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Science and Technology

Improving User Experience with Gamification and Reward Systems

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Master of Science in Computer Science

Submission date: June 2017

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TDT4900 COMPUTER TECHNOLOGY
Master Thesis, Spring 2017

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Abstract

The use of mobile technology is steadily increasing in the modern society. Smartphones and tablets have already surpassed desktops on internet usage in 2016. As the possibilities to use these technologies as tools are endless, games have in particular become an attractive field of research to check whether they can have other uses than entertainment. Games are also more often being played by children in Norwegian with 77% of children between 9 and 15 years old playing at least one or more electronic game on an average day in 2015. Statistics also prove that children lack motivation towards doing chores as lower than 50% of children between ages of 9 and 15 years old did help with daily housework in Norway 2010. This study tries to take advantage of the increasing use of smartphones and tablets to motivate and encourage more children to help with housework by the use of gamification. However, the features of gamification are often poorly implemented and are therefore weakening the intention of it by having a reversed effect. This study also attempts to find a better and more satisfying use of this method by implementing a reward model based on gamification mechanics and theory.

The first part of this study will present a detailed review of game design theory, game mechanics, the positive and negative effects of gamification, and motivation theory related to games. Further, a brief overview of application related to chores is presented to find flaws and good uses of game mechanics. The findings from this part serves as a foundation for the proposed solution which attempts to enhance the children's motivation, engagement, and enjoyment towards doing chores. Finding the quality of these perceptions was done by conducting an experiment, where 22 children participated. The analysis has also revealed the usability of the proposed solution.

Findings from the experiment suggest that the solution positively affects every category of the perceptions examined. However, several flaws and improvements are found and can be dealt with to increase the affected perceptions further. Lastly, a reward model can not single handily contribute to making a task's motivation intrinsic as it does not necessarily have a direct impact on its execution.

Sammendrag

Bruken av mobilteknologi øker stadig i det moderne samfunnet. Smarttelefoner og nettbrett har allerede forbi-passert datamaskiner på internettbruk i 2016. Etersom mulighetene med disse teknologiene som verktøy er uendelige, har spill blitt et attraktivt område for forskning, for å sjekke om spill kan brukes i andre sammenhenger enn bare underholdning. Barn spiller mer spill enn før i følge Statistisk sentralbyrå, hvor 77% av barn i Norge mellom 9 og 15 år spilte minst et elektronisk spill i løpet av en vanlig dag i 2015. Statistikk viser også til at barn i Norge mangler motivasjon for å hjelpe til med husarbeid, da det under 50% av barn mellom 9 og 15 år som hjelper til med daglig husarbeid. Dette studiet prøver å ta nytte av den økte bruken av mobilteknologi for å motivere og oppfordre barn til å hjelpe til med husarbeid ved å bruke elementer fra spill og gamification. Det er derimot vist at elementer i gamification ofte er dårlig implementert og kan derfor svekke intensjonene med en reversert effekt. Studiet prøver også å finne en bedre og mer tilfredstillende implementasjon av denne metoden for å implementere en belønningsmodell som er basert på mekanismer og teori fra gamification.

Den første delen av dette studiet presenterer en detaljert gjennomgang av spillmekanikk, positive og negative effekter av gamification, spilldesign-teori og motivasjonsteori relatert til spill. I tillegg er det presentert en kort oversikt over applikasjoner som er relatert til husarbeid og populære applikasjoner for å finne god og dårlig bruk av spillmekanismer. Funnene fra denne delen er brukt som et grunnlag for den foreslåtte løsningen som prøver å styrke barnas motivasjon, engasjement og glede av å utføre husarbeid. Effekten av disse oppfatningene ble funnet ved å utføre brukertesting hvor 22 barn deltok. Analysen av resultatene viser også hva brukervennligheten til den foreslåtte løsningen er.

Funnene fra brukertestene viser at løsningen påvirker alle de forskjellige oppfatningene på en positive måte. Likevel er det flere mangler og svakheter som ble oppdaget. Ved å rette opp i disse manglene og lage forbedringer til svakheterne, kan den foreslåtte løsningen påvirke oppfatningene av implementasjonen mer positivt. Etter å ha analysert resultatene i lys av teori, blir det også konkludert med at en belønningmodell ikke alene burde bidra til å øke den indre motivasjonen til å utføre en oppgave, siden den ikke nødvendigvis har en direkte innflytelse på oppgavens utførelse.

Acknowledgements

This Thesis could not have been completed without the help of several people. Enormous gratitude is therefore given to my supervisors at the Norwegian University of Science and Technology (NTNU), Alf Ing Wang and Ole Andreas Alsos, for their guidance, support, and ideas for making this Thesis as good as possible. Additional gratitude is given to Alsos, for giving me freedom to create and explore any features I wanted to.

I would also like to thank Camilla Dahlstrøm for helping me with the ideation phase and shaping concepts for the prototype. David Hovind deserves great thanks for giving me support and information related to the *Mænage*-project code, as well as answering all my questions related to implementation.

Lastly, my sincerest thanks are given to every student, employee, parent, and child from NTNU and Brundalen Elementary School for providing invaluable feedback during the different iterations of the development phase. Without this continuous feedback, the study would not have been completed.

Morten Kartevoll

Trondheim, 14th June 2017

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Part I

Introduction

The first part of the Master's Thesis introduces information which is relevant to know before reading the rest of the report. It contains the background motivation and a detailed problem description. In addition, the scope of the Thesis will be introduced, as well as the target audience of the end product. Lastly, the first part includes a thorough outline of the remaining parts of the Thesis.

Chapter 1

Motivation

The modern society is becoming more dependent on smartphones and tablets as the internet usage of mobiles and tablets surpassed desktop in 2016 [1]. Findings from a behavioral measurement in the U.S, sampling almost 12 000 participants, concluded that smartphone users spend 170 minutes a day on average on their phone, and tablet users spend 75 minutes a day on average on their tablet [2]. The possibilities to use these technologies as tools in various situations has become an attractive field for researchers [3, 4, 5, 6].

According to Statistics Norway, 77% of children between 9 and 15 play one or more electronic games on an average day in 2015 [7]. Which is one of the reasons games, in particular, are catching researchers' attention, and especially the question if games can be used to a greater extent than mere entertainment. Gamification refers to using game elements in a non-game context which is often done in order to increase motivation towards performing a task [8]. Gamification is however often put in a negative light when related to serious applications, as the lowest level of gamification often is used [9].

The workload in families with children is not divided evenly between the family members [10]. Additionally, less than 50% of children between 9 and 15 years old helps with housework and chores, which indicate a lack of motivation towards these tasks [11]. Finally, parents are becoming stressed, and tired of having to repetitively tell their children what to do in the household [12]. An application which could help these problems could be beneficial to many families. *Mænage* is a serious application designed to motivate and encourage family members to help with chores by using a low level of gamification.

In this Master's Thesis, different theories of game design and gamification are examined in order to create a reward model, which can be used to improve *Mæn-*

age by enhancing users' motivation, enjoyment, and engagement towards doing chores. The results will bring forth a more suitable use of gamification, bringing us one step closer to solving the problem using the lowest level of gamification. By the end of the Thesis results will also illustrate whether gamification elements, in a serious game application, can properly motivate children to help with daily chores. The results from this study will hopefully help the development of *Mænage*, and thereby hopefully solve some of the problems families are encountering related to chores and housework.

Chapter 2

Problem Description and Context

This Master's Thesis is written Spring 2017 as part of the Master program in Computer Science at the Department of Computer and Information Science (IDI) at the Norwegian University of Science and Technology (NTNU). The problem description and project were first encountered during the specialisation project fall of 2016 [13]. As the Master's Thesis is a continuation of the specialization project the problem description is the same in both:

Game Technology: Making household tasks fun with gamification and pervasive game

Takimi is a digital family application that aims to motivate children and their parents to do house work together. Through weekly Takimies (family meetings) they each choose which tasks they want to do, vacuuming, taking out the trash or making dinner, our hypothesis is that these tasks can be more fun and motivating with gamification. The student will design, develop and evaluate a number of small game prototypes for the Takimi platform that can make the household tasks fun and motivating for the family.

During the specialization project an introduction to Takimi and the concept which had become the digital family application *Mænage* was inspected and analyzed. After being introduced to the application a more accurate focus was decided to be the main topic, namely the reward model of the application. Since this was the first phase the focus was to conduct a preliminary study on reward models and how to use these to enhance the experience of using applications. The specialization project was also used to ideate and create a rough sketch for the reward model prototype.

Designing, developing, implementing, and evaluating this prototype were the primary

objectives of the Master's Thesis. With a contribution of 4 000 lines of code, animations, sounds, and illustrations the extension, *Mænage Extended*, was created.

The first phase of the Master's Thesis was used to create a high fidelity prototype. This prototype was going to be tested in order to get valuable feedback to improve the implementation done in the second phase. A more substantial test scenario was after that performed when the final solution was operational. To perform such a test scenario surveys had to be created, how to conduct observations had to be planned, in addition to finding and having proper precautions related to anonymity and information security. The last phase of the Master's Thesis was used to analyze the data collected from the test scenario, and write the outcome the reader will be presented with later in this report.

The following text is taken from the specialization project to create a complete Thesis: Part III, Section 6.1, Section 6.2, and Chapter 16. Besides, Section 14.1 is based upon the text from the specialization project.

Chapter 3

Scope and Target Audience

The parts in the Master's Thesis shall be executed and written during the Spring semester of 2017. The submission deadline for the Thesis is the 14th of June. The official time limit for the Thesis is 21 weeks. There is only one person who will write the report, Morten Kartevoll. During the project, the supervisors (Alf Inge Wang and Ole Andreas Alsos) and others may provide aids and contribution. As this Master's Thesis builds upon the specialization project written before by the same author and has the same problem description, the target audience will also be the same. Since the application audience is families with children in between 3-15 years old, the target audience will be this group.

Chapter 4

Report Outline

This Master's Thesis includes seven parts, the introduction, the research methodology, the preliminary study, the application solution, results and execution of an extensive testing scenario, discussion of the results and solution, and finally the conclusion which summarizes the Thesis. This section is the last part of **Part I** which has introduced the Thesis to the reader.

Part II Describes which research methodologies have been used throughout the project, as well as presenting the goals and research questions of the Thesis.

In **Part III** the preliminary study is presented, where motivation theory, serious games, reward systems, gamification, and important game design decisions are inspected. Related articles and papers are also reviewed. In addition to inspecting theory, several chore-related and popular applications are analyzed according to their functionality regarding reward systems.

Part IV includes a description of the solution. From the application extension concept to the different stages of development are described. The application is presented in detail with descriptions and illustrations, which displays changes the application has encountered. A more technical aspect of the implementation is also included, as well as the requirements set at the beginning of the development phase.

During **Part V** the reader will be presented with a detailed description of the execution of the thorough experiment performed in an elementary school. In addition, the results of the experiment are presented in context with the different data generation methods used.

Part VI includes the discussion of the Thesis, where results are analyzed. Additionally, the methods used during the project are questioned, and alternative

methods are discussed. Lastly, the goal and research questions are evaluated. An overview of the future work related to the application is also presented to the reader.

Finally, **Part VII** is giving a conclusion and summary of the entire project. It will also provide a presentation of the future work which needs to be done to improve the application.

Part II

Research Methodology

The following sections and chapters will describe the research methodology of the Thesis. It will first present a description of the goals and research questions which will be answered during the project. Afterward, a chapter includes the reasoning of the research methods used in the different phases of the project, and how these methods were used.

Chapter 5

Project Goals and Research Questions

This chapter will present the primary goal of the project and the different research questions. The research approach is based on the Goal, Question, Metrics approach defined by Basili [14]. In this method, a research goal is first set, which is the conceptual level. After that, a set of research questions is defined which is suppose to supplement the research goal. These questions are the operational level. In the end, the metrics, quantitative level, is described to answer the research questions.

5.1 Project Goals

After finishing the specialization project with a proposed solution for the reward model and the extension of the application *Mænage*, a goal was created to check whether or not the proposed solution was an appropriate solution. The Master's Thesis goal also take into consideration the research questions used in the specialization project [13]. The goal described below are quite broad, but Section 5.2 presents a decomposition of it.

Examine perceived user perceptions of an application created to motivate and encourage family members to contribute to chores in the family household.

The only goal of this project is presented as to test the application which will be created, and check whether or not the application contributes to motivation, enjoyment, engagement, and usability, especially in the younger users, as they are the primary focus. The user perception will mainly be tested in relationship to the reward model and elements which have been created concerning it. The fi-

nal solution proposed in this project will be built from the conclusions from the specialization project and results from prototype user tests.

5.2 Research Questions

Since the theme for the specialization project and this Master Thesis has mainly been motivation and how to enhance motivation towards tasks, chores, some of the research questions were directly or indirectly related to the research questions from the specialization project [13]. The perceptions looked upon will therefore mainly be enjoyment, engagement, and motivation towards doing chores. Besides, looking at all the mechanisms' affection towards users in the final solution would be beneficial to suggest further development.

RQ1: How is the user's motivation affected by *Mænage Extended*?

This research question is one of the most important questions because it will answer whether or not the theory and results gotten from user tests have been properly implemented in the final solution. It will also give an indication of whether or not this proof of concept is useful for the original application *Mænage*.

RQ2: Which mechanisms used in the application seems to be the most effective form of motivation?

The use of this research question is to find which mechanisms are most effective. In addition, it will quite nicely supplement RQ1. Lastly, it will give useful information to answer what the future development should be.

RQ3: How easy was the *Mænage Extended* to understand and use?

If the proposed solution is difficult to use the motivation may be influenced negatively, hence the question of the usability of the application is asked. This question will include how easy the application is to use, how easy the application is to learn, and what the perceived control the user has when using the application.

RQ4: How is the user's enjoyment affected by the application?

The users should not only be motivated to do chores. By examining user's enjoyment information regarding how to use features and which features works best is figured out. Also, their enjoyment of the application can have an effect on the motivation.

RQ5: How is the user's engagement affected by the application?

The user's engagement towards the application is also important as it creates personal involvement and a connection to the user.

RQ6: How does *Mænage Extended* contribute to intrinsic motivation?

This question is a directly related research question five from the specialization project, and will further examine the interaction between rewards and intrinsic motivation.

These research questions were set to further illustrate that the reward model presented later in this Thesis will work in an application created to motivate and encourage family members to contribute to housework. The questions can also reveal functionality and elements which need further development to be completed. Finally, they can illustrate that without intrinsic motivation present from the beginning, using an extrinsically motivated reward system may improve the overall motivation to do certain tasks.

Chapter 6

Research Method

This chapter will present which methods have been used to do a preliminary study, create a prototype, implemented the proposed solution, and test the prototype and the final implementation. The method for data generation is also presented. For it to be possible to answer the research question an extension to *Mænage* must be created. The different phases are roughly illustrated in Figure 6.1.

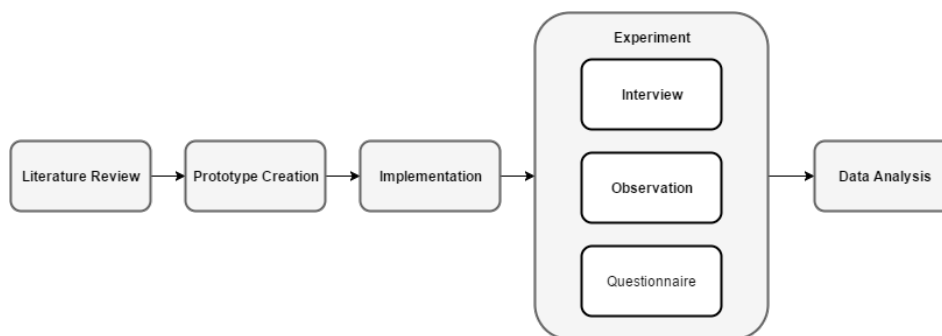


Figure 6.1 Different phases in the Master's Thesis

6.1 Literature review

During this stage, a detailed review of the theory of games, motivation, gamification, and reward systems was performed. Firstly a set of recommended articles were reviewed, and later a snowball-search was executed using Google Scholar and Web of Science. Search words like "household", "chores", "intrinsic motivation", "rewards", "children", "gamification", and "game-based learning" was used to mention a few. The number of citations, as well as looking for known publishers and authors were a priority.

Five different game design books were also further used to substantiate the choices made for the final reward system design. The research review was divided into two parts, the first being an exploration of the topics mentioned above in the early stages of the project. The second part is the remainder of the research time and is done when the topic, reward models, had been chosen. B.J. Oates mentions that the objective of the second part is: "*to gather and present evidence to support your claim that you have crafted some new knowledge*" [15]. The literature review done in the specialization project was a foundation for the extension, and conclusions drawn from the specialization project will be the starting grounds for creating a high fidelity prototype.

6.2 Development

The development phase of this project can be divided into the prototype phase and the implementation phase. During the prototype phase, many students helped to improve the prototype. By using rapid prototyping introduced principles of Design Thinking [16] a high fidelity prototype was created. After the high fidelity prototype was properly built with a prototype tool a more formal testing took place where six persons participated, three of them being parents. The number of test users was selected related to Nielsen's *Proportion of usability problems found* graph [17]. This chart takes into account the proportion of usability problems found and the number of test users to calculate the optimal number of test users in order to find problems with the tested tool. The optimal amount found in this graph is six to eight test users.

Under the actual testing of the prototype, several methods were used. One of these is the ten points described by Svanæs [18]. These pointers include for example teaching the tester to talk out loud what he/she thinks while the test is ongoing, that the test person will not get help if it is necessary, introduce the purpose of the tool, and explain limitations with the prototype. The actual testing of the prototype is described in more detail in Chapter 18.

The implementation phase used a type of agile methodology similar to the Kanban method. Tasks were tracked by using a real post-it board. The categories of the board were the backlog, incomplete tasks, needs testing, and completed tasks. All of the tasks were obtained from decomposing the requirements described in Chapter 17.

6.3 Data Collection

A research strategy which uses a single data generation method has a fair chance of getting decent findings. However, using only one data generation method does not provide the possibility to corroborate or question the results by comparing them to data found from another data generation methods. By using data generation method triangulation the chance to validate my findings to a higher degree could be performed [15]. In addition to using triangulation to get a better possibility to verify the data gathered, a combination of quantitative and qualitative data generation methods are used. By conducting at least one method from each of these data generation methods a broader understanding of the test users' thoughts and actions could be achieved. The sections below will give a brief description of the different data generation methods used during this project. Chapter 22 contains a more detailed description of the execution of these methods.

To give the test users more confidence and freedom to discuss every data generation method used groups of two or three. Being more than one will additionally be less frightening for the test users, especially since they are children. On the other hand, the use of groups can mitigate the possibility of complete and unaffected feedback. Some people can also feel that it is harder to say their honest opinion when others surround them [15]. All the data generation methods were also anonymous; hence no names and faces were displayed during the testing.

6.3.1 Interview

The interviews conducted during the final user testing were semi-structured interviews and gave qualitative data [15]. One could give reasons for using a structured interview because the interviews were used as a warm-up strategy, and children often have less attention span than adults. However, using a semi-structured interview will give a better flow of the conversation and the interviewees can often give a more detailed description as well as feel less controlled by the questions. The interviews were also audio-recorded to more freely have a conversation with the interviewees, which also enhances the quality of the semi-structured interviews.

Information was given about the audio recording beforehand, as well as which use it was going to have, and that they were going to be deleted after being analyzed [15]. The primary purpose of the interviews held was to map the habits of the children related to housework, as well as games and technology use (tablets, phones, and consoles). Besides, it worked as a great introduction, where the children could relax and answer the simple questions given, presented in Appendix C. The main reason for conducting this interview was to compare the obtained data

from it to the data gotten from the questionnaire to look at connections between them.

6.3.2 Observation

The test users got a brief explanation of the different pages in the application before the testing started. This brief could be looked upon as an oral tutorial of the application, which would be similar to a tutorial implemented for first-time users. When the test users were going to try *Manage Extended*, they first got a set of tasks, one at the time, which needed to be complete before they could freely interact with the application. One of the reasons to make the test users go through this set of tasks before freely testing the application was to examine if they understood the different pages explained during the short brief.

The observation used can be explained as overt and systematic, because the test users were informed that they were going to be observed and the observation was planned out in advance [15]. The planning included planning the tasks which were going to be done and creating extra exercises if the test users did not know what to do during the free testing. As the test users had complete freedom to do whatever they wanted, the testing did not strive for strictness, but rather playfulness and fun. By presenting the tasks and stages of the testing to the children, they could become more at ease and more easily confront faults with proper feedback. The testing of the application was video recorded in order to retrace comments and problems, as well as valuable feedback given. By using an iPhone, the application testing was documented from above, meaning no faces would be seen, which would protect the anonymity of the participants.

6.3.3 Questionnaire

After the testing of the application, a questionnaire was conducted to get quantitative data regarding the test user's feedback and thoughts. The questionnaire is primarily based on the Likert Scale with five alternatives; "strongly disagree", "disagree", "neutral", "agree", "strongly agree" [15]. The remaining questions in the questionnaire were a simple gender question and the age of the participant. In addition to using a textual explanation of the Likert Scale, visual explanation in the form of smiley faces was used, in order to create a simpler questionnaire more understandable for children.

The questions used in the questionnaire relates to motivation, enjoyment, engagement, and usability. Inspiration is drawn from the GameFlow evaluation criteria as well as Malone's framework for intrinsic motivation which are described in Part III

and Appendix A. Besides, the questionnaire asks questions related to functionality regarding motivation, which in turn validates the combination of functionality and theory used. The questions were also partly based on the motivation survey used by Kebritchi, Hirumi, and Ba [19].

6.3.4 Validity and Reliability

When conducting data generation methods, there is always concerns about whether the level of validity and reliability of information is meeting a sufficient height. The Hawthorn Effect mentioned by Oates can, for example, have an effect on people modifying their answers, because they know they are being observed [15]. This phenomenon can happen when an overt observation is performed. If this phenomenon occurs, the data will have more positive result than it should have had.

The results gotten from the observation and questionnaire does not say anything about the use of the application over a longer period, as well as the results from testing the application in an actual family. Because of the limited testing period sufficient evidence to prove that the solution is working over a longer period can not be contributed to this report. However, the results will determine if the concept is enhancing the perceived motivation, engagement, and enjoyment of the test users, which will give an indication of which elements can be used during further development of the application.

Part III

Preliminary Study

The preliminary study part will include a detailed literature review of serious games, motivation related to games and motivation theories, gamification, as well as issues and benefits in the respective categories. Different types of reward systems and social interaction are also included. A chapter more directly related to research and game design theory is added. Lastly, a short analysis of some existing popular games and chore related applications is conducted and presented. This part is taken from the specialization project, which was written as a foundation for the Master's Thesis [13].

Chapter 7

Serious Games

This section will discuss what serious games are, their functionality and areas of use, and effects they can have. It will not take the discussion of the differences between games, plays, simulation, and serious games. That said a short section of the different definitions is in order.

7.1 Definitions

The definitions of play, game, and simulation is described in this section.

7.1.1 Play

Salen & Zimmerman discusses the different definitions given previously of the ambiguous word *play* [20]. They wanted to create a definition which was more design-centric and one which would help them to create meaningful play in games. As they also mention, play can be categorized into three categories: Being playful, ludic activities, and game play. The first being the broadest category where play refers to not only the standard activities but ideas of being in a playful state as well. Ludic activities refer to not only games which include play activities, but also activities which can be considered to be part of non-game behaviors. Game play is often used to define play when there are rules between players which formalize the interaction. Regarding the three categories described, Salen & Zimmerman defines play in the following manner: "*Play is free movement within a more rigid structure.*" [20].

7.1.2 Game

Games consist of a system, players, artificial real life, conflict, rules, and quantifiable outcome according to Salen & Zimmerman [20]. These components are

a result of a comparison between several authors done by Salen & Zimmerman. As mentioned above, game play is the use of rules to formalize interaction, but Salen & Zimmerman defines games further as: "*A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome.*" [20]

7.1.3 Simulation

As the definition given by Salen & Zimmerman includes complex concepts, namely procedures and the concept of "reality", a deeper description other than the definition will not be given [20]. Salen & Zimmerman defines simulation as: "*A simulation is a procedural representation of aspects of 'reality'.*" [20]

7.2 What is serious games?

Serious games are defined in various ways, as the other genres play, simulation and game. Bossomaier describes serious games with its similarities to the three other genres: play, games, and simulation [21]. That said, he identifies serious games with the learning objective that players have outside of the game. Bossomaier discusses further that serious games are evaluated with an important dimension not found in games or simulations, namely a dimension which stretches between the topics of practice and context [21]. Susi et al. describe serious games in a similar way: "*Serious games are digital games used for purposes other than mere entertainment.*" and that games should motivate and engage the player who will trigger the development of an extensive set of skills and abilities [22]. Although, they define serious games as "*games that engage the user, and contribute to the achievement of a defined purpose other than pure entertainment (whether or not the user is consciously aware of it)*" [22]. This definition is matching the definition of serious games given by Michael & Chen: "*serious games are games that do not have entertainment, enjoyment, or fun as their primary purpose*" [23]. That said, they do underline that serious games can be entertaining, enjoying, and fun, it just has another primary function, namely to teach the player something. Michael and Chen also include that serious games have the same goals as education through entertainment (edutainment), but serious games enhance the learning outcome to a greater extent than teaching facts and memorization by rote. It combines all features of education and learning, meaning teaching, training, and informing, as well as including all ages.

Corti states that game-based learning/serious games "is all about leveraging the power of computer games to captivate and engage end-users for a specific purpose,

such as to develop new knowledge and skills" [24]. Despite the statement given, it is pointed out that even though the motivational characteristics of video games may be the used to entice training and development professionals, it is far beyond the mere usage of fun to engage learners. That is just the tip of the iceberg of game-based learning/serious games. When comparing serious games to other computer games, Zyda [25] has another perspective of the entertainment part of serious games relative to the view of Michael & Chen [23], as it is pointed out that serious games are not just art, story, and software. He argues that pedagogy, here meaning education and instruction through activities, is, in addition to the previously mentioned characteristics, what makes games serious. Further, it is argued that even though pedagogy is a significant importance to making serious games, it must be integrated into the story, and the entertainment component still comes first. They, therefore, defines serious games as: *"a mental contest, played with a computer in accordance with specific rules, that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives"*.

The interest of the term serious games has grown at a relatively high rate. This can be shown when Susi et al. mentioned that the term serious games are becoming more and more popular [22]. In early 2007 they did a google search on the term "serious games" and got 1,090,000 hits. After doing a similar search in the fall of 2016, the number had drastically increased to 38,800,000 showing that the term is becoming more popular.

7.3 Different areas of use

The flexibility in serious games makes it possible for it to be used in a variety of areas. It can vary from learning young children valuable lessons, to teach a military personnel in important aspects of warfare. The main areas which is normally defined when talking about serious games are described in the sections below [23, 21, 22](I did not include subcategories of the different categories, for example healthcare personnel and healthcare patients under healthcare):

7.3.1 Military

The flexibility in serious games makes it possible for it to be used in a variety of areas. It can vary from teaching young children valuable lessons, to prepare a military personnel in important aspects of warfare. The main areas which are normally defined when talking about serious games are described in the sections below [23, 21, 22](I did not include subcategories of the different categories, for

example, healthcare personnel and healthcare patients under healthcare):



Figure 7.1 *America's Army*. Illustration taken from [23]

7.3.2 Government

Training and simulations are crucial to handle a situation correctly, and it is often, therefore, governmental games concern situation ranging from municipal to nation level. It can, for instance, be terrorist attacks, fire fighting, or other crisis management. By using simulations instead of pure practice, in reality, high cost in material resources, dangerous situation, and expensive recreations can be avoided.

7.3.3 Education

Educational serious games may be the most attractive section of the ones discussed here. There is plenty of research papers and literature reviews which looks upon the effects of serious games and game-based learning [23, 22, 26, 27, 28]. Educational games were first introduced in the 1990s, but the hype decreased as soon as it arose since the games were of poor quality and. They were according to Squire & Jenkins a combination of the entertainment from a bad lecture and the educational value of a bad game [29]. As the time passed the first decade of the millennium, a two-sided discussion arose whether or not serious games in education, and in the other fields, was beneficial or not. There are also a number of concerns that must be addressed if educational games should be integrated more into the educational system, for example, the cost of hardware, technical support, time, and not to speak of the quality of the game itself [22]. In later years, the game-based learning success *Kahoot!* has been widely used for learning in classrooms and other scenarios.

Wang studies the wear-off effects of this learning tool as other studies often only look at the immediate effect of game-based learning [30]. Another valuable point on game-based learning is the way it is integrated into the learning environment. The way it is integrated will highly affect the users' motivation, engagement, thinking, activity level, social interaction, creativity, enjoyment, attention, and learning [31].

7.3.4 Corporate

Corporate training is a large industry and benefits from many of the same scenarios which the government department does. With good simulations of the market and business strategies, companies can earn much by choosing games, instead of the traditional way. As the number of employees which is familiar with games increases, their interest is also effectively caught by the interactive serious games [23, 22].

7.3.5 Healthcare

Healthcare may be the sector which will benefit the most from using serious games applications. As Susi et al. points out, there are a lot of opportunities if one take a glance over the many areas of which healthcare covers, namely physical fitness, education of self-care, therapy, recovery and rehabilitation, training and simulations, diagnosis and treatment, and cognitive functioning are just a small overview of some of the areas [22]. In the field of cognitive functioning, for example, the general view of working memory is something which is established during the very early stage of life and after that decreases slowly with age. This is why Jaeggi et al. made quite an impression when they came to the conclusion that working memory could be improved by the use of a simple video game. Not only did they conclude with an increased level of working memory, but the increase in working memory also generalized to other working memory tasks [32]. There has also been a number of other studies illustrating the enhancement in brain activity with the help of games [33, 34].



Figure 7.2 Healthcare games (*Packy and Marlon*, *Glucoboy*, *Escape From Diab*, and *Nanoswarm*)

Kharrazi et al. discuss the use of serious games for patients with chronic conditions such as Diabetes [35]. They state that one of the most important factors for a child to have better health outcomes is the empowering of consistent comply with the treatment they have. It is also mentioned that the motivation and engagement of the games are crucial. Several serious games are mentioned for diabetes self-management (Packy and Marlon), blood sugar monitoring (Glucoboy), healthy eating and exercising (Escape from Diab), and behavior toward a healthier lifestyle (Nanoswarm). The study they did present a significant increase in compliance rates.

7.4 Positive and negative effects

It is known that several fields may benefit from serious games and games in general. However, does studies show an increase in education level and learning outcome, or are there more standpoints on that games distracts the users away from what is really important?

Stoll questions the use of serious games as educational means, especially in classrooms, because he is critical to the *"obsession of turning the classroom into a funhouse"* [36]. He further argues that games are directing students away from scholarship, meaning reading and writing. His explanation of using serious games will promote the trivial, like quick answers and fast action, as educational and steal important focus away from critical thinking and reflection. On the other side Squire et al. disagree by saying that whether or not formal education is turned into a game or not, is not what is important [37]. The question which must be addressed is the question educational technologists must ask themselves: *"How will one educate the digital native speakers, which have been raised on interactive games and digital technology and expect the same kind of interaction from educational media?"* [37].

Michael & Chen discusses an important topic related to serious games, and that is the issue of design and development [23]. An important factor in serious games is that it's marked includes not only experienced gamers, but also possible first-time players and the games must, therefore, be even more accessible. Not to mention that they must be intuitive. While discussing players of the games, serious games might be "boring" to hardcore gamers, since it is more important that the model or simulation can be used to solve a problem rather than providing "rich experiences". It is also important that the essential parts of the learning process in the game, meaning the environment and assumptions about the simulations, are correct to deflect the possibility to teach wrong skills. Another important aspect of designing the educational games are the use of entertaining game techniques.

Michael & Chen argues that the use of randomness may be provoking creativity and curiosity in entertaining games, but the use of it in serious games where the important elements are among other learning, can take the focus away from the conscious decisions students/players make [23]. They also mention that the focus should be on problem-solving, important elements of learning, assumptions which are necessary for workable simulations, natural communication, instead of rich experiences, fun, simplified simulation processes, and perfect communication. That said the use of simple gamification could to some extent have positive feedback.

There are a number of other scientific articles which reports effects of serious games and games, both positive and negative. Corti and Squire & Jenkins focuses on the fact that games, simulated environments, and systems, allow learners to experience situations that are impossible in the real world for reasons like safety, cost, and time [24, 29]. Analyses have been done regularly over the years showing games promote learning as referred by Susi et al. [22]. A number of possible adverse effects that games might have are described by Mitchell & Savill-Smith [38]. These effects involve health issues, psycho-social issues, and the consequences of violent computer games. While discussing the negative effects, they look at games from another point of view when they review the possible positive effects like analytical and spatial skills, strategic skills and insights, as well as learning and recollection capabilities, psycho-motor skills, visual selective attention. They even propose that violent games can have their beneficial effects, as they can provide a form of release when it comes to a persons frustration. As mentioned earlier corporate training is a field where serious games can have positive effects, especially if game elements such as competitive scoring, an incremental difficulty of levels, and role playing, according to Totty [39].

7.4.1 Literature reviews

A number of literature reviews have been done on serious games and their effects, as well as their effectiveness [26, 27, 28]. Girard et al. look at how effective serious games were as educational tools [27]. They mentioned that the overall results from their review of nine studies lead them to think that "serious games might be powerful tools for learning". That said they also mentioned the lack of empirical studies done on serious games in learning. Connolly et. al reviewed 129 papers which reported empirical evidence about the impacts and outcomes of serious games related to learning and engagement [26]. They mention as discussed above that serious games and computer games can have both negative and positive impacts. In this review, it is suggested that the lack of empirical evidence are starting to be addressed. There was an empirical evidence describing that game-based learning was effective. That said they do clearly state that there is a need for more ran-

domized control trials to achieve a more rigorous evidence of effectiveness. Lastly, it is mentioned that for games to be used properly in learning, beyond the scope of simple simulations and puzzles, a greater understanding of what the different games can offer in the form of tasks, activities, and operations, must be applied, and after that match them against desired outcomes.

Qian & Clark studies the recent research of game-based learning and provides an overview of 29 studies (50% educational genres, and 54% participants from elementary, middle, or high school) about students acquisition of skills as outcome [28]. Their conclusion of the study was closely related to the others, where there exists empirical evidence of effectiveness, but further research is necessary to define games as effective as learning tools. As a conclusion another perspective was taken. They said that their study revealed "*that the effectiveness of game-based learning seems to depend on game designs*". More specific games designs which use a combination of established learning theories and design elements which have been favorable in entertainment games. By using a game design like this, effective learning may be reached. Finally, Qian & Clark says that design games as game genres tend to work better than just having students play games which are educational or entertaining [28]. Creating a focus on the design was also done by Bossomaier when he said that games could often be weak because of their lack of connecting the gameplay to the learning objective [21]. He also mentioned that many children who play commercial computer games bring the standards of these games, which have been developed to entertain and amuse the players' senses, to the maybe poorly design and created educational games. Thus it requires careful designing of the educational games gameplay and learning outcome, as well as other elements seen in commercial games.

Kahoot! is a game based student response system. It can create quizzes, discussions, or surveys with a collection of questions from different or specific topics. It is created to be run by an infinite number of users which can simultaneously take the quiz, discussion, or survey in real-time [40]. By using game elements like points, audio, and leaderboards *Kahoot!* is used to engage and teach players in any environment. *Kahoot!* have been played by over 50 million users and is available in 180 countries, which makes it one of the largest serious game successes [41].

7.5 Summary

The aspects of serious games were presented in this chapter. The most important parts in this chapter are the points which are made between positive and negative sides of serious games as these can map strengths and weaknesses of the proposed

solution which will later be presented. Another important element to remember is to keep in mind that serious games are games with other purposes than mere entertainment. What is perhaps the most important aspect presented in this chapter is the different studies illustrating that creating a focus on design as learning objectives and gameplay must be connected to be effective learning tools.

When the prototype and solution are created, it is vital the focus on design and connection between the learning objective and gameplay is implemented. The solution should not be another serious game falling into the pitfalls of poorly designed tools.

Chapter 8

Motivation

In this chapter a presentation of different aspects of motivating elements in a game is described, as well as model and frameworks which can increase or evaluate the design of a game. In addition, the differences between extrinsic and intrinsic motivation are discussed.

8.1 Extrinsic and Intrinsic motivation

Lepper & Greene said that intrinsic motivation is all about what makes something fun or rewarding by itself, instead of doing it for an external reward, which makes extrinsic motivation doing an activity for the sake of the external reward [42]. On the other side, Schell illustrates that the differences between intrinsic and extrinsic motivation can be harder to distinguish, in reality, then playing because one want to, or playing because one want to be rewarded [43]. He also mentions that "The key idea is that 'intrinsic' and 'extrinsic' are not binary, but a gradient where the more the motivation comes from "your true self," the more internal it is.". Malone's theory of intrinsic motivation describes that good computer games or any other intrinsic situation have three essential characteristics categories: challenge, fantasy, and curiosity [44, 45]. Out of these categories, a framework was created, which is further described in the section below.

8.2 Malone's framework for intrinsic motivation

Malone's three essential characteristic categories show how one can make a game intrinsically motivating [44, 45]. A more detailed description of his framework for intrinsic motivation will now be presented. It should be mentioned that this framework is simple to suggest additions or extensions to games. The entire framework is included in Appendix A.

8.2.1 Challenge

Challenge is something every game must have, and therefore a goal which is uncertain is necessary. Goals should be obvious or easily generated. Goals which are practical or based on fantasy are often the best. It is important that the player receives some form of performance feedback to tell whether they are getting closer to the goal. For a game to maintain an exciting level and the player, it must be able to keep the fact of win or lose as an uncertain outcome. This can be done by using variable difficulty level, using multiple goals at each level, hide information from the users, or by using randomness. An interesting point is made by using hidden information, which is that by making a game uncertain, a player's curiosity can be a trigger, as well as provide challenges for the player. Self-esteem is closely related to goals and challenges, whereas a person's self-esteem can be boosted by succeeding at a goal or winning a prize. On the other side, it is important to be careful to not lower a person's self-esteem to a level where the player does not want to play the game anymore if failures of challenges occur. A tension is created where performance feedback and reducing self-esteem to a level of discouraging instead of inviting a player to try again.

8.2.2 Fantasy

Malone suggests that games are often made more interesting by using fantasies. Fantasies can vary in degree and can both be social or physical impossibilities. As motivation can be divided in extrinsic and intrinsic, so can fantasies. An extrinsic fantasy takes advantage over that the fantasy is only dependent on the skill provided, while in intrinsic fantasy the skill is also dependent on the fantasy. This means that the events of the intrinsic fantasy world are often dependent on whether or not the skill is used appropriately, but also how its use is different from the correct use. Fantasies also should build on the needs of satisfaction by the player. Even though Malone points out that if it were possible to create fantasies which would fulfill the needs of different kinds of peoples, games would get a broader appeal, he also says that "it is very difficult to know what emotional needs people have and how these needs might be partially met by computer games".

8.2.3 Curiosity

By creating environments which are not too complicated or too simple, relative to the player's experience and knowledge, the environment can achieve an optimal level of informational complexity [46, 47], which can stimulate and create player curiosity. Curiosity is also independent of any goal-seeking or fantasy-fulfillment. Malone further states that in general *"an optimally complex environment will be*

one where the learners know enough to have expectations about what will happen, but where these expectations are sometimes unmet" [45]. Games and computer games can appeal to curiosity in different ways, and in a set of categories, sensory and cognitive. Appealing to the sensory curiosity can be done by the use of audio or visual effects. These effects can be used in various techniques like using them as decorations, to enhance fantasy, as rewards, or as representation systems (represent information more easily than using words and numbers).

8.3 Flow

In the 90's Csikszentmihalyi did extensive research on what makes activities and experiences enjoyable [48]. With his research, he found out that the optimal experience, or flow as he called it, was the same over the world. He described flow as something which is "so gratifying that people are willing to do it for its own sake, with little concern for what they will get out of it, even when it is difficult or dangerous", which draws close relationships to intrinsic motivation as described before. Csikszentmihalyi meant that a flow experience includes eight elements:

1. a task that can be completed
2. the ability to concentrate on a task
3. that concentration is possible because the task has clear goals
4. that concentration is possible because the task provides immediate feedback
5. the ability to exercise a sense of control over actions
6. a deep but effortless involvement that removes awareness of the frustrations of everyday life
7. concern for self disappears, but sense of self emerges stronger afterwards
8. the sense of the duration of time is altered

Csikszentmihalyi meant with a combination of these elements a person would feel a deep enjoyment so rewarding that the spending the amount of energy it would require to achieve it would be worthwhile. One key element with flow is that the activity itself must be intrinsically motivating and rewarding as well as being autotelic, meaning having an end or purpose in itself. The theory of flow has been applied in several research areas before. Vass et al. used workflow to support creativity in problem-solving [49], while Jennings used flow to create a framework to build engaging commercial websites [50]. More lately flow has been used to

offer a new theoretical perspective on how to build new ideas and how to foster the implementation of these ideas at work (Capitalizing on Creativity at Work: Fostering the Implementation of Creative). Kane said that players need to have options for what they can do, be, and have in a game [51]. In other words, a player ought to feel that they are playing the game at hand, not being played by the game. Sweetser & Wyeth created the GameFlow model which is a model of enjoyment in games, based on the evidence that there are many flow experiences in games [52]. The GameFlow model will be presented in the following section.

8.4 The GameFlow model

The model consist of eight elements, concentration, challenge, skills, control, clear goals, feedback, immersion, and social interaction; each has some criteria related to the elements of flow which were presented by Csikszentmihalyi [48]. To summarize the model a game must hold the player's attention and concentration while there is a high workload, while the challenges and tasks at hand are challenging enough to be enjoyable. The challenges given to the game should also match the perceived skill level of the player. A player must also receive appropriate feedback on the player's progress against the current goal. When the player is adequately skilled as well as the activity having clear goals, and appropriate feedback is given the player will have a sense of control over the environment and the assignment at hand.

Given the circumstances described above the player could feel a total immersion into the task and hopefully the game itself. This total immersion can cause the player to have reduced concern about time, their everyday life, and themselves. The final part of the GameFlow model is social interaction which does not correlate to any of the elements in flow but is a feature which is highly recommended in the user-experience literature. As mentioned by Sweetser & Wyeth, people like to play games with other people, regardless of whether or not the like the game [52]. A more detailed list of criteria in the different elements of the model is described in Appendix A.

8.5 Skinner's box

B.F. Skinner was an American psychologist and behaviorist. Related to behaviorism he used reinforcement to strengthen what he called *operant conditioning* [53, 54]. He also considered the rate of response as the most effective measure of response. To study operant conditioning, he constructed the operant conditioning

chamber, often called Skinner's box. This tool was used to, among other, analyze different schedules of reinforcement used in operant conditioning. Regarding the schedules of reinforcement Skinner used a box with a level which would deliver food to the animal through a gap in the wall. The animal was rewarded in different schedules: fixed interval schedule, fixed ratio schedule, and random ratio schedule. The first schedule used a timer and rewarded the animal with food every time the timer reached zero, e.g. five minutes. These results were illustrated that this method was not specifically effective as the animal understood that it would not get rewarded regardless of whether or not it used the lever. Fixed ratio schedule was more effective as the animal had to interact with the lever at fixed number of times to be rewarded. The latter was proven to be the most effective as the animal could not predict a precise number of times it had to press the lever to be rewarded. This resulted in a more consistent use of the lever than in the other experiments related to schedules.

8.6 Self-determination

Ryan & Deci dove into the analysis of self-determination, and especially how factors have an influence on intrinsic motivation, both enhancing and undermining it [55]. The findings from their research are the hypothesize of three psychological needs humans have, namely competence, autonomy, and relatedness. When these needs are satisfied self-motivation and mental health are increased, while when the needs are not met motivation can be significantly diminished, as well as the well-being of the human. This self-determination theory is basically explaining human motivation towards doing a task or activity to being internally driven. *Competence* means that humans need to have a feeling of mastery about a situation or content, where the mastery is achieved through clear and visual goals. *Autonomy* relates to the feeling of freedom and being in control by directing ones own actions. Lastly *relatedness* refers to the feeling of being connected with others in different forms, for example via family or friends. It should be mentioned that Ryan & Deci mentions that some elements can decrease the internal motivation for doing a task or activity, for instance, the use of a poorly implemented reward system [55]. The rewards can simply make the person, do the task, less interested and even make people do the least challenging tasks because it is easier and a safe way to receive a reward.

8.7 Summary

This chapter has presented the different elements of motivation theory. The three aspects of Malone's framework, fantasy, challenge, and curiosity will be essential to the proposed solution, especially the curiosity and challenge, as they will nicely supplement the reward model which are designed. Another important part which is important to the proposed solution is the GameFlow model and how to use different features properly. Finally, the self-determination theory described by Ryan & Deci is valuable as it gives a nice representation of the functionality features should have to motivate users.

Chapter 9

Gamification

In the following sections, the term gamification will be described. The sections will also delve into some issues and benefits which can evolve from the use of gamification.

9.1 What is gamification?

Gamification is described as *"the use of games design elements in non-game contexts"* by Deterding et al. [8], while Houtari & Hamari defines gamification in a different perspective: *"a process of enhancing a service with affordances for gameful experiences in order to support user's overall value creation"* [56]. Gamification could take many forms especially since games for non-entertaining purposes is becoming more popular, and the simple use of gamification can often motivate to do simple tasks which often otherwise would not be done according to McGonigal [57].

Bossomaier mentions that the mechanics of gamification fundamentally can be categorized as points, badges, leaderboards, and levels [21]. Regardless of the attention which gamification has got, one shall remember that gamification has been around for a long time. One can argue that the Olympiads of Ancient Greece, 3000 years ago, used prizes that were made of olive leaves and the Boy Scout and Girl Guide movements have used badges for over a century [21]. Leaderboards are seen in some form in nearly every sport, and points or levels are frequently utilized in a wide range of membership arrangements. Paul Jones says that gamification is not a new invention: *"Gamification is an overblown term for old-school marketing."* [58].

9.2 Serious games and gamification

Deterding et al. describe the differences and how serious games and gamification are related [8]. Gamification is gaming in parts, meaning integrated elements of game design, or game "atoms", while serious games are gaming in whole, meaning a design of full-fledged games for non-entertainment purposes [59]. Which "game atoms" should be used? According to Reeves & Read a set of ten elements have been identified from great (entertaining) games [60]. These components are; some sort of self-representation (avatar), three-dimensional environments, narrative context, feedback, reputations, ranks, and levels, marketplaces and economies, competition under rules that are explicit and enforced, teams, parallel communication systems that can be easily configured, and time pressure. Although these ingredients might be the key elements in a great recipe Reeves & Read indicates that they are not a final solution which works in every game and that without the certain treatment they can fail miserably [60].

Deterding et al. mention that the relationship between serious games and gamification are not that far away from each other as serious games can be training games, health games, or newsgames, there can likewise be gamified design for training, health, or news, as well as other areas [8]. As they did their literature review they found various design elements which were categorized in a set of different levels of abstraction (see Figure 9.1). These levels are included in their final definition where it is said that gamification refers to "the use, rather than the extension, of design, rather than game-based technology or other game-related practices, elements, rather than full-fledged games, characteristics of games, rather than play or playfulness, in non-game contexts, regardless of specific usage intentions, contexts, or media of implementation".

9.3 Issues and benefits

As mentioned before the concept of gamification, in general, is not a new feature. That said there has still been a focus on creating models or researching effects of gamification. Anderson et al. created a model for how a user reacts to badges and particularly how badges influence user behavior [61]. They validated the effect of the model against Stack Overflow, where a community of programmers who want to learn, share and advance at programming. The results illustrated a devotion of time which increased respectively to how close it was before the user got the badge. As the distribution of activity is shifting in turns of which badge the user is closest to, it is crucial, in an educational context, that the effect from badges are balanced with care.

Level	Description	Example
<i>Game interface design patterns</i>	Common, successful interaction design components and design solutions for a known problem in a context, including prototypical implementations	Badge, leaderboard, level
<i>Game design patterns and mechanics</i>	Commonly reoccurring parts of the design of a game that concern gameplay	Time constraint, limited resources, turns
<i>Game design principles and heuristics</i>	Evaluative guidelines to approach a design problem or analyze a given design solution	Enduring play, clear goals, variety of game styles
<i>Game models</i>	Conceptual models of the components of games or game experience	MDA; challenge, fantasy, curiosity; game design atoms; CEGE
<i>Game design methods</i>	Game design-specific practices and processes	Playtesting, playcentric design, value conscious game design

Figure 9.1 Levels of Game Design Elements. Taken from [8]

Bossomaier mentions that gamification can achieve higher participation in several areas, as online and multiplayer games are more commonly used by persons [21]. Fitz-Walter et al. created an application which was supposed to increase participation during orientation week at the beginning of a semester [62]. Even though the application was only partly successful, it highlighted an interesting point: students might only attend three events, if that was where they would get points.

There exist studies which illustrate that badges have low to no effect. Hakulinen et al. performed a quantitative study of students (281) studying aspects of computer science [3]. When students performed well or correctly used good study practices, badges were awarded. The behavior change of the students, in general, was near to none, although a small fraction showed behavior change. One should note that the badges given were meant merely as a motivator towards learning, and had no impact at all on the final grade given in the course. Again the design and correct use of gamification is important.

There are several applications which are supposed to increase different areas related to education. Mathland, which is an application created to blend skill development with high participation, was developed by Franelli and was embedded in a

math class in Canton [4], close to Detroit. The key elements of the application are that each student gets an avatar, and the avatar can be tracked on a leader board which is visible for the entire class. When tests and assignments are completed, the pupils are moved up and down on the leader board. Even though there was no control study, an improvement in attendance (13% over two years) and statewide assessment (22% over three years) was made.

The use of gamification, in general, is often criticized. Bogost attacked and criticized the lowest level of gamification, meaning using gamification with a simple point collecting system [63, 9]. He said that gamification should be more meaningful than this simple use, by using more game dynamics like mechanisms where customizable goals were available. As seen before games can weaken the intrinsic motivation by using external rewards, and this conclusion is followed up with extensive reinforced studies across different domains [5]. Even though the intrinsic motivation might be lowered by external rewards, using these types of rewards can still be used productively. Another review of a large number of studies related to external motivation, more specifically financial incentives, can lead users to unethical practices, exaggeration, and at best lower performance [6]. Bossomaier mentions that gamification is best used for concrete tasks, where intrinsic motivation might not be as necessary as other places, as well as having a strong effect in areas where motivation and attendance are low [21].

9.4 Summary

Similar to the chapter of serious games, the most valuable aspect of this chapter is to analyze and not fall into the pitfalls of the use of gamification. For example, using the lowest level of gamification should be avoided according to Bogost [9, 63]. To achieve a higher level of gamification the different elements of the proposed solution will be connected to prevent effects similar to Hakulinen et al.'s study illustrated [3]. Finally, the proposed solution should take into account the ten different elements from great entertaining games presented by Reeves & Read [60]. By considering these elements and remembering that gamification is only "atoms" of serious games.

Chapter 10

Reward Systems

During this section, a description of different types of rewards will be presented. Important considerations when designing reward systems are also discussed. First, a short introduction of reward systems is in order.

10.1 How are reward systems used?

Rewards are often used to encourage players, in different forms, after a task have been accomplished. They can also be used to ease the disappointment with a compromise in some form. Reeves & Read [60] and Salen & Zimmerman [20] also discusses how reward systems can provide social meaning, not just inside games, but as a trophy or something to brag about outside games. Wang & Sun also concluded their study with reward systems in modern games are often used to contribute to some social meaning [64]. They also state that reward systems, after reviewing multiple psychological theories, can provide fun by promoting intrinsically rewarding experiences and by giving extrinsic rewards, where the initial being the more or equally important.

Another important statement given by Salen & Zimmerman is their suggestion of successful game design being dependent on creating meaningful play [20]. This happens when the relation between what the player does and its outcome are discernible, meaning easily recognizable by the player, as well as being integrated purposefully. Reward systems can, therefore, build relationships by providing immediate feedback making outcomes discernible, and rewards which are useful to integrate outcomes.

Reward systems also play an important role when players try new games, because appropriately rewarding (it should be related to invested effort) the player can

enhance the learning of the game, where continued enjoyment is the goal [65, 66]. Pagulayan et al. also mentioned the importance of using rewards and feedback to provide the player of some representation of the distance and progress towards the different objectives [66]. Players should be able to pinpoint their score or status of objectives at any point of games, and by giving positive feedback and scores, games can motivate mastery of the game [67].

Players can often choose how to utilize the rewards they have earned in the game. Since there are a variety of different reward types, the utilization of them can be categorized as proposed by Hao & Sun [64]. The categorization is based on a dual-axis where the self-other axis represents the orientation of personal enjoyment versus community enjoyment, and the progress-casual axis represents how serious the gaming activities of the player is. The latter can be viewed as trivial play versus power play. In the advancement, category players use their rewards to develop their progress in the game. Reviewing rewards can be done by players who for example like to check their collection of achievements, look at previews obtained cinematics, or to enjoy the display of a neat looking avatar. Reviewing the rewards are to some degree providing entertainment and the joy in accomplishment [68]. The social category is all about using rewards as a social tool, like sharing information about it, establish status, or merely use it as a way to achieve player interaction. Lastly the cooperate/compete category is where players use their rewards as a means to maintain the advantage over other players or to work together to receive other rewards.

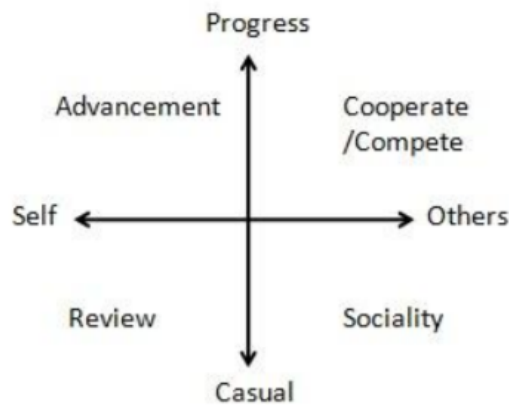


Figure 10.1 Reward usage classifications. Taken from [64]

10.2 Reward types

The following sections (list of reward types) is based on the findings of and described by, Wang & Sun [64].

10.2.1 Score system

Score systems have been used in a wide variety of games and centuries and are used to give the player an evaluation of the performance done. Since scores, in general, does not have a direct effect on the gameplay it often is used as a tool for evaluating own performance or comparison to other players. Rating systems are a known phenomena being used in different sports and games, for example in Chess, World of Warcraft, and Overwatch. In a rating system, the score of a player is based on the performance of multiple events, rather than a single performance, and the score is increased or decreased according to results from matches.



Figure 10.2 Ranking system in Overwatch

10.2.2 Experience

Experience is often associated with the use of an avatar which is controlled by a player. The avatars can earn experience from different actions during gameplay, by killing monsters, finishing quests, and completing events. As experience often is bound to a single avatar, it can also be the level of the player's account. Experience are rarely used to reflect skill; instead, it indicates time and effort from the player. Experience and level are often associated with each other, where one's level increases after a certain number of experience points have been collected. By earning more experience points and reaching a higher level, certain events and mechanisms are often unlocked, such as avatar skills and attributes.

10.2.3 Items

Virtual items are often rewarded to the player after killing monsters and are often used as a means for motivating player exploration, as well as triggering curiosity and interest. Items can also be one of the main sources to increase the strength of the player's avatar, which can in time increase the ranking and establishment of a player. Item rewards are sometimes used as the primary source of motivation, Diablo series, and many players dedicate extensive time to receive the best items, and other times even real money.



Figure 10.3 Screenshot of legendary items in Diablo III

10.2.4 Resources

Resources and items have some similarities, but can be differentiated in an important aspect, namely the use of them. Resources are often utilized in a practical relationship, or to be shared, while items have collecting and social comparison value. Resources usually have no direct impact on the avatar, meaning how strong, and which skills are available. Resources are also used as different forms of currency.

10.2.5 Achievements

Achievements are usually titles and badges given and bound to an avatar of the player account. An achievement is given when clearly stated conditions are met, for example, to kill a certain amount of a specific monster. These achievements are often only meta-goals, and usually does not have any effect on gameplay other than icons, titles, and sometimes rewards which can be used in-game. Players may at times spend a massive amount of hours to try to achieve these sometimes

extremely hard objectives. An enthusiastic Russian World of Warcraft (Mist of Pandaria) player completed every achievement in the game in 2014 and had over 717 days logged on one of his characters [69].

10.2.6 Feedback messages

Feedback are used in a sense to motivate the player in a positive or negative way. Words like "perfect" or "good" or often used when the player is hitting something with perfection, but some games can also use reversed psychology to intimidate the user to continue playing. It is usually used to display instant rewards, more specifically successful actions. It is proven by Reeves et al. [70] and Bracken et al. [71] that giving praise to the player can affect the player's emotions and behavior.

10.2.7 Animation/Cinematic

Cinematic, or small videos, are often used to reward the player after an important part of a story have been completed, like killing a boss or ending the game. These cinematic can have a varying degree of quality, but often has a higher quality than the game itself. Blizzard's cinematic are known for their detail and impressive scenes [72]. By displaying these videos to the player, the purpose is to motivate them to continue playing the game, as well as immerse themselves into the story and the game. The cinematic can also be looked upon as milestones in a game.



Figure 10.4 Screenshot from World of Warcraft: Legion cinematic [72]

10.2.8 Unlocking mechanisms

Unlocking mechanisms give players access to game content (e.g., new levels, access to special virtual environments, and mini-games) once certain requirements are met. This kind of reward is best classified as access [73]. When discussing ways to arouse curiosity, Malone suggests that one of the most important features of intrinsically motivating environments is providing incomplete information about a subject [44].

10.3 Summary

There exist many different reward types ranging from visual entertainment to inner rewards which come from owning an item or getting feedback. Reward systems should build the relationship between elements by providing immediate feedback. Further, rewards are also useful for integrating outcomes [20]. A statement which should be remembered when combining the different reward types into a game or application is the complexity of it and how it affects the rest of the application. It should not cover other elements but rather enhance them, as they should encourage players not confuse them. Every reward type described by Wang & Sun could improve the motivational effects of the proposed solution [64].

Chapter 11

Social interaction

Social interaction is a strong component in the enjoyment gameplay, and people are even willingly to play games for social interaction even though they do not like the game [74]. For games to support social interaction, they should make it possible for players to compete, cooperate, and connect to each other [74, 66]. Lazzaro mentions that the experience the player gets when playing a game should be structured so that it improves player-to-player interaction, in addition, to create the possibility for enjoyment playing inside and outside the game [74]. He also mentions that direct social interaction through chats and online boards are important. The reason for social interaction being so important is that people like to interact with other individuals in a wide variety of ways, from simply talking to them to gloat or brag over a victory [74, 75].

When online games are as common as it is today, the virtual communities are becoming more important for players, as they can chat, form teams, and improve their skills by interacting with other players [76]. People have always enjoyed the satisfaction of competition, and that is why social competition is important in games [77]. As mentioned by Sweetser & Wyeth the social interaction of games are important, but it can interrupt the immersion of games, because "real people provide a link to the real world", which can in turn break concentration and disconnect the player from the fantasy game world [52].

Social aspects of the game can be important motivators for playing, because social relationships will be affected by, and affect activities in gameplay. Gamers rarely play alone, and even the players who play single player games have a tendency to share experiences and types of rewards with other players. Reward systems often create social meaning when players are required to work together, or by sharing information [78]. When receiving an achievement or after accomplishing goals while playing with a group or guild can increase the experience and feeling of belonging

to a group [79].

To summarize this chapter, the social aspects of an application can strongly affect the motivation of users'. The aspects of competing, cooperating, and, in general, connect with other players can create a willingness to play games solely for the social interaction. The possibility to take these social aspects and use them to create a dependency between the application and what happens on a daily basis will increase the engagement and enjoyment of using the application.

Chapter 12

Related work

This chapter will dig into articles, a Master's thesis, and game designs to propose a suitable solution to the goal of this project.

12.1 Gamification and Family Housework Applications

Bjering et al. explore the field of application design for families to determine how incorporated gamification is integrated into these applications [12]. In their study, an analysis of current (2015) applications were performed, where the applications were evaluated on product, description, target users, functionality, motivation/reward, game elements, pedagogical design, user interface, universal design, technical solution, and overall impression. Before they present their findings, a theoretical background is given, where the theory of motivation and gamification is described. One important note that is mentioned is about excessive use of points and reward systems. Here they claim that, if moving beyond "the superficial application of mere points", one could use gamification to create immersion and engage the user with other game elements.

After their analysis of the set of applications, they concluded with three points which they wanted to draw attention to:

1. the majority of the applications analyzed were characterized as instructive or hybrid instructive/manipulable, hence there lack constructive applications
2. the majority of the application uses obvious extrinsic rewards
3. the majority of the applications target individual family members, instead of uniting the whole family as a team.

They are focusing on relating these main takeaways with the three principles of self-determination theory: Competence, autonomy, and relatedness [55]. By using obvious extrinsic rewards ones specific skills and expertise can increase, but there is also a chance that the extrinsic rewards can become an obstacle on the road to receiving the prize, which does not facilitate intrinsic motivation and competence. On the other hand, one could use a less fixed system to provide more freedom, meaning using a constructive approach. The topic of targeting individuals or the family as a whole concerns autonomy, since when the targets are individual family members one would not feel the freedom of choosing chore as a group versus being handed a task by a someone in charge. That said individual competition could enhance the engagement and meaning of the game. It is also mentioned that the classification of persons inside the game can affect the gameplay and autonomy in different ways.

Gamification can strengthen autonomy if used correctly. This can be done by using gamification where players have a balance between their skills and challenges, experience flow and find the participating in the activity at hand meaningful. When relatedness is mentioned, the authors describe it as if the application can relate to relatedness in a varying degree dependent on which game elements is used. An example which is used is the idea of combining direct collaboration with the concepts of inspiration and happiness to promote what applications seem to lack, namely positive social interaction, self-worth, and intrinsic motivation. A couple of suggestions are also presented as inspiration for designers who want to motivate the entire family with use of gamification: 1) Let the family members be a team which is explorers of chores. 2) Instead of using a large number of extrinsic rewards, focus on the principles of self-determination theory. 3) Use collaboration rather than using individual family members.

12.2 Takimi - The design of a digital application for motivating families to jointly do chores

The Takimi application is a concept developed by Bjering in her Master's thesis at the Norwegian University of Technology and Science (NTNU) [80]. Her findings and results have been used as a foundation for the concept of the application where the resulting reward system of this project will be utilized. In her thesis, she analyzed the currently available applications related to chores and household work. She also used quantitative and qualitative methods to research children and parents relationship to chores and digital devices. Furthermore, she created a prototype named *Takimi* based on the results of her findings. This prototype was iteratively

tested with paper prototypes. Some of her focus was on the establishment of an application which would be innovatively related to the use of rewards. With other words, she wanted to eliminate the usage of points and rewards in order to achieve a higher collaboration within the family in addition to developing intrinsically motivated participants. Although she wanted to exclude the use of rewards, she did ideate on the use of points and badges during the second iteration. Because this direction was not tested properly, Bjering focused on increasing focus on the family as a whole rather than the individual members.

12.2.1 Analysis of applications

An analysis of the applications available for iPhone, on App Store, was conducted, whereas 15 different applications were tested. To some extent, the results of this analysis were presented in the article *Gamification and Family Housework Applications*, described above [12]. What is not presented in this report is the findings of which specific types of motivation and rewards are being used.

Overall the applications which were tested was instructive, had often focus on extrinsic rewards, and little use of visual pictures/graphical and sound instead a larger focus was on textual explanations. There was also to a great extent focus on competition in several of the applications, as well as using the individual participants in focus rather than the collaboration of the family. These result can be seen in Figure 12.1. In addition, it should be mentioned that none of the applications had parents as participants, little to no focus on playing and creativity, and the possibility of children choosing tasks by themselves was not a case. Regarding the use of extrinsic reward, and other types of feedback, it seems like many of the applications were incomplete, and the design was not thought through. Next a list of the game elements and reward types which were used for motivation and rewards: Visual progression, avatar level development, coins, competition among children, points, stars, extrinsic rewards give to children, unlock-ables, randomness, rewards which can change layout in the application, visual feedback, punishment, treasure (items), character development, experience points, limit amount of time, money system.

A more detailed overview of the analysis done by Bjering can be found in Appendix B. During the review of these applications, Bjering commented that many of them were good applications, but despite that, there were a lot of flaws in them. Related to using points and extrinsic rewards, Bjering refers to the comment Margaret Robertson made about "pointification", which was to use points as the absolute core functionality of the experience instead of the experience itself. She further comments that it seems like this has been the thought process of the

developers of the applications. In a way, you are not solving the problem with the task itself being boring. On the other side, Bjering wanted to create a solution which was innovative, by not using as many rewards, limited competition, and focus on collaboration and making own decisions, which creates an understanding for why the strategy canvas is described as is.

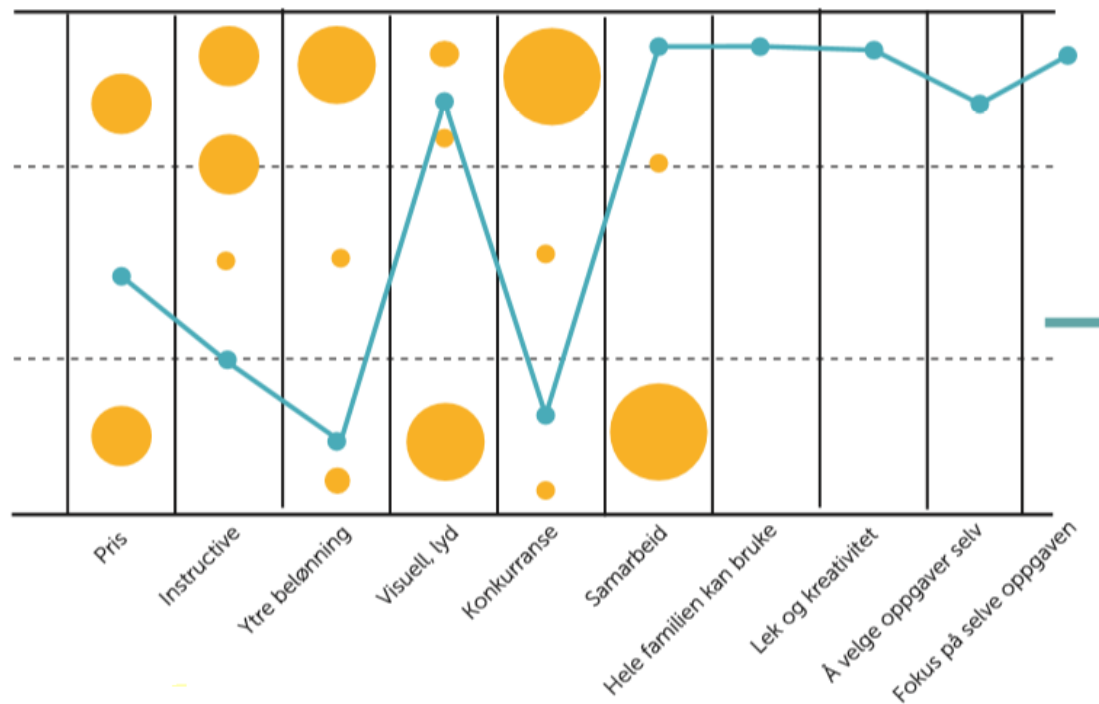


Figure 12.1 Strategy canvas from 15 plus one applications. Taken from [80]

12.2.2 Main insights

In the Master's thesis written by Bjering, there are several valuable insights. These concerns collaboration, the use of game elements when designing the application, as well as how to facilitate intrinsic motivation. The latter includes the use of autonomy, relatedness, and competence. For a child to realize important chores are, the child must get the responsibility of a chore, and the children should be able to choose the task by themselves. Clear goals and feedback were also some of the key points used. It was also mentioned that reward systems and extrinsic rewards could be used as motivators to find intrinsic motivation. However, it should be used wisely because it could lead to the task being an obstacle for the reward, which many of the applications which were tested fell into. An interesting fact

about the families she interviewed and questioned was that only one out of two children (9-15 years old) did chores (46% did, and 54% did not). In addition, many families indicated that they had tried different calendar systems and reward systems without success. The families also expressed the importance of fixed chore sessions and area of responsibility. Last but not least, many indicated that doing chores together was easier and more enjoyable than doing it alone.

Bjering wanted to explore the possibilities with decreasing focus on the use of competitions and rewards. Instead, a larger focus should be on the collaboration in the family, both as a team and by themselves, facilitate the use of playing and creativity while doing the chores, and the possibility to decide chores by yourselves, which could increase the autonomy, relatedness, and competence of the participants.

12.3 Sounds and points

Wang & Lieberoth studied game features, sound and points, in a game-based student response system, Kahoot!, to determine their impact on the users' motivation, concentration, engagement, enjoyment, perceived learning, and classroom dynamics [81]. This study used a full two-by-two matrix, meaning using all the different combinations using sound and music. The reasoning behind it was that design elements rarely had been tested in completely isolated environments.

Their findings suggest that concentration was significantly lower when no audio and points were present, while the other variations had no statistical difference. The effect on engagement is suggested by the findings to be largely impacted by points, as well as being to a less effect dependent on audio. When reviewing the effect on enjoyment, it is again clear that by using no sound and points, a negative effect is emerging. Perceived learning was affected little to nothing by the different variations, but a small tendency shows that no points can have a little effect on perceived learning, maybe because the students were not feeling the pressure as much if it would have been perceived as a competition/game show. The results of motivation and effort were similar to some of the other categories. Using no audio and points led to many agreeing that they did not make an effort to do well. An interesting note should also be taken because when no points were used (audio was used), students wanted to do well since it seemed more like a formal test. From observations done by the professor, the classroom dynamics were heavily affected by the use of audio and points, where audio may be the most crucial for making the experience as interactive as possible, although combining audio and points creates the best effect.

The authors conclude with the use of audio and points are crucial for making Kahoot! a good classroom experience. Although, they do mention that there has been little attention given to more complex relationships within the data, such as gender.

12.4 Designing games

In the following sections, five different design books will be presented, as well as their statements and tips and tricks on how to create great games, especially related to motivation and rewards. It should be noted that these books are relating to game design in general and not specifically to serious games. In addition, a section of various statements and considerations about reward systems is included. When reading rewards or punishment, it could be anything from a textual reward or punishment to an actual extrinsic reward, and it can also be a sound or anything to give positive or negative feedback.

12.4.1 The Art of Game Design: A Book of Lenses [43]

Schell wrote a game design fundamentals book which includes 100 pointers, or lenses as he refers to them, for creating a successful and good game [43]. The lenses summarize the tips for designers, the process of creating a game, the game mechanics, and elements, and how to treat players and enhance their experience.

Schell stated that even though we like to play games and wonderful experiences can arise from them, there always exists something which is more important we should have been doing, which could have said about all entertainment.

There are many lenses which can be related to my project, but there are some which are more specifically applicable: "The Lense of Needs", "The Lense of Motivation", "The Lense of Triangularity", "The Lense of Rewards", "The Lense of Feedback", and "The Lense of Economy".

By thinking of what can fulfill the basic human needs, for example, competence, autonomy, and relatedness mentioned by Deci & Ryan of a person one could improve the enjoyment of a game [5]. It is also important that the needs are not only promised but fulfilled. If not, the player will easily move on to a game which does fulfill what has been promised. It is important to think about that people enjoy being judged, that is judged fairly [43].

Motivation is an important aspect of games, both extrinsic and intrinsic. What

some people think about extrinsic motivation can often be clouded by the viewpoint of "cheap" game design, but good designers know that motivation often builds upon on another. It should also be mentioned that Schell indicates that extrinsic and intrinsic motivation is not binary, but a gradient which flows toward the motivation coming from your true self (meaning doing it for its own sake). Another point which is mentioned is adding extrinsic motivation to something which is already intrinsically motivating should be done with care or not at all, since it often drains away the intrinsic joy with it. This statement especially refers to the "pointification" by simply adding badges, points, and rewards.

Triangularity in this setting is referring to the choice a player can take between a low-risk low reward situation and a high-risk high reward situation. A situation like this is referred to, by Schell, as "*One of the most exciting and interesting choices for a player*". He also mentions that a dull and monotonous game can often become exciting and rewarding with pinch of triangularity.

Although some forms of rewards can drain intrinsic motivation, Schell says that in general the more types of rewards can fit in a game the better. It is important to think about a couple of rule of thumbs from a psychological point of view: 1) Increasing rewards as time goes by to address the players needs to get more and better rewards. 2) Using the power of varying rewards over fixed rewards, as they can become boring and predictable. Besides thinking about if the correct rewards and the correct amount is given at any point is crucial.

The loop of interaction where players receive feedback from the system is an important part of any game because it can dramatically affect what the player does in his next move. Feedback is often one of the key components which can to a greater extent influence the understanding and enjoyment a player has towards experiences with a game. By using feedback correctly, one can create a game which is clear, challenging, and rewarding.

As Schell defines it, it is two meaningful decisions which must be taken care of when working with the economy. The first one is how players should earn money, and the second is how should they spend money. These two features are often in a loop, where the player spends money to make money, directly or indirectly. Money can also be devoted to meaningless things for pure enjoyment. A problem with balancing economy is that by doing this, especially in games where trading is allowed, e.g. Massive Multiplayer Online Role Playing Games (MMORPG), since it will eventually affect many other features as fairness, challenges, choices, chance, cooperation, time, rewards, punishment, and freedom. Schell does mention that

balancing economy does have the same goals as any other game mechanics, namely that the players can enjoy a fun, entertaining, and challenging game.

12.4.2 Game Design Workshop: A Playcentric Approach to Creating Innovative Games [82]

Fullerton describes everything a beginner or working game designer needs to know about game design theory, concepting, prototyping, testing, and tuning, as well as include what it means to be a professional game designer [82].

As Schell [43] states that having the choice between low-risk low reward versus high-risk high reward, it is mentioned in this book by Josh Holmes: *For every reward, there must be risk. ... Balance is the key to a great game experience.* In addition, it is mentioned that complex designs (reward systems) are not necessarily a recipe for success related to player experience. A complex reward system is not necessarily a good design even though it gives the player a lot of different options. Balance is important.

Another aspect which is closely related to rewards is the aspect of choices players make. Fullerton states that every choice should have a consequence to engage the player's mind. It has both upsides or downsides, and it should alter the course of the game. Strictly speaking, this "risk versus reward" concept refers to the same concept of "triangularity" in *The Art of Game Design* referred to in the previous section. So how are one going to react on the different outcomes from the risk taken? Fullerton refers to the two most direct possibilities, namely rewards and punishments. It is often desired not to punish the player as he/she are not playing games to suffer, but on the other side punishment can add layers of meaning, and carry dramatic tension, which can enhance and motivate players from another perspective. Again balance is important.

To create a balanced system of rewards and punishments rewards must have utility or value in the game, and the timing and amount of the rewards and punishments must be thought-through as they are crucial components (with other words rewards can become predictable and boring). In addition, the following guidelines should be followed according to Fullerton:

1. *Rewards that are useful in obtaining victory carry greater weight.*
2. *Rewards that have a romantic association, like magic weapons or gold, appear to be more valuable.*
3. *Rewards that are tied into the story line of the game have an added impact.*

In *Game Design Workshop* a reference to Yee's analysis of "Operant Conditioning" [83], described by Skinner [53, 54], which is making an interesting point on rewards. Yee has studied rewards and punishments in addictive games, and states that the addiction comes from the behavior theory "Operant Conditioning". Several schedules reinforcement can be used in Operant Conditioning: fixed interval schedule, fixed ratio schedule, and random ratio schedule, where the most effective method is the random ratio schedule. The reason is that the rat in Skinner's case, cannot predict when the reward is given, thereby making it more intriguing to the activity. Even though these rewards are powerful tools, there is one type of reward which is more powerful and valuable to many players: peer recognition. Achievements have little value if we cannot get acknowledgment from other players, both in-game and in the real world. Players, if possible, should, therefore, have their efforts recognized when a goal is reached, even though they are not "winning".

Another important aspect of game design which is discussed is anticipation, surprises, and progression related to rewards. Likewise to Schell [43], Fullerton mentions that rewards must be scaled appropriately according to the level of effort, here mentioned as anticipation. Surprises should be handled with care because players must feel in control. Therefore choices often are dominant, but surprises are still *one of the most electrifying tools for a designer*. The ability to illustrate progress is essential. *"No matter what the game, whether it is an arcade shooter or a simulation, providing a path for the player to follow gives a sense of achievement"*. Milestones are often used a good way to display progress and how far a player has come in the search for his/her goal.

Fullerton describes economies of games by four categories. These categories are the flexibility of size in an economy, supply of currency if any, prices, and trading opportunities. Game designers need to think about these categories to properly use currency and resources. The flexibility of size in economy relates to the growth of the economy. Are resources produced and if they are is the growth of the economy controlled in any way? Supply of currency if any relates to how is money given to the players, and how it is controlled by the system. Prices relate to whether or not the prices are changeable, meaning fixed or varied. Lastly, the trading opportunities relate to how functions of trading are performed. Is it possible to trade uneven, or must trades be of same values?

12.4.3 Rules of Play: Game Design Fundamentals [20]

Salen & Zimmerman describes a theoretical guide for game design and is divided into four units [20]. First, the core concepts of game design are introduced, then a detailed discussion of rules, play, and culture is presented to enhance the inform-

ation given on the core concepts. Some key concepts related to meaningful play is rewards and schedule, conditioned pleasure, meaningful happiness, and boredom and anxiety.

Choices have to be done, and the choices which are made should be rewarded or punished in different forms and variations to achieve meaningful play. Rewards and punishment are supposed to shape the player's behavior. It is again referred to Skinner's operant behavior, to which a game designer should be conscious of because it reminds the designer how the game is encouraging or discouraging the player [53, 54]. The operant behavior also affects the motivation of the players to continue playing. The schedule of when to give rewards or punishment is also discussed where fixed versus variable schedules are the primary focus as discussed in the previous section.

Salen & Zimmerman states that in the big picture rewards and punishments are just two sides of a coin, where both are crucial for creating a structure which produces meaningful experiences for the player. They also say that one of the deepest challenges with game design is creating an elusive balance between anxiety and pleasure. Boredom is an important point which must not be forgotten. Are the player entertained? If not, he/she will probably not play the game anymore.

Another important aspect of the big picture is that the integration of rewards, punishment, and events into the game experience is much more important than the visibility in maintaining the player's pleasure. If the player understands the implications given regarding the reward system, the player can use this knowledge to set their short-term goals.

12.4.4 Level Up: The Guide To Create Great Video Game Design [84]

In comparison to the other books mentioned in Section 12.4.1, 12.4.2, and 12.4.3, *Level Up!* is more playful and creative, using a light and funny way to describe game design essentials [84]. In more detail, positive messaging, avoid redundancy, greed, and reward as motivators are discussed in this section.

Regarding positive messaging to enhance the feeling of rewards Rogers gives some valuable pointers [84]:

- One should use sound and voice effects to get the attention of the player when he/she gets a reward.
- The voice and sound effects should be in tone with the rest of the game.

- Freeze gameplay in some way to preserve the moment of reward.
- There can never be enough particles when awarding players with achievements or high scores.
- Clear cause and effect of the rewards must be provided
- Regarding text: fonts must be easy to read.
- Celebratory effects should cover as much of the screen as possible without disturbing gameplay.

An aspect of game design which is pointed out by Rogers is the aspect of redundancy. Players should not get bored while playing the game, so using varying forms of positive messaging, rewards, and activities are essential. A rule of thumb Rogers uses when creating a level design in games is to introduce two or three new mechanisms, enemies, and rewards every level. In addition, Rogers mentions that *"There are other rewards than just treasures. I'm talking about surprise and fun"*, which underlines the aspect of keeping the player curious and intrigued. He also mentions that progress by itself should also be thought about as a reward.

The aspect of player greed should never be underestimated by a designer. Rogers, therefore, proposes some valuable tips to exploit greed:

- Treasures and rewards should be used to motivate players to fight challenges and enemies.
- Players should have a customizable space where they can show off trophies and rewards. By using shelves which must be filled up, players can get the "catch them all" feeling.
- Exploit the "me too" factor, especially in multiplayer games (a player sees something he wants from other players).
- Guidelines are often a good way to lead the player to hidden treasures.
- Collectibles can also be used to guide the player to where to go next.

Greed and rewards can both be impressive motivators. Rogers describes rewards as *"what players are ultimately working toward"*, and he further states that *you can't have a game without a victory condition, and you should never have a victory without a reward*". He also listed some guidelines for correctly using rewards:

- Players should be exposed for the different types of rewards as early as possible in the game.

- Reward as soon as possible, often, and used in various ways.
- When a goal or winning condition is met, evidence must show success.
- The reward should matter to the player.
- Sounds and visual effects are powerful rewards.

Rogers made some solid points when discussing the economy in games and how to balance the price of items. He mentioned that the economy should be planned for the entire game, meaning players should not be able to buy the best item in the game from the beginning. Another key point was to provide enough money for the players so that they need to choose between different rewards, as well as creating a variety of items so that the player must come back and buy whatever he could not afford last time. Treasure items should also not have to separate values because no one wants to get treasures which seem irrelevant. Money is a fascinating aspect of games as the player can have immense amounts of it, especially compared to real life. If items can be bought, they should be priced at balanced rates. Rogers mentions that an easy way to price items is first to classify them by rarity. Which items should be bought at the beginning? It is also mentioned that the economy does not have to be set in stone as prices and values often change as production move along and users need become more visible. He also mentions that by using different colors and sizes. The in-game stores should also be specifically made for the game it is supposed to be in.

12.4.5 The Gamification of Learning and Instruction Field-book: Ideas Into Practice [85]

Kapp wrote this book to provide a step-by-step approach to understanding and being able to implement concepts which are essential in gamification [85]. I chose to include a further description of correct reasons to use gamification, as well as the harmony between extrinsic and intrinsic motivation and how to use it.

It is important that the interactivity and gamified elements are used because of the correct reasons to create an interactive learning experience. Gamification should not merely be used because it is fun, everyone is doing it, the learning will be effortless, everyone loves gamification, and because it is easy to implement. It should be implemented if the intention is to create interactivity in the learning delivery, overcome disengagement, provide opportunities for deep thoughts and reflection, positively change behavior, and lastly to provide authentic practice. The reasoning does not require every point described. One of the key aspects is that implementing gamification is not easily done correctly.

Kapp discusses the difference between extrinsic and intrinsic motivation it mentions that the difference between them are not black and white, in reality, they are intermingled and work side-by-side to motivate learners. A list of areas where extrinsic motivation can be used effectively are presented by Kapp [85]:

- *"To increase a learner's expression of task enjoyment and free time spent performing a task. This results from using performance-contingent rewards, that is, rewards given depending on the performance of the learner."*
- *"To strengthen the perception of freedom of action. This results when rewards for high performance appear."*
- *"To engage a learner when the activity is one that learners do not find of inherent interest or value"*
- *"To engage learners when they initially view the activity as low value."*
- *"To narrowly focus attention and to shorten time perspectives."*

On the other side, intrinsic motivation can be considered concerning the theory of self-determination [55]. By using the theory of self-determination and intrinsic motivation the three elements, autonomy, competence, and relatedness can be mapped upon a design for gamified applications and used in the following ways:

- Establish senses of control and choices.
- Contribute to the confidence in the learners ability to reach a goal or face challenges.
- Support learners with clear paths toward content and mastery.
- Provide some sort of social interaction to other learners through activities with them
- In addition to reward learners through their main goals, also reward them on incremental learning.

As mentioned before extrinsic and intrinsic motivation are co-existing. It is difficult, from a practical standpoint, to separate them. Humans are more often than not simultaneously motivated from both external and internal sources. After discussing research related to the topic, Kapp draws the conclusion related to game design. This conclusion states that for a game design to be good and effective one cannot rely on merely one side of the motivation. Just relying on points and rewards would not be an effective method, but also including learner control, sense

of challenge, and a guided path towards mastery would expand the horizon for the game. Designers have to create both internal and external motivation and use them to guide learners.

12.4.6 Other

During the analysis of game reward systems, Wang & Sun proposed several reward system considerations [64]. The following list is a summary of these considerations:

Life constraint

If the target audience includes casual gamers, then there should be rewards which are available for short playing sessions.

Create autolic experiences

It is not a given that extrinsic rewards only gives extrinsic motivation. By, for example, creating subgoals intrinsically rewarding experiences can be reached because the players can easier immerse themselves in the gameplay.

Balance

The balance between effort paid/time spent and the value of rewards must be balanced to some degree. If not, players will get frustrated. Hardcore gamers should still get an advantage, but casual gamers should be able to enjoy the game.

Uncertainty and secrecy

Uncertainty can be a great contributor to fun in games. That said it should be used with caution as it can frustrate the player. Rewards which are tightly related to skills should not be hardly affected by uncertainty. Additionally, critical resources should be expectable to a certain degree, while using secrecy can cause a great degree of curiosity and encourage players to interact other players.

Accumulated versus instant feedback

Accumulated rewards are often used to mark the players progress and are therefore better suited in a long-term and social sense of achievement. On the other hand, instant feedback will provide responsive and juiciness to the experience, which in time will help to maintain the attractiveness of the game.

Social purpose

To social purpose which needs to be considered is the possibility to share, compare, and establish status related to other players.

Physical world activities

Reward systems which are related to physical activity have made people more willing to play because more physical activity or health are important to people.

12.5 Summary

This chapter contains information which is directly applicable to the design and implementation of the proposed solution as so many design principles are discussed. Parts of the analysis of applications reviewed by Bjering can be directly used as an addition to my own analysis since the applications are all chore related. The effects of sound and points in a game-based learning tool also contribute to an understanding of the reasons for using sounds and points as feedback and rewards. The primary takeaways from this chapter are the different principles regarding rewards from the different game design books reviewed. For example, the use of triangularity and how it can increase excitement and enjoyment of a game. Another design principle is the one of how motivation builds upon each other, and that motivation is a gradient rather than two opposites, namely extrinsic and intrinsic. The feedback principles by Rogers are also valuable to increase the enjoyment of a single feature. Finally, the use of economy and how to make rewards intriguing by using milestones and risk are important aspects of the proposed solution.

Chapter 13

Application Review

In this chapter, an analysis of successful game applications as well as chore-related applications is presented. The features looked upon will be their use of reward types and how they motivate the player. Many of the applications related to tasks have already been analyzed by Bjering [12], and will therefore not be included in this analysis. Bjering's analysis can be found in Appendix B. They will also be included in Section 13.3.

13.1 Non-Chore Related

This section will present some of the most popular applications and their use of motivation and rewards.

13.1.1 Pokémon Go

Pokémon Go is an augmented reality, location based, 3D, monster catching application, based on the success of the Pokémon world. In the game, your tasks are to "catch 'em all" and defeat your opponents team in Gyms. In this application, the player has to move around in the real world to catch the monsters.

Pokémon Go uses many different kinds of reward types, even though there are few activities to do in the game. Some of the badges which can be achieved have a low connection to the rest of the game, and they do not give the player anything else than a symbol. The game is also well designed related to casual, and hardcore gamers, especially since the player have access to every item available by level requirement before the experience needed is increasing exponentially. It is also very possible to play the game without buying in-game purchases, and just relying on the rewards which are naturally given to you.



Figure 13.1 Pokémon Go screenshots.

Reward types	Motivation
<ul style="list-style-type: none"> • Unlock-ables • clear feedback • badges • coins (used as currency) • daily rewards (more experience) • avatar experience • items (potions, revives, pokéballs) • resources used to develop your monsters' level • hidden rewards • sound and visual effects 	<ul style="list-style-type: none"> • "Catch 'em all" • Capture gyms to assist your team • Level up to get new items • Social interaction (Showing off your pokemon)

Table 13.1 Pokémon Go rewards and motivations

13.1.2 Clash Royale

Clash Royale is the multiplayer, real-time arena, application in the Clash of Clans series. The arena is based on placing cards which cost a certain amount of resources. The decks can be easily customized. Further, cards can get upgraded, as well as the player being able to progress his/her way through nine different arena levels, which unlocks different cards. There are also challenges and the possibilities to create clans. By opening chests, the player can get cards which can be used to upgrade already gotten cards or unlock new cards. The different rewards and motivations are listed in Table 13.2.

Clash Royale's activities are mostly based on competitive play, meaning playing versus other players is the primary activity. But it is also possible to observe other players. Coins and gems are used as the resource, where gems are more attractive since the player can buy, and use them to do things coins cannot do. Casual play is possible, but a lot of resources is needed to reach the higher levels.



Figure 13.2 Clash Royale screenshots.

13.2 Chore Related

The following sections will analyze three different chore related applications, which uses rewards and motivation in different aspects.

Reward types	Motivation
<ul style="list-style-type: none"> • Unlock-ables • clear feedback • achievements • coins and gems(used as currency) • daily rewards (chests which contains many cards, possibility to buy cards, and receive donated cards) • player experience • cards • sound and visual effects • hidden rewards (most cards are hidden in chests) 	<ul style="list-style-type: none"> • Catch them all(cards) • Be the best in ranked play • Level up/get to new arena to get new cards • Social interaction (dominating other players)

Table 13.2 Clash Royale rewards and motivations

13.2.1 Homey

Homey is a mobile chart for the entire family. It is a to-do list with pictures of what needs to be done and rewards the player will receive when it is done. When the player is done with the task, he/she can take a picture to prove that it is done. After receiving coins and trophies, the player can choose from the already created list of possible rewards, or create one by him/herself. A calendar is included with different categories of when the chore needs to be done.

The Homey application is probably not finished since some of the functionality is not working, and the user interface is messy, and the rewards and motivation are strictly focused on one person. There are no visual effects, and the feedback given is limited. Using pictures to validate each other's work was a smart idea, but the application lack interactivity. Most elements on in it are static.

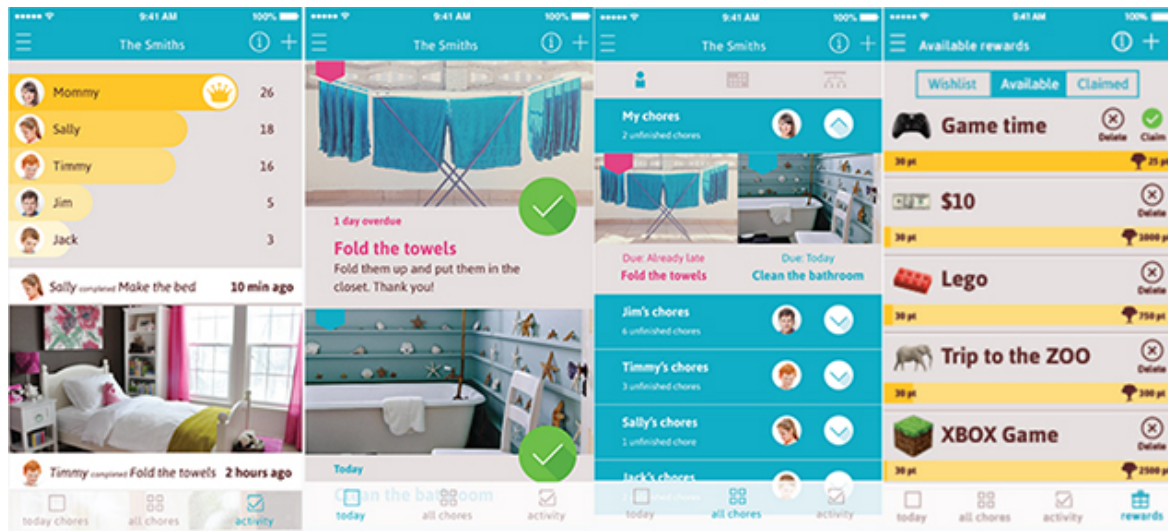


Figure 13.3 Homey screenshots. Taken from [86]

Reward types	Motivation
<ul style="list-style-type: none"> • Trophies • Coins(used as currency) • Feedback • External rewards (allowance, products, activities) • Penalty 	<ul style="list-style-type: none"> • Leaderboard • Exchanging coins for external rewards • Overview of what is completed • Time pressure • Clearing the available tasks

Table 13.3 Homey rewards and motivations

13.2.2 OurHome

OurHome is an application for simple coordination between parents and children in a family. Players will be rewarded with points which can be used to purchase rewards. A calendar is included where tasks will show, and the chores are easily marked with thumbnails of the person who are going to do them. An overview of points collected by the individual members is also available.

OurHome uses points as a reward which can be exchanged for customized rewards given by the parents. There is also some visual feedback given in certain events, but the application lack interactivity, and most elements are static.



Figure 13.4 OurHome screenshots. Taken from [87]

Reward types	Motivation
<ul style="list-style-type: none"> • Points(used as currency) • Feedback • External rewards(customizables) • Penalty 	<ul style="list-style-type: none"> • Leaderboard • Indirect competition (who got the most points) • Exchanging coins for external rewards • Overview of what is completed • Time pressure(calender) • Clearing the available tasks

Table 13.4 OurHome rewards and motivations

13.2.3 Chortopia

This application uses a story as entertainment. To move on in the story, the child has to do chores. The child is the hero and must complete the quest (chores) to save the villagers in the story. In addition to following a story, games (for now there is just a simple card game) can be played in the application. Cards are given after a level is complete (a set of three chores). When three chores are set together, the parents creates a new "advenchore".

Chortopia does not use points and trophies like the other chore applications analyzed. The application is relying on the story to be entertaining, and that the children want to continue to do chores because of it, and the other motivations described above. This application is targeting children and wants the parents to approve or send the chores back to the child.



Figure 13.5 Chortopia screenshots

Reward types	Motivation
<ul style="list-style-type: none"> • Chests (which contain cards) • Feedback • More content in story • Visual and sound effects 	<ul style="list-style-type: none"> • Indirect competition (who has completed more levels) • Most wins in the mini-games • Completing the story • Clearing the available tasks

Table 13.5 Chortopia rewards and motivations

13.3 Discussion

In this section, a summary of the findings from my own analysis and Bjerling's analysis, found in Appendix B, will be given. The two features which will be discussed is reward types and motivation.

13.3.1 Reward Types

Similar to the findings of Bjering [80], this analysis found that the use of extrinsic rewards like points, badges, and highscores was used to a great extent. This is not necessarily bad by itself, but seen as many of the applications had lacking completeness it felt like the applications were todo-lists with points, hence falling into the category of "pointification". That said *Chortopia* used a story to motivate children between ages six and eight to do chores, hence creating a fantasy to increase intrinsic motivation. On the other hand, it could be viewed as just another form of reward, being able to view the next chapter in the story.

It was quite obvious that the chore related applications used different styles regarding game elements when compared to the popular game applications, where more features from GameFlow [52], and other theories were clearly integrated. In addition, many of the chore related applications barely used any form of visual feedback or sounds to encourage the players, which is an important form of reward in games [84]. Overall it is clear that the reward types used can be pretty narrow. The main problem is not which kinds of rewards are implemented; it is how they are implemented concerning learning and the collaboration in the family [74, 66, 52, 21, 23].

13.3.2 Motivation

In general, the use of motivation in the chore related applications were often the rewards themselves, and the simple exchange which were present. Some applications also used indirect or direct competition between the players in leaderboards. One could also say that clearing the available tasks is one of the motivations which are used, although this does not motivate to do the chore itself, it merely motivates to finish what is given to individuals. Compared to the popular game applications there was little use of social interaction as the individual family members often did their chores and no two-way communication were used. That said the use of photos to approve chores could be view as a social interaction, but it still does not justify the children and parents as equal family members, as some are Judges and other are workers.

Part IV

Mænage Extended

This part presents the final solution of the reward system. First, a description of the concept will be described. Further, the technologies used both during the prototyping phase and developing phase will be discussed. Afterward, the proposed solution from the specialization project is presented. The requirements for the application is then displayed followed by the prototyping phase where the application's different functionality is illustrated. Finally, the final solution is described with changes from the prototype and the development phase. The software architecture and the testing approach are also discussed.

Chapter 14

Concept

In this chapter, the central concept of the developed application will be presented. In addition, the concept of the original application, *Mænage*, will also be presented for the reader to see the evolution of the final proposal, as well as create a context in the hierarchy of development. This chapter will not describe the application in detail; instead, it will give a general description to grasp the essential parts of the concept.

14.1 The concept of Mænage

Mænage was created by Serious Games AS, and is a foundation for the application design proposed in this Thesis. *Mænage* is an application developed for multiple platforms. The features of the application are similar, to some extent, to Bjering's proposed solution presented in Section 12.2. Bjering's proposed solution *Takimi* grew into *Mænage* with several changes. As the concept of both *Takimi* and *Mænage* has the same foundation, so does the concept of my proposed solution. The latter solution has increased focus on the family as a whole rather than on the individual members. Fun and engagement are also core functionality. Because of this *Mænage* is meant to inspire and motivate planning and to create a simple everyday life related to doing chores and housework. It should in addition to high player freedom, facilitate teamwork, and learning. The concept of *Mænage* is basically to make the household chores into a game, by creating a platform which can easily distribute, execute, and reward tasks. Besides, it gives users the possibility to perform the chores in different fun and engaging ways. To illustrate this the following section will display a more detailed view of the application as it was before it was developed further during this project.



Figure 14.1 Mænage logo and login.

14.1.1 Interface and functionality

The main page is display in Figure 14.2. The usual flow of the application is to distribute chores to family members by dragging or shooting, chores from the carousel element in the top. Chores presented in the carousel has different amounts of points related to it which can be seen by looking at the size of the circle representing the chore. When a family member has finished a task, it is dragged down to the next container, which displays the goal and progress of the individual family member. The goal container can either present the personal goals or the family goal. The advances in these containers are represented as water and will increase as the family members releases chores into the container.

Chores themselves are highly customizable, as seen in Figure 14.3, and are displayed as visible when touched upon, which can be seen on the right side of Figure 14.3. In addition, the reward, in the form of points, given to the users are also customizable. This customization gives the family options where they can decide how much a chore is valued. The reasoning behind it is that different families have the same chores with various difficulties.

To account for easily visible information about the individual users an avatar page, as well as a family page is used. The avatar page is, of course, customizable for the players' desire (see Figure 14.4). Which may not be as clearly illustrated in these figures is the focus of which fun and engagement should be implemented in the tasks, by giving the player tips to different forms of gamified elements which can be included in the chores, e.g. timers, role playing, and points.

The reward model of *Mænage* is fairly simple and can be is displayed in Figure 14.5. After a user has completed a chore points are given. If the user has enough points to get a reward the user can exchange these points into the reward. If the user does not have enough points, he/she has to do more chores to receive more points.

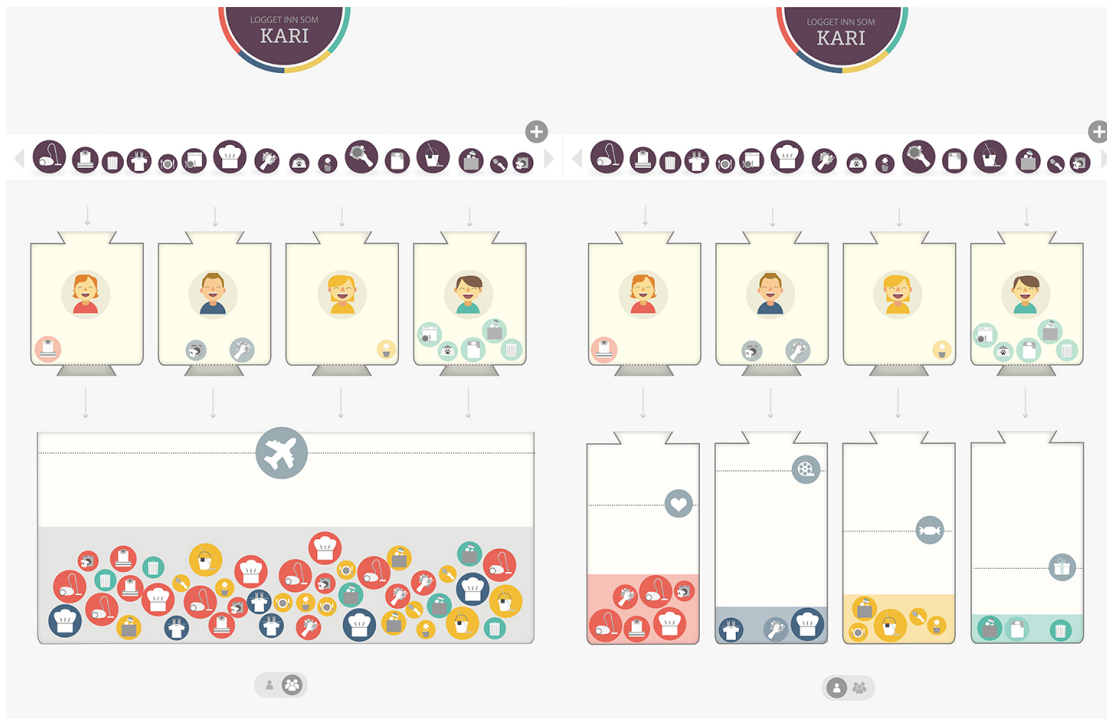


Figure 14.2 Main page of *Mænage*. Family progression on left, individual progression on right.

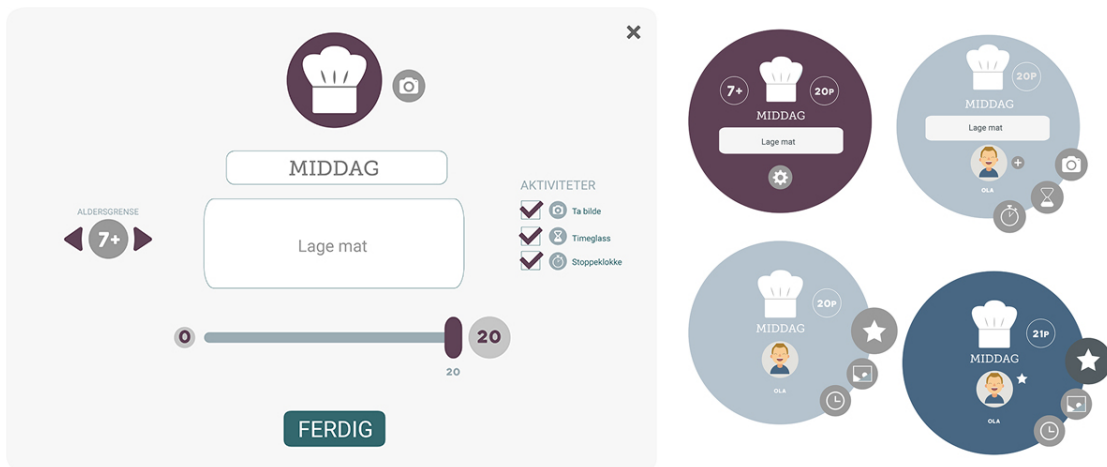


Figure 14.3 Customizable chores.

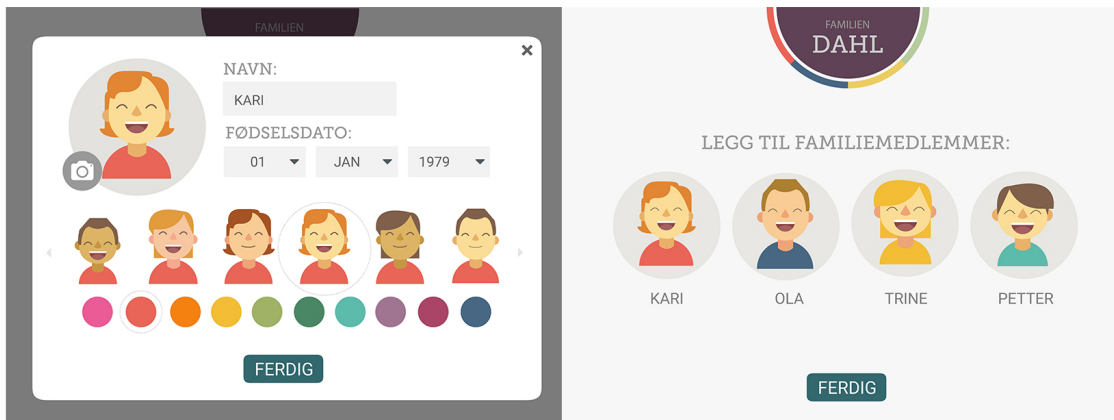


Figure 14.4 Family member avatar and family page

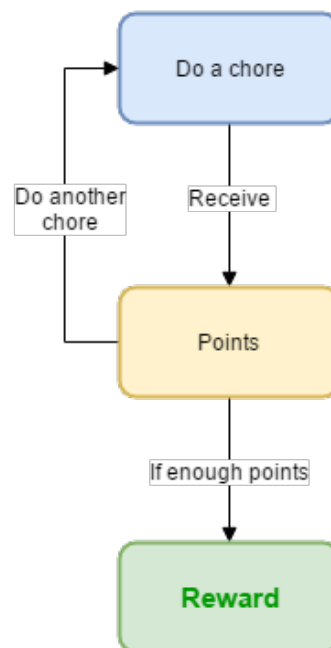


Figure 14.5 Original reward model in *Mænage*

14.2 The concept of *Mænage* Extended

The concept of the extended application of *Mænage* was created after the combination of multiple workshops and game design theory [13]. The workshops are thoroughly described in Appendix D. The concept developed is using the original *Mænage* application as a foundation, where every part of it is used, except parts

which have been directly changed to create *Mænage Extended*. The concept is primarily based on using gamification indirectly or directly to motivate the users to do more chores. Moreover, the developed solution also relies on game design theory explained by Rogers [84]. The concept also tries to avoid pitfalls described as "pointification" by several authors [43, 85, 20].

By adding another level of resources into the application, in the form of gems, the users can be motivated from another angle. These gems can be used to buy rewards in an in-game store. The rewards in the store are mainly there to excite the younger users, whereas parents can customize and add rewards of their choice. Choosing rewards may seem to be the users choice, but the parents still have full control of what is available, making both ends happy. The main reason to add another set of resources is to increase the engagement and enjoyment, but most importantly expand the possibility to play with the application to motivate the users. The aspect of an in-game store can be seen in numerous successful applications. However, *Mænage Extended* is not merely using a store because of the possibility to use resources, but also as a platform to include various visual effects to motivate users. The store does not have a feature where real money can be used to buy the resources.

Many of the chore related applications inspected during the preliminary study phase did lack an aspect of fun, and merely incorporated the organizational aspects of doing chores. Although some applications did use gamification, the majority of them failed to use it to an appropriate degree, as it was simply laid upon the application and not intermingled with the rest of the functionality. *Mænage* did have some playful parts but did lack visual feedback, and a higher degree of enticement to properly catch the full attention of younger users. Despite its playful parts it still works as a todo-list. The concept of *Mænage Extended* is therefore directed at the lack of playful interaction to enhance the original application, meaning *Mænage*.

Chapter 15

Technologies

During this chapter, a description of different technologies used during the project will be described. Even though this chapter will dive into the technologies used, it will not explain every tool to a full extent.

15.1 Prototyping

In the early stages of the project, it was decided to create a high fidelity prototype. The reasoning behind it was that creating the interaction between screens is particularly easy, as long as there is a minimum of variables included in the picture. If there had been variables which needed to be tested before implementing the prototype, a decent option would have been *Axure*. However, creating a high fidelity prototype in *Axure* requires a good amount of time. No particular variables were needed to do a proper testing of the prototype, and therefore the solution was to use *InVision*, a much simpler, easier, and free to use prototyping tool. Another reason to create a high fidelity prototype instead of a low fidelity prototype was that it was much easier to create a natural environment where the test users would feel in control, therefore being able to give better feedback. The creation of the different illustrations, icons, and backgrounds was done in *Adobe Photoshop* and *Adobe Illustrator*. Later on, animations were made in *Pencil2D*.

15.2 Developing

As this project already had decided to use the *Unity 2D Game Engine*, it was not a hard choice to stick to this solution, compared to creating the entire project from scratch and finding technologies which would have suited my needs. Although *Unity* is an excellent tool for cross-platform application development, no previous experience with it had occurred. Luckily *Unity* parses *JavaScript* and

C#, something which were familiar, hence only making the *Unity* layer unfamiliar.

The team which worked on *Mænage* and I had a discussion on whether complete access to the code was necessary, or if it would be enough with just the *Unity* part, e.i. not database access. It was planned to work alongside the development team of *Mænage* by using a feature branch, in *Git*, as a master branch. By operating in this manner, the necessary updates to the *Mænage* application would easily be received. Furthermore, being able to develop *Mænage Extended* without interfering with the original team's code would be easier. Although this was the original plan, having database access would have helped in the development phase. The development team of *Mænage* did not work during my implementation phase. Therefore, even though the branch system was a good idea, it was not set into motion since there were no commits from the original team.

Another reason for not needing the database was the short period test user would try the application, around 15 minutes. Even though the code is not directly applicable to the original *Mænage* back end system, it became a fact that the back-end should be re-written anyway, in the middle of the development phase. Another reason was that the functionality of my solution was not necessarily what was going to be used in the final result of *Mænage*, and is therefore just a proof of concept.

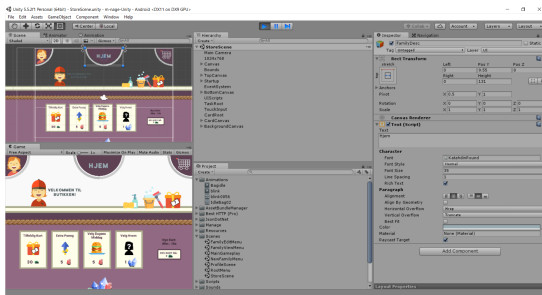


Figure 15.1 Screen capture of *Mænage Extended* in *Unity*



Figure 15.2 *Unity* logo

Chapter 16

Proposed Solution

This chapter will describe the first draft of the proposed solution after reviewing theory and workshops. This part is taken from an earlier work, namely my specialization project [13].

16.1 Flow of Solution

The model illustrated in Figure 16.1 describes a flow chart of how the different reward types are proposed to be implemented into the application. Some aspects of the proposed solution are not included in the figure and will be presented after the description of the reward model.

Doing a chore

A member of the family is doing a chore, which is available in his/her tank (illustrated in Figure 14.2). After it is approved this member will get a certain amount of points decided by the difficulty of the chore. The family member will also receive a certain amount of resources (gems), which is described below. The number of gems is dependent on how well the chore is done and the difficulty of the task. These two rewards will always be given, the first in a fixed amount, while the latter will vary. As Rogers mentions: by rewarding often and in various forms, rewards can become powerful motivators [84]. In addition to these two rewards (points and gems), the family member can also receive badges if certain requirements are met, e.g. vacuuming ten times.

Badges

The badges will also give a title which can be displayed on the receiver's profile. By implementing these badges and titles, the player will have something

to show for [84]. Further, Rogers says that greed should never be underestimated as a motivator, for example by using the "catch them all" and "me too" feature explained in Section 12.4.4. The badges will in addition to a title, also reward the player with some extra resources, points, or even secret rewards. Some of the badges could also be hidden (still visible, but the requirements should not be visible) to trigger curiosity [44, 84]. The badges could also serve the same functionality as avatar level does in many games e.g. Pokémon Go and Clash Royale, where items and cards are unlocked when achieving a certain level. Badges could unlock items in the store.

Coins/Gems

The primary purpose of the gems, given by doing chores and receiving medals, are to be transmuted into coins. Whether or not to use the functionality of receiving gems which will be transformed into coins, or just using gems as they are, should be tested. That said it would be much easier to entice the player as different gems (diamond, ruby, sapphire, emerald, amethyst, and topaz) can have different values [84]. The outcome will also be uncertain to the player who can trigger curiosity and the motivation to do the challenge (chore) as good as possible [44]. This uncertainty will trigger excitement when the player receives them after a chore is done, while coins will simply be the same type, just a bunch of them. By using currency, the younger users can also get a simple introduction to savings and the decisions they have to make when using these savings.

Store

The rewards available in the store can vary from puzzle pieces used to complete a puzzle, or something as simple as choosing the dinner once. The reasoning behind having an in-game store where the user can use rewards is to allow the players to set goals besides their primary goals [44, 52, 64]. Furthermore, the players will also feel in control of where to use their own earned resource [52], which relates to autonomy [55]. Some of the rewards which can be bought from the in-game store will also give you points which will increase the level of both the user's pool, as well as the family pool. The store should contain a set of example rewards, but players should also be able to create their own prizes, to some degree. The store should also fit, theme-wise, into the application as mentioned by Rogers [84].

Points

When enough points have been collected, the family member or family can either choose the reward or continue saving for a bigger reward. By doing this the users of the application, again, have control over their actions, and it can especially be intriguing to go for a bigger reward if it is unknown.

The use of triangularity is one of the most interesting and exciting choices humans make [43, 82].

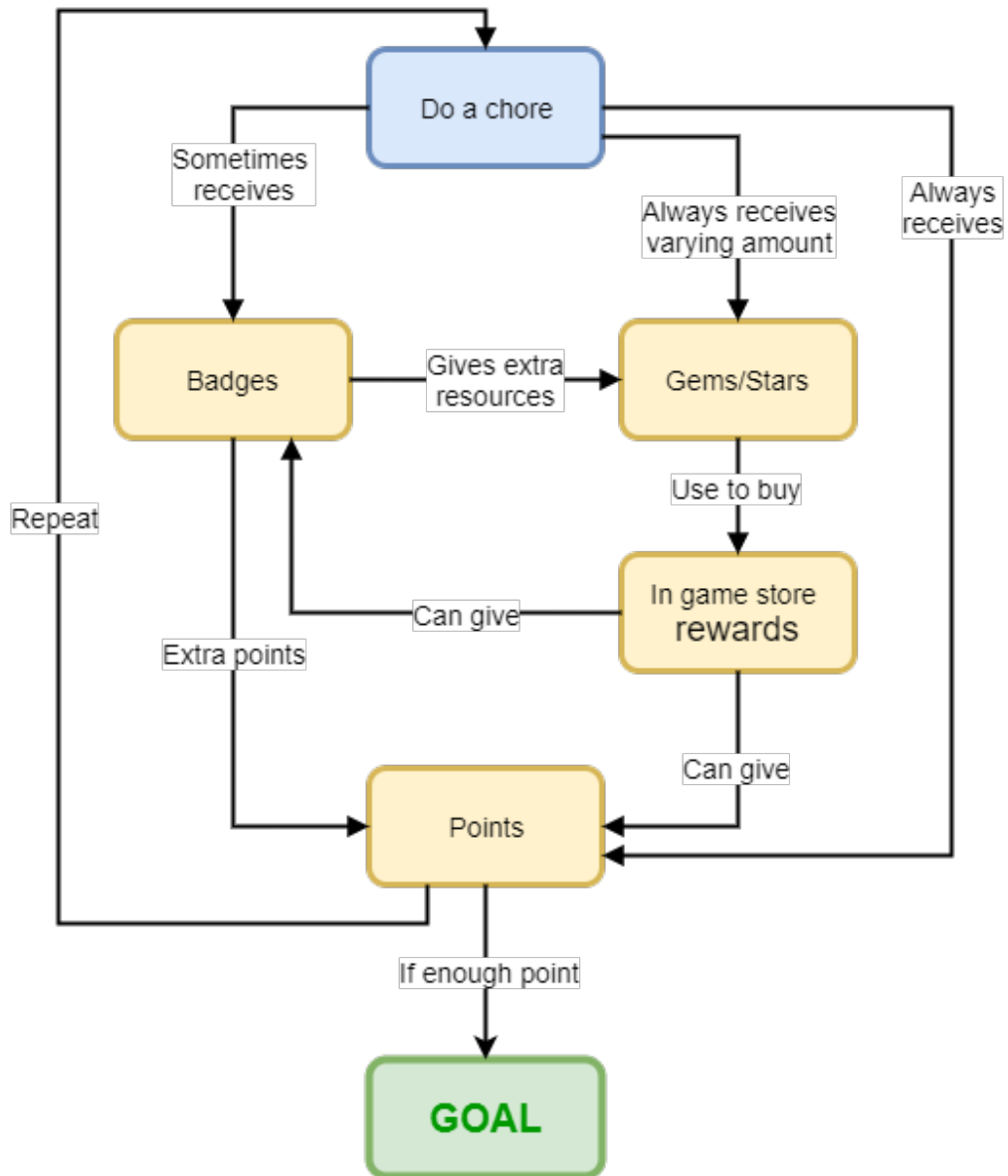


Figure 16.1 Proposed reward model

16.2 Leaderboard

A leaderboard which will show the statistics internally in a family can be implemented to illustrate how much the individual members does. The statistics could include the total number of points gathered, the number of chores done, the number of badges received, and numbers of shots hit (chores into the tank). The leaderboard could be implemented on the family page, where one can see all the individual members. The reasoning behind it is to avoid a significant focus on competition, but still motivate those who like to compare themselves to others, which relates to the need for relatedness and mastery discussed by [55]. Speaking of statistics, in the individual family member page the badges and rewards obtained should be displayed, since people like to review what they have accomplished [84].

16.3 Feedback

Feedback by visual or textual effects, or by sound, can be a powerful reward by itself. The uses of these effects will, therefore, be an important part of the reward system. As Rogers mentions: "*there can never be enough particles*" [84]. These effects will primarily be used when rewards are given, when completing a chore, and even when simple interactions are performed with the application. These interactions could be when shooting a chore into one of the tanks or swiping through the chores in a tank to make them move.

16.4 Randomized features

The use of randomization can be a powerful tool in game design by provoking curiosity and entertainment [44, 45, 23]. However, the use of it in a serious game, where learning is one of the essential elements, can take the focus away from conscious decisions the players have done. The primary resources, points, and gems should therefore not be randomized, at least not to a high degree. Skinner concluded that randomized schedule of rewards was the most effective use compared to fixed schedule and fixed ratio [53, 54]. That said as mentioned earlier in this section, using randomization should be done with care as it may affect the decisions of players.

16.5 Values

As the economy and currency can be a hard part to balance, implementation principles should be followed, since it affects so many other features of the game [43].

Rogers says it is important that the players will be introduced to all the rewards and resources as soon as possible, so they know that the rewards exists and understand their functionality [84]. He also mentions that using different sizes and colors of the currency (treasures) is preferred. By using Schell's money earned/money spent loop [43], Fullerton's four categories of important economy questions [82], and Roger's tips [84], a proposed system is created. It should be mentioned, as Rogers emphasizes, that economies does change and should not be set in stone [84].

The proposed values (see Table 16.1) of which the chores are categorized are very easy, easy, medium, hard, very hard. There are many ways points could be given. In addition, the varying amount of gems rewarded is dependent on how good a chore has been performed. This evaluation could have three categories to keep it simple. These could be bad, okay, and good, and could have different multipliers attached to them, see Table 16.2.

Type of increase\Difficulty	Very Easy	Easy	Medium	Hard	Very Hard
Fixed	100p	200p	300p	400p	500p
Incremental	100p	200p	400p	700p	1100p
Factor of two	100p	200p	400p	800p	1600p
Varying	100p	200p	300p	500p	1000p

Table 16.1 Chore difficulty reward

Type(Bad/multiplier)\Evaluation	Bad	Okay	Good
1/+.5	1xgem	1.5xgem	2xgem
1/+1	1xgem	2xgem	3xgem
.5/*2	.5xgem	1xgem	2xgem
.5/+.5	.5gem	1xgem	1.5xgem
.25/*2	.25gem	.5xgem	1xgem

Table 16.2 Evaluation multiplier table

The rows which have green markings are the ones which are chosen as values. It should be noted that the rows with yellow marking should be taken into consideration as they are potentially better balanced. The reasoning behind the green rows is that they are easily understood by players as they are only increased with a fixed rate. Since the difficulty and evaluation of the chore are as flexible and customizable as it is, players should not be able to ruin the balance. The points

rewarded by the difficulty could be illustrated with how much time and effort is put into the chore. So to receive as many points as the hardest chore, one must do five of the easiest chores, potentially ten times if the yellow row is used (see Table 16.1). It could also be possible to reward the player with a decreasing multiplier, somewhat similar to what *Kahoot!* are doing (starting with a full score and decreasing as time goes by). This multiplier would be comparable to a degree of punishing the player, as not perfectly doing the chore would resolve in fewer gems.

Chapter 17

Requirements

In this chapter, the different requirements will be described. The final set of requirements is based not only on the preliminary study and the proposed solution from Section 16, but also partly from the evolution of the prototype.

17.1 Functional Requirements

This section will present the final table of requirements worked with during this project. Bare in mind that functional requirements displayed in this section do not contain every functional requirement for the entire solution, only the ones for the functionality added.

ID	Description	Priority
F1	The application must a store screen	High
F2	The application must have a profile screen	High
F3	The application must give an extra set of resources (gems)	High
F4	The application must have a navigation bar	High
F5	The application must have a consistent design and user interface	Medium
F6	The user should be able to receive rewards manually	Medium
F7	The user should be able to trade in between different gems	Medium
F8	The user should be able to buy cards from the store	High
F9	The application will strive to display visual or textual feedback to the user	Medium
F10	The application will have a leaderboard	Low
F11	The application will have fixed values on important elements(points and gems)	Medium
F12	The application will categorize chores into different difficulties	Low
F13	The application must have an inventory for every player	Medium
F14	Every user should have their own account	Medium
F15	The application must include individual trophies	Medium
F16	The application must strive to use sound effects to encourage the user	Medium
F17	The application must strive to motivate the users to do chores	Medium

Table 17.1 Functional requirements

17.2 Non-Functional Requirements

This section will display the non-functional requirement for *Manage Extended*, and does not include those already set for *Manage*. The listed items below are therefore in a smaller number than in a normal project where the entire application would have been included. In addition, the primary goals for the extension are to increase motivation, enjoyment, and engagement of the user, which are user perceptions, not non-functional requirements. Usability was the only relevant quality attribute during the experiment since it is a prototype and a proof of concept.

ID	Category	Description
NF1	Usability	It should not take longer than 5 minutes to learn how to use the system
NF2	Usability	The application must have an easy and intuitive navigation system

Table 17.2 Functional requirements

Chapter 18

Prototyping

During this chapter, a description of the prototype and the functionality of the application is illustrated and discussed. The first section will describe and display the high fidelity prototype created from the proposed solution. Secondly, a description of the prototype testing, as well as the results from it will be mentioned. Lastly, notes which must be taken into account when starting to implement are discussed. The notes are mainly from the conclusions of the testing results, but also notes from less comprehensive iterations of the testing.

18.1 High fidelity prototype

The high fidelity prototype was created in consideration to the proposed model seen in Figure 16.1. The following sections will describe each page/scene in the *Mænage Extended* high fidelity prototype.

18.1.1 Main Page

The main page is where chores are distributed, set as finished, accepted, and rewarded. The main page will not have much difference from the original application, *Mænage*. There are however minor changes illustrated in Figure 18.2. These changes are primarily the navigation bar on the top of the page, where paths to the user profile and store are represented respectively from left to right. Because of a misunderstanding, it was believed that the chore had to be accepted before it could be dragged into the goal container. This understanding was however not the case, and the users could drag the tasks down into the goal container and receive some points first, and then receive more points if the chore was *liked* (accepted as finished by the parents). The prototype takes into account the first understanding of the application.

When parents have approved one or more chores, users can drag them into the goal container, but first, a mysterious bag should appear, as shown in Figure 18.3. This bag should first show how many chores the user had done with a number on the front of the bag. After the user taps the bag, it opens, and the first chore's gem reward is presented with lights and colors, as presented in Figure 18.4 and 18.5 [84].

After the user has clicked through a number of rewards, according to the amount of chores he/she has gotten approved, all the gems are flowing from the bag, into the user's profile [84, 43]. This stream of rewards can be viewed on the rightmost side in Figure 18.1.



Figure 18.1 Gems flow from bag to users profile

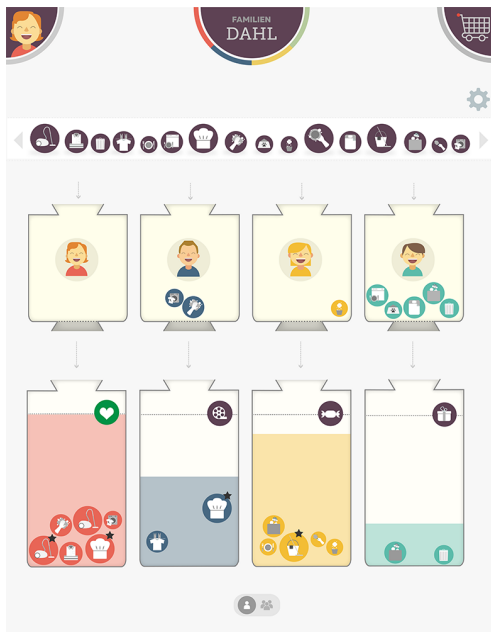


Figure 18.2 Main page of *Mænage Extended*



Figure 18.3 Mysterious Bag



Figure 18.4 Mysterious bag Opening



Figure 18.5 Mysterious bag showing amount of rewards

18.1.2 Store Page

When the user navigates to the store page, the structure of the page is the same as the main page, hence being separated into two parts. The store is illustrated in Figure 18.6. The uppermost part, the counter elements, is currently just for visual entertainment. The navigation bar is also available here, meaning it is possible to access both the main page and the profile from the store. The cards displayed in the middle are rewards users can buy for the gems earned from doing chores, or from receiving medals. Cards are meant to enhance the motivation towards doing chores and can only be purchased if enough gems are obtained [44, 52, 64]. In addition, the cards should be customizable by the parents such as they have control over which cards are available. By doing this the users, children, still feel in control of their choice, although the decision has already been made by the parents since they have created a list of things which could be in the store [52]. The user can tap the card in order to see a more detailed description of what the card does, in addition to buying it illustrated in Figure 18.7.



Figure 18.6 Store

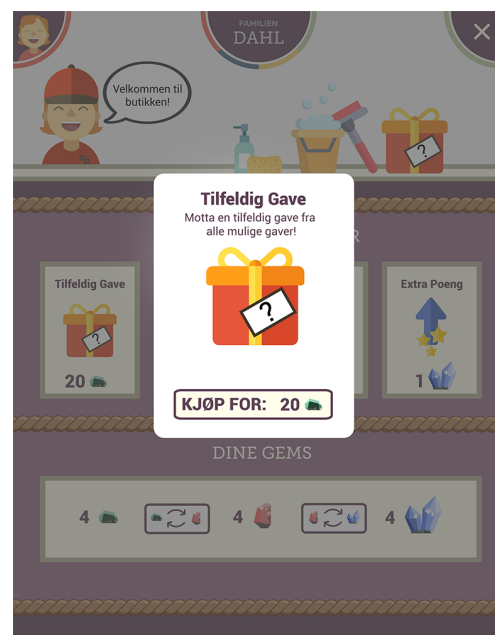


Figure 18.7 Inspecting card

At the bottom of the page, there is an overview of the earned gems, as well as the possibility to trade gems in between the different gem rarities. It is possible to trade gems in both directions, meaning from green to red and from red to green, as well as from red to blue and from blue to red. The trading overlay is displayed in Figure 18.8. By giving the user the option to interact more with the application,

the user will feel more in control of what is happening, which in turn will motivate the user [52].



Figure 18.8 Trade overlay

18.1.3 Profile Page

The profile page consists of an overview of what the user has earned and bought. As seen in Figure 18.9 there is an overview of which gems the user has, which cards have been bought from the store, the user's avatar, and at the bottom, there is an overview over the different medals earned. First, the avatar part should be where the user can customize his/her avatar and change the current title which is displayed to other users. The cards beneath the overview of gems illustrate which cards are still available for use.

At the bottom, a section with all the different medals is displayed. They are categorized into four categories dependent on which stage they are. These levels are incomplete (presented with a question mark), bronze, silver, and gold which can be seen at the bottom in Figure 18.10. When a user earns a medal, rewards are automatically added to their corresponding place. A progress bar will track the amount of tasks it takes to complete the different difficulties. This progress bar motivates the user to perform the respective chores to achieve the medal and reward.

18.2 High fidelity prototype testing

During this section, a description of the prototype testing will be described, and improvements based on the feedback from users will be discussed. This prototype test was primarily to gain acceptance of the new concept, as well as being able to test user friendliness in general (navigation, understanding of user interface, and learning curve). Six people tested the final high fidelity prototype, however far more students gave feedback along the way when creating the prototype, especially

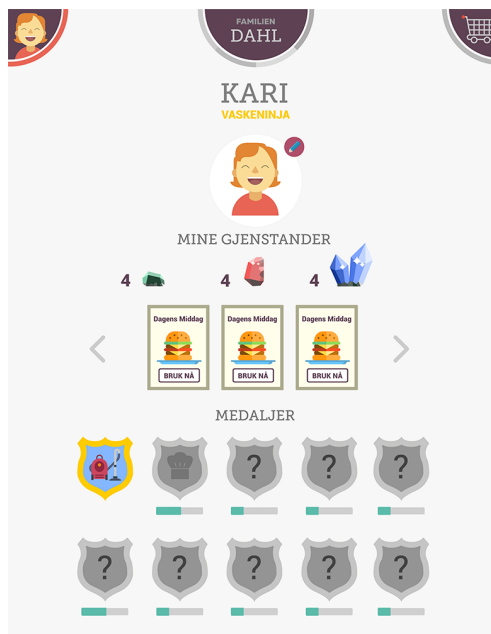


Figure 18.9 Profile

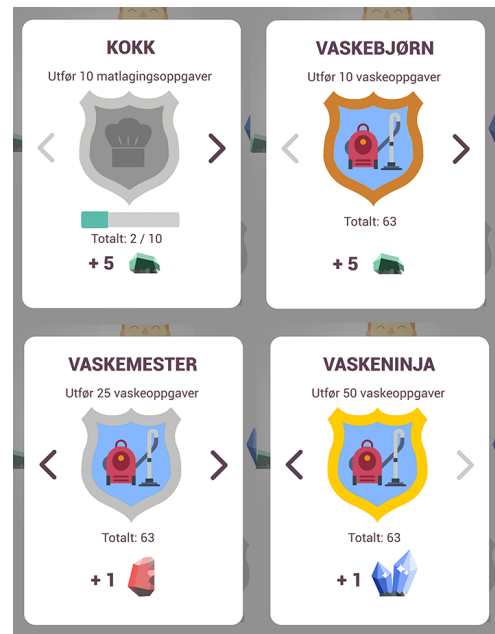


Figure 18.10 The different types of medals

concerning the user interface. As the feedback on the concept was one of the primarily wanted evaluations, three of the six test persons were parents. To make the prototype testing as comfortable as possible for the users a tablet was used with the high fidelity prototype.

18.2.1 Execution

For the test participants to understand what was going to happen during the testing of the prototype a short description of what my Master's Thesis was given. Further, a description of the purpose and concept of the application was introduced. Limitations to the prototype were also explained, as well as that the participant could quit the test at any time. Because this was a test to evaluate the concept the user was asked to explain what was currently observed on the different pages. The following list of tasks represent the objectives in the test (the test begins on the main page):

1. From what you see on the main page, do you think there exists more pages to navigate to?
2. *After navigating to the profile* - What do you believe you see here?
3. Locate the medals and inspect the one which is complete

- (a) *After inspecting medal* - Describe what you see here
 - (b) Find the bronze and silver medal of the same kind
4. *After navigating to the store* - What do you believe you see here?
 - (a) How can you exchange gems to other gems?
 5. How is it possible to navigate to the main page from the store and profile?
 6. *After the reward bag shows up* - What do you believe you see here, and what do you think you have to do with it?

After completing the listed tasks above the testers was asked to give feedback on the application, and especially make examples for improvement, if they thought there were any.

18.2.2 Results and Improvements

In general, every participant was able to use the application as intended. The parents were especially excited about the concept, and the possibilities for making chores more motivating for children. Two of them said that it would be good to have an application like this because the most irritating thing is constantly to remind the children of what they have to do. The last parent said "*It is a genius thing to combine games and housework, where competition also can influence the users*". Everyone also mentioned that once they had tried the application, it was easy to understand every functionality.

Store page

In the store page, several said that the trading overlay had weird logic. They understood what to do, but some stumbled on which way the arrow pointed related to which side the plus and minus were on (since it switches to the other hand when dragging/tapping the arrow). An easy solution to the problem could be to set the plus and minus buttons straight above the switch and not move them at all when the switch is changed. There were few, but still some, which did not completely understand what the cards' function was. Keep in mind that they had not gotten an explanation of the application, just a brief description of the concept of *Mænage*. When they understood that they could click on the cards to inspect them, the cards were instantly interpreted as they should. There were also few who did not understand what some of the card titles meant, and what the icons meant. An easy solution to this could be to have a longer and better title and more representative image for the card. For example, instead of having "*Today's Dinner*" as title, it could have been "*Choose Today's Dinner*".

Profile Page

In the profile page, the avatar and overview of gems were easily understood. A few testers thought that the cards in the profile were cards the user could afford with the number of gems he/she had. This problem could be solved with making a more distinct inventory container for the cards, and by having an appropriate title like "*Bought Cards*". Regarding the medals, one of the testers thought it would be fun to accept the reward manually, so that it is visual for the user, which corresponds to game design theories [52, 43, 82].

The medals overlay was somewhat vague for a few of the testers. For example, it was believed that the user got the number of gems after each point of progress. It was also little visual effects used to enhance the higher level of gems, except the color, and the progress amount should be more clear according to some. To improve this problem the reward could be hidden until the medal is achieved, which would also increase the motivate towards achieving the medals [44, 52, 64, 44, 84]. The visual effects could be simple small star animations, and when the medal is received a screen could present the medal to enhance the memory of getting it [84]. It was also mentioned that the medal overlay should have a cancel button, even thought it was possible to click the gray area around. A simple exit-cross on the top of the box would be sufficient to solve this.

In General

The navigation to the home screen was pretty obvious to many, but a couple of testers mentioned that it would be better with a *Home*-button instead of the one who was present at the prototype. Before the test began, it was said that the participants were *Kari* during the tasks. That said, what was not mentioned was that the testers were logged in as *Kari*. Therefore, some thought the profile button's functionality was to change user but quickly understood that it was the profile when they clicked it. Being presented with the reward bag, illustrated in Section 18.1.1, everyone understood that there was something inside which most certainly was a prize of some sort. They quickly clicked their way through it to receive all the rewards.

In general, the concept was very well accepted, and the testers thought it was a fun and exciting idea. There were some concerns covered during this section, but all the concerns raised are easily fixed. Maybe the most important notes which could be taken from the prototype testing was that the users thought the application was very user-friendly and intuitive, especially after they had been through every element once. Hence, a tutorial explaining the application the first time the

user uses it would be beneficial for the user friendliness.

Chapter 19

Final Solution

In this chapter, the final solution will be described with a primary focus on the changes done from the proposed solution, through the prototype and implementation phase. It will not describe every functionality, only the functionality added after the prototyping phase. It would have been quite repetitive to describe the entire application again, when only minor, and some major changes, have been done after the high fidelity prototype. Three sections will first represent changes which have been done in the three pages of the application, while the last section will describe and discuss changes concerning the proposed solution. A demo video of the final implementation can be viewed at <https://www.youtube.com/watch?v=TEJjmqHiEKY>.

19.1 Changes in the Main Page

There are currently no major changes made to the main page considering the high fidelity prototype. One of the reasons for it was to keep it as similar to the original application as possible. There are however some minor changes which will be illustrated and described. First, there are a couple of textual additions to the goal pool where the progress of the current goal, if any, are represented with numbers. These textual additions will give the user an indication as to how far he/she have left before reaching the goal, and how much progress have been made [43, 82]. The main reasoning for adding the progress with numbers was that several of the prototype testers mentioned that it is difficult to understand exactly how many points they had. A textual feedback is also given if the user does not have any goal set. An indication for not having any set goal was implemented because users were trying to complete multiple tasks without understanding that they did not have any goal. The progress and feedback can be viewed in Figure 19.1 and 19.2.

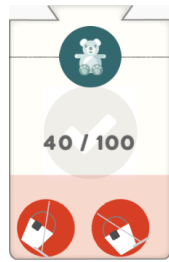


Figure 19.1 Goal progress



Figure 19.2 No goal



Figure 19.3 Main page top

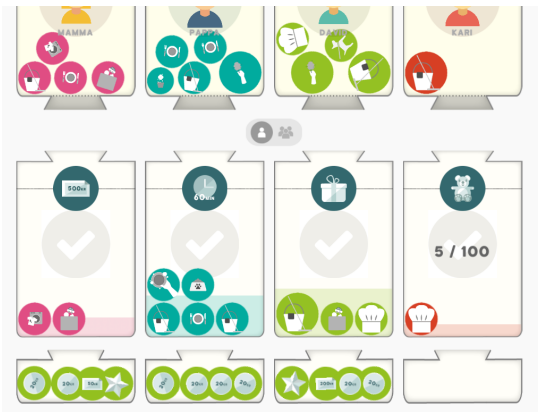


Figure 19.4 Main page bottom

The main page is illustrated in Figure 19.3 and 19.4. Another minor change considering the high fidelity prototype is the reward bag. Sounds and animations have been added here. The reward bag is given when chores are approved, meaning liked, in the application by a parent. Figure 19.5 will illustrate the animation in an image sequence. First, the bag is jumping around to create attention. Furthermore, it does not have the amount or number of completed tasks on it to create more excitement towards what is in it. A text describing what has happened for the bag to appear are visible. Before the first reward is displayed, particles appear, and sound effects will be played. When the gem is fully displayed a "tada" sound is played, and particles continue to appear to give a rewarding feeling. It will also create a positive and fun effect for the user [81, 84]. This second step is repeated for as many tasks have been completed. The last step of Figure 19.5 illustrates the gems received flying to the user's avatar.

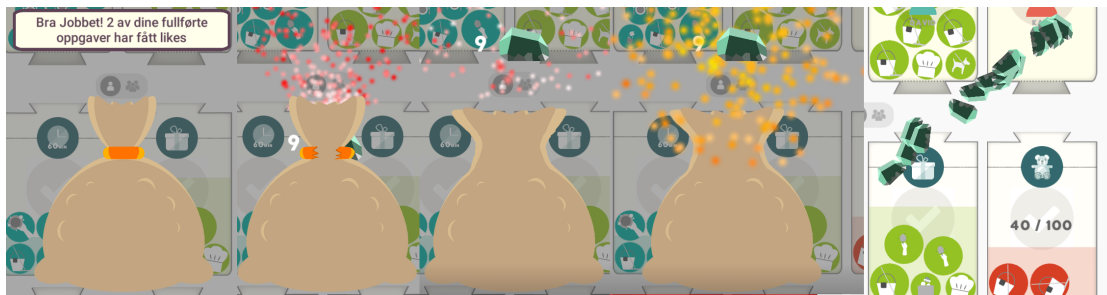


Figure 19.5 The different stages of receiving the reward bag

The last minor change was to remove the possibility to move and complete other than your own chores, to prevent harassment to the other family members using the application. Disabling this possibility is not visible for the user, and everyone still has access to the taskbar on the uppermost part of the page.

19.2 Changes in the Store Page

The store page consists of some minor changes, but it is basically the same as it was in the prototype, except for some changes to the background elements, a new functionality, and some small changes in the trading section. Besides, the scale of the different elements had to be modified to fit the final solution. The largest change was reorganizing elements such that it would fit properly into landscape mode instead of portrait mode. The possibilities for more cards was added, 11 in total. A selection of these are represented in Figure 19.6 and 19.7.



Figure 19.6 Top part of store



Figure 19.7 Variations of cards

A new functionality was also added, namely the possibility to get new cards at once instead of having to wait for the timer to go to zero. To use this functionality

the user has to pay two green gems every time he/she wants new cards. These cards are randomized and will, therefore, create some curiosity. It will also make the user want to log in and see what the new cards are when the timer reaches zero. The timer is set to 24 hours, but could be changed after the application has been tested over a longer period.

In the trade section the feedback received from the prototype testing was implemented so that the trading overlay got a new design illustrated in Figure 19.8.



Figure 19.8 Trading overlay - looks the same for red and blue

Furthermore, the titles of some cards were also changed accordingly to the feedback from the prototype testing. Icons which were more intuitive were also created, for the users to not needing to read the title of the cards.

Another new feature implemented was a visual representation of notifying the user of a newly achieved achievement. When a user has done enough tasks or earned enough points and so on a medal overlay is displaying over the entire screen. This overlay has the same effect as the reward bag previously mentioned. The medal overlay is presented in Figure 19.9. When the overlay is displayed, an achievement sound is played to grab the attention of the user, as well as create a moment the user will not forget. In addition to the sound, particles are used to enhance the feeling of achieving something [84]. Which medal the user gets is unknown to force the user to go to the profile and inspect which medal is earned. This hidden aspect will also create excitement for which medal is received and what the reward is. When the user is presented with the overlay, there is a possibility to go directly to the profile or to continue where the user was. The medal overlay can occur on every page since it is possible to complete medals on every page.

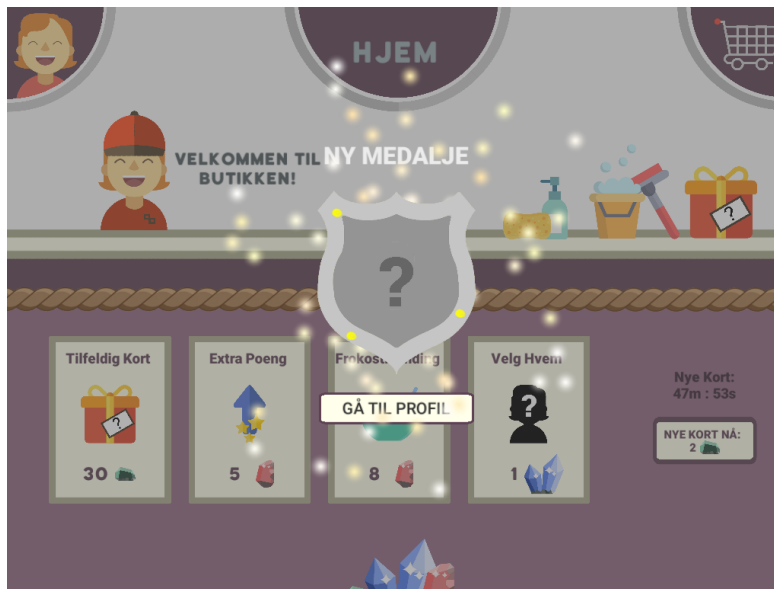


Figure 19.9 Receiving a medal

The last change done on the store page is the navigation menu. The old *home*-button was changed to a button which the user should more easily understand since the old one could be misinterpreted. Since the new *home*-button still has different functionality in the store and profile compared to the main page, it will be easier to understand which are doing what.

19.3 Changes in the Profile Page

The profile page had the most considerable changes related to the visual representation of elements illustrated in Figure 19.10 and 19.11. The changes created more space to display the cards bought from the store. The changes done to the inventory would hopefully make the user understand that these cards are the ones actually owned and not the ones which can be afforded. When cards are utilized, the user has to open the card using the same method as when buying a card. This method creates a security if the user accidentally "used" the card without wanting to. As seen on the store page and the profile page an icon placed in the middle is used to order to inform the users that there is more content below.

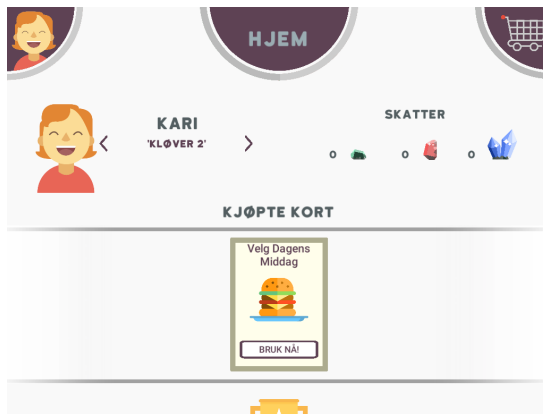


Figure 19.10 Top part of profile

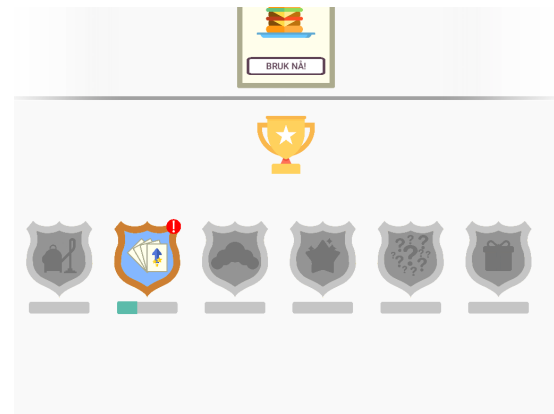


Figure 19.11 Bottom part of profile

The medals represented at the bottom of the page has gotten a notification icon when a stage of it is completed and will disappear when the reward is received. The medals also have an overlay similar to the cards and trading section, which were introduced in the prototype. There are however some minor differences made to this overlay which was implemented after receiving feedback from the prototype. One of these features was to receive the reward gotten from the medal manually. The different stages of receiving the reward are represented in Figure 19.12.



Figure 19.12 Receiving reward from a medal

The reward for medals which are incomplete are unknown, and this will increase the curiosity as well as excitement when the medal is received [64, 85, 84]. All overlays except the new medal overlay also have an exit button (exit-cross in the corner), for people to easily understand how to escape the overlay. Such an addition was also requested from the testers of the prototype. Another statement from the prototype testers was to make the medals shine and make them more decorated. A simple addition by using small star blinks made the medals much more enticing. This animation can be seen in Figure 19.13 where the star animations are at their

biggest. The progress is also easier to understand since it is placed on the progress bar which is filled as the progression develops.



Figure 19.13 Different stages of medals after changes

19.4 Differences from the proposed solution

The proposed solution has a bunch of ideas which sounded straightforward and easy at the time, but not all of them could easily be integrated into the application without making the application too complicated. The primary audience is children, and the functionality should, therefore, be kept to a manageable level. The biggest differences between the proposed solution and the final implementation is listed below.

In the proposed solution the rewards given by the medals should have been gems and points, but after implementing the medals, it was quickly understood that giving points, in addition, would have been too easy to receive the costly rewards, on the main page. Expensive rewards refer to actual money, gifts, and trips.

The chores will not be graded as illustrated in Table 16.2, but will rather be approved with a like from the parents. When parents have passed the chore, the user will get the gems according to the difficulty of the chore. The number of gems given are described in Table 19.1 and should be customizable by the parents.

Amount of points	Gem Type	Amount
1-9p	Green	3
10-19p	Green	6
20-29p	Green	9
30-39p	Green	12
40-50p	Green	15

Table 19.1 Chore difficulty gem reward

The gems received from the chores are not automatically transformed into coins, they are staying as gems and coins are not used at all. The reasoning behind this is that it is much more visual pleasing, as well as receiving the best of something and then it is transformed into something less valuable (even though the total value is the same) can hurt the motivation towards earning it. Even if the application uses gems and points, and not coins, the children will still learn to use a currency and the means of deciding when to use the savings.

The store does not contain puzzles as the proposed solution mentions, and the reasoning behind this decision was as mentioned before that it is yet another complexity level. Moreover, sticking to one type of item should be sufficient in the beginning, and more items can be added during later development.

As it is now, the application does not allow to save more points than the goal in the main page needs; hence the triangulation discussed in Section 16 is not used on the main page. It is however used in the store where the user must decide whether to use gems on random cards, buy cheap cards, or save for the more expensive cards.

There is no directly used leaderboard in the application, however, the badges, and pool level does indirectly work as competitive factors, which the leaderboard's functionality was supposed to be. Implementing a leaderboard is also something which could be done in the future, if necessary.

Feedback in various forms is used in the application. However, more feedback could be implemented, especially in the minor places, for example when using or buying cards.

Chapter 20

Software Architecture

The software architecture of *Mænage Extended* is described in this chapter. The complete structure of the entire application will not be presented, only what has been added to the original *Mænage* application.

20.1 Architecture overview

Since *Mænage Extended* is built upon *Mænage* and for reasons explained earlier a database was chosen not to be used, the architecture will look somewhat different than projects with databases included.

The architectural overview is illustrated in Figure 20.1. The original application is represented as a package called *Mænage* and the other packages in the overview are the scenes in Unity which have been added to the original application. The original application uses controllers to handle the different elements in the application like the different pools and tasks. While "synchronizers" are used to synchronize information with the database through a service which sets up a connection to the *Mænage* database. As the extension was implemented on top of the original application a similar structure to the one already implemented was used, except the "synchronizers", since no database access was used for the extended application. Instead of a database, a temporary class was used to store information like elements in the inventory, gems, and progress for medals. Since every element in a scene is destroyed when another is loaded there was a huge need to store information, which was not predicted to such an extent when the implementation phase started.

The different scenes in the application load the various controllers, which in turn initiates and instantiates every element which should be on stage. These are therefore the main logic parts controlling the different elements, such as cards (card

controller), the reward bag (reward bag controller), and the inventory (inventory controller). Elements such as cards can also be called from the User Interface layer by including direct logic into User Interface elements, which can be stored in Prefabs or directly on stage. Prefabs are reusable parts in Unity. The card element is, for example, a prefab created to be reused multiple places. Figure 20.1 also explains the flow between scenes, as it is possible to navigate to all scenes from the navigation bar on top of every scene. Every scene also takes advantage of the temporary storage as seen in Figure 20.1 represented with double dotted lines.

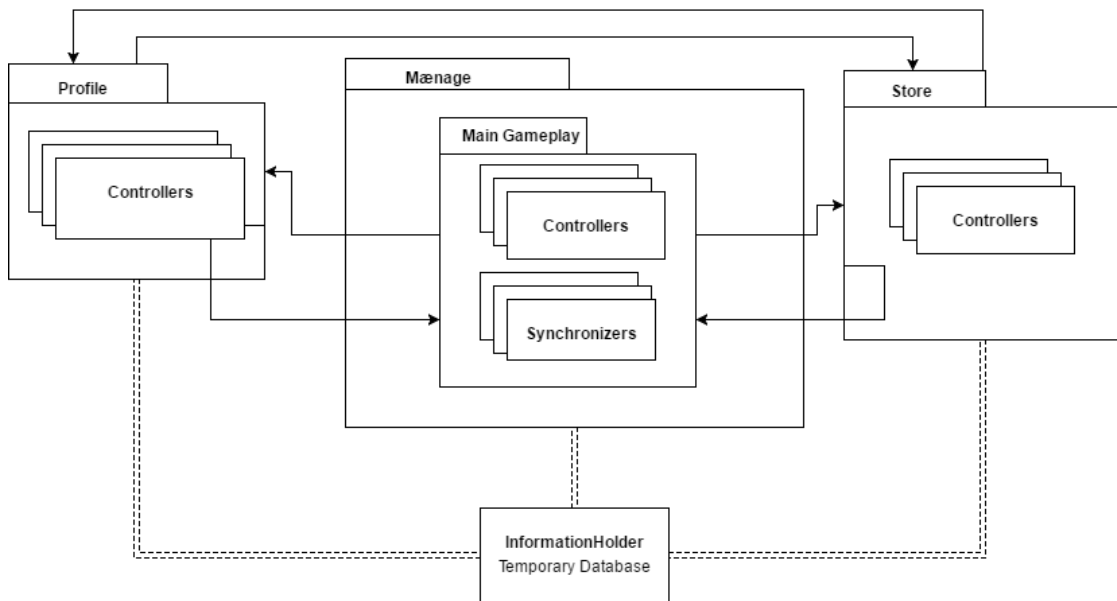


Figure 20.1 Architectural overview of *Manage Extended*

20.2 Class Overview

This section will present a complete overview of the classes used in the project. It will not include classes in *Manage* which were not affected by the extension. The classes which were influenced by the extension are displayed under the *Old Logic* in *Logic*-package illustrated in Figure 20.2

The *Application Logic* illustrates where the most important logic is contained. As mentioned in Section 20.1 each scene holds controllers which initiate the different elements, but logic is also written here, for example, which new card should be given and when a card has been purchased from the store. The controllers in the different scenes are the most important classes, as they control most functionality

not written in the Unity user interface prefabs. In addition to controlling functionality, they also communicate with the local storage *InformationHolder* which saves the information needed when elements are destroyed and needs to be rebuilt later. Note that this is only a temporary storage and the information in it will be deleted when the application is force quit. Some minor changes had to be done to the old logic to update progress, illustrate different amounts to the user, as well as improving the touch possibilities. Finally, the medals had to be given when a certain degree of progress had been made, making these classes indirectly vital for the visual implementation of the application.

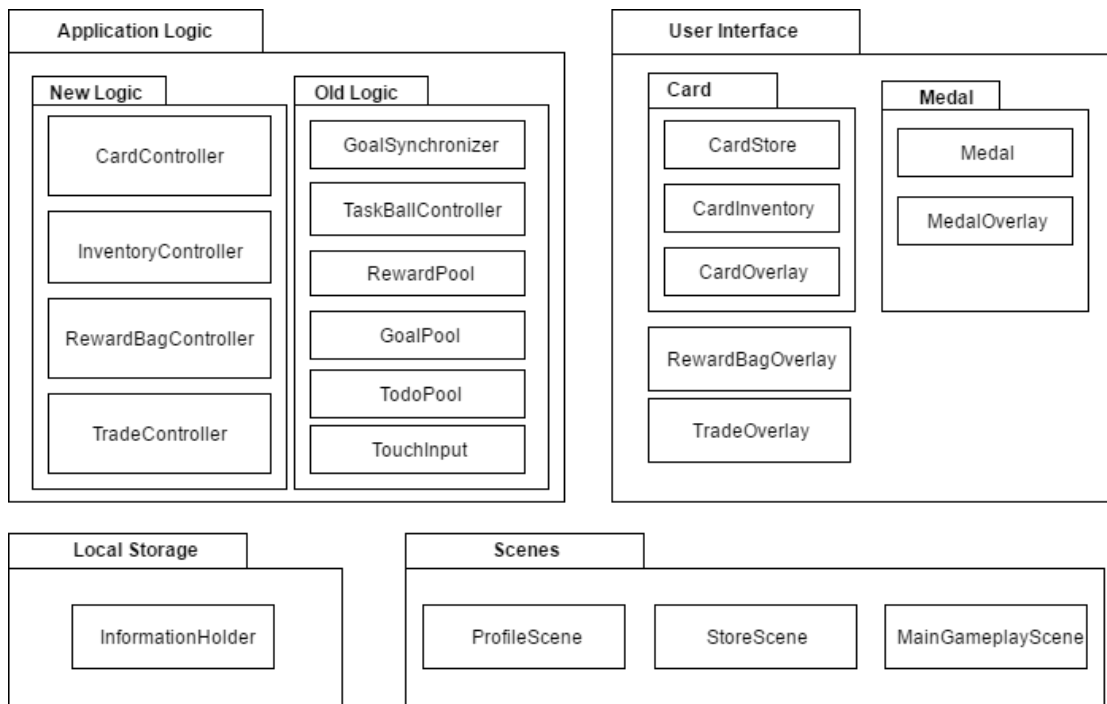


Figure 20.2 Class Overview

The user interface is maybe what is most important to the application. The reasoning for this is because it is the children who need the motivation to do the chores. Although there are barely anything except button logic in the different user interface classes, there do exist logic in the prefabs which the user interface classes represent. For example sound and on click functionality can directly be initiated from the prefabs. Animations connected to the different elements are also initiated in the prefab, but controlled from one of the controllers, making the user interface classes an important channel for the controllers to regulate images, sound, and states.

As mentioned before the local storage *InformationHolder* holds information temporary for the classes to be loaded accurately instead of using a database, as discussed earlier. Examples of the information contained in this class is the number of different types of gems, progress achieved versus progress needed to complete medals, and cards.

The *Scenes*-package are merely included in the diagram to illustrate which scenes are present in the application. There are however a certain amount of information in them, for example, background elements and other static visual elements are placed here. The scenes are also divided into two canvases, the top canvas, and bottom canvas, where the camera are pointed. The navigation bar is for example included in the top canvas.

Chapter 21

Testing

During this chapter, a brief description of the testing approach used is described. The testing method was used to test functionality and other aspects with the application like user friendliness. An overview of the degree of fulfillment related to the different requirements is also described.

21.1 Approach

When the implementation phase was ongoing, the functional requirements were used to keep a set of goals which should be completed to be satisfied with the outcome. The requirements were often divided into smaller tasks, which were tested and approved before continuing to the next task. All these tasks were written on post-its to create a hands-on Kanban board.

By testing the "happy path" for the completed tasks first, and then continuing to try breaking the functionality, it was quickly concluded if the task was finished. Since the application testing was going to be partly "do what you want", special paths was necessary to be tested for the application not to break during the test. Although several special paths were covered, handling all paths would be a task for a larger team than one. As long as the application did not break and did not interrupt the users to a great extent, special paths could be handled to a small completion degree.

The solution was also tested on several people throughout the development process to get quick feedback on functionality which was not included in the prototype. For example, the visual effects and sounds were important to make a complete experience. These test persons were often individuals who had seen the application before and had some relationship to it, to get valuable feedback without having to

explain the entire concept.

The non-functional requirements are hard to test as the development phase progressed. The completeness of these will rather be accordingly to the results of the final application tests.

21.2 Validation of Requirements

This section will describe the validation of the different requirements set earlier in Chapter 17. By using post-its, tasks were easily moved from an incomplete state to a satisfactory tested and complete state. When all the tasks in a requirement were completed, it was easy to see when the requirement was complete. Since there was only one developer, the quality assurance of the completed functional requirement had to be done by the same developer. Even though only one developer was involved, the iterative testing illustrated that the functionality worked as it should. Table 21.1 and Table 21.2 illustrates the completion of the different functional requirements. The remaining paragraphs of this section describe the tables mentioned in more detail. In the end, almost every functional requirement was completed. However, some were not fulfilled. For example, F10; *The application will have a leaderboard*, was not implemented as the application already had badges which could be compared between users, as well as the level of the goal pool in the main page seen in Figure 19.4. These two functions had somewhat the same functionality as the leaderboard, and the leaderboard was therefore put on hold for future work which can be read about in Chapter 29.

F12; *The application will categorize will categorize chores into different difficulties*, was not completely fulfilled as the categories of the chores basically are points between 1-9 (very easy), 10-19 (easy), 20-29 (medium), 30-39 (hard), and 40-50 (very hard). Gems are given with an incremental increase of three in the different categories. Although a more proper solution could have been used, it was easier to add to the solution already created, which was only points between 1-50. These requirements were set to low because they can easily be changed in a later development phase and were not particularly relevant to the motivational parts of the application.

F13-F15 states that users should have individual user accounts, which is not implemented in the current solution. However, it is simulated to a high degree in the final solution. The rest of the functional requirements are fulfilled to a satisfactory extent. That said some of them could always get improvements later, like F5, F9, and F16.

The validation of the non-functional requirements is represented by the results of the final user testing in Chapter V. Since they are primarily directed against the usability of the application, the application had to be tested to make a satisfactory conclusion to whether the non-functional requirements were fulfilled or not. In summary, seven questions were asked during the survey which was directly related to the usability, and all scored at least 80% agreeing with the application being easy to learn and use.

ID	Description	Completion	Comments
F1	The application must have a store screen	C	A store page with cards and the possibility to trade gems. The store could be extended in future development.
F2	The application must have a profile screen	C	A profile page with overview of the resources got as well as the medals and cards owned.
F3	The application must give an extra set of resources (gems)	C	The first resource is points and the second is gems.
F4	The application must have a navigation bar	C	Can be reached on top of every page, with the profile, main page, and store as paths.
F5	The application must have a consistent design and user interface	C	Consistent design is used throughout the application. More colorful background is used in the store to engage the user.
F6	The user should be able to receive rewards manually	C	The user can manually received the reward in the profile page.
F7	The user should be able to trade in between different gems	C	Two different buttons creating the possibility to exchange gems in every way except directly from green to blue and blue to green.
F8	The user should be able to buy cards from the store	C	The user have the option to buy four different cards. Random new cards are given when a countdown is completed, or if a fixed amount of gems are paid.

Table 21.1 Validation of the functional requirements, part 1. In the Completion column: C (Complete), PC (Partly Complete), NC (Not Complete)

ID	Description	Completion	Comments
F9	The application will strive to display visual or textual feedback to the user	PC	Although there are several textual and visual feedback given, there could have been more entertaining feedback, like the reward bag, or the flying gems.
F10	The application will have a leaderboard	NC	a leaderboard is not included to simplify the application for the users. It could be implemented in the family page in the future if a needed.
F11	The application will have fixed values on important elements(points and gems)	C	Random values and features are used in voluntary features of the application, like changing cards, and buying a random card.
F12	The application will categorize chores into different difficulties	PC	The chores have a scale of points, but they are not simplified into categories like originally planned.
F13	The application must have an inventory for every player	PC	The inventory in the final solution is simulated as the individual log in feature is not implemented. However the inventory is fully functional.
F14	Every user should have their own account	PC	Simulated in the final solution. Similar to the requirement above the application needs a individual log in feature.
F15	The application must include individual trophies	PC	Similar to the requirement above the application needs a individual log in feature.
F16	The application must strive to use sound effects to encourage the user	PC	As F9 this could be improved by implementing sound effects in a higher number of elements and features than is done in the final solution.
F17	The application must strive to motivate the users to do chores	C	Medals, visual and textual feedback, cards, gifts, and other motivational factors are used to fulfill this requirement.

Table 21.2 Validation of the functional requirements, part 2. In the Completion column: C (Complete), PC (Partly Complete), NC (Not Complete)

Part V

Execution & Results

This part will present the execution of the final testing, as well as the results from it. First, a detailed description of the different data generation methods will be given, in addition to the circumstances of which the testing took place. Secondly, the results from the interviews, observations, and questionnaires will be presented.

Chapter 22

Execution

During this chapter, a detailed description of the execution will be presented. In addition to a describing the performance of the different data generation methods, this chapter also describes the research context and the participants.

22.1 Research Context and Participants

After contacting the elementary school of Brundalen in Trondheim, the suggestion of coming to them for an application testing was approved by the principal Sidsel Brevig, as well as the leader of the *SFO*-department, Tone Stubban. The primary reasons for testing the application at this school was that my supervisor, Ole Andreas Alsos, already had good connections with the school and had already tested the original application there earlier. In addition, the final testing was going to be conducted during the *SFO*-schedule, which means it would not interrupt any classes or important program planned.

The children going to *SFO* are in between six to ten years old, which suits the audience of the application. It was also requested that the children between eight to ten years old were the wanted participants, as long as they were available. This age range was requested since they often have more experience with technology and contribute to housework. The testing was conducted over two days, the 15th and 16th of May 2017, and the amount of time planned per group was set to be 30 minutes. Since the testing would take 30 minutes, only a limited number of children could test the application over the two days. A total of 22 children participated in the experiment.

By conducting the experiment on children in which I had no connection to, the familiarity bias which often occurs in a Master's Thesis experiments can be ruled

out. That said, there exist several problems with testing an application with children. For example, children often have a far lower sense of concentration and can therefore often become impatient to the formalities with a proper testing. Impatience and the lack of attention were the reasoning for using such a high degree of freedom during the testing, as well as using more visually describing explanations during the brief and in the questionnaire.

22.2 Interview

As a warm up part of the testing, the interviews were simple questions to map the knowledge and contribution related to technology and performing chores at home. But before going through the themes of the interview, the participants were asked if they had participated in user tests before. Regardless if they had been involved previously or not a short introduction, similar to the one used during the prototype testing, were used to explain to the participants how to act during the experiment. Besides, an overview of the different parts of the phases was explained.

As the interview was a semi-structured interview, follow up questions of why/when/how were often used. This part's main functionality was to make the participants feel at ease and map simple information, hence the planned time for it was five minutes. This time could, of course, vary as the participants could have much to say or be concise with their answers.

22.3 Brief

The short brief included general information about how the different pages worked. The brief was going to work as a first-time tutorial often given in applications. First, the participants were introduced to the concept with the application. Secondly, the participants were presented to the test family, the *Vikings*, and the family member of which they were going to be, namely *Kari*. Lastly, a more general explanation of the different pages were explained, for example, what the most important objects were and what was possible with the application. The possibility to obtain medals, buying cards, and distribute, execute and reward chores was explained. Before the next part of the experiment started it was asked if the participants had any questions. The amount of time planned for the brief was 3-5 minutes.

22.4 Observation

As the actual testing of the application was video recorded from above, it was important that the tablet used was to some extent held in the same place. As predicted this led to some problems along the way where participants forgot that the tablet was being video recorded and took the tablet out of the camera area. The participants also forgot about the camera by putting their head below it because of engagement illustrated in Figure 22.1. Even though the children blocked the camera, information was not lost because of the observer, and the audio recording.

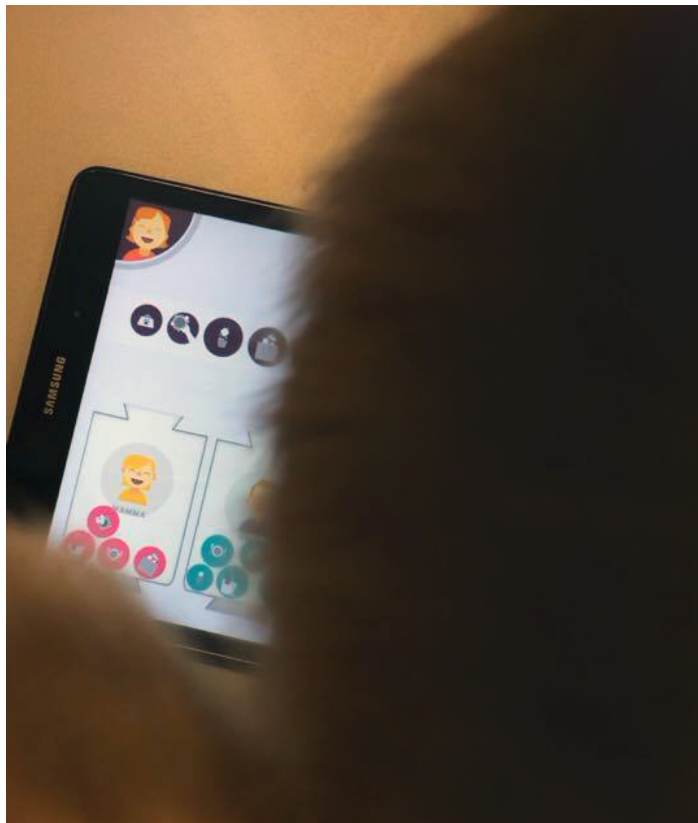


Figure 22.1 Heads of two participants blocking the camera

As mentioned in Section 6.3 the participants were first faced with tasks which would confirm their understanding of the brief given. These tasks are listed below:

1. Give *Kari* a chore.
 - (a) Pretend like you are doing the chore assigned to *Kari*.
2. When the chore is completed set it as complete.

- (a) We are now waiting for the parents to like/approve the chore completed
3. (Reward bag is displayed) If they are not automatically opening the bag: What are you going to do now?
4. Go to the store and see if you have enough rewards to buy a card
 - (a) If yes: buy a card
 - (b) If no: go back to main page and do more chores
5. (When buying card new medal overlay is displayed) What is this? Go to the profile and check which medal has been received.
6. If they do not understand the manual receiving of the reward: Open medal and receive reward.
7. Use the card you just bought.

After the tasks described above had been completed, the participants had full freedom what to do in the application. For those who did not know what to do, a set of tasks were predefined. These tasks were to achieve a silver and gold medal, obtain the blue gem, reach at least one goal in the main page, shoot one or more tasks to the other family members, trade gems at least once, and buy a random card. During the observations, a constant focus was on how and what the participants did, and especially how they reacted to the different effects and rewards. By looking for different reactions like concentration, amusement, anger, and frustration, results from the different generation methods would hopefully give more sense. It would also be easier to specify which functions and effects had the greatest impact on the participants. The amount of time planned for this part was 15 minutes.

22.5 Questionnaire

After the actual testing of the application had been finished, the participants needed to fill out a questionnaire. The questionnaire consisted of a total of 25 questions, two of these were related to gender and age while the others were related to the application. As mentioned in Section 6.3 the questions related to the application would be of a five point Likert Scale [15]. An example of these questions is illustrated in Figure 22.2. Before the participants started filling out the questionnaire, the different parts of it were explained properly. It was also informed that if the test users did not understand words or questions they could ask for help. In addition, information was also given about answering the truth

and not what was expected. The full-size questionnaire can be found in Appendix C. This is the version used when punching in the data, as the questionnaire was performed on paper and the format in Figure 22.2 in the experiment. As mentioned in Section 6.3.3 the questions used in this questionnaire is mainly based on the framework for intrinsic motivation created by Malone and the GameFlow evaluation criteria which relate to rewards [44, 45, 52].

3. Jeg synes appen var gøy å bruke.



Figure 22.2 Example of question from the questionnaire

As mentioned the first two questions were related to gender and age. The next question was a simple question mostly used for the participants to understand how the questionnaire worked in practice. The question is illustrated in Figure 22.2. In addition to working as a test question, it will also contribute to the overall enjoyment of the application.

To get a sense of how the application affected the motivation of the participants five questions were asked related to motivation towards doing chores, and motivation towards interaction with the application. These items can be seen in Table 22.1.

ID	Statement
4	I was motivated to do chores after I tried the application.
5	I was motivated to use the application because of images, lights, and sound.
6	I was motivated to obtain the different medals in the application.
7	I was motivated to earn green/red/blue gems.
8	I was motivated to achieve the goals I had in the application.

Table 22.1 Motivation questions

To establish the enjoyment of the participants of the final testing five questions were asked to find out if the participants enjoyed the game in general and the particular functionality of the application. The questions related to enjoyment can be seen in Table 22.2.

ID	Statement
3	I thought the application was fun to use.
11	I thought it was fun to earn treasures and points.
12	I thought it was fun to achieve goals and medals.
17	I thought the progress towards the goals and medals were obvious.
25	I thought the application was cool and entertaining

Table 22.2 Enjoyment questions

To find the participants' engagement when using the application three questions were asked. These were especially centered around curiosity. The questions related to engagement are displayed in Table 22.3.

ID	Statement
9	I thought it was exciting to see what was in the reward bag.
10	I was so engaged in the application, that I became less aware of my surroundings
13	I was curious what I got when I obtained a medal

Table 22.3 Engagement questions

The usability of the application was found after using the following questions display in Table 22.4. Several of the questions relates to learning how to use and how to find parts of the application, while others go into having easily specific functionality were understood and learned.

ID	Statement
14	I was easily taught how the application worked
15	I thought the application was easy to use
16	I felt in control of my what I was doing in the application
18	It was easy to understand which tasks I had
19	It was easy to find what I was looking for in the application
20	I thought the application was easier to understand after I had used it for a while
21	I understood that the different tasks gave me different rewards

Table 22.4 Usability questions

Lastly, three questions related to if the participant actually would have wanted to use the application after having tested it. These questions are also used to check

whether the answer in the rest of the questionnaire make sense. The questions are displayed in Table 22.5.

ID	Statement
22	I think that the application would be a good tool to use when I do chores
23	If I had the chance I would use this application at home
24	Chores would have been more fun if I had used the application

Table 22.5 General questions

Chapter 23

Results

This chapter presents the different results from the different data generation methods used in the final testing of the application. First, the results from the interview will be displayed. Secondly, the observations are described, and finally, the results from the questionnaires are illustrated with graphs and diagrams. The questionnaire will first and foremost present the data without considering the gender of the participants. In addition, it will also look at differences and similarities between the answers given by the different genders.

23.1 Participants

In total 22 children participated voluntarily in the final testing of *Mænage Extended*. 18 of these children completed the entire experiment while the last four only completed the observation and questionnaire, due to lack of time. The distribution of age and gender can be viewed respectively in Figure 23.1 and Figure 23.2. As mentioned earlier the children ages in the SFO-department are between six and ten years old, so the statistics of having 13 of eight years old, seven of nine years old, and two of ten years old were not surprising.

Fortunately, the amount of males and females were equal which means looking at differences in answers between the genders will become easier. In addition, it will be more likely to give a proper conclusion to whether or not the solution is something encourage and work on both genders.

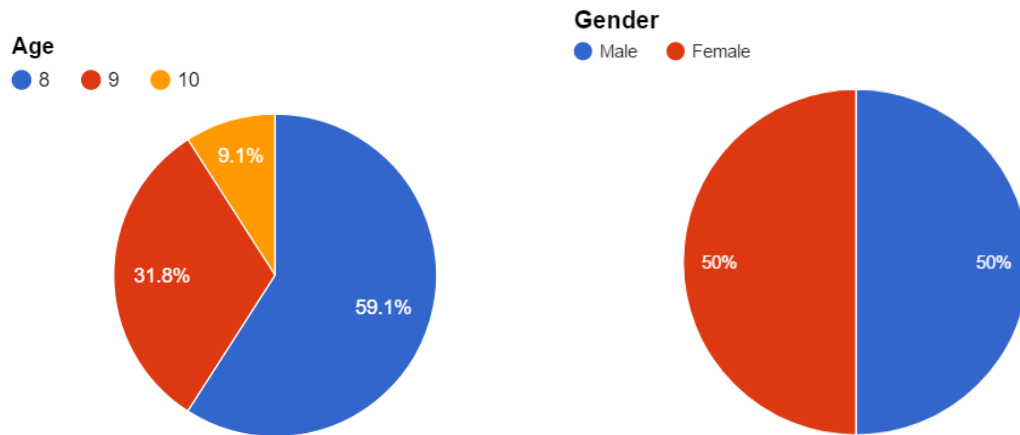


Figure 23.1 Age distribution of participants

Figure 23.2 Gender distribution of participants

23.2 Results from Interview

18 children were in total interviewed in six groups. In general, the results from the interviews were somewhat similar. However, there were outliers which will be described when an overview of the different questions in this section is given.

Q1: Do you do any chores at home to help your parents?

In general, all the children did some chores at home, ranging from cleaning their room, going out with the garbage, helping with dinner or set the table, get the mail, vacuum, and empty the dishwasher. However, one of the children did not do anything to help with the chores. Many of the children did say that doing chores, especially cleaning, was very boring. They also mentioned that they thought chores were boring because it was things they did not want to do. On the other side, a few said that they liked to do chores because they liked when it was clean and neat.

Q2: Do you think it is important to help with the chores? Why/Why not?

Everyone did agree that doing chores was important to help parents. That said there were different follow-up comments on why it was important. The majority understood the consequences of not contributing to clean; namely, the house would become dirty and messy. One group said that it is important to do chores, for the workload to be spread in the family. One girl said "I

clean my room when I am not able to walk into it. I get angry when mom and dad say I need to clean". She did, however, agree with the rest of the group with it being important to help around the house. Another girl said that she likes to do housework and that she always helps around the house. One boy mentioned that he sometimes would shout out as loud as he could because he got angry when the parents told him to do chores.

Q3: Do you do chores just because you get rewarded?

This question raised a lot of different opinions. Many said that they got a reward for doing the chores they had the responsibility for, as well as mentioning that they often helped because sometimes rewards were given. One boy said that he often helped because he knew he had to do it, and when the task was complete time could be spent on more fun and enjoying activities like playing games. There were also a couple of groups which agreed that they sometimes did chores when they got a reward and other times on free will.

Q4: Do you have to do chores even if you do not want to?

Every person interviewed had somewhat the same answer, namely that it did happen that they had to do things when they did not want to.

Q5: Do you use any tools like lists when doing chores, or are your parents just telling you what to do?

There were a wide variety of answers to this question. Two groups did not use lists at all, and they were just told which chores they needed to do. Two other groups used lists when they had many chores to do, especially when there was a lot to do in one day. The last two groups used lists regularly. One girl's family had an overview of the different chores which needed to be done on the computer.

Q6: Do you think chores would be more fun if it would become a game/play?

Every group agreed that it would be more fun to do chores if they were more like a game or play. However, two groups did have a different opinion on whether or not it would be efficient. *"...maybe it would not be as efficient and done the correct way if it was a game"* was the comment from one group, while the other group said *"...and maybe it would take less time"*.

Q7: Do you use tables and smart-phones?

It was no doubt that the participants were familiar and some knowledge of the technologies mentioned in the question. There was, however, a large difference in the amount of time they were using. For example, a girl in

one of the groups said that she owned a smartphone where she often played games. Others in the same group said that they used the computer more often. Children in other groups stated that they did not use tablets and smartphones as often during the summer because they could be outside and practice football or other sports. Some said that they used the tablet at least one hour a day playing games and watching Youtube, while others stated that they only used it a couple of times a week.

Q8: Do you play games? (Tablet/Smart-phone/PC/Console etc)

At least one person in every group played some sort of games on different platforms, ranging from tablets and smartphones to PC and consoles. There were also those children who were not that interested in games, but rather watched videos and surfed the web. The games which were played ranged from simple Snake-like games to Pokémon Go, and First Person Shooters.

23.3 Results from Observation

As mentioned in Section 22.4 the participants had to go through several predefined tasks before being allowed to interact freely with the application. The observations presented in this segment will not be presented as observations of the different tasks given. Observations made by the observer, comments, and feedback from the participants will be presented in regards to which page in the application they were mentioned or observed in.

23.3.1 General

One thing which became apparent quite fast was that the navigation through predefined scrolling length felt unnatural for several participants. One commented that he found the scrolling "*unpleasant*" as he could not control it properly. From observing the participants, several had problems with controlling elements because of the scrolling. The individual issues will be presented in the subsequent sections. Although there were some problems and negative feedback on minor parts, the participants were in general very excited and enjoyed themselves far more than expected. Most groups did not want to continue to the next part of the experiment, the questionnaire, since they wanted to earn a little more gems, and buy the most expensive card. The male participants were, in general, more excited and often forgot to pay attention to where the tablet needed to stay for the camera to record it. That said, some females were far more excited in situations than some males, which will be presented in more detail in Section 23.4. The functionality of the application was easy to understand, as it was evident that the participants knew

its function after doing it once. In Figure 23.3 and 23.4 the participants' eagerness is illustrated as they are trying the different functionality of the application.

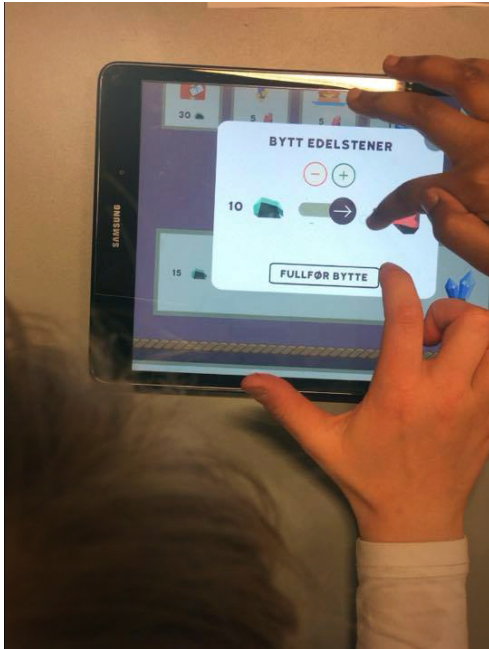


Figure 23.3 Two eager participants

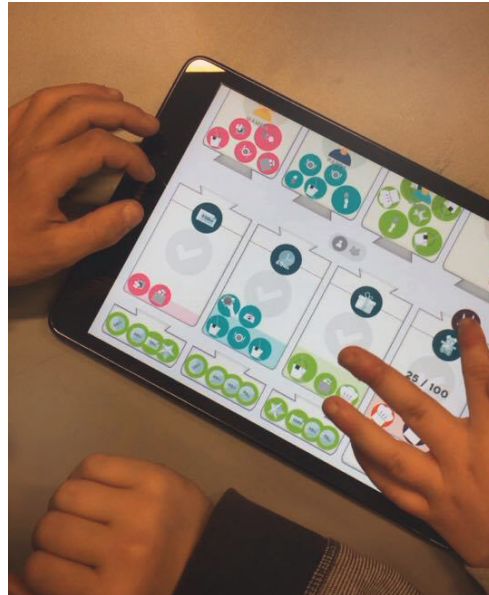


Figure 23.4 Three eager participants

23.3.2 Main Page

The first instance of the scrolling problem started on the main page. The problem was that the participant did not immediately understand that he/she had to scroll down before dragging a task from the todo-pool to the "complete" pool, hence making the situation unpleasant. That said, how to navigate with scrolling was understood fairly quickly, but several participants mentioned it was weird that they could not drag the task to the next pool when they were at the top part of the main page. There were also several participants who thought it was possible to drag the task back to the taskbar to delete it. Others thought they could drag a task when an overlay was displayed to the next level. This flaw could be fixed with making the task small again if dragging is performed. Several of the participants thought it was funny and became competitive when they distributed tasks. They did not want the other family members to achieve as many points and gems as them, hence doing a lot of chores themselves.

What was maybe the most enjoyable and exciting moment for the participants was when they received the reward bag. All the groups consisting of males skipped

quickly through the animation to see what was in it. They, therefore, went almost directly to the flying gems part, which was greeted with a lot of excitement. Several of the boys screamed in excitement and yelled as if they had gotten something of great value. The excitement was especially noticeable when they had done a lot of tasks, and massive amounts of gems flew through the screen. Although the females were not as excited as the males, they were also very excited when receiving gems. They did, however, more often not skip through the stages of opening the reward bag. Both genders did start to skip through a lot of the rewards as they quickly understood that they got gems according to the difficulty of the tasks they did, hence fewer iterations of showing the rewards should be implemented.

23.3.3 Store Page

An element which were not commented on, but which were observed was the number of different gems should have been displayed as part of the navigation bar. The reasoning behind this is because many groups tended to wonder how many gems they had. Although they were enthusiastic and excited when they saw how much they had in store, it became a disturbance in the flow of using the application.

Every group understood the use of resources, meaning the amount of which the cost of the cards related to the amount they had. What was also encountered several times during the observation, was the immediately need to save for the card which had the highest cost. Not many groups did understand the trade button at once but quickly realized how to use it after it was inspected.

What did often occur was that if the participants wanted to trade many gems at once, they exchanged ten at the time, when they could have used the plus and minus functionality. From the observations, it became apparent that the children, in general, had a tendency not to read the titles and text, but merely look at the icons. This observation was backed up quickly when the questions were asked what the cards' function was. More times than not the children answered wrong, or partly wrong. Several of the participants also thought they knew what the medal was when they were wrong.

The card purchased most often was the *"More playtime"* card. Both genders thought this was a valuable card and one of the girls said *"This is so cool!"* when she realized she could use it to get more actual playtime. A boy commented *"Now we are going to mess with them!"* after he bought the *"Choose whom"* card which gives the opportunity to decide who is going to do the worst chore next time. One of the most exciting moment for the participants were when they had the possibility to trade in gems for a big blue gem. In general, it was easy to observe

that having visual appearing resources and using animations to a certain extent had a significant impact on the excitement and engagement of the participants regardless of gender.

23.3.4 Profile Page

The participants quickly understood the different elements of the profile page. The medal themselves looked interesting according to the children, but what seems to be even more important is the reward which they got from it. After the profile had been visited once, it was rarely visited. It was only visited when a new medal was obtained to get the reward from it. This observation may seem to be negative, but since there is less interaction in the profile than it is on the other pages, it is only natural that the test users interact more with the store and the main page. The overlay displayed when a new medal is received raised curiosity towards what it was, and one participant enthusiastically said "*WOW, a new medal!*". Interest was raised towards a number of gems received from the reward when the participants understood that they got gems from obtaining medals.

23.4 Results from Questionnaire

In this section, the values for the different questions described in Section 22.5 will be presented. The descriptive statistics in the following sections has summarized the original five-point Likert Scale into three categories namely *Disagree*, *Neutral*, and *Agree*. If there is a need to see the fully detailed questionnaire results it can be viewed in Appendix E. The reasoning behind summarizing the Likert Scale into three categories was to make the data more distinct and readable. In addition, the data is analyzed relative to the gender of the participants to see if there are major differences between them. The data is represented as a percentage of how many participants answered disagree, neutral, or agree.

23.4.1 Motivation

Table 23.1 describes the statistics related to the *motivation* questions in the questionnaire. In statement four there is a statistical significance between how motivated the different genders were to do chores after they had tried the application. The difference can partly be explained by the differences seen in statement six and seven, which relates to motivation towards obtaining medals and gems. Overall the application seemed to motivate the test users in different ways; hence the functionality implemented works to some extent. As mentioned earlier the two first questions in the questionnaire were related to gender and age, and the third

is represented in the enjoyment section below, hence the reason for the ID to start at four.

ID	Statement	Group	Disagree	Neutral	Agree
4	I was motivated to do chores after I tried the application.	All	18.2%	22.7%	59.1%
		Female	18.2%	36.4%	45.5%
		Male	18.2%	9.1%	72.7%
5	I was motivated to use the application because of images, lights, and sound.	All	4.5%	13.6%	81.9%
		Female	0%	27.3%	72.7%
		Male	9.1%	0%	90.9%
6	I was motivated to obtain the different medals in the application.	All	4.5%	18.2%	77.3%
		Female	9.1%	36.4%	54.5%
		Male	0%	0%	100%
7	I was motivated to earn green/red/blue gems	All	0%	9.1%	90.9%
		Female	0%	18.2%	81.8%
		Male	0%	0%	100%
8	I was motivated to achieve the goals I had in the application	All	9.1%	0%	90.9%
		Female	9.1%	0%	90.9%
		Male	9.1%	0%	90.9%

Table 23.1 Motivation questions results

23.4.2 Enjoyment

In Table 23.2 the questions related to *enjoyment* are presented. The only statistical difference which should be highlighted is in statement 12. This difference can be partly explained with statement six in Table 23.1, where it is clearly more motivating for males to obtain the medals in the application. By looking at the statistics from every participant, it was easily understood that they enjoyed using the application.

23.4.3 Engagement

As seen in Table 23.3 the questions related to the engagement of the application is presented. The statistical difference in statement ten can easily be proved with the observations done because so many males often did not pay as much attentions to the surrounding as the females did.

ID	Statement	Group	Disagree	Neutral	Agree
3	I thought the application was fun to use.	All	0%	0%	100%
		Female	0%	0%	100%
		Male	0%	0%	100%
11	I thought it was fun to earn treasures and points.	All	4.5%	0%	95.4%
		Female	0%	0%	100%
		Male	9.1%	0%	90.9%
12	I thought it was fun to achieve goals and medals.	All	4.5%	9.1%	86.4%
		Female	9.1%	18.2%	72.7%
		Male	0%	0%	100%
17	I thought the progress towards the goals and medals were obvious.	All	0%	9.1%	90.9%
		Female	0%	9.1%	90.9%
		Male	0%	9.1%	90.9%
25	I thought the application was cool and entertaining	All	0%	0%	100%
		Female	0%	0%	100%
		Male	0%	0%	100%

Table 23.2 Enjoyment questions results

ID	Statement	Group	Disagree	Neutral	Agree
9	I thought it was exciting to see what was in the reward bag.	All	0%	0%	100%
		Female	0%	0%	100%
		Male	0%	0%	100%
10	I was so engaged in the application, that I became less aware of my surroundings	All	18.2%	31.8%	50.0%
		Female	36.4%	27.3%	36.4%
		Male	0%	36.4%	63.6%
13	I was curious what I got when I obtained a medal	All	4.5%	27.3%	68.2%
		Female	9.1%	27.3%	63.6%
		Male	0%	27.3%	72.7%

Table 23.3 Engagement questions results

23.4.4 Usability

The usability questions are presented in Table 23.4. There are minor differences which could be highlighted in these questions. First of all statement 15 had a clear difference between males and females. A significantly higher amount of girls agreed that the application was easy to use. The large number could have multiple reasons, but from experience from the observations, it was obvious that the girls paid more attention when the short brief was explained. The boys, on the other hand, were more eager to try the application and test it, which could also answer the minor differences in statement 18 and 20. In general, it seemed like the participants found the application very easy to use and understand.

ID	Statement	Group	Disagree	Neutral	Agree
14	I was easily taught how the application worked	All	4.5%	0%	95.5%
		Female	9.1%	0%	90.9%
		Male	0%	0%	100%
15	I thought the application was easy to use	All	0%	13.6%	86.4%
		Female	0%	0%	100%
		Male	0%	27.3%	72.7%
16	I felt in control of my what I was doing in the application	All	0%	9.1%	90.9%
		Female	0%	9.1%	90.9%
		Male	0%	9.1%	90.9%
18	It was easy to understand which tasks I had	All	0%	9.1%	90.9%
		Female	0%	0%	100%
		Male	0%	18.2%	81.8%
19	It was easy to find what I was looking for in the application	All	0%	18.2%	81.8%
		Female	0%	18.2%	81.8%
		Male	0%	18.2%	81.8%
20	I thought the application was easier to understand after I had used it for a while	All	0%	9.1%	90.9%
		Female	0%	0%	100%
		Male	0%	18.2%	81.8%
21	I understood that the different tasks gave me different rewards	All	4.5%	4.5%	90.9%
		Female	9.1%	0%	90.9%
		Male	0%	9.1%	90.9%

Table 23.4 Usability questions results

23.4.5 General

This section presents the questions related to the application in general, and the results from the questionnaire are displayed in Table 23.5. There are no large statistical differences which need to be highlighted in this category. In general, it seems like both genders see the benefits of using the application, and besides, believes that chores would become more fun if *Maenage Extended* is used.

ID	Statement	Group	Disagree	Neutral	Agree
22	I think that the application would be a good tool to use when I do chores	All	4.5%	9.1%	86.4%
		Female	9.1%	0%	90.9%
		Male	0%	18.2%	81.8%
23	If I had the chance I would use this application at home	All	0%	9.1%	90.9%
		Female	0%	9.1%	90.9%
		Male	0%	9.1%	90.0%
24	Chores would have been more fun if I had used the application	All	4.5%	13.6%	81.8%
		Female	0%	18.2%	81.8%
		Male	9.1%	9.1%	81.8%

Table 23.5 General questions results

Part VI

Discussion

This part will present discussions and further analysis of the results presented in the previous part. An analysis of the research methods used will also be reviewed. A brief assessment of the application is also included. Lastly, a more detailed evaluation of the entire project will be given, including answers to the research questions and project goal.

Chapter 24

Research Methodology Evaluation

Throughout this chapter, a discussion will present the research methodologies used. The triangulation used will also be reviewed, and finally, the factors which could have had an impact on the results are described.

24.1 Methods

During this project, several methods have been used including observations, interviews, and questionnaires. This section will only review the methods employed during the Master's Thesis.

24.1.1 Systematic Observation

Using a systematic observation gives the advantage of discovering what people do, rather than what they say they do, as well as being a great means of collecting considerable amounts of qualitative data. However, there are downsides to using a systematic observation, for example being restricted to studying overt behavior; hence it cannot explain intentions, meanings, and reasons [15]. Using observation when testing applications on children is a great data generation method because so much is said and done by them, especially if they are in groups and encourage each other.

24.1.2 Semi-structured Interview

Interviews also have both advantages and disadvantages. They are good with in-depth information and details, in addition to being flexible. The interviewees often feel at ease as they can freely speak their mind, especially in semi-structured interviews which were used in the experiment in this project. However, they can

be misleading because the interviewee does not necessarily speak the truth or know what he/she does. Besides, they are quite time-consuming with conduction, transcribing, and analyzing [15].

24.1.3 Closed Questionnaire

Questionnaires are quickly completed by participants, in particular with the use of closed questions. Conducting this method is also efficient for the researcher. Nevertheless, questionnaires can have a frustrating effect on some participants leading them not to read questions correctly or not answer at all. Questionnaires also give less detail and information than if proper interviews were held in some situations [15]. Creating questionnaires for children can also lead to misunderstandings regarding words and question types. Questionnaires should also be pre-tested as they can easily contain faults or misleading parts. The questionnaire in this project was approved by one of the supervisors, in addition to being tested on a couple of students.

24.2 Triangulation

The project contained with a certain degree of triangulation. However, using an interview after the questionnaire could improve the level of it, which could have produced more detailed feedback regarding functionality, the questionnaire, and the application in general. After conducting the final testing, it was evident that an additional interview would not necessarily have been a good idea. The participants were already restless after completing the questionnaire, meaning data gotten from the hypothetical interview could have had misleading information.

24.3 Threats to validity

During the final testing, there could have been several factors which could have created data that does not contribute properly to the research questions. For example the fact that the testing period of the experiment only was around 15 minutes. This amount of time does not correctly illustrate how the participants would have used the application in practice, but rather demonstrate the acceptance of the functionality and concept of the application. A longer experiment should be conducted in the future to check whether the application and its functionality work in a more realistic scenario.

The fact that the participants tried the application in groups of two or three

may have made some test users answer the questionnaire in a similar way to the other participants. Similarly, they could have taken each other's side rather than saying their honest opinion. Having more participants could also have contributed to more excitement for the different functionality. However, this does not necessarily have to be a negative factor.

By being video- and audio-recorded in two of the data generation methods used, the participants may have been affected by being recorded. The recording could have led to the test users answering questions and doing tasks the way they thought the observer wanted. However, this was obviously not a big problem since a good majority of the participants were too excited to remember that they were being recorded.

Chapter 25

Result Analysis

In this chapter, the results presented in Part V will be discussed and analyzed. The results will be analyzed in the same categories as they were presented in. The reasoning is, as mentioned earlier, they correspond with the different research questions presented in Section 5.2. Finally, a summary of the results will be given, which will also contribute to a more general understanding of the results.

25.1 Motivation

The questionnaire illustrated that the participants became motivated to do chores, either directly or indirectly by the application. Statement four; *I was motivated to do chores after I tried the application* was the statement which got the worst percentage of agrees in the motivation section with 59% agrees. Females agreed far less with the statement than the males with 46% to 73% respectively. After analyzing the observations, it was the boys who became most excited, hence becoming more motivated, to obtain medals and earn gems, which could have had an effect on the statement above. The excitement is also clearly visible in the statements about achieving medals and collecting gems were 54% and 82% of females agreed with the respective statements, while the males agreed 100% with both statements. It can also be seen in statement five where the 91% of males agreed with being motivated by images, lights, and sounds from the application, while "only" 73% of females agree. Another reason for statement four's values can be because the application only motivated the participants to a certain degree, but they still find chores boring.

I was motivated to achieve the goals I had in the application was the statement which had the most similar percentages between the genders with 91% agrees. The rewards gotten from the primary goals are much more rewarding, and are the main

attraction for doing chores in the application and could, therefore, be the reason for the high amount of agrees. The gems, cards, and medals should not completely overrun the main functionality of the original application. However, they should cover what seems boring with excitement. It looked like the participants felt a high degree of excitement according to observations and results from the questionnaire.

Earning gems and obtaining medals could also be as motivating as the results illustrates because every male answered that they played many different games on different platforms. Therefore knowing that resources often gives you the possibility to buy items, and medals giving the player some reward. In other words, it seemed like the males knew what they got when it was illustrated to them, while many girls did not quite understand it at once.

As the intention of the original application was to create motivation and encourage family members to do chores, it certainly seems like the extension is enhancing these features, by the data received from the experiment.

25.2 Enjoyment

The children that participated in the experiment clearly enjoyed using the application. The majority were very curious of when the application was going to be released, and one even said: *"I'm going to check the featured apps in the app store until it is released."* The enjoyment questions got the best average percentage of agrees from the participants. *I thought the application was fun to use* and *I thought the application was cool and entertaining* were the statements with the best scores with 100% of every participant agreeing with them. These results in addition to the observations done during the testing undoubtedly illustrate that the participants enjoyed using the application, as well as give a good indication of whether the concepts work in practice.

73% of females agreed with *I thought it was fun to achieve goals and medals*. It is not necessarily a low number, but compared to 100% of males agreeing with it, it is a statistical difference. It can be explained with some of the statements from the motivational questions which relates to the same functionality, where only 54% of females agreed. It was also observed that fewer girls were enjoying achieving goals and medals on the same level as males. However, throughout the enjoyment questions, there are only one male and one female which have disagreed with a statement.

With an increase in the level of gamification, the perceived enjoyment of the

participants is clearly at a high level. Especially the use of gems as a secondary resource has truly been a large factor in the enjoyment of the application, which was clearly illustrated in the questionnaire, but even more clear during the observations. Although some participants commented on elements in the application which they thought were strange and weird, it did not jeopardize their total enjoyment of *Mænage Extended*. The elements which got comments were mostly related to usability and will be discussed in Section 25.4.

25.3 Engagement

As mentioned earlier it was very clear from the observations that the participants were engaged on different occasions during the testing, but especially when the reward bag was given. The positive results were also evident from the statement *I thought it was exciting to see what was in the reward bag* where 100% of the children agreed with it. The use of particles and visual entertainment works very well. Even though the visual feedback is not represented to a similar degree in other parts of the application as with the reward bag, it is engaging the users.

I was so engaged in the application, that I became less aware of my surroundings was the statement which got the worst statistics in the questionnaire. The statistics of this statement was rather peculiar, because from the observation the participants were clearly less aware of their surroundings, by not listening to my instructions, putting their head over the camera, and taking the tablet away from the instructed area of recording. What is not peculiar is the amount of agrees and disagrees related between the genders, as the females were obviously less engaged than the males. However becoming highly engaged and less aware of the surroundings could make the users of the application do fewer chores, and more importantly not pay attention to their parents, as experienced during the observations. An example of this was when one of the SFO-employees came into the room and gave some information to the children testing the application at the time. There was no reaction from the children, and the employee had to repeat herself three times before they listened. Therefore balancing the wanted engagement in the users is hard. Testing the application over a longer period would answer questions which relate to the balancing of engagement.

What was a bit of a surprise was the statistics in the last engagement statement; namely, *I was curious what I got when I obtained a medal* where only 64% of females and 73% of males agreed. Besides, 27% from both genders were neutral to the statement. The statistics could have gotten such results from a poorly implemented functionality. When the user gets a new medal, an overlay is displayed

with a question mark on the medal and a button leading the profile as seen in Figure 19.9. The intention of it was to trigger curiosity and lead the users to the medal in the profile and give them the reward there. In addition, the medal's reward is hidden before they are obtained, but these were rarely discovered by the participants. A better way of giving a medal could have been to display the medal received in the overlay, as well as a button saying *Claim reward*. By clicking this button the user could have automatically gotten the reward. Gems could have flown similar to after the reward bag, or the user could automatically be directed to the profile and the medal overlay where they could see in more detail which medal and what reward they got.

25.4 Usability

The usability of an application has a great deal to do with the overall impression with the different concepts and functionalities used in it. The usability of *Mænage Extended* were examined both during observation and questionnaire, where both negative and positive sides were discovered.

Overall the usability questions favored females for reasons given earlier. Only two answers were disagreeing with all the statements related to usability, which gives an excellent indication of whether the application is easy to use and easy to learn.

Even though the statistical results were positive, some comments regarding the usability were made during the observations which could have had an impact for some in the questionnaire. One male commented "*The scrolling is kinda unpleasant*", and after asking him why he responded that it forced him to be in one of two places, hence being distinct and not continuous. Others also commented that the scrolling was sometimes annoying. Besides, a few participants did not immediately understand where to find the different elements in the application. The reasons could be due to lack of information, too few indications of where to go, or bad design of navigation. That said the small things the participants did mention did not have a strong effect on their answers, which could mean that it was not a big deal, and their experience of the entire application was not affected by it.

I though the application was easy to use was the statement which had fewest agrees considering males with 73%. The females on the other side agreed 100% with the statement which partly proves the observation made about the females paying more attention to the brief. Besides, the brief did describe some of the areas the males had problems with. Although the majority of the questions have

the same results, the percentages often lead in favor for females being able to more easily learn the application, as well as the perceived ease of use.

25.5 General

First and foremost the importance of statistical differences should be reviewed. For example, the amount of participants who participated in the observations and questionnaires were only 22 children. When taking into consideration that there were 50-50 with males and females, each person counts 9% in the female and male rows in the tables presented in Chapter 23.4. Looking at differences between the genders 27% does only account for a three-person difference. Nevertheless, it will give a good indication of how the results could have been in a larger scale experiment. In addition, as the majority of questions has an overall result of above 80% of the participant agreeing with the statements it is clear that the test users liked the different aspects of the application. There are of course exceptions to this statement which has been presented in the sections above.

The more general question which was asked in the final part of the questionnaire had a high degree of participants agreeing to the statements. With 91% of the participants agreeing with that they would have used the application at home if they had the chance, concluded with the experiment as a success. Especially, in relationship to the extension enhancing motivation, enjoyment, and engagement towards doing chores. As 82% of the participants additionally agreed with chores would have been more fun if they had used the application, and only 5% disagreed the statistics give an indication of the application working as intended.

Chapter 26

Application Evaluation

In this chapter, the solution created is briefly evaluation. The non-functional requirements are also discussed since they were not evaluated during Section 21.2.

26.1 Design Evaluation

There are definitely improvements which could be done to the design of the application, especially minor differences which could easily be implemented, but also significant changes to the architecture.

The architecture should be restructured so that a database is used to store the different data about the different users. Adding the elements in the extended solution is probably the biggest change which needs to be done for the application to become ready for release. There is also minor functionalities which should have been fixed, for example, the scrolling which annoyed several of the participants in the final testing. A more detailed description of the minor and major improvements are discussed in Chapter 29.

Although there are some changes to the application which needs to be implemented the core foundation of the reward model, clearly introduced elements which the children liked. The pages are fine as they are, but a more smooth transition between them could have been implemented. A feature which has not been discussed as much in the application but which are crucial for the extension to work as intended is the individual log in feature. The original application gave the family members the possibility of messing around with the other's chores and goals. With an individual login, as assumed in this project, the user not only gets more attachment and ownership to the profile/avatar, but also many of the harassment problems detected can be avoided.

26.2 Non-Functional Requirements

There were only two NFRs in this project. *It should not take longer than 5 minutes to learn how to use the system* was the first one. This NFR could only be answered after the final testing were performed. The short brief given before the testing could have helped the participants to learn the application, as there was no first-time tutorial provided in-game. If there were a first-time tutorial it would have given the same information as the brief, if not more information and to a better degree with more illustrations. In addition to observing and checking that the participants used less than 5 minutes to learn the application, the questionnaire supports the claim, since 96% of the participants agreed with the application being easily learned.

The second NFR *The application must have an easy and intuitive navigation system* include not only the navigation system but also that the functionality of the application is intuitive. This NFR are somewhat harder to test than the first NFR, but with the observations done and the data from the questionnaire, the application is clearly intuitive and easy to use. The navigation elements of the application were intuitive based on several questions, but mainly on the *It was easy to find what I was looking for in the application* statement. The data received from this statement had 0% of the participants disagreeing with it, and 82% agreeing. From these statistics, the second NFR is also claimed as fulfilled.

Chapter 27

Evaluation of Project

This chapter will present the fulfillment of research questions as well as the project goal. The fulfillment of the research questions will be described individually, and the project goal will give a more general overview of the results gotten.

27.1 Fulfillment of the Research Questions

After doing the preliminary study in the specialization project, it became apparent that creating a reward model for an application will have a significant effect on the entire system [13]. As the reward model was designed and a prototype of it was made, it became clear that focus had to set on particular user perceptions to get proper results from testing the prototype and the final solution. The perceptions which were focused on were motivation, engagement, and enjoyment. Also, the usability of the application was tested, as it could have an effect on the other user perceptions.

27.1.1 RQ1: How is the user's motivation affected by *Manage Extended*?

In order to motivate the users of the application several theories and game design were examined in the preliminary study seen in Part III. There were sufficient information on how to motivate users, like Malone's framework for intrinsic motivation [44]. For something to be motivating it is important that the elements surrounding it are enjoyed and does engage the user, hence the **RQ1**, **RQ4**, and **RQ5** have a direct connection, as the two latter does affect the first. By using game designs described by several authors the conclusion to implement a higher level of gamification was made by the utilization of an in-game store, an additional form of resource, medals, and the possibility for the users to have more influence

over the family [84, 43, 82, 20, 85]. In addition to using comments and rules from these designs, taking the GameFlow model into consideration when creating the extension ensured that the functionality had the wanted quality [52].

The research question can easily be answered with the results of the experiment. The users' motivation were positively affected by *Mænage Extended*, as a relatively high amount of the participants found the different functionality of the application motivating. Although various elements positively impacted the motivation, it became clear that the motivation of children can only be affected so much by a reward model. What was valuable to observe was the difference in motivation between the female and male participants, where the boys became more motivated by the use of medals and resources. In the future, a larger focus could arguably be on getting the female users as motivated as the males. It should also be mentioned that the application is far from complete, which gives room for increasing motivation towards chores from implementing new functionality. For instance, giving examples for how to execute the different tasks in a more fun and playful way, with the use of timers, role playing, and competition. However, this was not a part of the Thesis and should be investigated further in later development.

27.1.2 RQ2: Which mechanisms used in the application seems to be the most effective form of motivation?

During the observations and questionnaires, it was visible that several of the functionality contributed to enhancing the motivation of the users. However, it seemed like one of the mechanisms had a larger effect on motivation than others, namely the use of a second resource, meaning the gems. It was not necessarily the gems by themselves which created such excitement but the context in which they were implemented, especially how the reward bag got received by the participants. The results from the questionnaire illustrated that having goals in some sort, and having clear goals with progress bars obviously is a good mechanism to use to motivate. Having the possibility to set some of these goals or sub-goals by themselves, as mentioned in the GameFlow model and Malone's framework, will trigger motivation in the user [52, 44]. An example of these sub-goals could be to obtain the most valuable gem, or buying a desired high-value card in the store. It is, however, hard to say with 100% confidence which mechanism have had the greatest effect on motivation since the elements in the game are so intermingled and dependent on each other. In general, it seems like every functionality offers a high amount of motivation as very few disagreed to the different statements related to motivation in the questionnaire.

27.1.3 RQ3: How easy was the *Mænage Extended* to understand and use?

The application introduces a relatively high level of gamification which will also increase the complexity of the application. In addition to having implemented more elements, two addition pages were added to the original application. The results from the questionnaire and observation heavily illustrated the ease of use, and that the application was easily taught. *Mænage Extended* does have some flaws which were pointed out. However, in general, it got excellent feedback related to the usability. As there were only two disagrees in total related to usability questions it is clear that the children found the application easy to use and easy to understand.

27.1.4 RQ4: How is the user's enjoyment affected by the application?

As mentioned the motivation gotten from the application is partly dependent on the user's enjoyment and engagement. It was discovered that using pleasing visual elements were increasing enjoyment [84]. In addition to using an overall consistently design and components which do not interrupt the flow of the game [52, 82, 20]. The flow of the application, in general, were also important, taking into account elements from the GameFlow model like feedback, as well as curiosity and challenge in Malone's framework [44, 52].

From the observed participants and the answered questionnaires it obvious that the user's enjoyment is affected by the application. This is especially proved with 100% of the participants agreeing with the application being fun to use, and additionally being cool and entertaining. That said not every functionality were as successful as others, especially with the female participants. For example, the medals were less enjoying than earning treasures. In conclusion, the user's enjoyment was positively affected by the application.

27.1.5 RQ5: How is the user's engagement affected by the application?

The reward model used in the application focused on creating different types of curiosity for the user by using various elements, such as sounds and images, or descriptions. By setting up the secrets where a user needs to interact with the application and complete chores to uncover these secrets, the users are easily engaged [52, 44]. By using randomness in situations, as well as uncertain multiple goals, the user can engage himself/herself in their wanted goal, which does contribute to

creating enjoyment for a larger user group [44].

The user's engagement was affected by the application, but not to a similar degree to the enjoyment and the motivation. There was, however, parts of the curiosity which scored high, namely the use of the reward bag and what was in it. By combining hidden information with sensory curiosity, the effect is surprisingly powerful, which can be proven with the excitement observed in the final testing, as well as 100% of the participants agreeing that the reward bag was exciting. In general, the participants, especially the females, were split between agreeing with being engaged, being neutral and disagreeing. Similar to the other perceptions, the engagement of users are affected positively.

27.1.6 RQ6: How does *Mænage Extended* contribute to intrinsic motivation?

From the other research questions, it is clear that *Mænage Extended* does enhance the user perceptions indirectly or directly towards doing chores. However, does the functionality in the application contribute to intrinsic motivation? As mentioned in the preliminary study motivation are not divided into intrinsic and extrinsic motivation, but rather a gradient going from one to the other [43]. Also, Malone described intrinsic situations as having three essential parts, namely challenge, fantasy, and curiosity. As mentioned a reward model should not single handily contribute to every essential part, and the focus of this project has been the challenge, and curiosity [44]. The fantasy should not have a foundation in the reward model, but rather the chores, as they are the part which hopefully could become intrinsic. Nevertheless, the reward model should nicely supplement the fantasy.

By providing the user with freedom to being able chose one's action, for example to choices the user can do in the application by buying cards, and determining the goals, as well as making decisions in the family, the application relates to autonomy [55]. Besides, competence is obtained with using the medals as mastery, and relatedness is achieved by competing with the different family members and using cards which interact with the family [55].

The conclusion is that *Mænage Extended* does partly contribute to intrinsic motivation by implementing the different functionality which does have elements from for example Malone's framework for intrinsic motivation. One could argue that the use of extrinsic rewards in the application contradicts the intrinsic intentions [42]. But as most children have less to none intrinsic motivation towards doing chores, setting the objective to be fully intrinsic motivation would be impossible.

The extension *Mænage Extension* is, therefore, a good start for the continuous development towards making chores intrinsic.

27.2 Fulfillment of the Project Goal

Examine perceived user perceptions of an application created to motivate and encourage family members to contribute to chores in the family household. was the project goal of this Thesis. The goal was divided into the research questions which were discussed above. As the final testing gave data and results to confirm that the application enhances the motivation, engagement, and enjoyment of the users, the perceived user perceptions are unquestionably examined. That said a more detailed examination should be performed in future as the study done in this Thesis only gives an indication of what the data will be. The project concludes with the research questions as fulfilled, some more than others, and, therefore, the project goal is also found as fulfilled.

Part VII

Conclusion & Future Work

This final part will conclude the project. A concluding chapter which describes the most important elements of the project is first presented. The last words in this project report will be the future work which should be done to improve the application.

Chapter 28

Conclusion

In this project, a state-of-the-art related to serious games, reward types and systems, motivation, as well as gamification was conducted. By reviewing current research on these subjects and examining five game design books, a reward system was proposed with a foundation based on theories proven through the years.

Additionally, an analysis of the current applications which are related to chores were analyzed. A couple of the most popular game application were also examined to gain extra inspiration. The results from the analysis illustrated a lacking aspect of proper implementation of the reward systems, and a low level of gamification leading to "pointification".

Lastly, the project includes the creation and testing of the prototype, implementing it as an extension to the application *Mænage*, as well as conducting an experiment and analyzing the results from the data generated. The results gotten from the experiment will give an indication of the application's affection towards users related to motivation, engagement, enjoyment, and usability.

The expansion illustrates the strengths of using gamification to increase motivation, enjoyment, and engagement towards tasks, more specifically chores. By testing the application on 22 children, which were the central part of the audience, weaknesses and strengths were discovered. Besides, the usability and the desire to use the application were uncovered.

The results from the user tests gave an indication of how effective gamification can be, hence contributing to the positive use of gamification to motivate, engage, and create enjoying content for children. *Mænage Extended* illustrates that chores can be motivating, engaging, and enjoying for children by the use of a gamified reward model. Additionally, the extension contributes to the fact that for gamification to

properly work the design needs to be well thought through. *Research question 1* asked how the motivation was affected by the implemented solution. The results from the data generation methods illustrated that the solution affected the users' motivation positively. Even though males and females were differently affected by the application according to motivation, the overall perceived motivation was high.

Research question 2 asked which motivational mechanisms were most effective. The results displayed the use of a second resource, the gems, as the most effective form of motivation. It was concluded with that it was not necessarily the gems alone, but the scenarios in which they were used which made them as motivating to obtain. In addition, using visually pleasing elements and sounds as feedback also contributed greatly to motivation.

Research question 3 asked how the usability of the implemented solution was. From the results, it was concluded that the solution was not only easy to use, but easily learned as well.

Research question 4 asked how the user's enjoyment is affected by the application. From the results generated, enjoyment was clearly affected positively by the features of the application. Similar to the motivation the application had different affection to genders in some areas, especially the use of medals where the males had a higher level of enjoyment.

Research question 5 asked how the user's engagement is affected by the proposed solution. In contrast with the motivation and enjoyment of the application, the engagement was overall affecting the users to a relatively lower degree. What was most engaging was the reward bag which directly relates to receiving gems.

Research question 6 asked how *Mænage Extended* provides intrinsic motivation. In general, it was concluded with that the application contributes towards intrinsic motivation, but does not directly create intrinsic motivation. It was also described that the reward model implemented during this Thesis should not single handily help to reach intrinsic motivation because features not implemented yet could better do this.

The *project goal* consisted of testing the different user perceptions towards the extended solution *Mænage Extended*. In this Thesis the motivation, engagement, enjoyment, and perceived usability of users have been examined. The resulting conclusion to the project goal is that the mentioned perceptions have been positively affected by the use of a higher level of gamification than was already used in

the original application *Mænage*. The project has illustrated that it is possible to extend an application with gamification without using a low level of gamification. By using proper game design, mechanisms, and concepts the extended application has succeeded in entertaining, engaging, and motivating children towards doing chores.

Chapter 29

Future Work

During this chapter, the future work which needs to be done related to the feedback gotten from the final testing will be presented. In addition, ideas which could improve the application will also be given. The tasks which need to be done will be displayed as a list, and some of the points in the list will be further described if needed. Lastly, a section on the future work related to testing will be presented. The future work presented in these sections are not a list of everything that needs to be done for the application to be released. It is improvements and additions which could improve the reward model implementations which have been a part of *Mænage Extended*.

29.1 Implementation

In the testing phase, several improvements which need to be fixed were discovered. Some of the improvements are minor details in elements which have already been implemented, and others are significant improvements which are crucial for the extension to work as intended in the future. First, a list of the important improvements are presented:

- Create database entities for the extension elements
- Implement an individual log in feature
- Create possibility for parents to create cards
- Fix scrolling to be continuous instead of distinct

Since I did not have database access, the entities in the extension need to be added to the database set. The individual log in the current extension is only a simulated login, hence this feature needs to be properly implemented. Since the application

is using a website to create chores and add goals, the possibility to customize cards should also be included on this site. The scrolling part was annoying to several participants, hence being categorized as a major improvement. The following list will describe the minor improvements which could be done to improve the application:

- Increase the use of sounds and visual feedback
- Create an overview of gem amounts in the navigation bar
- Change the receive method in reward bag
- Balance values after practical testing
- Drag chores in overlays
- Delete chore by dragging it back to chore bar
- Inspect other profiles
- New medal overlay improvements

The extension, as it is now, have only implemented feedback as sounds and visual elements in certain features, and by including a complete set of sounds and visual feedback the children would have become more engaged. Several of the participants had some problems with finding the gems, and they could, therefore, be displayed in the navigation bar, which is available on top of every page.

As many of the participants in the final testing often skipped through the animations of a majority of the rewards, this feature could be simplified. By only displaying the total amount of gems in three iterations, green, red, blue, the reward bag would be much more simplified and more entertaining for the children. A variation of this could be to automatically transform a tier of gems to a higher tier, if there is enough, to present the rewards as better. This would give a sense of accomplishment.

Since there was not performed a functional testing where the children performed chores over time, the values should be re-balanced after this hypothetical testing period. It should be possible to drag tasks into the next pool while in the chore overlay. By minimizing the chore overlay into the original task, the chore could then be dragged to the next pool. Another improvement is to delete a chore by dragging it back to the chore-bar. When the individual login is implemented, it should also be possible to inspect the other family member's profiles, where motivation towards achieving higher medals and for example tactically using cards

before others could be the case. Since the new badge overlay did not create as much excitement as originally planned, improvements could be made as mentioned in Section 25.3.

29.2 Ideas

After conducting the different data generation methods some ideas came to mind which could further improve the application. For example when a medal is received the user's avatar can change clothes related to what the title is. An example could be if the title was *Washing Ninja* the avatar could have clothes like a ninja with a vacuum machine on the headband. These customizations would increase the freedom of the user, and as well increasing the visual pleasing by customization.

Another idea which had not been thought of before was an overview of which cards are active in the family and who has activated them. The family page which was illustrated in the original application could have had this feature. By using this, overview the family could easily see who is going to choose the dinner, desert, or other cards.

Lastly, by using the family page more, there could also be implemented the leaderboard which was considering user statistics originally thought about in the proposed solution. The leaderboard would increase the relatedness of the application hence the application would have another feature of interaction with the family members.

29.3 Testing

As the testing done during this project did not account for practical testing scenarios, due to time limitations, a more general testing situation should be created where several families take the application home and use it for a defined amount of time. The feedback from these families would make it possible to see if the effects of motivation, enjoyment, and engagement have the same effect over a longer period. Also, the testing done in this project did only focus on the elements of the reward model, and not nearly enough on the rest of the application for it to be released in any form, except maybe a closed alpha version.

Bibliography

- [1] Mobile and tablet internet usage exceeds desktop for first time worldwide. <http://gs.statcounter.com/press/mobile-and-tablet-internet-usage-exceeds-desktop-for-first-time-worldwide>. Accessed from world wide web: 29-05-2017.
- [2] How people use their devices - what marketers need to know. <https://storage.googleapis.com/think/docs/twg-how-people-use-their-devices-2016.pdf>. Accessed from world wide web: 29-05-2017.
- [3] Lasse Hakulinen, Tapio Auvinen, and Ari Korhonen. Empirical study on the effect of achievement badges in trakla2 online learning environment. In *Learning and Teaching in Computing and Engineering (LaTiCE), 2013*, pages 47–54. IEEE, 2013.
- [4] M Ross. Case study: Math teacher uses gamification to help at-risk students succeed, 2010.
- [5] Edward L Deci and Richard M Ryan. Facilitating optimal motivation and psychological well-being across life’s domains. *Canadian Psychology/Psychologie canadienne*, 49(1):14, 2008.
- [6] A Grant and J Singh. The problem with financial incentives and what to do about it. *Knowledge@ Wharton*, Retrieved from: <http://knowledge.wharton.upenn.edu/article.cfm>, 2011.
- [7] Norsk mediebarometer 2015. https://www.ssb.no/kultur-og-fritid/artikler-og-publikasjoner/_attachment/262805?_ts=159b78419c8. Accessed from world wide web: 30-05-2017.
- [8] Sebastian Deterding, Dan Dixon, Rilla Khaled, and Lennart Nacke. From game design elements to gamefulness: defining gamification. In *Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments*, pages 9–15. ACM, 2011.

- [9] Ian Bogost. Why gamification is bullshit 2. *The gameful world: Approaches, issues, applications*, 65, 2015.
- [10] Eva Bernhardt, Turid Noack, and Torkild Hovde Lyngstad. Shared housework in norway and sweden: advancing the gender revolution. *Journal of European Social Policy*, 18(3):275–288, 2008.
- [11] Tidene skifter 1971-2010. <https://www.ssb.no/a/publikasjoner/pdf/sa125/sa125.pdf>. Accessed from world wide web: 30-05-2017.
- [12] Anne Berit Kigen Bjerling, Marikken Høiseth, and Ole Andreas Alsos. Gamification and family housework applications. In *International Conference on Entertainment Computing*, pages 209–223. Springer, 2015.
- [13] Morten Kartevoll. Making household tasks fun with gamification and reward systems. Master’s thesis, Norwegian University of Technology and Science, 2016.
- [14] Victor R Basili. Software modeling and measurement: the goal/question/metric paradigm. 1992.
- [15] Briony J Oates. *Researching information systems and computing*. Sage, 2005.
- [16] Federico Lozano. Design thinking - has taken the world by storm. <http://pracademy.co/designthinking/>. Accessed from world wide web: 12-12-2016.
- [17] Jakob Nielsen. *Usability engineering*. Elsevier, 1994.
- [18] Dag Svanæs. Brukskvalitetstesting. *Slides from ItsLearning*, IT3402 NTNU, 2015.
- [19] Mansureh Kebritchi, Atsusi Hirumi, and Haiyan Bai. The effects of modern mathematics computer games on mathematics achievement and class motivation. *Computers & education*, 55(2):427–443, 2010.
- [20] Katie Salen and Eric Zimmerman. *Rules of play: Game design fundamentals*. MIT press, 2004.
- [21] Terry Bossomaier. *Serious Games and Gaming*, pages 201–232. Springer Netherlands, 2015.
- [22] Mikael Johannesson Susi, Tarja and Per Backlund. Serious games - an overview. Technical report, University of Skövde, Sweden, 2007.

- [23] David R. Michael and Sandra L. Chen. Serious games: Games that educate, train, and inform. *Muska & Lipman/Premier-Trade*, 2005.
- [24] Kevin Corti. Game-based learning: a serious business application. *Informe de PixelLearning*, 34(6):1–20, 2010.
- [25] Mikael Zyda. From visual simulation to virtual reality to games. *IEEE Computer*, 38(9):25–32, Sept 2010.
- [26] Elizabeth A. Boyle Ewan MacArthur Thomas Hainey Connolly, Thomas M. and James M. Boyle. A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education*, 59(2):661–686, 2012.
- [27] Jean Ecalle Girard, C. and Annie Magnan. Serious games as new educational tools: how effective are they? a metaanalysis of recent studies. *Journal of Computer Assisted Learning*, 29(3):207–219, 2013.
- [28] Meihua Qian and Karen R Clark. Game-based learning and 21st century skills: A review of recent research. *Computers in Human Behavior*, 63:50–58, 2016.
- [29] Kurt Squire and Henry Jenkins. Harnessing the power of games in education. *Insight*, 3(1):5–33, 2003.
- [30] Alf Inge Wang. The wear out effect of a game-based student response system. *Computers & Education*, 82:217–227, 2015.
- [31] Alf Inge Wang, Aleksander Aanesl Elvemo, and Vegard Gannes. Three social classroom applications to improve student attitudes. *Education Research International*, 2014, 2014.
- [32] Susanne M Jaeggi, Martin Buschkuhl, John Jonides, and Walter J Perrig. Improving fluid intelligence with training on working memory. *Proceedings of the National Academy of Sciences*, 105(19):6829–6833, 2008.
- [33] Tilo Strobach, Peter A Frensch, and Torsten Schubert. Video game practice optimizes executive control skills in dual-task and task switching situations. *Acta psychologica*, 140(1):13–24, 2012.
- [34] Joaquin A Anguera, Jacqueline Boccanfuso, James L Rintoul, Omar Al-Hashimi, Farhoud Faraji, Jacqueline Janowich, Eric Kong, Yudy Larraburo, Christine Rolle, E Johnston, et al. Video game training enhances cognitive control in older adults. *Nature*, 501(7465):97–101, 2013.

- [35] Hadi Kharrazi, Anthony Faiola, and Joseph Defazio. Healthcare game design: behavioral modeling of serious gaming design for children with chronic diseases. In *International Conference on Human-Computer Interaction*, pages 335–344. Springer, 2009.
- [36] Clifford Stoll. *High tech heretic: Reflections of a computer contrarian*. Anchor, 2000.
- [37] Kurt Squire and Constance Steinkuehler. Meet the gamers. *Library journal*, 130(7):38–41, 2005.
- [38] Alice Mitchell and Carol Savill-Smith. The use of computer and video games for learning: A review of the literature. 2004.
- [39] Michael Totty. Business solutions: Better training through gaming. *The Wall Street Journal*, 6, 2005.
- [40] What is a kahoot? <http://blog.getkahoot.com/post/58906886260/what-is-a-kahoot>. Accessed from world wide web: 12-12-2016.
- [41] Kahoot! is gamifying the classroom. <http://www.wired.co.uk/article/kahoot-gaming-education-platform-norway>. Accessed from world wide web: 12-12-2016.
- [42] Mark R Lepper and David Greene. The hidden costs of rewards, 1978.
- [43] Jesse Schell. *The Art of Game Design: A book of lenses*. CRC Press, 2014.
- [44] Thomas W Malone. Toward a theory of intrinsically motivating instruction. *Cognitive science*, 5(4):333–369, 1981.
- [45] Thomas W Malone. What makes things fun to learn? heuristics for designing instructional computer games. In *Proceedings of the 3rd ACM SIGSMALL symposium and the first SIGPC symposium on Small systems*, pages 162–169. ACM, 1980.
- [46] Daniel E Berlyne. Structure and direction in thinking. 1965.
- [47] Jean Piaget and Margaret Cook. *The origins of intelligence in children*, volume 8. International Universities Press New York, 1952.
- [48] Mihaly Csikszentmihalyi. Flow and the psychology of discovery and invention. *New Yprk: Harper Collins*, 1996.

- [49] Marc Vass, John M Carroll, and Clifford A Shaffer. Supporting creativity in problem solving environments. In *Proceedings of the 4th conference on Creativity & cognition*, pages 31–37. ACM, 2002.
- [50] Morgan Jennings. Theory and models for creating engaging and immersive ecommerce websites. In *Proceedings of the 2000 ACM SIGCPR conference on Computer personnel research*, pages 77–85. ACM, 2000.
- [51] Brad Kane. Postcard from gdc 2003: 34 ways to put emotions into games. *Gamasutra, March*, 8, 2003.
- [52] Penelope Sweetser and Peta Wyeth. Gameflow: a model for evaluating player enjoyment in games. *Computers in Entertainment (CIE)*, 3(3):3–3, 2005.
- [53] Burrhus Frederic Skinner. *Science and human behavior*. Simon and Schuster, 1953.
- [54] BF Skinner. *The behavior of organisms: an experimental analysis*. 1938.
- [55] Richard M Ryan and Edward L Deci. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American psychologist*, 55(1):68, 2000.
- [56] Kai Huotari and Juho Hamari. Defining gamification: a service marketing perspective. In *Proceeding of the 16th International Academic MindTrek Conference*, pages 17–22. ACM, 2012.
- [57] Jane McGonigal. *Reality is broken: Why games make us better and how they can change the world*. Penguin, 2011.
- [58] Janna Quitney Anderson and Harrison Rainie. *Gamification: Experts Expect 'Game Layers' to Expand In the Future, With Positive and Negative Results*. Pew Internet & American Life Project, 2012.
- [59] Ian Schreiber and B Brathwaite. Challenges for game designers. 2008.
- [60] Byron Reeves and J Leighton Read. *Total engagement: How games and virtual worlds are changing the way people work and businesses compete*. Harvard Business Press, 2013.
- [61] Ashton Anderson, Daniel Huttenlocher, Jon Kleinberg, and Jure Leskovec. Steering user behavior with badges. In *Proceedings of the 22nd international conference on World Wide Web*, pages 95–106. ACM, 2013.

- [62] Zachary Fitz-Walter, Dian Tjondronegoro, and Peta Wyeth. Orientation passport: using gamification to engage university students. In *Proceedings of the 23rd Australian Computer-Human Interaction Conference*, pages 122–125. ACM, 2011.
- [63] Ian Bogost. The rhetoric of video games. *The ecology of games: Connecting youth, games, and learning*, pages 117–140, 2008.
- [64] Hao Wang and Chuen-Tsai Sun. Game reward systems: gaming experiences and social meanings. In *Proceedings of DiGRA 2011 Conference: Think Design Play*, pages 1–12, 2011.
- [65] Emily Brown and Paul Cairns. A grounded investigation of game immersion. In *CHI'04 extended abstracts on Human factors in computing systems*, pages 1297–1300. ACM, 2004.
- [66] Randy J Pagulayan, Kevin Keeker, Dennis Wixon, Ramon L Romero, and Thomas Fuller. User-centered design in games. 2002.
- [67] Melissa A Federoff. *Heuristics and usability guidelines for the creation and evaluation of fun in video games*. PhD thesis, Citeseer, 2002.
- [68] Ruth Formanek. Why they collect: Collectors reveal their motivations. *Interpreting objects and collections*, pages 327–335, 1994.
- [69] Wowprogress - achievement points rankings. <http://www.wowprogress.com/apoints/>. Accessed from world wide web: 15-11-2016.
- [70] Byron Reeves and Clifford Nass. *How people treat computers, television, and new media like real people and places*. CSLI Publications and Cambridge university press Cambridge, UK, 1996.
- [71] Cheryl Campanella Bracken, Leo W Jeffres, and Kimberly A Neuendorf. Criticism or praise? the impact of verbal versus text-only computer feedback on social presence, intrinsic motivation, and recall. *Cyberpsychology & behavior*, 7(3):349–357, 2004.
- [72] World of warcraft: Legion cinematic trailer. <http://eu.battle.net/wow/en/legion/>. Accessed from world wide web: 23-11-2016.
- [73] Neal Hallford, Jana Hallford, and Andre LaMothe. *Swords and Circuitry: A Designer's Guide to Computer Role-Playing Games*. Premier Press, Incorporated, 2001.

- [74] Nicole Lazzaro and Kevin Keeker. What's my method?: a game show on games. In *CHI'04 Extended Abstracts on Human Factors in Computing Systems*, pages 1093–1094. ACM, 2004.
- [75] Penelope Sweetser, Daniel Johnson, Jane Sweetser, and Janet Wiles. Creating engaging artificial characters for games. In *Proceedings of the second international conference on Entertainment computing*, pages 1–8. Carnegie Mellon University, 2003.
- [76] Steve Cornett. The usability of massively multiplayer online roleplaying games: designing for new users. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, pages 703–710. ACM, 2004.
- [77] Peter Vorderer, Tilo Hartmann, and Christoph Klimmt. Explaining the enjoyment of playing video games: the role of competition. In *Proceedings of the second international conference on Entertainment computing*, pages 1–9. Carnegie Mellon University, 2003.
- [78] Chuen-Tsai Sun, Holin Lin, and Chheng Hong Ho. Sharing tips with strangers: Exploiting gift culture in computer gaming. *CyberPsychology & Behavior*, 9(5):560–570, 2006.
- [79] Brian Sutton-Smith. *The ambiguity of play*. Harvard University Press, 2009.
- [80] Anne Berit Kigen Bjerling. Design av digital applikasjon for å motivere familier til å gjøre husarbeid i fellesskap. Master's thesis, Norwegian University of Technology and Science, 2015.
- [81] Alf Inge Wang and Andreas Lieberoth. The effect of points and audio on concentration, engagement, enjoyment, learning, motivation, and classroom dynamics using kahoot! In *Proceedings From the 10th European Conference of Game Based Learning*. Academic Conferences and Publishing International Limited, 2016.
- [82] Tracy Fullerton. *Game design workshop: a playcentric approach to creating innovative games*. CRC press, 2014.
- [83] Nick Yee. Eq: The virtual skinner box. <http://www.nickyee.com/hub/home.html>. Accessed from world wide web: 12-12-2016.
- [84] Scott Rogers. *Level Up! The guide to great video game design*. John Wiley & Sons, 2014.
- [85] Karl M Kapp, Lucas Blair, and Rich Mesch. *The gamification of learning and instruction fieldbook: Ideas into practice*. John Wiley & Sons, 2014.

- [86] Homey. <http://www.homeyapp.net/>. Accessed from world wide web: 12-12-2016.
- [87] Ourhome is your home made easy. <http://ourhomeapp.com/>. Accessed from world wide web: 12-12-2016.
- [88] Margaret Robertson. Cant play, wont play. <http://hideandseek.net/2010/10/06/cant-play-wont-play/>. Accessed from world wide web: 23-11-2016.

Appendices

Appendix A: Figures

.1 Malones Framework for intrinsic motivation

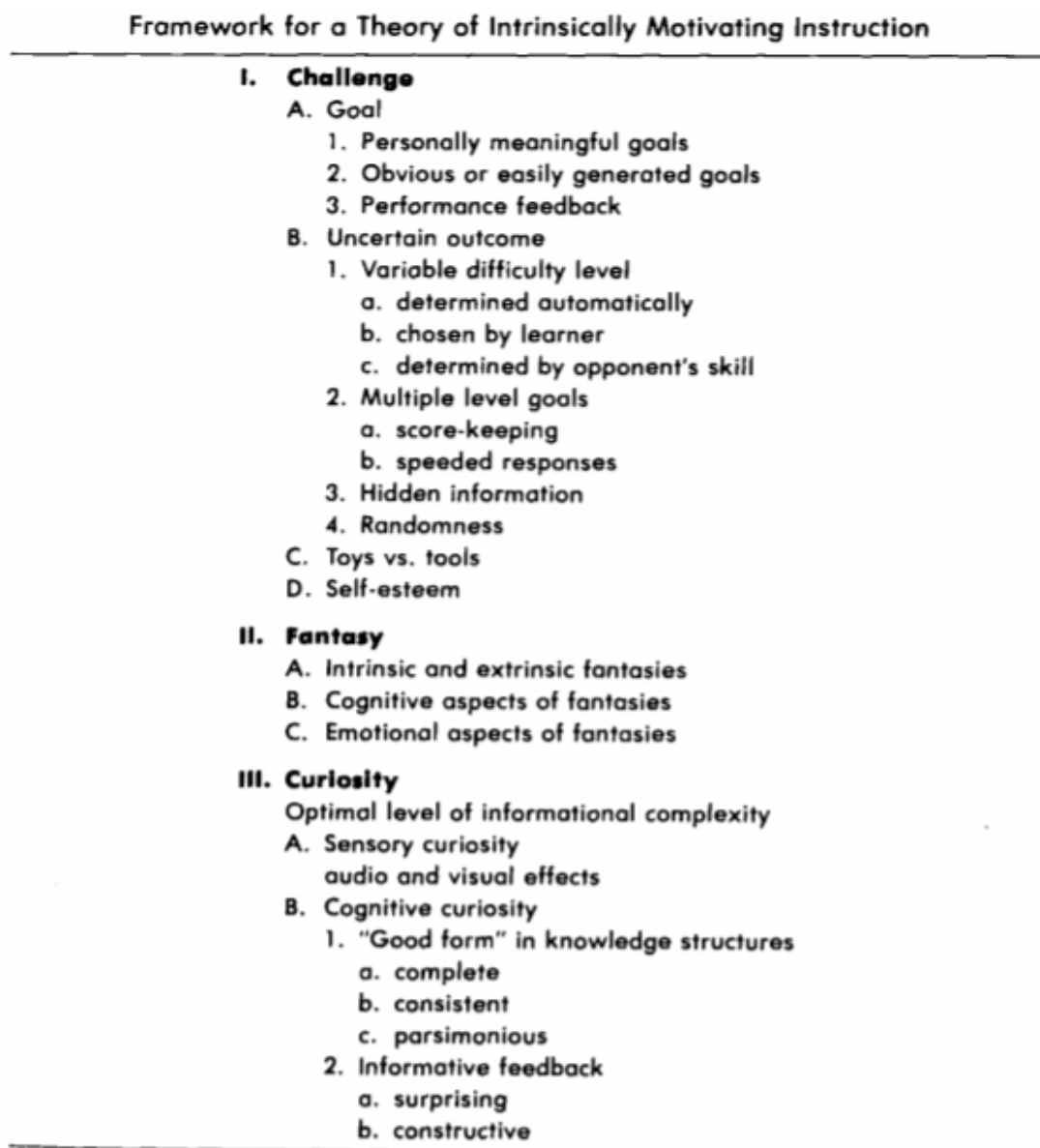


Figure 1 Malone's Framework for intrinsic motivation. Taken from [44]

.2 GameFlow evaluation criteria

Table II. GameFlow Criteria for Player Enjoyment in Games



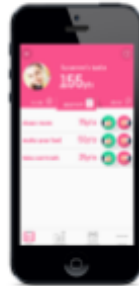



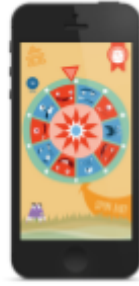

Element	Criteria
<p>Concentration Games should require concentration and the player should be able to concentrate on the game</p>	<ul style="list-style-type: none"> - games should provide a lot of stimuli from different sources - games must provide stimuli that are worth attending to - games should quickly grab the players' attention and maintain their focus throughout the game - players shouldn't be burdened with tasks that don't feel important - games should have a high workload, while still being appropriate for the players' perceptual, cognitive, and memory limits - players should not be distracted from tasks that they want or need to concentrate on
<p>Challenge Games should be sufficiently challenging and match the player's skill level</p>	<ul style="list-style-type: none"> - challenges in games must match the players' skill levels - games should provide different levels of challenge for different players - the level of challenge should increase as the player progresses through the game and increases their skill level - games should provide new challenges at an appropriate pace
<p>Player Skills Games must support player skill development and mastery</p>	<ul style="list-style-type: none"> - players should be able to start playing the game without reading the manual - learning the game should not be boring, but be part of the fun - games should include online help so players don't need to exit the game - players should be taught to play the game through tutorials or initial levels that feel like playing the game - games should increase the players' skills at an appropriate pace as they progress through the game - players should be rewarded appropriately for their effort and skill development - game interfaces and mechanics should be easy to learn and use
<p>Control Players should feel a sense of control over their actions in the game</p>	<ul style="list-style-type: none"> - players should feel a sense of control over their characters or units and their movements and interactions in the game world - players should feel a sense of control over the game interface and input devices - players should feel a sense of control over the game shell (starting, stopping, saving, etc.) - players should not be able to make errors that are detrimental to the game and should be supported in recovering from errors - players should feel a sense of control and impact onto the game world (like their actions matter and they are shaping the game world) - players should feel a sense of control over the actions that they take and the strategies that they use and that they are free to play the game the way that they want (not simply discovering actions and strategies planned by the game developers)

Figure 2 GameFlow evaluation criteria, part 1. Taken from [52]

Clear Goals Games should provide the player with clear goals at appropriate times	<ul style="list-style-type: none"> - overriding goals should be clear and presented early - intermediate goals should be clear and presented at appropriate times
Feedback Players must receive appropriate feedback at appropriate times	<ul style="list-style-type: none"> - players should receive feedback on progress toward their goals - players should receive immediate feedback on their actions - players should always know their status or score
Immersion Players should experience deep but effortless involvement in the game	<ul style="list-style-type: none"> - players should become less aware of their surroundings - players should become less self-aware and less worried about everyday life or self - players should experience an altered sense of time - players should feel emotionally involved in the game - players should feel viscerally involved in the game
Social Interaction Games should support and create opportunities for social interaction	<ul style="list-style-type: none"> - games should support competition and cooperation between players - games should support social interaction between players (chat, etc.) - games should support social communities inside and outside the game

Figure 3 GameFlow evaluation criteria, part 2. Taken from [52]

Appendix B: Bjering's application analysis [80]

PRODUKT	BESKRIVELSE	BRUKER	BRUK	PEDAGOGISK DESIGN
 YOU RULE CHORES Opposite Inc	<p>"You Rule is a powerful chore management app that gives parents ultimate control over family productivity while transforming kids into happy chore-doing maniacs."</p>	<p>Barn er hovedbruker, alder 5-11 år. En forelder er dommer. Opptil 6 søsken kan delta.</p> 	<p>Starter med guide til hvordan bruke appen. Barna velger en karakter som utvikles etter hvert som de gjør oppgaver. Forelder godkjenner at oppgavene er gjort og kan gi ut belønning.</p>	<p>Hybrid instructive/manipulable: spillapp m bruk av ytre belønning, ukeslinje, konkur. med søsken. Litt mulig å ta valg, eks. vanskelighet og type oppgave.</p>
 FUNIFI DO Funify Limited	<p>"Makes chores fun by motivating kids to do their tasks! Funifi is changing child-parent communication. Get kids excited about doing chores through our incentive based platform".</p>	<p>Barn er hovedbruker, alder 6-8 år. En eller to foreldre er administratorer. Flere barn kan være med.</p> 	<p>Foreldre kan legge inn predefinerte eller egne oppgaver med poeng til et eller flere barn. De må godkjenne når gjort. Barn ser oppgaver og belønninger. Egen Cleanipedia med vasketips.</p>	<p>Instructive/manipulable: goal and mission, overt extrinsic rewards,</p>
 CHORE-INATOR Binary Formations LLC	<p>"Chore-inator brings consistency, accountability, and structure to any household! It's simple interface engages kids and keeps them motivated to help out in the house".</p>	<p>Barn er hovedbruker, kan ha flere. Foreldre administrerer, men slagord er "Laget for foreldre av foreldre".</p> 	<p>Barna kan ta bilde av det de har gjort, og få godkjenning av foreldrene.</p>	<p>Instructive/M</p>
 CHORE MONSTER	<p>"ChoreMonster makes chores fun by engaging and rewarding your kids! The kids earn points by completing their chores, get rewards from their parents and spin the wheel to win monsters"</p>	<p>Barn, alder 6-8 år. To deler, en for foreldre og en for barn. Kan legge til flere barn.</p> 	<p>Oppgavefordeling, foreldre godkjenner. X antall poeng per oppgave.</p>	<p>Instructive: game-app, overt extrinsic rewards, goal. Not open for creativity.</p>

MOTIVASJON, SPILLELEMENTER	GRENSESNITT	UNIVERSELL DESIGN	TEKNISK	KOMMENTAR
<p>Ytre motivasjon: Gullmynter for hver oppgave, ønskeliste for ting/opplevelser.</p> <ul style="list-style-type: none"> Hovedside m/ visuell progresjons-status til barna barna Nivå: avatarens karakterutvikling Gullmynter Konkurranse mellom barna om å nå opp til ukentlig mållinje 	<p>Separat grensesnitt for barn og forelder; Foreldre må logge inn for å gjøre endringer og godkjenne.</p> <p>Utnytter skjerm godt.</p>	<p>Håndtegnede bilder på alle bakgrunner. Visuell fremstilling av hvem som leder. Oppgavene er tekstbaserte. Monstrene lager lyd. Musikk i bakgrunnen.</p>	<p>App for ios. Koster 39 kr</p> <p>Kan kun brukes på én telefon eller ett nettbrett (synker ikke til andre enheter)</p> <p>Engelsk språk.</p>	<p>Fin app med god design og god bruk av spillelementer. Skeptisk til foreldre som dommere over barna.</p>
<p>Poeng for hver oppgave; en belønning "koster" et visst antall poeng. Belønning man kan etterspørre.</p> <ul style="list-style-type: none"> Poeng Belønning 	<p>To brukergrensesnitt; et for foreldre og et for barn. Barn swiper mellom ulike oppgaver.</p>	<p>Fine farger, og en del visualiseringer i tillegg til tekst.</p> <p>Lyd?</p>	<p>App til IOS og Android, gratis. Mulig å sende inn forslag til appen.</p> <p>Tilknyttet epost til forelder, synker via nett.</p> <p>Engelsk språk</p>	<p>I stadig utvikling.</p>
<p>Stjerner for hver oppgave gir belønning. Ukelønn også mulig.</p> <ul style="list-style-type: none"> Bonusoppgaver Stjerner Belønning Bildebevis 	<p>To bruker-grensesnitt: et for foreldre og et for barn. Enkelt hos barna, vanskelig hos voksne.</p>	<p>To grensesnitt.</p>	<p>App til IOS, koster 29 kr.</p> <p>Synker via dropbox.</p> <p>Engelsk språk</p>	<p>Mange tilpasnings-muligheter. Tungvint grensesnitt for voksne.</p>
<p>Å kunne vinne monstre, etter å ha gjort oppgave. Også egen belønning som foreldre kan bestemme, f.eks is. Egne monsterfilmer.</p> <ul style="list-style-type: none"> Unlockables: man har mulighet til å vinne og "låse opp" monstre Sjanse (lotteri) med lykkehjul Poeng Belønning 	<p>To ulike grensesnitt, et for barn og et for voksne. Fint grensesnitt for barna. Veldig forvirrende og rotete for voksne.</p>	<p>Visuell og fin, lite tekst. Kunne gjerne vært bilder til oppgavene. Morsomme lyder.</p>	<p>App for IOS og Android, Windows, Kindle Fire. Gratis.</p> <p>Appen er koblet opp mot eposten til foreldrene og synker via nett.</p> <p>Engelsk, fransk, tysk, italiensk, spansk</p>	<p>Fin app for barna, håpløs for voksne. Passord og brukernavn tar mye tid og må huskes.</p>

Figure 5 Bjering's application analysis, part 2

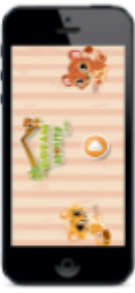







PRODUKT	BESKRIVELSE	BRUKER	BRUK	PEDAGOGISK DESIGN
 <p>DREAMHOUSE TASKS Damaris Avila</p>	<p>"Make the morning and bedtime routine a little easier and a lot more fun. Create a lifestyle of positive engagement with your kids and good habits that will take them into their adolescence."</p>	<p>Barn i alderen 6-8 år. Forelder administrerer oppgavene, som er delt inn etter morgen og kveld.</p> 	<p>Appen viser et hus med fire rom. I hvert rom er det stjerner, som symboliserer oppgaver barna skal gjøre. Oppgavene kan ha en timer. Når oppgavene i et rom er ferdig, blir rommet mørkt.</p>	<p>Hybrid: Instructive, Manipulable: guided discovery, some capacity to make choices, some extrinsic reward, clear goal.</p>
 <p>LICKETY SPLIT Swirly Studios LLC</p>	<p>"Tired of nagging your kids to get ready? The Lickety Split Musical Timer turns daily tasks into a fun, beat-the-clock game. The abstract concept of time becomes tangible for kids".</p>	<p>Barn, alder 0-5 år.</p> 	<p>Timeglass m/ klassisk musikk; to hovedfunksjoner: 1) Nedtelling; for å få barn til å holde ut tiden. F.eks til 2 minutters tannpuss, lesing 2) Nedtelling; bli ferdig før timeglasset; f.eks rydde rommet, ta på pysj osv.</p>	<p>Instructive: very clear mission and goal, drill and practice. However, limited extrinsic reward.</p>
 <p>JUST HELPING MY DAD Oceanhouse Media</p>	<p>"Join Little Critter in this interactive book app as he spends the day helping his dad! From making breakfast to cutting the grass, find out how Little Critter always tries his hardest!"</p>	<p>Barn, 0-5 år Interaktiv barnebok</p> 	<p>Lille Critter vil hjelpe faren sin en hel dag. Han prøver iherdig, men stort sett blir det mye rot. Likevel setter faren pris på at Critter vil hjelpe til. Les selv, eller hør ferdiginnspilt tale. Lær nye ord.</p>	<p>Manipulable: guided discovery, choose between reading and listening, choose pace.</p>
 <p>TEJAS & LOLLIPOP Azawhistlekids</p>	<p>"This fun and interactive app is not only a good story, but one that will teach children the good habit of tidying their own room"</p>	<p>Barn, alder 3+ Interaktiv barnebok</p> 	<p>Tejas og hunden hans Lollipop mediterer, og Lollipop lærer Tejas hvordan han kan rydde rommet sitt ved å ta på "krigerdrakten". Barnet som leser kan hjelpe Tejas, ved å dra alle alle lekene på plass.</p>	<p>Manipulable: guided discovery, some capacity to make choices: choose between reading or listening, choose pace.</p>

Figure 6 Bjering's application analysis, part 3

MOTIVASJON, SPILLELEMENTER	GRENSESNITT	UNIVERSELL DESIGN	TEKNISK	KOMMENTAR
<p>Extrinsic: Et stjernemål per uke, så kan man mate dyret sitt (Avatar)</p> <ul style="list-style-type: none"> • Personlig-gjøring; endre fargetema og dyrekarakter • Belønning: ikke spesifisert, gratulasjoner • Stjerner i progresjonsbar 	<p>Enkel navigasjon for barna: swipe mellom hvert rom. Forholdsvis greit å legge til oppgaver.</p>	<p>Svært visuelt og tiltalende app med store bilder. Enkeltoppgavene er likevel beskrevet med tekst. Pling-lyd når utført oppgave. Lett å følge progresjonen med tydelig bar i øvre høyre hjørne.</p>	<p>App for IOS, koster 19 kr.</p> <p>Opp til 6 søsken kan dele på én applikasjon (en iPad eller tlf).</p> <p>Er ikke koblet opp mot nett.</p> <p>Engelsk språk</p>	<p>Flott, visuelt app for de minste, lett å navigere i, gjør morgen- og kveldsrutiner enklere, ikke nødvendigvis en spesiell belønning.</p>
<p>Positiv, muntlig og visuelt tilbakemelding; en stemme med oppmuntrende ord og gledesrop fra barn. Time-glasset blir lei seg hvis man ikke klarer oppgaven.</p> <ul style="list-style-type: none"> • Tidtaking • Synlig progresjon/tid; sand i timeglass. 	<p>Enkel navigasjon i appen.</p>	<p>All informasjon gis muntlig; er dermed barnevennlig.</p> <p>Klassisk musikk.</p>	<p>App til IOS og android. Gratis, begrenset prøveversjon. Fullversjon: 9 kr.</p> <p>Engelsk, fransk, tysk, spansk, koreansk, kinesisk, portugisisk, tyrkisk, italiensk, nederlandsk, japansk</p>	<p>Enkelt verktøy for de minste, men litt begrenset.</p>
<p>Intrinsic: Critter ønsker å hjelpe til, fordi han synes det er gøy (+ få ros og oppmerksomhet fra faren og bedre selvfølelse og selvtillit ved å se at man klarer å utføre ting). Gjemte "skatter": En mus og en edderkopp gjemmer seg på hvert bilde, og når historien er over, får man se hvor mange man klarte å finne.</p>	<p>Enkelt brukergrensesnitt. Swipe til venstre for å bla i boken. Alle ting man ser på bildet kan trykkes på, lære ord og uttale. Har laget interaktiv bok på en god måte.</p>	<p>Store, flotte bilder, tydelig og stor tekst. Mulig å høre lyd eller lese selv. God universell design.</p> <p>Musikk og tale.</p>	<p>App for ios og android. Koster 19 kr for ios og 12 kr for android.</p> <p>Engelsk språk.</p>	<p>Flott, visuelt interaktiv barnebok som viser at motivasjon ikke kun trenger være ytre, viser barna gleden av å hjelpe til.</p>
<p>Tejas skylder på alle for rotet, men lærer å se hva et ryddig rom betyr, og at alle ting har sin plass: Nå kan man leke fritt, og trenger ikke lete etter en spesiell leke. Skryt og ros og stolthet fra moren til Tejas.</p> <ul style="list-style-type: none"> • Få på plass ting: Å putte alle lekene på plass i hyllen, for deretter å få ros 	<p>Enkelt brukergrensesnitt: man swiper mellom hvert bilde, eller trykker på poten. Kan trykke på ulike objekter, og starte animasjoner på nytt.</p>	<p>Store, vakre bilder og klar tekst. Flott fortellerstemme.</p> <p>Musikk og tale.</p>	<p>App for ios. Koster 19 kr.</p> <p>Engelsk språk.</p>	<p>Visuelt og morsom bok med nydelig stemme, lærer barna viktigheten og friheten av å være organisert og ha det ryddig rundt seg.</p>

Figure 7 Bjering's application analysis, part 4

PRODUKT	BESKRIVELSE	BRUKER	BRUK	PEDAGOGISK DESIGN
 <p>ALLOWANCE & CHORES BOT, Wingboat LLC</p>	<p>"Allowance & Chore Bot allow families to easily track chores, allowance, and saving in one app that the whole family can use!"</p>	<p>Barn, ikke spesifisert alder.</p> 	<p>Oppgavefordeling. Kan velge å gi penger for oppgaver, eller ukelønn. Mulig å se ukelønns historikk i graf med prognose for fremtidig inntjening.</p>	<p>Instructive: overt extrinsic rewards, goals</p>
 <p>EPIC WIN Supermono Ltd</p>	<p>"EpicWin is an iPhone app that puts the adventure back into your life. It's a streamlined to-do list, to quickly note down all your everyday tasks, but with a role-playing spin."</p>	<p>Voksne, ungdom, eldre barn</p> 	<p>En to-do-liste app, og legger selv inn oppgaver med tid, beskrivelse og mengde "epicness". Når man har utført en oppgave i virkeligheten, kan man motta belønning.</p>	<p>Hybrid: Instructive / Manipulable: game app, extrinsic rewards, goals and mission oriented, guided discovery.</p>
 <p>HABIT-RPG OCDevel LLC</p>	<p>" A habit-improvement app which uses game mechanics such as leveling and hit points, competition amongst friends, and rewards - to motivate players to live healthy and productive lives."</p>	<p>Voksne, ungdom, eldre barn</p> 	<p>HabitRpg er en nettside/app med avansert to-do-liste. Man kan legge inn vaneendringer, daglige gjøremål, engangsoppgaver, og belønninger, og du er en rpg-avатар.</p>	<p>Hybrid: Instructive/ manipulable: game app, overt extrinsic rewards, clear goals and missions</p>
 <p>CHORE WARS Kevan Davis</p>	<p>"Recruit a party of adventurers from your household or office, and log your chores to claim experience points for them."</p>	<p>Voksne, ungdom, eldre barn</p> 	<p>Nettside der husarbeid – rollespill. Man har en eventyrkarakter, med sin styrke. Alle i familien kan bli med i et "Party", og så kan man "claime" arbeidsoppgaver (adventures).</p>	<p>Instructive/ Manipulable: game app, overt extrinsic rewards, clear goals and mission, guided discovery</p>

Figure 8 Bjering's application analysis, part 5

MOTIVASJON, SPILLELEMENTER	GRENSESNITT	UNIVERSELL DESIGN	TEKNISK	KOMMENTAR
<p>Ytre: Ukelønn eller penger per oppgave.</p> <ul style="list-style-type: none"> • Robotmaskot som gir beskjeder og oppmuntring • Bonusoppgaver • Punishment: Kan trekke fra penger dersom ikke gjort oppgavene • Belønning: 	<p>En portal for foreldre og barn; foreldre kan låse opp med kode. Mange tilpasningsmuligheter, men må knote for å finne ut av det.</p> <p>Barna kan få egen påminnelse.</p>	<p>Fin maskot, men dessverre ingen lyd. Lite visualisering, og svært liten tekst og små ikoner. Ikke barnevennlig (f.eks grafen er vanskelig å forstå).</p>	<p>App til IOS. Gratis, begrenset prøveversjon. Fullversjon 29 kr.</p> <p>Engelsk språk</p> <p>Synkroniserer over nett, og kan dele utført oppgave på sosiale media.</p>	<p>App for fordeling av oppgaver og ukelønn. Mye fokus på penger, dårlig grensesnitt.</p>
<p>Ytre/indre: Rollespill, karakterutvikling, på 5 områder (strength, stamina, intellect, social, spirit). Å krysse av for noe man har gjort.</p> <ul style="list-style-type: none"> • Skatter: Ved å fullføre oppgaver kan man få tilgang til "loot" (skatter) • Nivå: Karakteren • Skattekart • Gull • Reise: Antall mil = progresjon 	<p>Enkel å manøvrere. Skattejakt-tema.</p>	<p>Ingen lyd. Forholdsvis grei tekst å lese, litt liten. Ikke mulig å legge inn egne bilder av oppgaver.</p>	<p>App for IOS, koster 29 kr</p> <p>Ikke koblet mot nett. Kan dele på sosiale media.</p> <p>Engelsk språk.</p>	<p>En litt morsommere to-do list, men har ikke kalender, og kan ikke konkurrere med venner/familie.</p>
<p>Rollespill og konkurranse</p> <ul style="list-style-type: none"> • Belønning • XP: Erfaringspoeng • HP: helsepoeng Avataren kan dø hvis du ikke gjør det du skal. • GP: gullpoeng • Konkurranse mot familie/venner • Karakterutvikling 	<p>Fint grensesnitt, enkelt å legge til og fjerne oppgaver.</p>	<p>Mye tekst, men fine visualiseringer. Alle oppgaver er tekstbasert. Ingen lyd.</p>	<p>Nettside for Firefox, chrome, safari og app for IOS og Android. Gratis.</p> <p>Synker mellom app og nettside.</p> <p>Engelsk språk.</p>	<p>Fin app for eldre barn eller voksne. Lett å se hva som skal gjøres, konkurranse og overlevelse.</p>
<ul style="list-style-type: none"> • Konkurranse • Ulike rom har ulike oppgaver: bad, kjøkken, outside world. • Sjanse • Gull • XP • Nivå 		<p>Mye tekst og litt avansert system. Passer for de som har spilt rollespill tidligere.</p>	<p>Gratis nettside for en vanlig bruker. Hvis man vil ha fullversjon for å se eldre historikk og slippe reklame, må man oppgradere til gullversjon: 100 kr</p> <p>Engelsk språk.</p>	<p>Fint konsept, smart at man kan gjøre krav på oppgaver, mer eierskap.</p> <p>187</p>

Figure 9 Bjering's application analysis, part 6



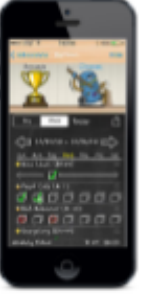

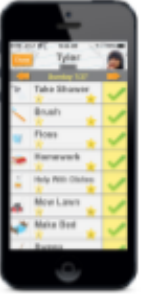

PRODUKT	BESKRIVELSE	BRUKER	BRUK	PEDAGOGISK DESIGN
 IREWARD CHART Swirly Studios LLC	<p>"iRewardChart is an app that brings the traditional reward chart onto mobile device, with a customizable, interactive interface"</p>	Barn, 0-5 år. Foreldre admin. 	Foreldre legger til oppgaver, mange predefinerte. Gjelder både husarbeid og manerer. Kalender med alle dager i uken, og antall stjerner.	Instructive: overt extrinsic rewards, drill and practice, goals.
 I-ALLOWANCE Swirly Studios LLC	<p>"Put piggy banks and paper money behind you! iAllowance is the only thing you need to manage your child's finances and teach him or her about saving and spending money".</p>	Barn, alder ikke spesifisert. Banksystem for hele familien 	IAllowance er et familie-finans-system: tjene, spare og bruke penger. Foreldre kan velge å bruke ekte penger, stjerner eller tid som valuta. Oppgavefordeling, belønning og ukelønn.	Instructive: clear goals, drill and practice, overt extrinsic rewards: money, time or stars.
 CHORE PAD Nannek	<p>"Hate doing chores? Gain experience points for doing chores and advance up the ranks. Install it for your kids! Can you become the Chore Master?"</p>	Voksne, ungdom, eldre barn. Folk i familien blir rangert etter nivå. 	To-do-liste med karakterutvikling og nivåer. Diverse husarbeid er allerede predefinert og man kan selv legge til egne. En timer kan ta tiden på oppgaven du gjør.	Instructive. bytt ut! med chore pad.

Figure 10 Bjerings application analysis, part 7

MOTIVASJON, SPILLELEMENTER	GRENSESNIITT	UNIVERSELL DESIGN	TEKNISK	KOMMENTAR
<p>Ytre: Å få stjerner for de oppgavene man gjør. Kan bruke stjernene til annen belønning.</p> <ul style="list-style-type: none"> • Belønning: stjerner • Balanse: se hvor mange stjerner man har • Punishment 	Vanskelig å finne frem i.	Fargede stjerner, ellers grå app. Alle oppgaver er tekstbasert, ikke lyd. Stjernelyd.	<p>App for IOS og android. Prøveversjon med mulighet for ett barn er gratis. Fullversjon 24 kr.</p> <p>Synker via Dropbox</p> <p>Engelsk språk.</p>	Et forsøk på å gjøre en tradisjonell huarbeidsliste interaktiv. Lykkes dessvere ikke.
<p>Motivasjon kommer fra å få penger, stjerner eller tid til å bruke.</p> <ul style="list-style-type: none"> • Belønning: (stjerner, tid eller penger) kan legges på ulike sparegriser; bruk, stjerner, korttidssparing, langtidssparing, veldedighet og skatt. • Progresjon og oversikt: "bank totals" med oversikt 	Laget som en krittavle; blir vanskelig å lese alt som står.	<p>Mye tekst og lite visualisering.</p> <p>Pengelyd når man utfører en oppgave.</p>	<p>App til IOS, koster 49 kr, prøveversjon gratis.</p> <p>Engelsk språk</p> <p>Synker via dropbox eller iCloud.</p>	Kan fungere som et ukelønnsapp, men veldig kompleks. Fint å lære barn om bruk av penger, men for tungvint.
<p>Karakterutvikling og tidtaking, og ønske om å gå opp i nivå med karakteren. Antall poeng – tid brukt på oppgaven.</p> <ul style="list-style-type: none"> • Nivå • Karakterutvikling • Tid • Poeng 	Kjedelig og ikke barnevennlig bruker-grensesnitt, utnytter ikke plass på skjerm.	Ikke visuell, mye tekst, ingen lyd.	<p>App for android, gratis prøveversjon med reklamer. Fullversjon koster 15 kr, og inkluderer mulighet for flere profiler og en oversikt over de ulike personene.</p> <p>Engelsk språk</p>	Virker ufullstendig.

Figure 11 Bjering's application analysis, part 8

Appendix C: Test Execution Elements

.3 Final Testing Interview

- Do you do any chores/housework at home?
- Is it important to help with the chores at home?
- Do you do chores/housework just to get a reward?
- Do you use any tools to see which chores you need to do, or are your parents just telling you which chores you have to do?
- Would the chores become more entertaining if it become more like a game?
- Do you use tablets and/or smartphones?
- Do you play games on the tablet/smartphone/PC/console?

.4 Final Testing Questionnaire



PunchData

QUESTIONS

RESPONSES 22

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Form description

Gender

Female

Male

Age

Short-answer text

I thought the application was fun to use.

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I was motivated to do chores after I tried the application

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I was motivated to use the application because of images, lights, and sound

1	2	3	4	5
---	---	---	---	---



I was motivated to obtain the different medals in the application

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I was motivated to earn green/red/blue gems

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I was motivated to achieve the goals I had in the application

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I thought it was exciting to see what was in the reward bag.

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I was so engaged in the game, that I became less aware of my surroundings

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I thought it was fun to earn treasures and points

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree



	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I was curious what I got when I obtained a medal

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I was easily taught how the application worked

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I thought the application was easy to use

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I felt in control of my what I was doing in the application

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I thought the progress towards the goals and medals were obvious

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

It was easy to understand which tasks I had

	1	2	3	4	5	
--	---	---	---	---	---	--



It was easy to find what I was looking for in the application

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I thought the application was easier to understand after I had used it for a while

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I understood that the different tasks gave me different rewards

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I think that the application would be a good tool to use when I do chores

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

If I had the chance I would use this application at home

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

Chores would have been more fun if I had used the application

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree



6/4/2017

PunchData - Google Forms

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree



Appendix D: Workshops

The workshops was centered around ideation, as they should inspire creativity. The participants on the workshop were Morten Kartevoll, Ole Andreas Alsos, and Camilla Dahlstrøm, which all have some relationship with the application.

.5 1st Workshop

The first workshop was conducted theme-wise, starting with ideation related to the reward aspects of the application. A brief discussion on general ideas and worthy notes which should be taken on the application was conducted. Numerous ideas were presented, and the following categories were the end results:

- Feedback from the game
- Virtual rewards
- Real rewards
- Activities when a reward is given
- Family-based rewards
- Level and experience

Even though Bjering wanted to remove extrinsic rewards [12, 80], it was concluded that removing these rewards would do more harm than good. The reasoning is because it is not a matter of, if to include it or not, but what matters is how it is implemented [3, 85, 84, 43, 20, 82, 23, 28, 21]. In addition, I wanted to take another approach than Bjering's total innovative approach, where using rewards systems can be a part of the application as long as it is implemented and well thought through. It should also not be used just because I want to "pointify" the application [88]. In addition to using extrinsic rewards it was concluded that using virtual rewards would increase the motivation of the users if done correctly. As a

lot of the applications related to chores where missing the use of extensive feedback in different forms, both visual, textual, and by using sounds, it was decided that focusing on making the application interactive and reactive using feedback is important to increase the completeness [84, 43, 82].



Figure 12 Reward ideas has been categorized

Another aspect in creating a more interactive application was to include some sort of activity when a user is rewarded. Two different types were proposed: The first was an extra type of game like a lottery which can reward the player with extra rewards or items. The second idea was more based around that the user has to do an activity in order to receive his reward. These activities could be pressing the screen to open a chest, make an animation run, or clean the dust away from the screen by swiping it. When the reward appear on the screen, visual effects and sounds should be played, as well as freezing the screen, in order to create an experience out of it [84]. In addition the player can feel a higher level of ownership to the reward.

Since the application is suppose to have both individual goals and family goals, one of the topics discussed were family-based rewards. Nearly all the applications analysed were focusing on individual tasks/chores and the rewards given to the

individual players. Bringing the family in focus was one of the main goals of the application proposed by Bjerging [12, 80], and it is also important related to reward theory in general, to feel a part of a community. Examples for these family-based rewards were things which could be built piece by piece, so that the family had to collect them together (puzzles, buildings, and Legos). Related to the puzzles and buildings, these could be a hint to a secret reward, family or individual, which could trigger curiosity.



Figure 13 Ideation during first workshop

Related to rewards, a discussion on levels and avatars emerged. One of the problems with avatars is that it is often put into games because it is easy, and because "everybody" is doing it [85]. There are a large number of considerations which should be thought through before choosing how and why avatars should be included, and especially to what extent. After discussing back and forth it was concluded that the avatar is a nice way of representing the members of the family. Regarding avatar experience points, it was decided that if it was going to be used it needed another purpose than only to be there. For example in Pokémon Go, the items available for use and the combat power limit of your Pokémon is dependent one the avatar level. An idea which was discussed were titles which individual members could receive. These titles could be given on dependent on the avatar level, or could be received if some kind of badges were to be implemented, and could for example be "Ninja Cleaner", "Grandmaster Vacuum", or "SuperDuper

Family Member".

Lastly, the idea of resources as currency was introduced. Bjering mentioned there were several families which thought that chores should be unpaid work, since everyone has to do their part in a household [12, 80]. In respect do this, virtual rewards could be included. In addition to receiving points for each chore, an additional varying reward in form of coins or gems could be given. This varying reward could be based on how well the chore has been done. By including this kind of varying reward in form of currency, it was reasoned that in addition to teaching the children of savings it would also trigger children to strive for mastery [55], as well as generate the curiosity of how much resources will be given [52, 48, 44, 45].

By including both extrinsic motivation and intrinsic motivation, they can build on each other. The resources could eventually be traded in a game store, where rewards like *"Decide today's dinner"*, *"Decided which movie we will watch"*, or an extra piece to the puzzle/building could be given. As Rogers mentions, it is important to use various forms of rewards so that the player does not get bored [84].

The next theme discussed in the workshop was the social part, or the community of the application. A similar categorization process to rewards was done. The categories which emerged were:

- Forum

- Leaderboards

- Sharing of game elements (pictures, badges, rewards)

- Competitions/Challenges

The forum idea included basically a place where children and parents could discuss how and why they used the different parts of the application. It was also mentioned that by using a forum, user-created content would easily appear, about how rewards were given, which chores are included, and how they could be done with play and fun. When posting or commenting on other posts the idea was that your name, as well as the title you currently had on your avatar, should be displayed [64, 55, 85] (of course it should be possible to be anonymous).

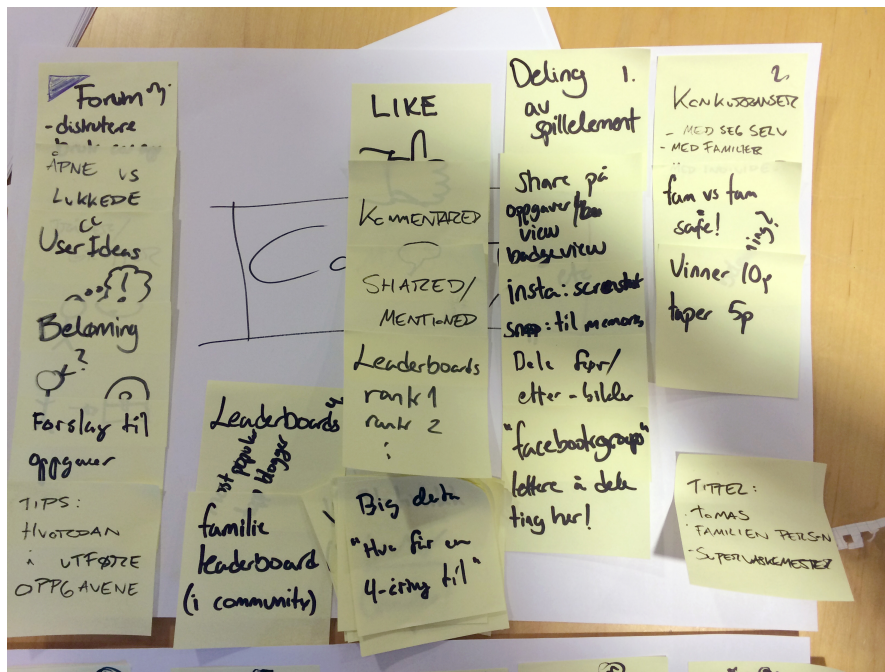


Figure 14 Social interaction ideas has been categorized

The discussion of whether or not to include leaderboards of some sort was interesting, as there were several concerns which needed to be addressed. For example how would leaderboards be balanced if they were based on the points you had gotten. Points given by chores should be customizable as the same chore can be in a different difficulty in different families. It was mentioned that the leaderboards could be based on shares and likes which was gotten from sharing game elements on social media, which would in turn create competition [55, 85, 84].

Using the share function to approve the chore could be a fun function, similar to the functionality in the *Homey* application. The functionality around sharing, liking, commenting and mentioning other persons was commended by everyone. This functionality would relate especially to the need of relatedness in self-determination theory [55].

The last subject discussed was the aspects of competition and challenges. It was mentioned competitions including individuals and the entire family. Because one of the main goals of *Mænage* is to increase the focus on the family as a whole, the use of competition and challenges, if any, should be centered around collaboration and teamwork. That said simple indirect or direct challenges and competitions could still be implemented.

.6 2nd Workshop

The second workshop was conducted in order to remove functionality suggested in the first workshop, which would just be an obstacle for what the application should do: make chores fun and motivating for the entire family, as well as contributing to the family community.

Since the application should focus on the family instead of individuals, one of the main goals of the workshop was to enhance this quality. It was therefore important to focus on the goals and rewards given to the entire family, as well as the activities in which the family can work together. Family goals were already in the application, and doing chores together, but collecting in game elements together in order to build something was not. Another part which was mentioned was the possibilities to include some sort of family challenges, where a subgoal would be decided to see if the family could be able to do it.

Since the reward system of the original application (*Mænage*) were fairly simple as seen in Figure 15, an expansion to it was in order. As Rogers said, it is important to use varying rewards and motivators in order to not bore the player [84]. By including the resource of coins/gems, as well as badges to give the player some sort of trophies of his/her achievements (which would also give a boost in points), the player would get a variety of rewards. This would also lead to a more overall functionality where the different types of rewards are connected in a logical way.

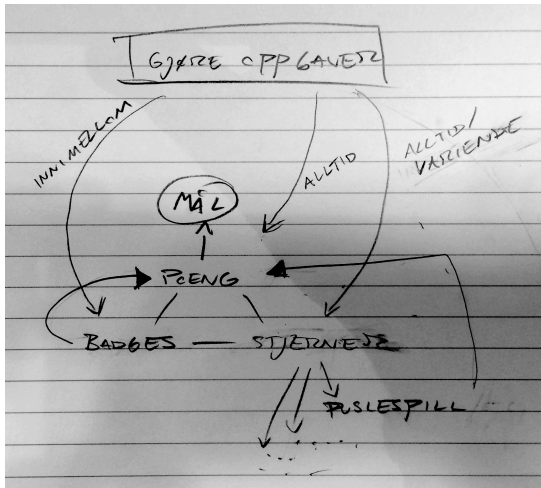


Figure 15 Reward model idea

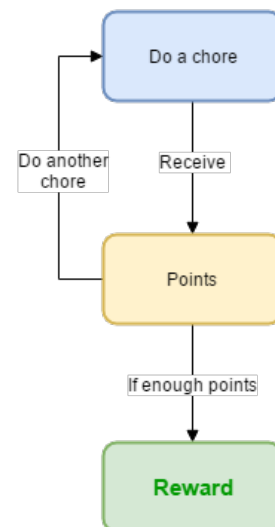


Figure 16 Original reward model in *Mænage*

As far as community goes, the forum idea was discontinued, because it would merely take focus away from what is important in the application. Besides it would increase the complexity of the application as well. It should still be possible to share game elements with social media, but the forum could be a website instead, as they often are. Competition outside of the family, meaning competitions versus other families would merely be an extra factor of complexity, and could decrease focus on what is important [12, 80]. That said, if feedback illustrate a need to socialize with other families inside the application a reevaluation to include it should be taken.

Building on what was discussed in the first workshop related to virtual and textual motivators/rewards, as well as using extensive sounds to reward the players should be included. When a chore is done, particles should sparkle and sound or textual cheering praise could be included. As Wang & Sun said: people love to get their work recognized and appreciated [64].

Appendix E: Complete Questionnaire Results

This appendix presents the complete results from the questionnaire with the entire five-point Likert Scale. The different values in the Likert Scale are presented as following: Strongly Disagree (SD), Disagree (D), Neutral (N), Agree (A), Strongly Agree (SA).

.7 Motivation

ID	Statement	Group	SD	D	N	A	SA
4	I was motivated to do chores after I tried the application.	All	9.1%	9.1%	22.7%	9.1%	50.0%
		Female	18.2%	0%	36.4%	18.2%	27.3%
		Male	0%	18.2%	9.1%	0%	72.7%
5	I was motivated to use the application because of images, lights, and sound.	All	4.5%	0%	13.6%	45.5%	36.4%
		Female	0%	0%	27.3%	63.3%	9.1%
		Male	9.1%	0%	0%	27.3%	63.6%
6	I was motivated to obtain the different medals in the application.	All	4.5%	0%	18.2%	0%	77.3%
		Female	9.1%	0%	36.3%	0%	54.5%
		Male	0%	0%	0%	0%	100%
7	I was motivated to earn green/red/blue gems	All	0%	0%	9.1%	9.1%	81.8%
		Female	0%	0%	18.2%	9.1%	72.7%
		Male	0%	0%	0%	9.1%	90.9%
8	I was motivated to achieve the goals I had in the application	All	0%	9.1%	0%	18.2%	72.7%
		Female	0%	9.1%	0%	27.3%	63.6%
		Male	0%	9.1%	0%	9.1%	81.8%

Table 1 Motivation questions results

.8 Enjoyment

ID	Statement	Group	SD	D	N	A	SA
3	I thought the application was fun to use.	All	0%	0%	0%	13.6%	86.4%
		Female	0%	0%	0%	18.2%	81.8%
		Male	0%	0%	0%	9.1%	90.9%
11	I thought it was fun to earn treasures and points.	All	4.5%	0%	0%	13.6%	81.8%
		Female	0%	0%	0%	27.3%	72.7%
		Male	9.1%	0%	0%	0%	90.9%
12	I thought it was fun to achieve goals and medals.	All	0%	4.5%	9.1%	9.1%	77.3%
		Female	0%	9.1%	18.2%	9.1%	63.6%
		Male	0%	0%	0%	9.1%	90.9%
17	I thought the progress towards the goals and medals were obvious.	All	0%	0%	9.1%	22.7%	68.2%
		Female	0%	0%	9.1%	27.3%	63.6%
		Male	0%	0%	9.1%	18.2%	72.7%
25	I thought the application was cool and entertaining	All	0%	0%	0%	22.7%	77.3%
		Female	0%	9.1%	0%	45.5%	54.5%
		Male	0%	9.1%	0%	0%	100%

Table 2 Enjoyment questions results

.9 Engagement

ID	Statement	Group	SD	D	N	A	SA
9	I thought it was exciting to see what was in the reward bag.	All	0%	0%	0%	27.3%	72.7%
		Female	0%	0%	0%	36.4%	63.6%
		Male	0%	0%	0%	18.2%	81.8%
10	I was so engaged in the application, that I became less aware of my surroundings	All	0%	18.2%	31.9%	22.7%	27.3%
		Female	0%	36.4%	27.3%	18.2%	18.2%
		Male	0%	0%	36.4%	27.3%	36.4%
13	I was curious what I got when I obtained a medal	All	0%	4.5%	27.3%	18.2%	50.0%
		Female	0%	9.1%	27.3%	18.2%	45.5%
		Male	0%	0%	27.3%	18.2%	54.5%

Table 3 Engagement questions results

.10 Usability

ID	Statement	Group	SD	D	N	A	SA
14	I was easily taught how the application worked	All	0%	4.5%	0%	36.4%	59.1%
		Female	0%	9.1%	0%	36.4%	54.5%
		Male	0%	0%	0%	36.4%	63.6%
15	I thought the application was easy to use	All	0%	0%	13.6%	22.7%	63.6%
		Female	0%	0%	0%	18.2%	81.8%
		Male	0%	0%	27.3%	27.3%	45.5%
16	I felt in control of my what I was doing in the application	All	0%	0%	9.1%	13.6%	77.3%
		Female	0%	0%	9.1%	0%	90.9%
		Male	0%	0%	9.1%	27.3%	63.6%
18	It was easy to understand which tasks I had	All	0%	0%	9.1%	13.6%	77.3%
		Female	0%	0%	0%	27.3%	72.7%
		Male	0%	0%	18.2%	0%	81.8%
19	It was easy to find what I was looking for in the application	All	0%	0%	18.2%	22.7%	59.1%
		Female	0%	0%	18.2%	27.3%	54.5%
		Male	0%	0%	18.2%	18.2%	63.6%
20	I thought the application was easier to understand after I had used it for a while	All	0%	0%	9.1%	22.7%	68.2%
		Female	0%	0%	0%	36.4%	63.6%
		Male	0%	0%	18.2%	9.1%	72.7%
21	I understood that the different tasks gave me different rewards	All	4.5%	0%	4.5%	31.8%	59.1%
		Female	9.1%	0%	0%	36.4%	54.5%
		Male	0%	0%	9.1%	27.3%	63.6%

Table 4 Usability questions results

.11 General

ID	Statement	Group	SD	D	N	A	SA
22	I think that the application would be a good tool to use when I do chores	All	4.5%	0%	9.1%	40.9%	45.5%
		Female	9.1%	0%	0%	72.7%	18.2%
		Male	0%	0%	18.2%	9.1%	72.7%
23	If I had the chance I would use this application at home	All	0%	0%	9.1%	13.6%	77.3%
		Female	0%	0%	9.1%	27.3%	63.6%
		Male	0%	0%	9.1%	0%	90.9%
24	Chores would have been more fun if I had used the application	All	4.5%	0%	13.6%	22.7%	59.1%
		Female	0%	0%	18.2%	18.2%	63.6%
		Male	9.1%	0%	9.1%	27.3%	54.5%

Table 5 General questions results