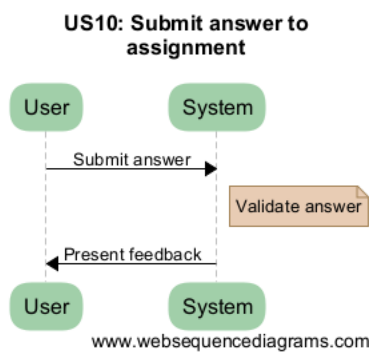
Figure 7.11: User story 10 - Submit answer to assignment

7.3.2   Supplementary Specification

- The system should automatically adapt to the screen size of the unit it runs on, with a special focus on being mobile friendly.

- The system should be platform independent.

- The source code should follow clean code principles.

- The number of calls to database should be kept to minimum.

Chapter 8

Architecture

The purpose of this chapter is to describe the architecture of the system under development. After determining the requirements for the system, we need a underlying architecture to meet these requirements. This architecture involves a series of decisions based on a wide range of factors, and each of these decisions can have considerable impact on the quality, performance, maintainability, and overall success of the application (Microsoft, 2016). All complex structures need to be built on a strong foundation that designs for common problems and values key decisions in the system.

8.1   Background and Overview

This section gives the reader some background before going into the architecture descriptions. Section 8.2 contains the descriptions of the architecture, with a look at logical, deployment and implementation view, in addition to the database EER model.

8.1.1   User story impact

This system is constructed of scripts that lie on specific levels with specific responsibilities. On the client side, they don't communicate with each other the way a regular set of classes would. The way a specific story would be achieved in the system is irrespective of the type of story implemented. Almost all user stories follow the same sequence regarding communication with the

server side, and any transfer of variables etc between the controllers is done via a factory. There-fore, no specific user stories have had any impact on the choice of architecture for the system. We knew initially that we needed a database to communicate with and a login functionality. The software technologies described in Chapter 6, that we currently use, is therefore sufficient for our system requirements.

8.1.2   Assumptions and dependencies

- The system is dependant on running on a web-server with a MongoDB database.

- The application requires an Internet connection to be used.

- The user of the system will need a desktop computer with a HTML5 compatible browser, tablet or mobile device to run the application.

8.1.3   Framework conditions

- The system will be developed as a web application using HTML5, AngularJS and Material Design on the client side.

- The system will use Express.js and Passport on the server side to handle database calls and authentication.

8.2   Architecture description

In this section we describe different perspectives of the system, to give the reader a greater understanding of how the system is architectured.

8.2.1   Logical View

We have decided to use a multilayered client-server architecture with HTML5 and AngularJS files on the client side. Node.js and Express.js files on the server side and a MongoDB database. Figure 8.1 shows the logical view of our application. The Angular.js client framework communicates with the Express.js and Socket.io frameworks inside the Node.js web server. The Express.js framework is the app server which also communicates with the MongoDB database.
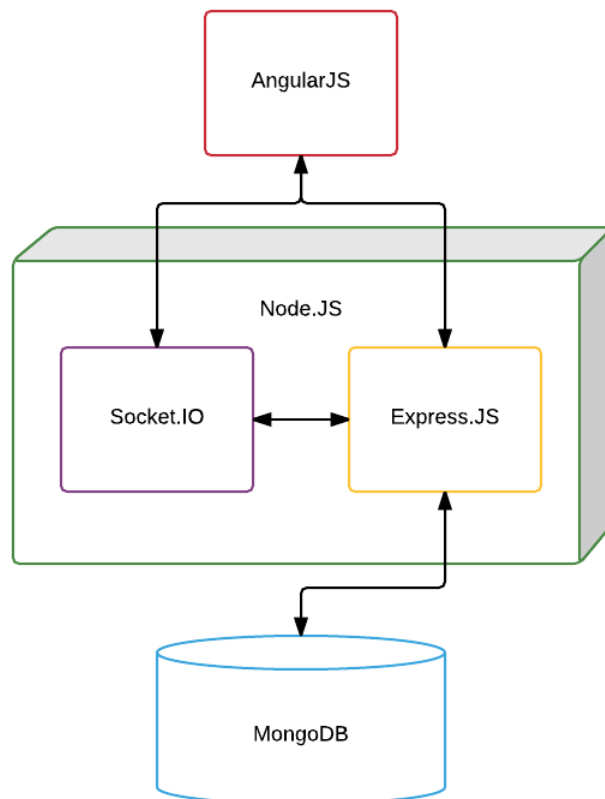
Figure 8.1: Logical view of our application.

We have chosen this architecture because it is a proven architecture used in several web

applications today. In this kind of application you need a domain layer both on the client side and on the server side. On the client side because you would want to process data fast without transferring it over the Internet when it is not necessary. On the server side you would want to process database requests securely and correctly, and you would want functionality like secure login. For this use, this architecture works well.

8.2.2   Deployment view

The model below describes the physical architecture of the system. The application runs on a mobile device, communicating with a web server, which again communicates with a NoSQL database. Figure 8.2 shows an illustration of the deployment view of the application. The player devices connect to the web server
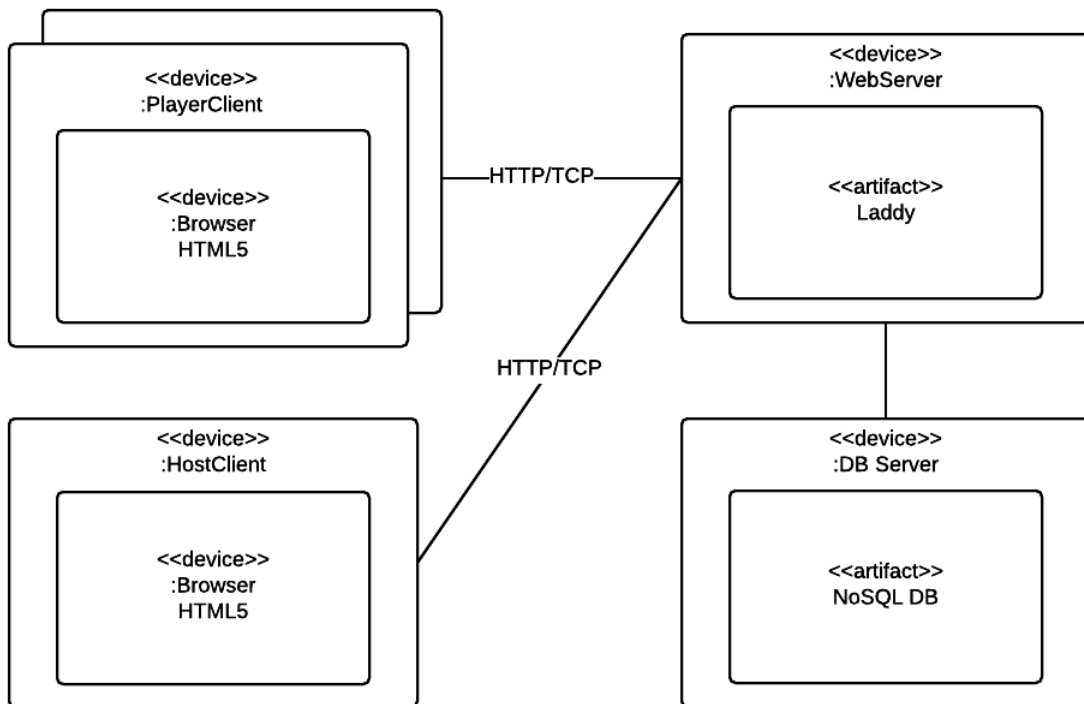
Figure 8.2: Deployment view of our application.

8.2.3   Implementation view

This is an overview of the package structure of the project. The package contents and the relation between these are illustrated in Figure 8.3.
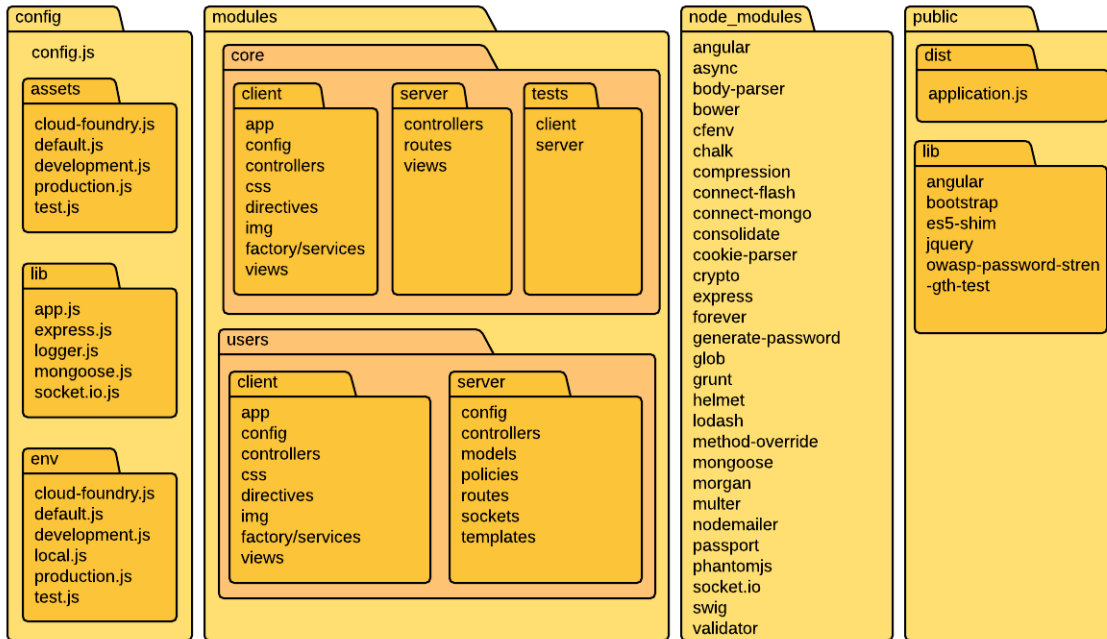
Figure 8.3: Implementation view of our application.

8.2.4   Information flow

Figure 8.4 illustrates the communication between the various components of the system.
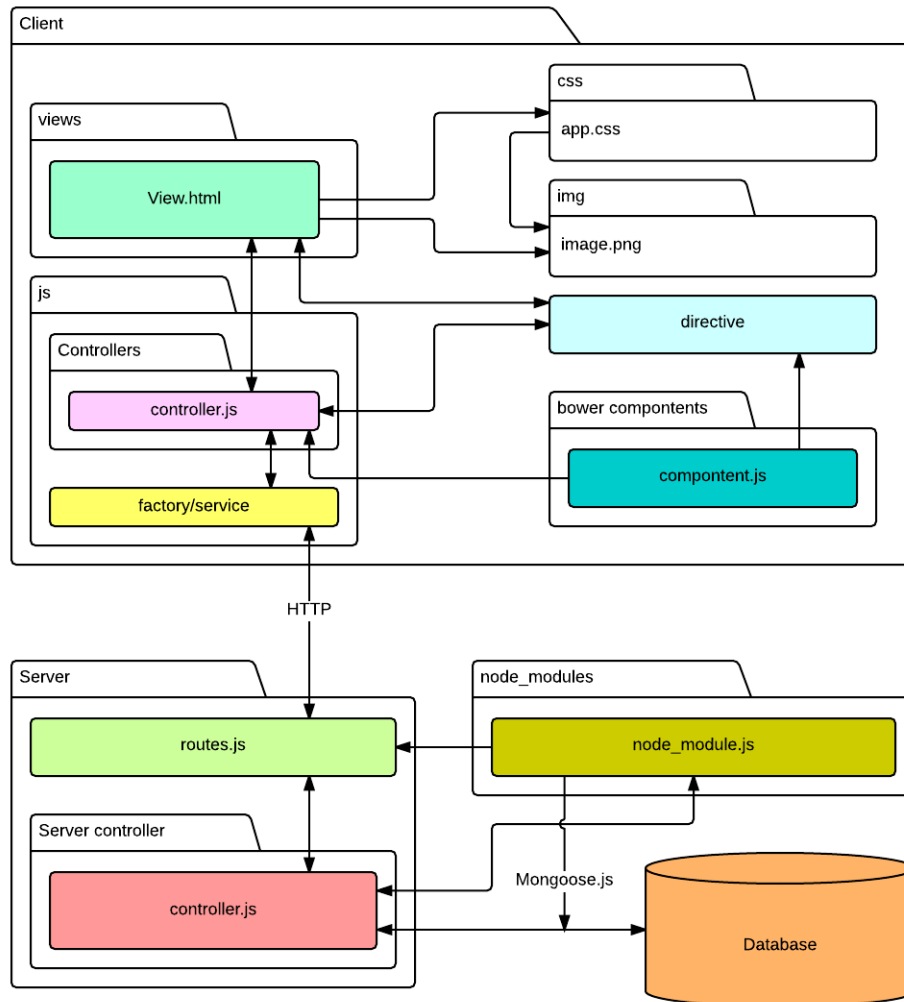
Figure 8.4: Information flow of our application.

8.2.5   EER model

Figure 8.5 shows the EER model of the system database and the different entity relations.

laddies

_id (pk)
name STRING
questions OBJECT
created DATE

0..*

0..*

level

_id (PK)
level INT
start INT
end INT

user

_id (PK)
salt STRING
provider STRING
created DATE
roles ARRAY
password STRING
username STRING
laddies ARRAY
nickname STRING
profileImageURL STRING
level ARRAY
inventory ARRAY
notifications ARRAY
chosenStyle STRING
title STRING
styleIndex STRING
styles ARRAY
updated DATE

title

_id (pk)
title STRING
desc STRING
levelreq INT

1

1

0..*

0..*

style

_id (pk)
name STRING
path STRING

0..*

item

_id (pk)
name STRING
desc STRING
path STRING

1

Figure 8.5: EER model of our application.

Chapter 9

Gameplay

9.1 Introduction

This chapter addresses all aspects of the application in terms of gameplay and game elements. First we introduce the various features and game elements for each role in the application, both admin and regular players. Then we will depict the artistic style outline, game assets and game flow. Finally, we explain in detail the various gamification features that we have implemented. The decisions and reasons behind the features of the game will also be explained in the final part. We do not go into the technical aspects of the application in this chapter.

One prototype has been made called Laddy. It is an interactive motivational quiz game that functions as a tool for educating students in various subjects using competition and rewards. The students answer questions individually in order to get points and climb the graphical ladder that is displayed to all participants on a big screen. Laddy has been developed to create different kinds of game elements and test them on different kinds of player types to see if we find any correlation. We also want to look into how well games like Laddy create a good learning platform and combine this with fun.

9.2   Laddy

This section will describe all aspects of the game for all roles in the application.

9.2.1   Creating and hosting a Laddy

The option to create laddies is currently only available for admin users. Figure 9.1 shows the admin home page. The reason behind this is to prevent people from making simple laddies for themselves and obtain all the unlockable styles and consumables, which would remove the sense of rarity of these items. The creation of laddies is made with the purpose of being as simplistic and easy as possible. An admin presses the create button in the home menu to enter the creator view. In this view the admin can name the quiz, add questions and save the Laddy when all the questions are added. Figure 9.2 shows the dialog for adding textual questions. Multiple choice questions can also be added. All laddies are saved to the profile of the user and can be started from the start option in the home menu. Figure 9.3 shows the selection page. When the Laddy is started a lobby is created and background music starts. The lobby is shown in Figure 9.4. Each lobby has an unique room code which players can use to join the game. This room code is randomly generated and displayed in the lobby page. The idea is that the admin displays the lobby page to the players, providing them with the room code. When a player joins, their name and character will pop up on the screen and a sound effect will play, confirming that they have joined. The game starts when the admin clicks the start button in the lobby.
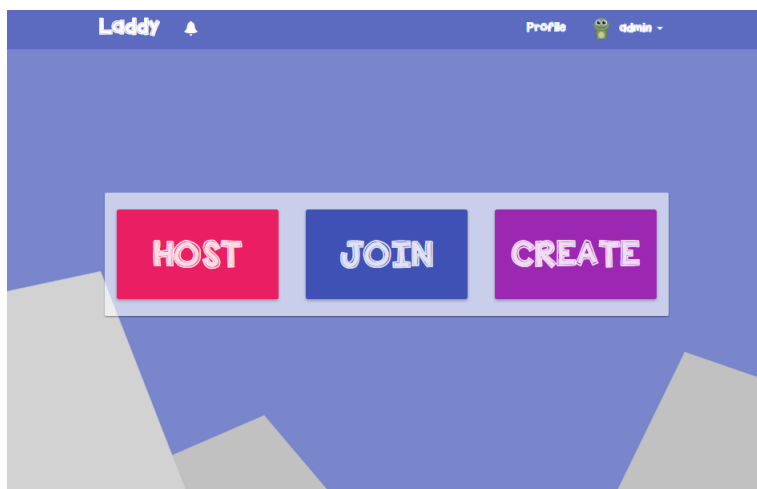
Figure 9.1: The home menu for an admin user.
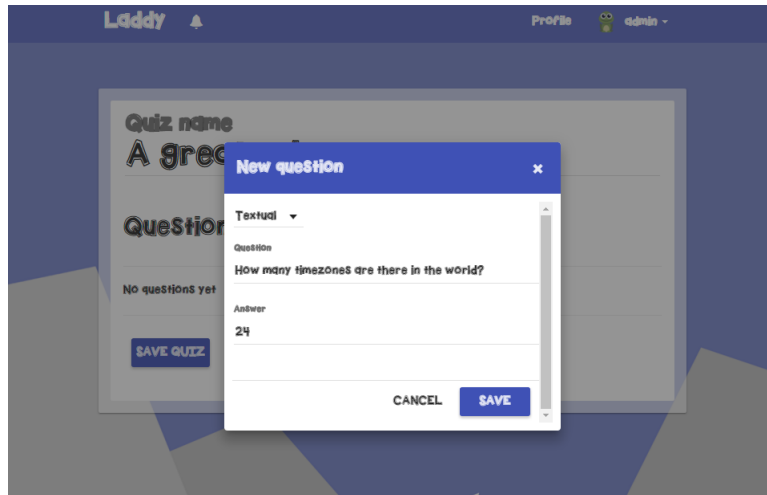
Figure 9.2: Creating a question for a quiz. The form appears in a dialog above the previous screen. The user selects the question type from the dropdown menu and fills in the required fields.
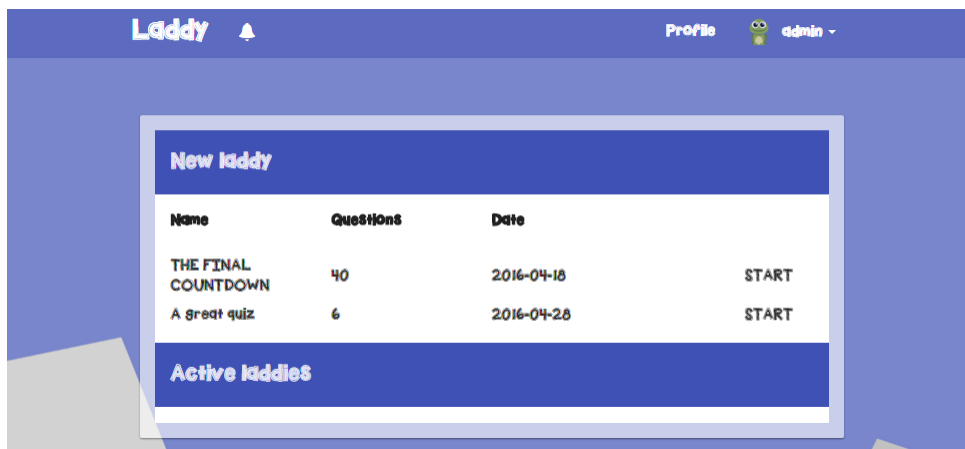
Figure 9.3: List of quizes for a user.

Figure 9.4: A game lobby displayed on the big screen.

9.2.2   Starting point for players

A player has to create a user before playing. After doing so the player is presented with a profile page where he can choose a nickname, a character and progress bar style. Figure 9.5 shows a screenshot of the profile page. It is not compulsory to do this customization, and the players can skip this process if they want to. The nickname will then be set to Anonymous and the character will be a default picture. When the players have customized their profiles, they are ready to join a Laddy. The admin should provide the players with the room code mentioned in the above section. Figure 9.6 shows the page for joining a game, which is also the home page for a basic user. At the beginning of a game, the leaderboard is a list of players with zero points and a potential score of 100. The current room code is also displayed in the corner in case players disconnect and need to reconnect. Figure 9.7 shows the leaderboard of a typical game.
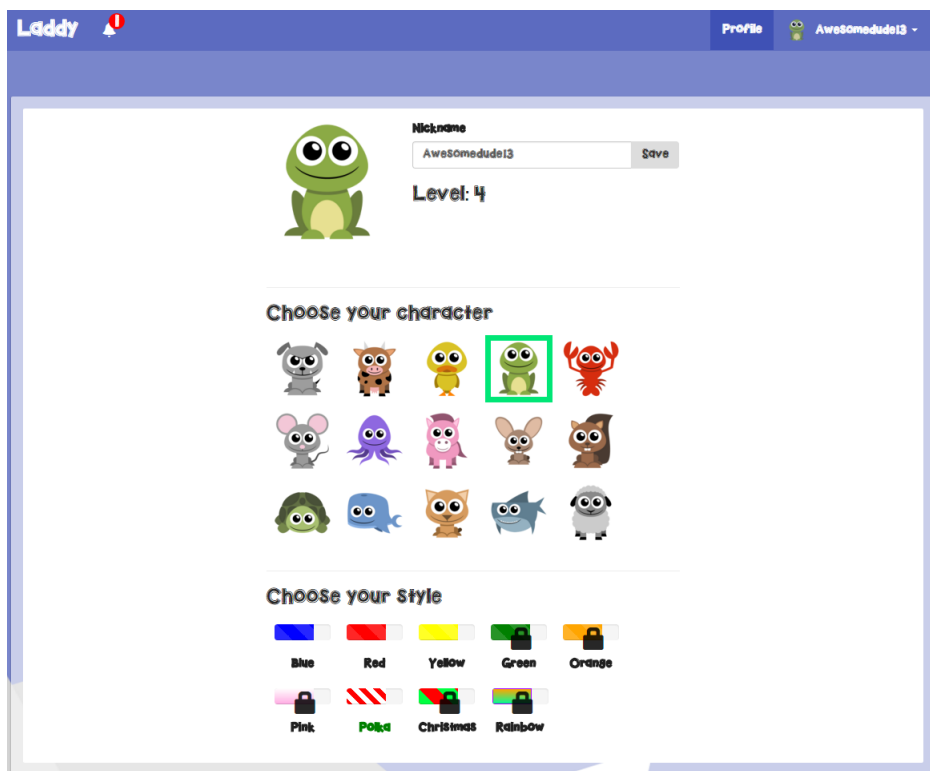
Figure 9.5: The profile screen for all users. Here you can customize nickname, avatar and bar-style
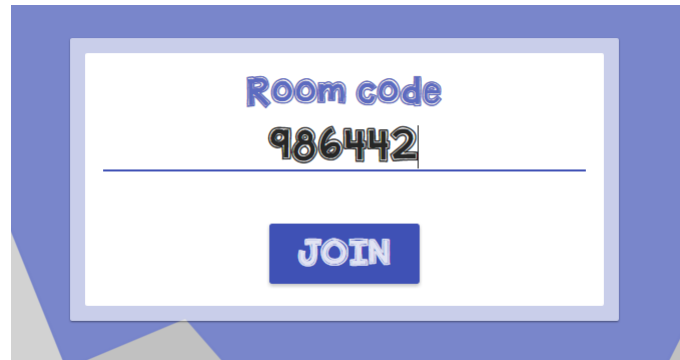
Figure 9.6: The join game view. The user has entered the room code and is ready to join.
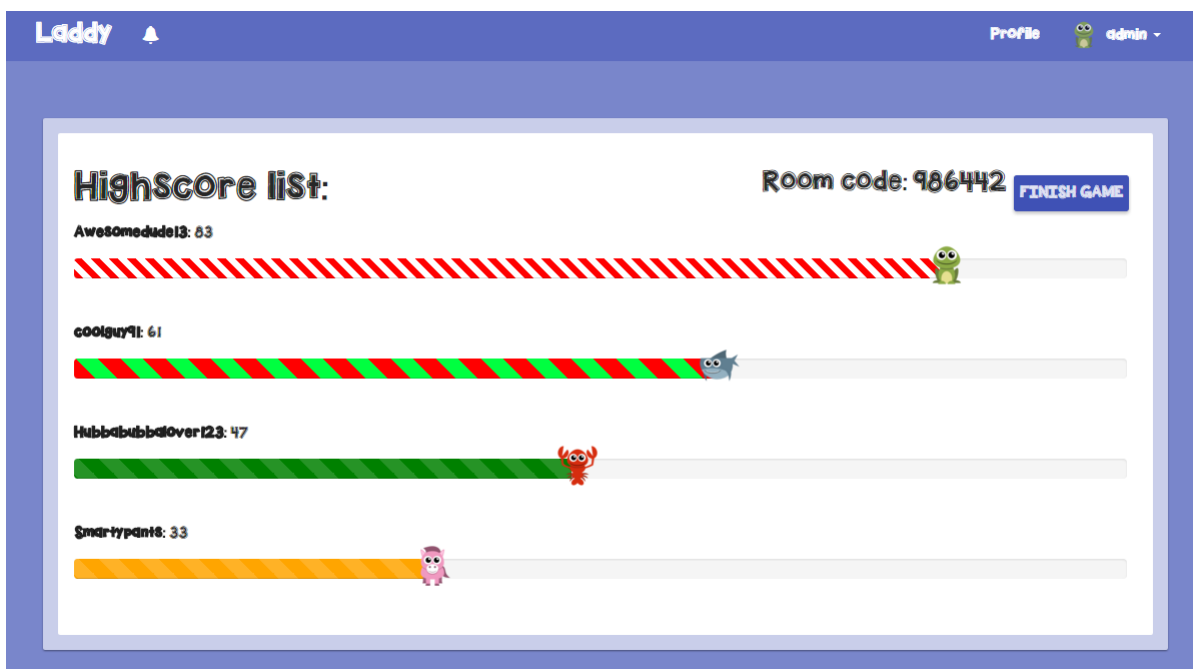
Figure 9.7: The leaderboard. Each participant in the game is represented with a selected character. The distance the player has moved from the left side of the screen indicates his progress.

9.2.3 Gameplay description

This section will describe the main gameplay and miscellaneous features of the game.

When a game has been started, each player is presented with a set of questions, shown in Figure 9.8. Each question is represented by a button with a number. By clicking one of the buttons, the assignment is presented in a new view, see Figure 9.9. As mentioned earlier, the assignments types can be multiple choice and free text answer (which can also be numbers and sequences). If a player answers a question correctly the first time, the maximum amount of

points of 30 will be awarded. The question dialog is then closed and the associated button for the question is grayed out, illustrated in Figure 9.10.
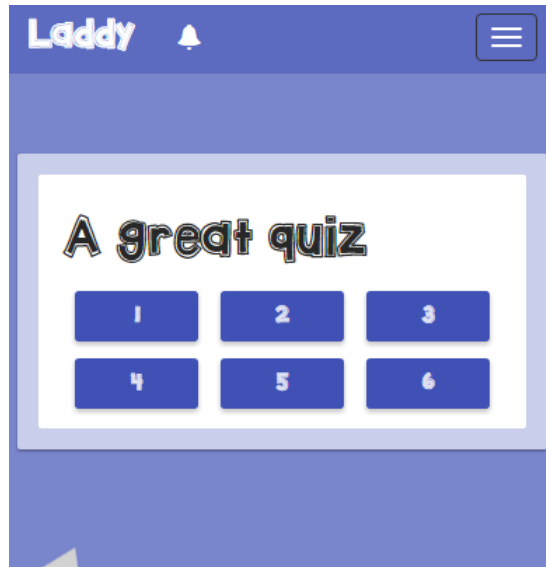
Figure 9.8: Overview of the questions presented on a mobile device.

Figure 9.9: Answering a question. The player is presented with this screen after selecting a question.
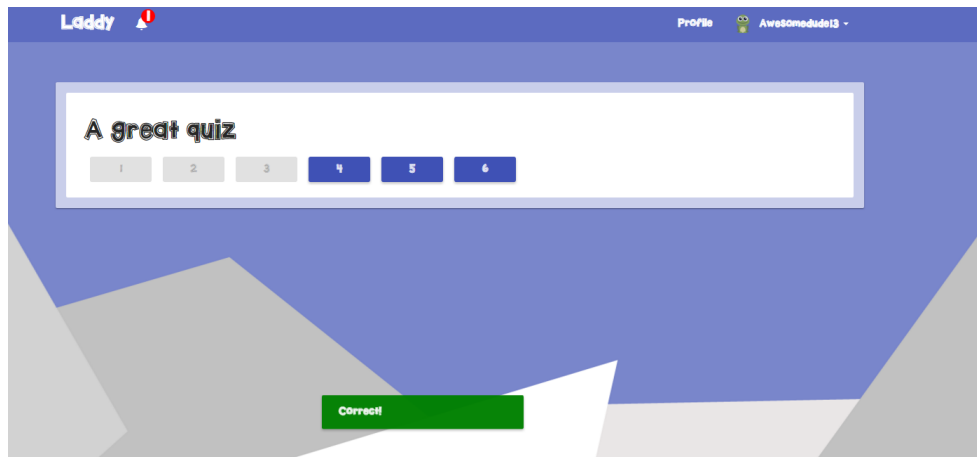
Figure 9.10: Answering a question correct. The user receives feedback in the form of toast.

If an incorrect answer is provided, the dialog will still be showing and the potential score of this question is reduced depending on the type of question. For each incorrect answer, the potential score is reduced by 10 on multiple choice questions and 5 on free text questions, see Figure 9.11.
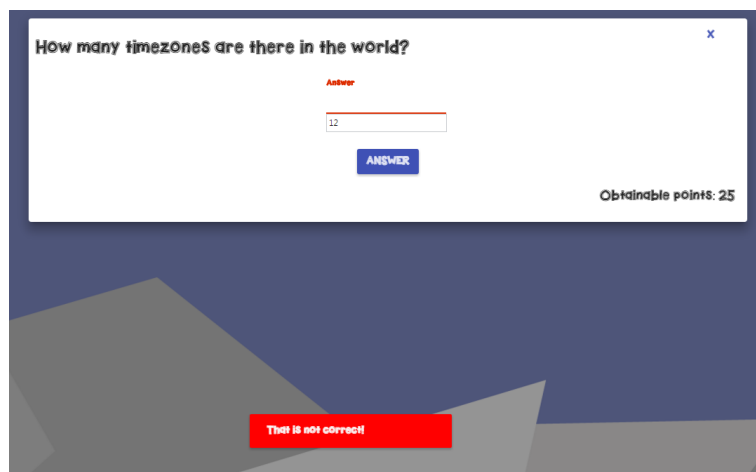
Figure 9.11: Answering a question incorrect. A toast is shown and the potential score(obtainable points) is reduced to 25.

If a player answers correctly, he will also receive experience points and if the player collects enough experience points he will reach a new level. By reaching a new level, the player will also receive either a new progress bar style as shown in Figure 9.7 or a consumable item called 50:50 as show in Figure 9.13. All players can choose from a set of three bar styles initially, in addition six more styles can be unlocked from leveling up. The 50:50's are items that players can use

when they answer multiple choice questions. As the name suggests, two of the four options in the assignment are removed. These items are further explained in Section 9.6.3.

As the players do the assignments, a leaderboard keeps track of the positions of all the players synchronously with the progress. If a player answers correctly, he can see his character move from the left side of the screen to the right, see Figure 9.7. The distance moved depends on how many points were awarded on that question. The list is sorted descending on player scores, which means if a player "overtakes" another player by obtaining more points than them, they will swap places.
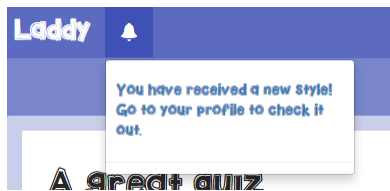
Figure 9.12: When a player reaches a new level he gets a notification about which items he has received.
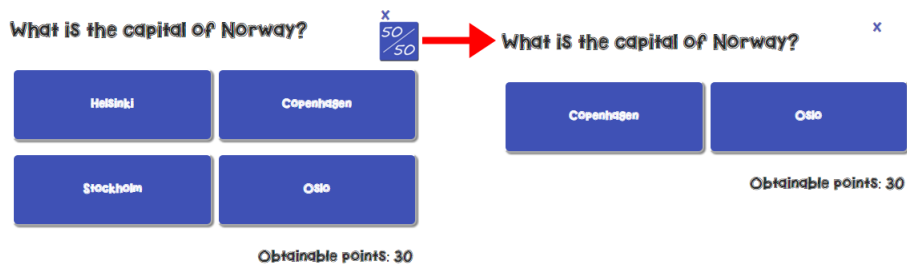
Figure 9.13: A player has used his 50:50

9.2.4 Finishing a Laddy

The Laddy is finished when admin presses the finish game button. How much time a Laddy should take, is up to each individual admin, but we assume that a time frame is set before the game is started. When the finish button is pressed, all players are presented with a rank and the winner is highlighted on the big screen as shown in Figure 9.14.
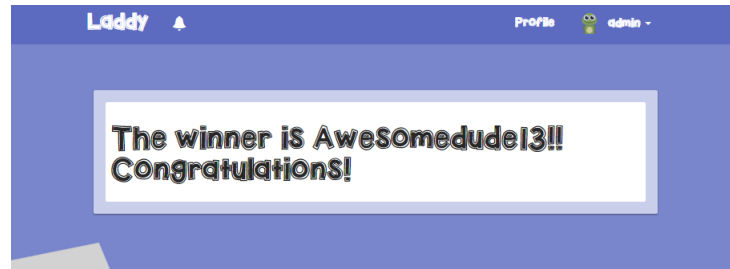
Figure 9.14: The game is finished and players are presented with their rank

9.3 Artistic Style Outline

The design itself is intended to be as appealing and playful as possible. Some inspiration is taken from the Jackbox Party Pack (Games, 2016), which contains a set of games that are intended to be played on a big screen and the players participate with their own devices(e.g. laptop or mobile phone). It uses a colorful design with childish fonts and a simple, yet clean and minimalistic layout. We have applied some of the elements and styles used in this game to The Laddy Games' look and feel. The most important elements are listed below.

- A minimalistic, colorful design with a cartoon-like font to create a playful atmosphere.

- Sound effects for various events like joining a game, answering correctly and answering incorrectly. We have also used the lobby music from Drawful, a game in the Jackbox Party Pack (Games, 2016) to help set the mood before playing. There is no music playing during a game, since we imagine that people have various preferences in music while working, and a specific kind of music might have a disturbing effect for some students.

- Animations between screens such as opening a question dialog and displaying messages.

- A navigation bar at the top which handles user navigation within the system. It includes the Laddy logo (home page), a notification bell with a dropdown containing notifications, a profile button and a settings dropdown. If the user is not logged in, the bar will display a sign in- and a sign up button.

- Sixteen colorful avatars to choose from and nine unlockable bar styles with various patterns and colors. Our choice for characters were cute animals, which most people can

relate to.

- The leaderboard that is displayed to all players on a big screen. Inspired by the space race screen in Socrative which we described in Section 3.2, but with a slight tweak to let the player customize the look of the progress bar and avatar instead of the admin.

9.4 Asset Breakdown

This section describes the main assets in the game in detail.

The leaderboard (Big screen)

Each player participating in the ladder is represented with an avatar and a nickname of the player's choice in a frame with a "tail" reaching to one end of the screen, indicating how far the player has reached. The "enemies" of each player are the other players in the ladder, which have the same appearance. The player will start to move from one end of the screen to the other as he/she completes tasks and it is the player who has got furthest that will be on top of the list. If a player's score exceeds another, the players will swap places vertically, indicating that the player has been "overtaken". All of these movements will have animations.

Question prompt

When a question is selected, a question is presented in the form of a dialog, showing the question and the input element (text-field/buttons).

Sound effects

In order to create excitement around events happening in the game, sound effects will play when particular events happen on the ladder:

- Player joins the game

- Player answers correctly

- Player answers incorrectly

• Background music for the lobby

9.5 Suggested Game Flow Diagram

Figure 9.15 shows the game flow of the intended gameplay.
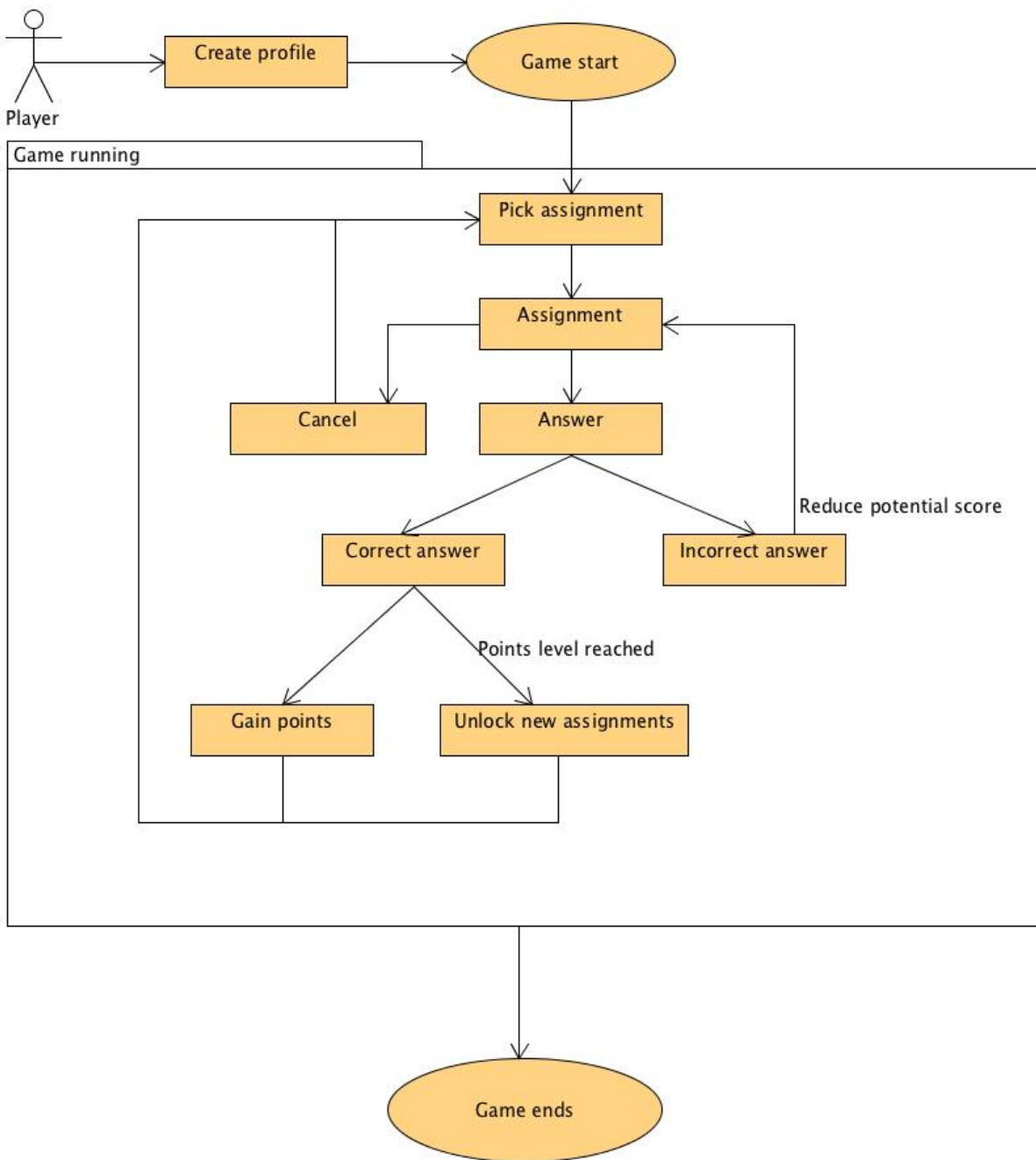
Figure 9.15: Game flow

9.6   Primary gamification features

This section will describe the main gamification techniques we have decided to implement initially. They are based on the features and game elements described in Section 3 and 4.

9.6.1   Competition

Both Kahoot! and Socrative use competition as one of their main motivational gamification features, by showing the leaderboard on a big screen throughout the game. Our implementation is more similar to Socrative, which shows the leaderboard during the entire game. The leaderboard is implemented to affect the Killers and Achievers. The Killers can match their progress to others and the Achievers can show off their unlocked items to others.

The game is also similar to Socrative in the way that the questions can be answered in different formats and the players have no time limit. A new feature we introduce to this concept is that players can select what question they want to answer in their desired order. They can also open and close questions as they like. As the game progresses, and the players change in positions and appearances, the leaderboard will update and keep the players informed about their status relative to others.

9.6.2   Customization

The customization feature is inspired by games such as Hearthstone, Spore and World of Warcraft which we described in Section 4.1.4. We implement this by letting the player choose their own nickname after registering as a user. Afterwards, they will be able to select a character look for their profile. The characters are a pool of cute animals, and the selected animal will be showed in the leaderboard next to the user's nickname. In addition, we have implemented a selection of bar styles for the players to obtain and use on the leaderboard. The bar styles are inspired from the Hearthstone cardbacks which gives each player their own unique style together with the avatar.

The customization features are added mainly to motivate the Explorers and maybe some of the Achievers. If a player is only focused on the game, he will not benefit from these features. We expect the explorers to investigate these kind of features and become trend setters in the games

when it comes to customization. We also include Achievers in the motivation to implementing this feature because collecting unlockable items is also achievements for some Achievers. We try to make the different bar styles a kind of status symbol in the game, not just fun, but in the end unimportant items.

> Achievers are proud of their formal status in the game's built-in level hierarchy, and of how short a time they took to reach it.
>
> *Richard A. Bartle*

Customization can start before the game, but players can be motivated to customize their profile throughout a game by sending them notifications when they receive new items. A player can easily disconnect from the game, make to changes to his profile and then rejoin the game with his new appearance.

9.6.3   Unlockable items

There are some items that the user can unlock during the game. When the player increases in level, there is a possibility of receiving a new item. The new item can either be a style for the progress bar or the 50:50 bonus. The available styles are also listed on the profile, some unlocked, some locked. When a style is unlocked, the lock icon is removed and the player can select this style and have it displayed on the leaderboard. If the player obtains the 50:50 bonus, it can be used during the answering of a multiple choice question to eliminate some options. It is completely random which item is unlocked, which is based on Section 4.1.2.

The idea of "usable items" is adopted from Mario Party which we described in Section 4.1.3 where you can collect items that affect the game. These are added features to motivate the Achievers and Explorers. The receiving of the 50:50 is not very prominent, because it is supposed to give an edge to the players who investigate what it actually does.

Part IV

User Experiments

This part describes how we planned, prepared and conducted the user experiment. It also describes and discusses the experiment results and experiences.

Chapter 10

Empirical Approach

This section describes the empirical approach we performed to obtain research data. As mentioned in Section 2.2, we used a mixed methods strategy for our experiment, using both quantitative and qualitative methods. The quantitative methods were the Bartle test and questionnaires. They provided structured, measurable data that dealt with system usability and general feedback to the game features. The qualitative methods were interviews, which will provide in-depth opinions concerning the various gamification features and other feedback to the application.

10.1   General Information

Initially we wanted to map the participants according to Bartle's player types (Bartle, 1996). This relates to the investigation of Section 2.1.1. To do this, we had them take the Bartle test (Andreassen and Downey, 2006) and store the data as anonymous nicknames so that we could track them through the whole experiment. After taking the test, we had the participants answer a questionnaire containing a small evaluation of the test along with some general information about the participant, such as age, gender, study programme and their previous experience with online games. The questions in this test are listed in Table 10.1.

1	I have played a lot of online multiplayer games earlier
2	I thought that the test was hard to complete
3	I understood all the questions in the test
4	I agree with the results I received from the test
5	I feel that the test questions were sufficient to determine my player type

Table 10.1: General questions

The possible answers to each question in the questionnaires was a set of checkboxes where the user selected one. In order to obtain more specific answers to each question, we wrote them in the form of claims, and it was up to the participants whether they agreed with these claims or not. The range of possible answers for each claim are listed in Table 10.2. This was used for all the following questionnaires as well.

Disagreed Completely	Disagreed	Neutral	Agreed	Agreed Completely

Table 10.2: Range of possible answers

10.2   System Usability Scale

The demands of evaluating usability in systems are important for cross-system comparison (Brooke et al., 1996). Subjective measures of usability are usually obtained through questionnaires and attitude scales, but often there is no need for a full context analysis and selection of suitable matrices. What is needed is an indication of the overall usability of a system. In response to these demands, System Usability Scale (SUS) was created to offer a simple, ten-item scale which gives an overall view of subjective assessment of usability. The list of usability questions is listed in Table 10.3.

1	I think that I would like to use this system frequently
2	I found the system unnecessarily complex
3	I thought the system was easy to use
4	I think that I would need the support of a technical person to be able to use this system
5	I found the various functions in this system were well integrated
6	I thought there was too much inconsistency in this system
7	I would imagine that most people would learn to use this system very quickly
8	I found the system very cumbersome to use
9	I felt very confident using the system
10	I needed to learn a lot of things before I could get going with this system

Table 10.3: SUS questions

10.3 Application Evaluation

After the experiment was conducted we wanted to examine the different user experiences. We used a questionnaire which everybody answered immediately after playing the game and also made a series of interviews with a random selection of the participants. This evaluation investigates our second and third research question and focuses on game elements, features and learning experience.

10.3.1 Quantitative Data Collection

The questionnaire for this part of the experiment was related to the game experience as a whole, but also the specific features of the game. We tried to distinguish every major aspect of the game and divided them into questions. The goal was to examine how the player perceived each feature. Table 10.4 shows the list of questions. The questionnaire used the same range of answers as the background information questionnaire as shown in Table 10.2.

1	I thought the competition was exciting
2	I felt that I got sufficient feedback from the game about my progress
3	I did not like to be compared with the other students on a big screen
4	I liked the concept of receiving useful rewards throughout the game
5	I liked that I could choose my own nickname in my profile
6	I liked that I could choose a character and style in my profile
7	I did not care about selecting any unlocked items throughout the game
8	I would like more stuff in the game that I can unlock and equip
9	I liked that I could answer questions in my own speed
10	I felt the competitiveness throughout the game.
11	I did not care about the comparison of players on the big screen
12	I enjoyed the 50/50 bonus that I received and used it during the game
13	I would like to receive more bonuses like the 50/50, which gives me an advantage in the gameplay
14	I did not care about what kind of rewards or progress my fellow participants had during the game
15	I enjoyed getting notifications when something new happened
16	I learned something during the game
17	I feel that this platform has potential to positively affect my future learning experience

Table 10.4: Application evaluation questionnaire

10.3.2   Qualitative Data Collection

The interview questions started as fairly open ones, allowing the interviewee to express opinions about any aspect of the application. The answers to the initial questions therefore varied in length, depending on the amount of information the interviewee provided. Secondly, we wanted some specific feedback to the various parts of the system, from the learning experience to the various gamification elements. The questions are listed in Table 10.5 The transcripts of all interviews can be found in Appendix B.

1	What did you think of the game?
2	What did you like about the game?
3	What did you not like about the game?
4	Do you have any suggestions for improvements/additions to the game?
5	Do you feel that this was a learning experience?
6	Which game element did you like best?
7	Would you like to use this in a learning environment? Why or why not?
8	Did you visit the profile when you received new items? Why or why not?
9	Did you use the 50/50 bonus? Did you like the concept of receiving such tools?
10	Did you pay attention to the big screen? If yes, how did you feel about it? If no, why not?
11	Do you have any suggestions to improvements or additions for the game?

Table 10.5: Application evaluation interview

Chapter 11

The Experiment

11.1 Introduction

This section describes the experiment process, along with experiment results and experience from both the participants and researchers.

The purpose of the experiment was to gather empirical data regarding the application's usability, the participant's feelings towards the different game features and how well this application fits into a educational environment. The experiment was conducted on April 19th, 2016. 21 students participated in the experiment where 95% of the participants were males and the age span was from 20 to 28 years. Most of the participants were software engineering master students and everyone tested the application for the first time. The experiment was not conducted during a lecture, but instead it was based on voluntary attendance of random students. Because of this, the Laddy quiz contained general questions about common knowledge such as geography and sports. The experiment contained a full system test of Laddy from the point where the players created new users to finishing a Laddy game.

We started with a short introduction of what we were going to do, while the participants got comfortable and set up their devices. When everyone was ready, we started off with an individual Bartle Test. This was estimated to take about five minutes. After the participants completed the test, the next step was to complete a questionnaire to gather background information about them and having them evaluate the Bartle test. Figure 11.1 shows the participants answering the first questionnaire.

Figure 11.1: Participant answering questionnaire on mobile device.

We asked the participants to login to the game, create a profile and join the game room we had set up. The participants were allowed to work in teams of two if they wanted to, and around half the participants decided to do so. They were also free to choose which device to work from, whether it was mobile phone, PC or tablet. We noticed that most of the people in pairs chose to use a laptop, while the majority of individuals used their mobile phones. The distribution in mobile phone and PC users were fairly even, but there were no tablet users. Time restrictions were not initially set, but we gave them an estimated playtime of around 30 minutes. When everyone had completed the registration and joined the lobby, we started the game.

The leaderboard showed up on the big screen and the chat started immediately between the paired participants. Some participants answered quickly and their completeness increased rapidly on the big screen while others took more time to answer. Figure 11.2 shows the game

session. After 15 to 20 minutes the progress bars started to slow down, some were already above 50% at this point. There was a pleasant ambiance at this time, and the participants seemed to enjoy themselves without stress. When the progress bars started to show very little progress, we gave the participants five minutes to finish. We actually experienced som ranking changes during these last five minutes.

Figure 11.2: Overview of the classroom. Big screen and Laddy master in front.

To finish off, we had the participants answer a questionnaire evaluating the game. While this was going on, the players discussed some of the Laddy questions and wanted to know the answers to the questions which they had not managed to answer.
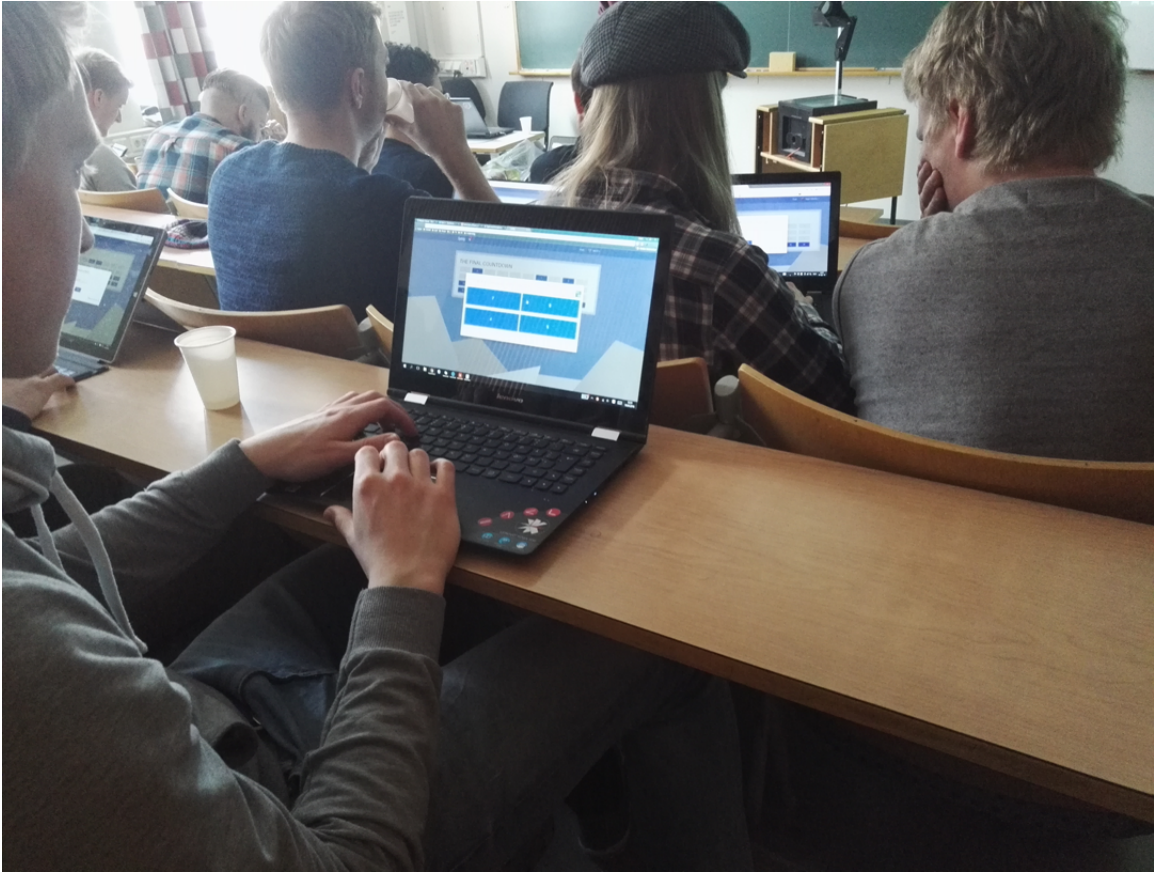
Figure 11.3: Participant answering multiple choice question on computer.

Chapter 12

Results

12.1   Bartle test

The Bartle test is a series of 30 questions and players are classified into four different categories from the results. The categories total 200% and each category can not exceed 100%. As seen in the results, some users get a total of 199% or 201% which is a result of rounding. However, normally a result looks like the user with participant number 2 in Table 12.1, 60% achiever, 80% explorer, 7% griefer and 53% socializer which totals 200%. This result is called the Bartle Quotient and is typically abbreviated by the first letter and then composed into a figure from the most to the least dominant. In our example, the user is 'EASG'.

Participant number	Achiever	Explorer	Griefer	Socializer
1	47	87	20	47
2	60	80	7	53
3	53	60	33	53
4	67	33	60	40
5	33	60	60	47
6	47	67	60	27
7	80	20	73	27
8	33	47	47	73
9	40	67	40	53
10	67	40	33	60
11	67	27	67	39
12	33	73	40	53
13	53	40	33	73
14	67	47	33	53
15	33	87	27	53
16	67	33	53	47
17	47	73	40	40
18	40	60	60	40
19	60	33	60	47
20	47	27	73	53
21	40	53	33	73
Avg	**51**	**53**	**45**	**50**
Sum	**1081**	**1114**	**952**	**1051**

Table 12.1: Results from the Bartle test. The most prominent results are highlighted in green.

Scores above 60 have been highlighted to show each players most prominent player type. 16 out of 21 players is classified as one or two player types. Players who are not classified have been named 'hybrids'. It is important to note that hybrid is not a player type and it is not a classification, it is just a name for players that have no prominent player type in our distribution.

After the Bartle test was completed, they were given a survey related to their experience with games and the test itself.

	Bartle test evaluation	Disagree	Neutral	Agree
1	I have played a lot of online multiplayer games earlier	9.5%	0%	90.5%
2	I understood all the questions in the test	0%	0%	100%
3	I agree with the results I received from the test	4.8%	23.8%	71.4%
4	I feel that the test questions were sufficient to determine my player type	28.5%	19%	52.4%

Table 12.2: Results from the evaluation of the Bartle test

User comments on Bartle test and first questionnaire

We included a field at the end of both questionnaires where participants could make additional comments, but these were not required fields. We received the following comments on the Bartle test evaluation.

- "I feel the test suits well with MMO-games, but maybe not for other types of online games(like CS:GO or DOTA)."

- "The questions are not relevant to games people actually do play."

- "The questions in this test are purely based on MMORPG-games. I don't feel it is sufficient to determine player types."

Author's comment: The test is made for players of Multiplayer Online games and the scepticism comes from the fact that the questions feel very MMO/MMORPG-related.

- "The test uses a lot of difficult words. I recommend using more common synonyms, making it easier for the user to understand the questions. If you can't understand the question, the validity of the answer sinks."

Author's comment: The language in the questions expects that the participants have played games before and have some experience with it.

- "I became a Griefer, but I do not identify as one. In Minecraft, that word means someone who vandalizes another player's property"

Author's comment: Minecraft ([Mojang](#), [2009](#)) is a collaborative building game where players collect resources used to build structures, tools, weapons etc. It is common etiquette in this game to respect each other's creations and property. The fact that one of the player types in the Bartle test has the same name as someone who disrespects these norms might affect players' reactions to the test results, considering the popularity of the game.

12.2   SUS Results

SUS generates one number which represents the overall SUS score of the application. This score is the sum of all the item scores where the items represent each of the questions asked. The answers range from 1 Strongly disagree to 5 Strongly agree. Each individual score is calculated in this way; 1,3,5,7 and 9 are positively charged and 5 would be the best outcome. Then you take this answer and subtract it by 1 and you get the score value. For 2,4,6,8 and 10 which are negatively charged, 1 is the best outcome. To get the score on these items, you subtract 5 from the answer value. The overall sum of the scores is then multiplied by 2.5. This gives a number in the range from 0 to 100.

	SUS questions	Avg	Var	Score
1	I think that I would like to use this system frequently	3.95	0.33	2.95
2	I found the system unnecessarily complex	4.38	0.24	3.38
3	I thought the system was easy to use	4.38	0.24	3.38
4	I think that I would need the support of a technical person to be able to use this system	4.76	0.18	3.76
5	I found the various functions in this system were well integrated	4.0	0.19	3.0
6	I thought there was too much inconsistency in this system	4.19	0.54	3.19
7	I would imagine that most people would learn to use this system very quickly	4.43	0.24	3.43
8	I found the system very cumbersome to use	4.23	0.75	3.24
9	I felt very confident using the system	4.33	0.41	3.33
10	I needed to learn a lot of things before I could get going with this system	4.38	0.33	3.38
	Total score			**82.6**

Table 12.3: SUS questions

Table 12.3 shows the results of our SUS test. The application scored 82.6, which is very promising. (Sauro, 2011) shows a created graph which indicates what usability level the application possesses. He means that the best way to interpret a score is to convert it to a percentile rank through a process called normalizing. The average SUS score of the 500 studies in the article is 68 which gives a C on the graph. Our total score of 82.6 equals an A. (Sauro, 2010) shows that A is the point where users are more likely to be recommending the product to friends.

12.3 Application evaluation results

Table 12.4 shows the results from the application evaluation questionnaire. The table shows the division stated as percentages. We have merged the answers into three categories for the sake of readability.

	Application evaluation	Disagree	Neutral	Agree
1	I thought the competition was exciting	0%	0%	100%
2	I felt that I got sufficient feedback from the game about my progress	13.6%	4.5%	81.8%
3	I did not like to be compared with the other students on a big screen	77.3%	4.5%	18.1%
4	I liked the concept of receiving useful rewards throughout the game	4.55%	18.2%	77.3%
5	I liked that I could choose my own nickname in my profile	0%	22.7%	77.3%
6	I liked that I could choose a character and style in my profile	0%	13.6%	86.4%
7	I did not care about selecting any unlocked items throughout the game	54.6%	18.2%	27.2%
8	I would like more stuff in the game that I can unlock and equip	13.6%	9.1%	77.3%
9	I liked that I could answer questions in my own speed	0%	0%	100%
10	I felt the competitiveness throughout the game	0%	9.1%	90.9%
11	I did not care about the comparison of players on the big screen	100%	0%	0%
12	I enjoyed the 50/50 bonus that I received and used it during the game	9.1%	27.3%	63.6%
13	I would like to receive more bonuses like the 50:50, which gives me an advantage in the gameplay	13.6%	9.1%	77.3%
14	I did not care about what kind of rewards or progress my fellow participants had during the game	31%	22.7%	36.4%
15	I enjoyed getting notifications when something new happened	13.6%	13.6%	72.7%
16	I learned something during the game	4.55%	9.1%	86.4%
17	I feel that this platform has potential to positively affect my future learning experience	0%	4.5%	95.5%

Table 12.4: Application evaluation questionnaire

12.3.1 Application evaluation results for player types

We want to look at the correlation between the different game features and the player types. The results from this investigation is shown in diagrams. Each player has a corner in the graph and the filling shows the result in percent where the corner presents 100%. If a player is neutral to a topic, this is counted towards a negative result. The diagrams are a presentation of the individual results from each player as we had nicknames throughout the experiment. From this we were able to compare the results from Table 12.4 with Table 12.1.
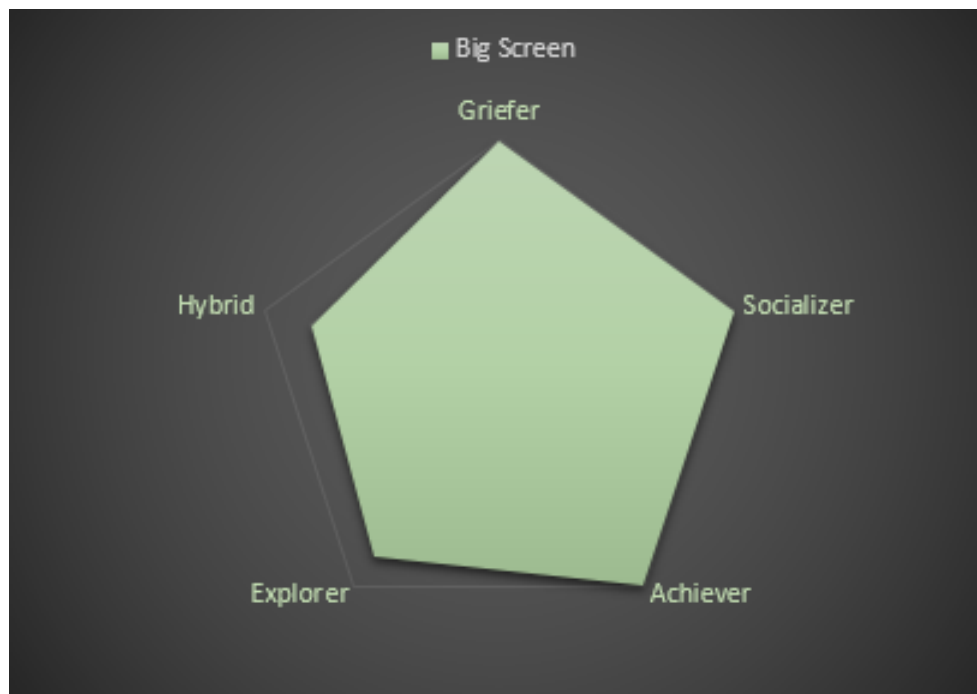
Figure 12.1: Diagram showing the results on question 3 regarding the big screen from the different player types.
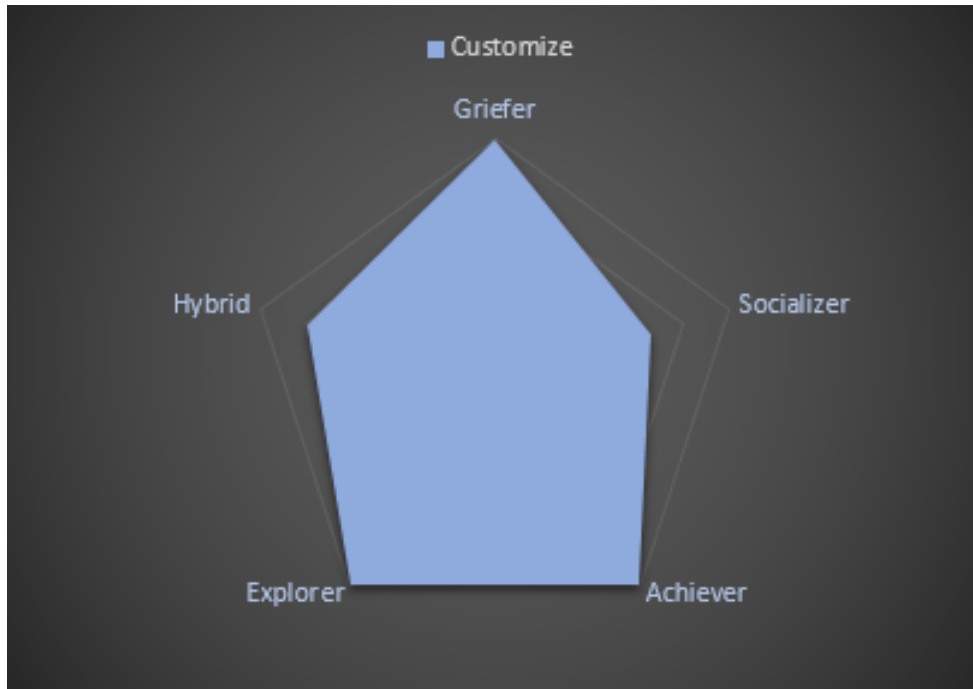
Figure 12.2: Diagram showing the results on question 6 regarding the customizing of avatar and style from the different player types.

Figure 12.3: Diagram showing the results on question 8 regarding unlocking of item from the different player types.

Figure 12.4: Diagram showing the results on question 10 regarding the competitiveness from the different player types.
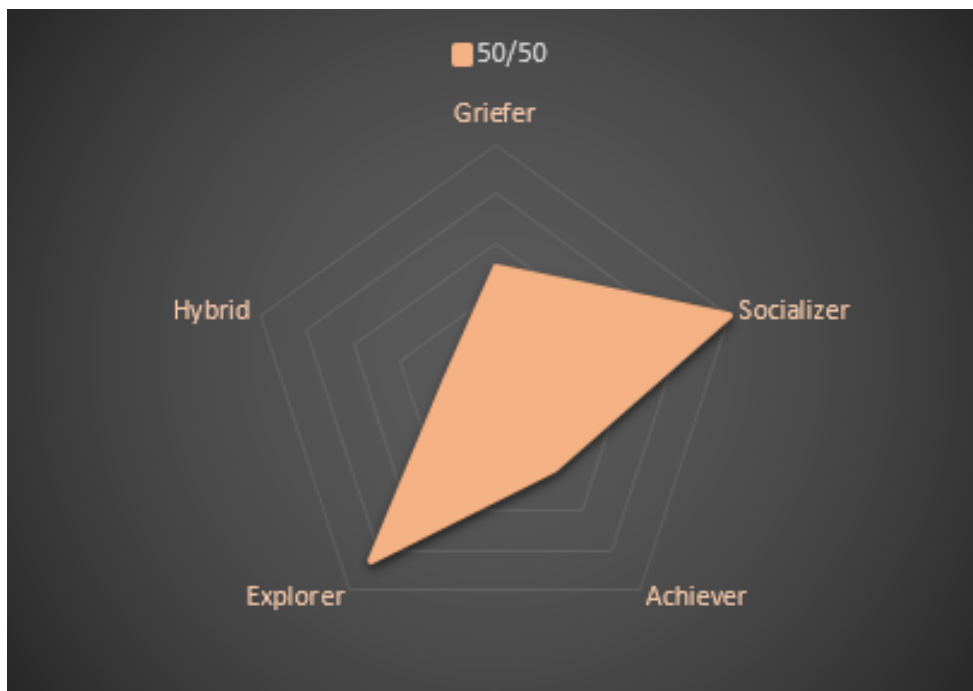
Figure 12.5: Diagram showing the results on question 12 regarding the 50/50 from the different player types.
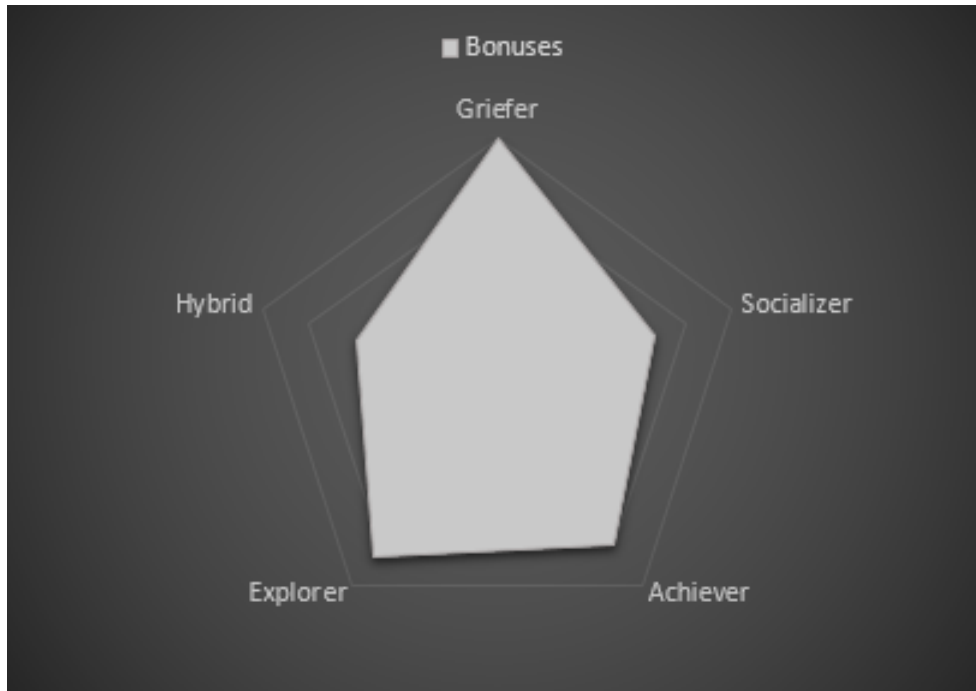
Figure 12.6: Diagram showing the results on question 13 regarding more bonuses from the different player types.

Figure 12.7: Diagram showing the results on question 14 regarding other players rewards and progress from the different player types.
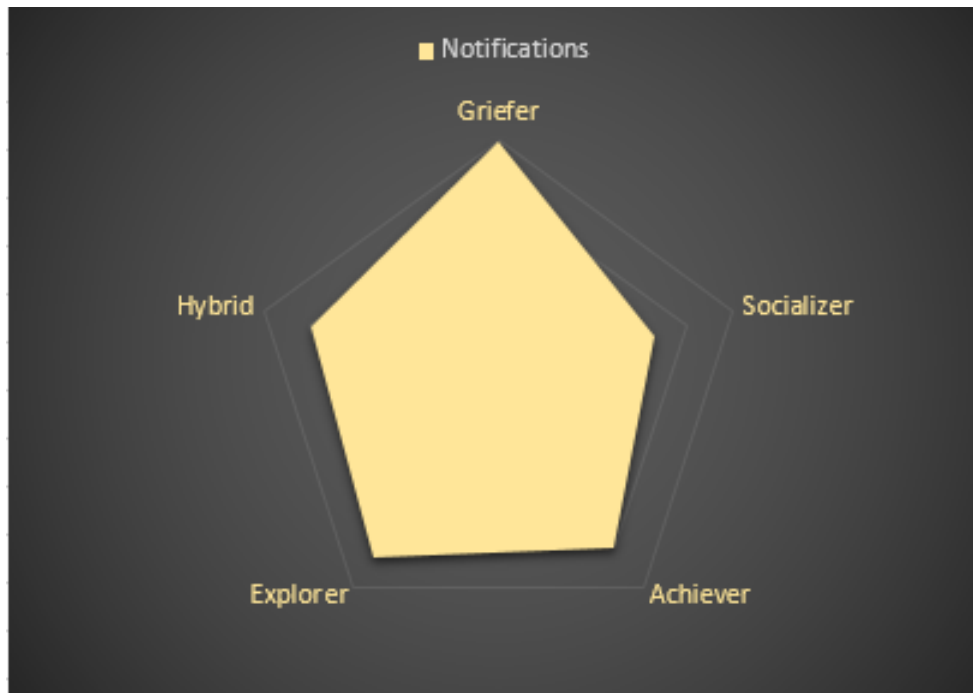
Figure 12.8: Diagram showing the results on question 15 regarding the notifications from the different player types.

12.3.2   Post experiment interviews

After the experiment was completed, we asked four students to participate in an interview regarding the game experience. The transcripts are included in Appendix B.

12.4   User comments on SUS and second questionnaire

In part two, we received the following comments.

"A little difficult to get back into the game?" "Add a way to get directly back into the game from the profile. Otherwise very good."

Author's comment: We have added a rejoin game feature, but it was removed in the period where we had the experiment because of some bugs.

"Better notification for when you receive perks. There should be perks for all types of questions"

Author's comment: We will discuss this topic in the Section 15.

"Improve the explanation for how points from the questions are translated into points on the leaderboard. I also didn't notice the 50:50 bonus until halfway through the questions."

Author's comment: Points are translated into percentage of potential score for the whole Laddy. This is not mentioned, but could be. The 50:50 was intended to be not too prominent, which is further discussed in 13.3.

12.5   Organizer Experiences

This section describes the experiences that the researchers had during the experiment process.

12.5.1   Part 1: Bartle test

We began by introducing ourselves and the topic of our thesis, before going into the agenda of the experiment. During the first part of the experiment, which was the Bartle test and a questionnaire, the participants seemed focused on the task and put a good effort into it. We thought that providing coffee, buns and biscuits helped create a good working atmosphere.

12.5.2   Part 2: Playing the game

In the second part, we tried to hold back on any information regarding the game itself, since we wanted the participants to explore the game features on their own and see if they got stuck at some point. No one seemed to have any problems with connecting to the system, setting up their profile or joining the game. One of the participants had an immediate reaction to the locking of some customizable items by complaining loudly about it, but this was an in-character reaction from this particular participant. We tried to observe the participants throughout the game for both positive and negative reactions to the game. It seemed that everyone knew what to do as soon as they joined the game and were presented with the list of tasks. The atmosphere in the room can be described as fairly quiet, but also friendly and good-humored. People were focused on completing tasks, but there were also discussions among the players, both inside and between teams. We supplied music through the classroom loudspeakers to provide some background sound, which meant that the teams could discuss without being heard very well by

the other players. This also seemed to lighten the mood and help remove the tension between the teams. As the game progressed and people started to move forward on the leaderboard, we noticed that a lot of players changed their cosmetic items as they unlocked them. We decided to comment on the changes, to give the players extra feedback on their achievement, as we imagine a teacher would do in a classroom. We are not sure about the effects of this action, but the goal was to keep the players engaged in the leaderboard and observe the other players' progress and appearance.

Towards the end of the game, we noticed that some players seemed frustrated with having remaining questions that they were not able to answer. They still had a chance to answer the questions for the minimal amount of points, but since they were clueless to the answers, they expressed a clear lack of motivation. When the time was up, we ended the game and the winner was announced with cheers from all participants. We thought that the session ended on a high note instead of just fading out. Everyone already knew who was going to win because of the leaderboard, but it was not clear who the actual person was, since everyone used nicknames. It was therefore interesting to see who was actually behind the nickname, and the person also appreciated the attention.

Summing up, we felt that this was a really positive experience. Everyone seemed to have had a good time and learned something from the experience, especially us who headed the session.

Chapter 13

Discussion and Evaluation

In this chapter, we will discuss our findings from the result chapter and assess their strengths and limitations.

13.1 Bartle test

First we look at the results from the first part of the experiment, which was the Bartle test and the associated questionnaire.

If we examine the numbers from Table 12.1, we see that the distribution in player types varies a lot from person to person. Some people have high numbers on certain player types, while other have relatively even numbers on all types. Among the people with high numbers, there is a majority of Explorers, while there are fewest Griefers and Socializers. In total numbers, people score high on Explorers and lowest on Griefers, while Achievers and Socializers are relatively even.

Looking at the participants' feedback to the system, we see that all participants fully understood the test and 71% agreed with the player type results they were given. 24% were neutral to the results, while 5% disagreed. We observe divided opinions whether the test was sufficient to determine their player type. 52% agreed, while 48% disagreed or were neutral. This gives us the impression that people were generally happy with their results, but many were not confident in the validity of the test. We can argue that the participants thought they were answering questions based on a MMORPG which is far from the genre of our game, and therefore question

the validity of the test. In the questionnaire 90% of the participants answered in the question-naire that they have played a lot of online multiplayer games before, which we feel correlates with their apparent understanding of the questions in the test. A person with a lot of experience in online games should be fairly confident when answering questions regarding this subject, and therefore have a stronger opinion towards the result they receive. It is therefore surprising that 24% of the participants were neutral towards their results. If we cross-reference the nick-names that were used in the test and questionnaire, we see that the majority of these 24% were in fact hybrid player types. Only a couple of these participants had scores higher than 60% in any player type. An explanation here could be that they, as players, did not have any strong opinions toward the questions and oscillated between answers that pulled them towards a cer-tain player type. Since they then ended up with low scores on all types, it probably was not seen as very interesting or 'cool', as discussed in Section 2.2.1. This may also be one of the factors that contributed to the large portion of participants disagreeing whether the test was sufficient or not.

One of the participants wrote in the feedback questionnaire that he did not agree with be-ing assessed as a Griefer, mainly because he did not like the name Griefer. While this is mainly a misunderstanding of the full meaning behind the player type, it is still a special case that may oc-cur in other instances of this test. (Royce, 2015) addresses this issue and states that it "annoyed nearly every person on staff because it's absurd to think that all PvPers are Griefers (you don't even need PvP to grief; as I've said before, the worst Griefers I ever met in an MMO happened to be pure PvE RPers)". Apparently, the current hosts of the Bartle test changed the terminology of the player type to try to be sensitive to very young participants, unaware of the impact that such a name change can have on people's perception of the test results.

A participant also mentioned that he did not notice the 50:50 bonus until late into the game. As mentioned earlier in Section 9.6.3, we tried to make this feature not too prominent to appeal to the Explorer player types. Looking at this players Bartle results, we observe that he scored low on Explorer, which corroborates the reason behind this implementation.

13.2 System Usability Scale (SUS)

SUS is the most used questionnaire for measuring usability and the results from SUS correlate highly with other questionnaire-based measurements of usability which confirms its validity. Our application scored 82.6 as shown in Table 12.3 which is a good result. A caveat here is that the participants received the SUS questionnaire immediately after playing the game, and the answers may be related to both user-friendliness and the gameplay itself. We do not allege that the score represent the overall quality of the application, but since it is expected to originate from honest answers from first-time users, it functions as an indicator.

It might be argued that the score benefited from having an experiment containing software engineering master students only. The system must therefore be tested on other students or pupils to corroborate this argument. On the other hand, we can look at which strengths this provides to our SUS results. Software engineering students can also be more fussy when it comes to system usability. They know what is good usability and may therefore be the best candidates to evaluating the system. It might be an advantage to conduct several tests on the usability of the application, but considering the time and effort it takes to organize such a test in our case, it is considered as unnecessary. Especially since this part of the experiment falls outside the main scope of our thesis.

13.3 Application evaluation

The application evaluation is a questionnaire and several interviews that provide empirical data. Some of the questions relate to the players' general perception of the game. Question one from the Table 12.4 is an example of this and the purpose of these questions is to see if we have succeeded in creating a game that people actually want to play. Our research is heavily based on testing out different game features and elements, but we also think that it is important to see how they combine. 100% of the players indicated that they had had an exciting experience, which gives a good base for examining what parts of the application that made the experience exciting for each player. Furthermore, the questionnaire investigates each individual game feature and element. The overall feedback on these questions is very good and we want to discuss some of the results we find to be the most interesting ones.

Question 7 asks if the players cared about selecting any unlocked items throughout the game. Only 54.6% answered that they disagree that they did not care, which means that only half of the players did care. We have some suggestions why this is the case:

- The implementation is not perfect. The game offers unlocking of the consumable item 50:50 and new styles for the progress bar. The 50:50 item is hard to spot and if you do not read the notification, it is easy to overlook, but as mentioned in Section 9.6.3, this was intended in order to appeal to the Explorers. We do not see a clear correlation between Explorer scores and their opinion towards the 50:50 bonus, which could mean that some players just did not like the way it was implemented.

- The progress bar style requires players to leave the game for a period of time and select it. As mentioned in the interview comments in Section 12.4, we removed the rejoin function because it did not work as expected and therefore it became cumbersome to go and do this.

- We did not implement as many unlockable items as people expect from modern games. If we compare our game to a popular game like DOTA 2, our game does not have anywhere near the same amount of unlockable items. Often items in games like this also have different rarity which helps to make them more appealing to collect.

One of the things we were most curios about was how well the game works as a learning platform. Question 17 addresses this. An overwhelming majority, 95.5% say that our game has the potential to affect their learning experience. We have to look at this question in combination with question 16 which asks if they actually learned something. 86.4% agreed that they learned something from the experiment. This is a satisfying result for a first try, but we expect that the learning outcome may even increase as players and organizers get familiar with the game.

The big screen is one of the most important features in the game. 100% of the players said that they, to some degree, cared about being compared on a big screen. A combination of real-time responsiveness, fun avatars and fitting sounds is what we think is the success of the implementation. However, not everyone likes being compared in this way and to be exposed. The purpose of the nicknames was to safeguard everyone's anonymity, but this is not enough to keep the players anonymous. People sitting beside or behind other players can for example easily find

out other players' nicknames. To solve this problem, the game could be played with exam rules about not permitting looking at other players screen. The problem is that this is something we definitely do not want because we lose the social aspect completely. Another solution would be to remove the nicknames which generally got good feedback in the questionnaire, and let the avatars be the only identification on the big screen by making them unique for each player.

We think it is hard to correlate the different game features and elements to the player types. In Figure 12.3.1, we can absolutely see tendencies, but we need a lot more data to be able to conclude on correlations. For example, only two players got classified as Griefers. This is not a representative selection of the player type. However, the trends we see from our selection are these:

1. Figure 12.5 shows that Hybrids, Griefers and Achievers do not care or do not like the 50:50 bonus. Perhaps they did not notice it, because it was not too obvious, or they just did not like the implementation, as mentioned earlier. Figure 12.6 shows that most of the players would like to see more bonuses like the 50:50, meaning that it is not an unfit feature. Our attempt here was to make this feature not too prominent, so that the Explorers would gain an advantage in the competition, and for some player it seems like it had the desired outcome, but for others it did not. We think that having more features like this and implementing it in a more fitting way would strengthen this aspect of the game. This is further discussed in Chapter 15.

2. Figure 12.3 shows that Socializers do not want more unlockable items. This point is a bit mysterious for us and could be arbitrary. Socializers should, from Bartle's definition, not especially care for such game elements, but rather want to see more player interaction. In-game items could be player interaction tools though, so maybe this is something they would want to see in the game.

3. Figure 12.4 shows that Achievers did not feel competitiveness from playing the game. This is a surprising result. One reason might be that the game did not challenge the achievers well enough, as we did not have any rewards or achievements for winning the game which may have resulted in lack of competitiveness.

13.3.1   Interviews

The interviews provided more in-depth feedback to the gameplay experience. We wanted descriptive answers regarding the specific game features and the game as a learning platform. When asked what they generally thought about the game, all interviewees concluded that they thought it was a entertaining experience. However, they had different reasons for what exactly made the game entertaining. To get a more detailed understanding of the players' opinions, we recommend reading the interview transcripts in Appendix B before continuing to read this part of the chapter. For the sake of readability, we have decided to name the four interviewees player A, B, C and D.

Player A had a clear opinion that he enjoyed the competition and the features that revolved around the competitive aspect of the game. He liked the fact that he had no time limit and several tries for each question, enabling him to "really think about the question". He also clearly expressed that he did not care about the cosmetic items such as the character and style customization. When asked why, and what he would rather enjoy, he answered that he wanted some kind of proof of his achievement to wear, rather than just styles and characters. If we examine this person's result in the Bartle Test, we find that he scored very low on Explorer and fairly high on Achiever and Griefer. This is a typical competitor who likes to achieve within a game and who cares about how he himself and other players perform in the competitive aspect of the game. He expressed that he was stimulated enough to enjoy the game, have fun and learn, but was also very open to other features that had a competitive spirit.

While player A only cared about certain aspects of the game, we see that player B cared about entirely different ones. He expressed that he loved the concept of receiving rewards and unlocking items in games. That is why this player had a larger appreciation of the character selection and unlocking of styles. He visited his profile numerous times throughout the game to customize his profile as he received new items. He also had a different opinion regarding the leaderboard. Where others would look to the leaderboard for their position among the others, this player would look primarily to examine the various styles and characters that the other players had unlocked and put on. Looking at B's results from the Bartle test, we see that he scored very high on Explorer, above average on Achiever, very low on Griefer and average on Socializer. We can already see here that this player and player A had very different scores on Explorer and

Griefer. There was nothing about the game elements that this player did not like, but he suggested that there should be an easier way to get back into the game, and some improvements to the mobile version should be added.

Player C had a more technical way of answering the interview questions, indicating that he has some experience with game design. He had a positive attitude towards all parts of the application, both the competitive and individual aspects. The choosing of cosmetic items and characters was something he liked, but did not care for during the game itself, since he wanted to focus on assignments. He made several suggestions for additions to both the cosmetic items and bonuses like the 50:50. This player scored high on Explorer, and below average on all other player types. Considering all the suggestions and specific feedback he gave, it seems he felt like there was a lack of depth in the game. He wanted more items, more abilities and more stuff to explore, even though enjoyed the existing features as they were.

Player D had similar thoughts and opinions as player C, but was not as picky towards the exact features and game design. Scoring high on Explorer and Griefer, average on Achiever and low on Socializer, this player seems like a more tactical and competitive player than player C. He was concerned about aspects of the game that gave him an advantage, such as the 50:50 bonus, but disregarded the aspects that did not. He used the leaderboard primarily to monitor his position among the other players, and saw the cosmetics as more of a helpful way of distinguishing the players, so he could find himself easier. He pointed out that he generally enjoys cosmetics and customizing, but not in our game, since he knew that he would not be using this game in the future, and therefore it did not matter.

All participants expressed that they liked our game concept and highlighted that they could take their time, try several times and select the questions they wanted. Some liked the gamification features like the character, style and nickname selection and some did not. These were features which they to some extent normally liked in games, but some felt that our implementation did not appeal to them, but could have if some modifications or additions had been made. We notice that these kind of features are something that people generally like, but people still have different preferences on exact features as well. Player A and B had opposite opinions towards the cosmetic customization of the game, and found motivation to do assignments for completely different reasons. Both participants liked the features that appealed to them and

wished for more content inside these categories. Player A wished for more bonuses and addition of achievement proof such as badges, while B wanted more cosmetic items that could be unlocked.

Player C wanted more content in general, both usable bonuses and cosmetic items. Player D did not want more specific content, but rather some optimization of the current features to make it more predictable and easier to plan and use tactically. Even though the players had similar opinions and were the same player type, we still see an interesting difference between them and notice two different types of Explorers. Player C is the more world-oriented Explorer, who takes his time to assess every aspect of the game and enjoys to customize as well as to find features that are competitively advantageous. Player D is more of a competitive Explorer, who is more tactical and less concerned about features that have less to do with the competition, even though he finds and assesses them. This may originate from the fact that Player D also scored high on the Griefer player type.

We can see from the interviews with these participant that there are some tendencies of correlations between the player types from the Bartle test and their preferences towards various features in our game. Even though the player type assertion is based on a test that has received a lot of criticism, we see that for these four players, the player types they were given are considered as fairly accurate according to the player type definitions. All participants made some suggestions for modifications and additions, which we will cover further in Chapter 15.

Part V

Summary and Recommendations for Further Work

This part describes the project process and results, how we have completed the thesis objectives and answered the research questions. It also provides recommendations for further work.

Chapter 14

Conclusions

In this project, we have attempted to complete the thesis objectives we set ourselves in order to create a social game-based classroom application. Initially, we examined existing solutions for such applications and discussed their strengths and weaknesses. Since we were going to develop a game for the same audience as these applications, it was favorable to look at what has already been made and achieved popularity, ensuring we do not make the same game twice. They also functioned as good examples on how such a game can look and act in terms of design and features. Some of these features and concepts were adopted in our game.

We have listed and described a series of games that we thought were good examples on how to implement game concepts such as competition, special events, unlockable and collectible items and customization. These are concepts that have proven to attract players to try out and keep playing the game, and an important reason for their popularity. This information comes from an area that is not familiar to many outside the modern online gaming community. Currently, this community primarily consist of younger generations, including the current authors. For this thesis, the overview has provided some favorable examples of features to implement in the thesis project. We think that this it can also be helpful for future research and development inside the area of modern games and player types.

All of this information has been used for inspiration in order to create a game called Laddy. Laddy is a multiplayer game-based learning platform where we have implemented some of the game features and elements we gathered information on. The players can choose an avatar, nickname and progress bar style before joining a game to separate themselves from the crowd.

When the game starts, the players are presented with a set of text and multiple questions created by an admin. The results are updated on a big screen that is preferably in front of a class, where each player is ranked based on their progress. Through the game, the players can unlock new items and receive experience points when they answer correct.

Finally, we conducted a user experiment to assess the quality and impact of our game, and also determine the participant's player type for analytical purposes. This report describes the entire process from planning and conducting of the user experiment. It also presents the experiment results and discusses the strengths and weaknesses. This information has been essential in order to answer the research questions of this thesis.

The first research question asked what the diversity of player types was like in a typical Norwegian classroom. It was included to see if we can observe any stereotypes or if the results are fairly equal among the students. The distribution we ended up with was based on the data from the Bartle test. The test was performed on a relatively small sample of participants and is not representative of all Norwegian classrooms. Therefore, these figures do not suffice as a definite answer to this research question, but is considered as more of an indication of the students' player type.

The conducted experiment resulted in a sample distribution of player types from a Norwegian class. We have calculated the average of each player type which shows that the participants in our experiment contained most Explorers and least Griefers. However, the distribution is well spread among the four player types. We observed some special cases where participants had high scores on certain types and low on the others, while some players had an even score over all types, which we have named hybrids.

We asked some questions in the first questionnaire of the experiment regarding the participant's player type, whether they agreed with the results and if they considered the test as a valid tool for determining it. Most participants, around 71%, agreed with their results and the rest were indifferent or disagreed. The reason for this may be the fact that only half the people agreed that this was a valid tool to determine their type. The rest disagreed or were neutral. We suspect that the people who agreed were fairly confident with their answers and did not consider how these questions would be perceived by another type of player.

Our second research question asked how well game elements and features adopted from

modern popular games would fit in a social game-based classroom application. We wanted to examine which of the features and elements that the participants thought fit well and not so well. Most of the game elements and features received positive feedback in the post-experiment questionnaire. However, the big screen combined with the profile customization options was our most successful implementation based on the player feedback. This includes the avatars, progress bar styles and nickname customization.

We did not get any direct response that indicated that any of the game elements or features did not fit well in our game. Some participants expressed that certain aspects of the game, such as the customizing of cosmetic items, were not for them, and preferred other aspects like the leaderboard and 50:50 bonuses. We think this relates to the player type of each participant. Others thought that all aspects fit well in the game, but were implemented in a way they did not prefer. Based on the feedback received from this specific group of people, it is indicated that game elements adopted from modern popular games fit well in social game-based classroom applications and have potential, if implemented correctly.

The third and final research question asked if there was any correlation between the participant's player type and the effects of the features implemented in the game. This question refers to the results from both the participants' results from the Bartle test, their feedback to the questionnaires in the experiment and the interviews. The goal was to examine their opinions in detail and see if we could link specific player types to specific features, or if there are any features that appealed to all types.

We had some circumstances where players who scored high on Explorer appreciated the features concerned with customizing the profile and unlocking items. They were also interested in other people's items and profiles. On the other hand, some players did not care for these features at all, and were more interested in the competition and positioning high on the leaderboard. These players scored low on Explorer and high on Griefer. This could indicate a correlation where Explorers prefer customizing and unlocking, while Griefers prefer the competition aspect. They also view the leaderboard differently, where Explorers look at the items of other players, while Griefers use the leaderboard to monitor their own position. We have to emphasize that this is an accentuated circumstance, and may be coincidental. Most of the players enjoyed the competition to some degree, including high-scoring Explorers. Some Griefers were

also intrigued by the customizing and unlocking of items.

Generally, a player scoring high on a specific player type is not guaranteed to enjoy a specific feature, since there are a lot of gray areas and special cases regarding player types. The size of our sample of results is also not sufficient to determine a definite correlation. However, from our results, we suspect that a person scoring high on nothing but Griefer is more likely to prefer competitive features. A high-scoring Explorer is also more likely to enjoy features such as customizing and unlocking of items. Regarding features that appeal to all player types, we observe that a leaderboard and item collecting appeals to all types of players.

Chapter 15

Recommendations for Further Work

This section describes our recommendations for further work based on this thesis. It covers our suggestions for general research as well as improvements and additions to Laddy.

15.1   Suggested Improvements to Laddy

We are aware of some deficiencies with Laddy that can be improved to achieve a more complete and well-functioning game. The suggestions are based on our own opinions and user feedback, and are listed below.

- The first suggestion we want to address is better notifications for when one receives perks. Some users expressed that this solution is not ideal, because it is not apparent enough. Maybe a more prominent notification or dialog is needed to ensure that the player notices that something new has happened.

- A collectible bonus that can be activated to help answering textual questions that is balanced. By balanced, we mean a balance between being too impactful or too irrelevant. Some ideas we came up with here is receiving hints to a question or a way of "asking the audience", where you can look at answers that other players have given to this question, which may give hints to the correct answer.

- Some participants mentioned that they did not notice the unlocked 50:50 bonus until late into the game. This was somewhat intentional in order to let the players, mainly Explorers,

discover these features themselves. A suggested improvement is to add an overview of bonuses that the player has collected. The attainable bonuses should also be introduced to the player at some point before they are unlocked, but these features should not be too prominent in order to appeal to the Explorer.

- The admin version of the game lacks some features such as editing and deleting quizes after creating them. There is also no way of reorganizing the order of questions in a quiz, so currently they have to be created in the correct sequence. Some flexibility here is favorable for the admin.

- There should be an easier way to rejoin a game, for instance after visiting the profile to change appearance, so the players can avoid entering the room code each time.

- Some minor bugs were discovered while playing from a mobile device. The feedback messages that popped up after answering caused the layout to jitter slightly and act weirdly. We have also noticed that the whole application does not perform ideally on less powerful devices in terms of animations and graphics. To solve this problem, we think that a framework that uses canvas and WebGL or something similar would provide smoother graphics and animations.

15.2   Suggested Additions to Laddy

From the experiment and interviews, we received some suggestions for additions to the game. These are user opinions that they think would make the game more appealing to them. We also have some ideas that are based on Chapter 4, the prestudy of this thesis, which were not prioritized due to time restrictions. The most suitable suggestions that we think would improve the game are listed below.

- **Taunt**
  Taunt is a concept that involves annoying or mocking opponents to produce a reaction from them. The way we could implement this in Laddy is to create unique sounds for each of the avatars, and when a player reaches top rank on the big screen, the sound is played. This can either be done automatically or manually triggered by the player.

- **Statistics**

  With a user system, we have the option to store user data and display this in different ways. It is also possible to reward players based their game history. This implementation can be done in several ways and our suggestions are the following.

  - A traditional way to show statistics is by presenting the data in various diagrams and interesting figures e.g. how many games you have played, how many games you have won and your general performance throughout the semester.

  - We could design a small "statistics world", in which the elements are more interactive and fun to analyze.

- **Achievements and badges**

  Together with a solution for statistics, we could also implement an achievement and badge system. A badge falls under the category of collectible items that is added to the player's inventory when they reach a certain goal or achievement, e.g. complete ten games or win a game. The player is then notified that they have unlocked the achievement and received the badge, which can be displayed in the player's avatar in future games.

- **Point booster**

  Before selecting a question, the player can use the point booster, which will give bonus rewards on the next question. If the subject of the question is known in advance, the player can be tactical and use the point booster on subjects he feels particularly strong in.

- **Double trouble**

  Some questions might give a double or even triple amount of points. This element could be added randomly to all questions or the players could decide which answers they are certain about and use an item accordingly.

- **Ranks and titles**

  Inspired by the Rank aspect of modern games in Section 4.1.1, the player can obtain various ranks or levels represented by titles, icons and numbers. Ranks are obtained as the player progresses in the game and is saved between games.

- **Unique items and rarity**

  The concept is of rare items is to include powerful or special items that are more difficult to obtain than others. They will often have a special design or text color that indicates their rarity. The condition for acquiring these can be to participate in special events, performing a difficult achievement or giving them an very low chance of obtaining them randomly when leveling up.

- **Perks**

  Before the game starts, the players can choose one out of a selection of perks. This perk gives you the upper hand in certain aspects of the game. For example, by choosing the perk "Pythagoras" a player can receive more points on answering mathematics questions correctly.

- **Duel challenge**

  The idea of the duel challenge is to introduce a way to make a comeback into the game. If you as a player is falling behind the leader, there is a possibility to challenge that person in order to either steal their points or receive some sort of bonus. The challenge itself could be to have both players answer the same question, and the first person to answer correctly wins the points. The concept of the idea is to create excitement and give the players motivation to keep fighting for first place, believing it is not over til it is over.

15.3   Further Research

Our suggestions for further research are the following.

- Our results show that based on the Bartle test, there is a diversity in player types, but this is far from representative of all players in Norwegian classrooms. We think that more experiments with more people would corroborate the mapping of player types in Norwegian classrooms. The distribution of participants in these experiments should also be more homogeneous, so that we can map a broader range of players in terms of gender, age and study. More data would yield a better understanding of the target audience for academic games.

- The tools we used for determining player types of the participants has potential for improvement. We are aware that the amount of testing and evaluations which we have done towards the current Bartle test are not sufficient to assert the level of accuracy or validity of it. However, considering our results, the feedback from our participants, people commenting on forums and James Bartle himself, we think that an ideal tool for determining player types in games is yet to be created. A test that yields more accurate data based on other factors than just experience with MMOs will benefit this area of research.

Appendix A

Definitions and Abbreviations

Gameplay The plot of a computer or video game or the way that it is played.

PVP Player(s) versus player(s), or PvP, is a type of multiplayer interactive conflict within a game between two or more live participants.

PVE Short for Player versus Environment, A MMORPG term used to talk about combat or quests in which you fight computer controlled opponents.

MMORPG Short for massively multiplayer online role-playing game it is a type of game genre. MMORPGs are online role-playing multiplayer games which allow thousands of players to play in the game's evolving virtual world at the same time via the Internet.

MMO A massively multiplayer online game (MMOG or MMO) is an online game which is capable of supporting large numbers of players simultaneously in the same instance (or world). neously in the same instance (or world). It is not a game genre, like a MMORPG, but rather the concept of many players in the same world.

MMR Short for matchmaking rating. MMR is a value that determines the skill level of each player.

TCG Short for trading card game.

NPC Short for a non-player character. A npc in a game is any character that is not controlled by a player.

Quests A quest is an assignment given to the player by the game, where the objective is typically to kill a certain amount of creatures or deliver something to another NPC, which the player receives rewards from completing.

Raid dungeons An area of the world that a group of players can enter to kill creatures and bosses in order to receive special rewards. A group that enters together receives their own instance of the area, meaning that no other players can come in and disturb them.

DOTA 2 Defence of the ancients 2. A multiplayer online battle arena created by Icefrog and Valve.

Levels and experience points Levels is a unit of measurement in games to quantify a players progress in a game. You reach new levels by acquiring experience points.

FPS First-Person Shooter. An FPS is a computer game genre that puts the player in a first-person perspective and usually involves shooting down opponents.

Runkeeper Application that track your runs, walks, bike rides, training workouts and all of the other fitness activities using the GPS.

Canvas The canvas element is part of HTML5 and allows for dynamic, scriptable rendering of 2D shapes and bitmap images. It is a low level, procedural model that updates a bitmap and does not have a built-in scene graph.

WebGL Web Graphics Library or WebGL is a JavaScript API for rendering interactive 3D computer graphics and 2D graphics within any compatible web browser.

Appendix B

Interview Transcripts

B.1   Inteview 1

What do you think about the game?

Apart from a few issues with animation on the mobile version, I thought it was really fun. It reminded me alot of Kahoot!, but there were some additional features that i found exciting.

What did you like about the game?

I liked the fact that you weren't punished for spending too much time on the questions, and that I got the same amount of points regardless of the time i spent. I also liked that I could try several times on a question if I got it wrong. It gave me time and space to really think about the question and finally get the correct answer. The fact that I could choose the question I wanted and come back to it whenever I felt like it was also good. I also liked that there were tools I could use throughout the game, like the 50:50 bonus.

What did you not like about the game?

There wasn't anything I didn't like specifically, but the part about selecting character and style in the profile was something I didn't care about.

Why is that?

I liked that I could choose a nickname, but I generally don't care about stuff like that in games.

Is there something we could have modified/added that would appeal to you?

Maybe some kind of proof of your earlier achievements, like how many times you have won earlier or how you have performed in total. I like those kind of cosmetics, but not just simple styles.

Did you feel that the game created a good learning environment?

I think the learning environment was good, but I never received the answer to the questions I couldn't answer or got wrong. There should be a way to go through the answers after a game, so I could actually learn the things I didn't know.

Did you focus on what happened on the big screen? What did you think about it?

I looked a lot on the big screen, but it was really just to see my own position. I did not care about who was where or if someone else had caught up, as long as I wasn't affected.

What could there be more/less of?

More tools like the 50:50 bonus would be cool.

B.2   Inteview 2

What do you think about the game?

I thought it was very educational. I ended up with a lot of new knowledge afterwards. The game itself I think was cool. The concept is not new to me since I've tried similar games before, but this worked well, so it was just as fun.

What did you like about the game?

I am a big fan of achievements etc in games, and receiving things throughout the game. So I went back to the profile a lot of times to change my character and style as I unlocked them, and found it a lot of fun. I didn't care so much about finishing fast, since it didn't seem like it was the point of the game. If there was a shorter time limit, I probably wouldn't have spent so much time in the profile.

What did you not like about the game?

I noticed some weird behavior with the animations on the mobile version, and you could have made it easier to get back into the game after going to the profile.

Did you feel that the game created a good learning environment?

Yes, I did. It reminded me of a typical quiz mood as we were playing.

What if there was a more subject based theme on the quiz?

I mean, I learned a lot when it was just common knowledge on the quiz, so I think it would work well with a more subject based quiz, like programming etc.

What could there be more/less of?

I feel there could have been more stuff to unlock throughout the game. The more the better, if you ask me. Maybe also something to help us with the text questions, since there was no help there. Maybe a hint or something.

Did you focus on what happened on the big screen? What did you think about it?

I was aware of it, yes. I was keen to get as high up as possible. So I stared up at it after every time I answered a question to see if I ascended in rank.

Did you care about whan styles and characters the other players had?

Yes, I did. I was interested in what the others had unlocked and if I also had acquired that. If I saw something someone else had, that I didn't, I got motivated to answer more questions to get it.

What did you think of the 50:50 bonus? Did you use it?

I thought a lot about it, and I used it, but I wasn't sure exactly when I got it?

The interviewer explains that you get one each time you level up.

I don't think I noticed when I leveled up either. Maybe that should have been clarified a little more, because I didn't notice the level system at all.

B.3   Inteview 3

What do you think about the game?

I thought it was fun. An interesting part that I liked was that you could take the quiz at your own pace. I got a little frustrated on the text question that the answer had to be spelled perfectly, which was a little difficult when you couldn't use Google. But it worked very well on multiple choice questions. It was cool to get "lifelines" along the way like the 50:50 bonus. I also liked the points system where you got less and less points if you answered incorrectly, and more if you get it right the first time. I think that was a good solution. I also think it was great that you could choose tasks yourself and skip some if you wanted. Even though we didn't have a clear time limit, I still got more focused by the roughly 30 minute playtime we were given.

What did you think about choosing characters and unlocked styles?

I found that fun to do in the beginning, but I feel it messes with the game flow during the game, because I wanted to focus on the questions, and it wasn't in my focus during the game itself. But I think the concept is cool. I imagine it being a fun feature over several games, where I can make these decisions prior to each game. I enjoyed combining the cute animals with the colors of the progressbar. I think you could take that part a step further with more content to unlock. Maybe more abilites as well, like the 50:50 bonus.

Did you focus on what happened on the big screen? What did you think about it?

Yes, I looked at it alot. It was fun to see what position I was in and what characters and styles the other players had chosen.

Did you feel that the game created a good learning environment?

Yes, I think so. There was a mood of competitiveness when you could see all the players' progress on the big screen. That gave me motivation at least. I also think it was fun to work in teams with another player, which created more discussion and we could learn from each other.

What could there be more/less of?

I would remove the text questions, and more punishment for answering multiple choice ques-

tions incorrect. I couldn't quite understand when the 50:50 bonus were awarded either. Things like these should maybe be clarified a bit. I would also like more stuff like the 50:50 bonus. And more content in general would make it more interesting to play frequently.

B.4 Inteview 4

What do you think about the game?

I think it was great. It was different from Kahoot! since you could choose what order to answer the questions and get response immediately afterwards. So I enjoyed jumping between questions in my own tempo. I also liked the concept of textual questions, but I would prefer if it wasn't so strict with the spelling of the answer. I also thought it was fun to choose a character and style in the beginning. I found it more "game-like" than Kahoot!, where there is only nickname. I didn't catch that you unlocked more cosmetics throughout the game. I saw the notifications, but I only cared wether I got a new 50:50 bonus or not, since it had an advantage in the game. I actually like unlocking new cosmetics and things like that from other games, so if it was a bit more clear, I probably would have cared about it more.

Did you feel that the game created a good learning environment?

Yes, I feel that people were concentrated about working with the questions.

What could there be more/less of?

I wish I could know the answer to questions I didn't answer correctly in some way. I also found it a little difficult to use the 50:50 bonuses because I couldn't plan when to use them. I wanted to place as high as possible and use the bonuses to my advantage when I didn't know when I got them.

Did you focus on what happened on the big screen? What did you think about it?

Yes, I thought that was exciting. I was very concerned about my position relative to the others. I found it easier to separate people from each other when everyone had chosen their own character. It was primarily my placement and the competitive part that was in focus for me. I didn't focus too much about the cosmetic items part, but I think it's because I didn't see the profile I

made as "permanent", since it was a one time thing. Normally I find these things interesting, as long as they are fun enough and is presented clearly to me. It would be cool to have something happen if you for instance were at the top 3 positions for a while. Like a fun taunt animation towards the others to mock them or something.

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