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Teaching teenagers economy through game based learning

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Abstract

This thesis is the result of a project exploring the potential of a game based approach to teach secondary school pupils personal finance. It describes the design, development and testing of a web-based game prototype. It has been tested through controlled observations and distribution of the game with an accompanying evaluation questionnaire. The design of the game is founded on: The current personal finance curriculum of 8th-10th grade, information gathered through interviews with professionals working with either finance, education or both, a preliminary questionnaire answered by the target group and a literature review. The game was developed using the JavaScript framework Meteor. The objective of the game is to set up a budget for an adult and play through a month of expenses while keeping within the budget. The prototype was tested in four different research contexts: At Kodeklubben Trondheim, at Rosenborg school, in a Skype session and through a distributed game link and questionnaire. Through the testing of the prototype and the results of the preliminary research, we conclude that there is a clear potential in using game-based learning in an educational setting. There is, however, both a need to investigate further and a potential to expand the prototype into a more extensive game.

Sammendrag

Denne masteroppgaven utforsker potensialet til en spillbasert tilnærming for å lære ungdomsskoleelever personlig økonomi. Grunnlaget for dette masterprosjektet er utviklingen og testingen av en web-basert spillprototype. Denne har blitt testet ved hjelp av kontrollerte observasjoner og distribusjon av spillet sammen med en spørreundersøkelse. Designet til spillet er basert på: Det eksisterende pensumet til ungdomsskolen om personlig økonomi, informasjon samlet gjennom intervjuer med fagfolk som jobber med økonomi, undervisning eller begge deler, en forhåndsundersøkelse gjennomført av målgruppen og et litteraturstudium. Spillprototypen ble utviklet ved å bruke JavaScript-rammeverket Meteor. Målet med spillet er å sette opp et budsjett for en voksen. Spilleren skal så spille gjennom en fiktiv måned med utgifter og samtidig holde seg innenfor budsjett. Prototypen ble testet i fire forskjellige situasjoner: På Kodeklubben Trondheim, på Rosenborg Skole, over Skype og gjennom distribusjon av en lenke til spillet med en tilhørende spørreundesøkelse. Etter å ha vurdert resultatene fra testingen av prototypen og resultatene fra forhåndsstudiet, konkluderer vi med at det er tydelig potensiale for å bruke spillbasert læring i undervisningssammenheng for å lære målgruppen om personlig økonomi. Det er fremdeles behov for å undersøke denne påstanden videre. Det er også et potensiale for å utvikle prototypen til et mer omfattende spill.

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Part I

Introduction and Methodology

This part presents the thesis, the motivation behind it, the methods used to conduct the research and our plans to implement these methods. This part will also give an overview of the research goals this thesis aims to answer, in addition to an overview of potential distortion of data.

1 Introduction

The world economy is growing, with increasing consumption as an important factor. The drive for increased consumption to maintain the economical growth dictates a world order where loans and credit are easily available and promoted frequently in media. Mobile payments are increasing globally [74]. The use of cash is decreasing [36]. The change in how people spend money affects everyone, especially the younger generation. They grow up in a world where it is increasingly important to have a concept of personal finance and debt [37]. At the same time, the generation in question has a completely different relationship with technology in their daily lives compared to the generations who grew up 20 or even 10 years ago. Serious games have long been a tool for teaching [41], but personal finance is an area in the school curriculum where these games are less prevalent.

Market research conducted by Respons Analyse for Den Norske Bank(DNB) in January 2015 compared Norway to 19 other countries, and found that Norwegians are less aware of their economical situation than citizens in many other European countries. In an accompanying report concerning assisting measures, DNB suggests that personal finance education needs to be revised and receive greater attention [55]. They also suggest looking at solutions which will facilitate learning beside traditional teaching. Statistics from 2012 and 2013 collected by Intrum Justitia show that 27894 young adults between 18 and 26 years have overdue debt which has gone to the debt collector [38]. This dept has a value of over 1.1 billion NOK. The consequence is that young adults, who later will want to apply for loans, have lessened their chances of getting one almost before their economical adulthood has begun.

1.1 Context

The idea of making a game for school children about personal finance came from the way media focused on young adults and their debt. "Luksusfellen" is a reality show where economists visit households in great personal debt and attempt to steer their lives in a less destructive direction [68]. Economists have also been frequently in the media, discussing solutions to young adults great personal debt and lack of economical sense, and calling to the politicians for action [47] [1]. We presented the idea to our supervisor, Alf Inge Wang, and he agreed it would be interesting to explore the topic further.

1.2 Personal motivation

Both of the authors of this thesis are intrigued by the idea of creating software which solve peoples' every day problems. This is one of the reasons why we study computer science. Being able to make something of our own for our master thesis and not just performing research on existing products is in itself a motivating factor. The problem domain of personal finance and learning is also something we are interested in. Pia Lindkjølen has earlier taught children how to program and found it inspiring to be able to teach and wanted to continue working with children in her master thesis. We find this problem domain interesting, and we find it motivating to be working towards changing the attitudes of young minds.

1.3 Goals

The goals for this project are divided into two areas: The *first* is to explore if serious games is a good way to teach children aged 12-16 about personal finance. If so, how can this be done? Are there aspects of personal finance that are better suited to be taught through games? What game mechanics can be used? The latter question is interesting because a well-developed game could increase motivation for learning more about personal finance as well as release resources for the teacher. This brings us to the *second* goal of this thesis: To explore the effect of teaching children personal finance through games, focusing on elements such as motivation, efficiency and perceived learning. Based on this loose exploration of goals, this study seeks to:

- Explore if or how a game based approach can teach children aged 12-16 how to handle their personal finance.
- Explore the effects of teaching children aged 12-16 about personal finance through computer games.

1.4 Structure of thesis

Part I Introduction and Methodology

- **Introduction** contains a description of the different motivations for this project and an introduction of the overarching goals.
- **Methodology** presents the evaluation theory and research methodology used in this study. It also contains a description of how the theory will be implemented.

Part II Preliminary Research

- **Games and learning** is our literary review for this study, presenting current research on the topics, learning through games, game design and learning through video games. It rounds off with a presentation of relevant technologies.
- **Related Work** presents existing economic initiatives targeting children in various age groups.
- **Interviews and Questionnaires** is a compilation of the information we received by talking with people working with finance or in the school system, as well as a summary of a preliminary questionnaire.

Part III Design and Development

- **Game Design** is a presentation of the game design, screenshots and ideas that were discarded and rationales for the designs.
- **Choice of technology** describes the technology we have used while developing the game prototype.
- **Software Architecture** describes the Meteor architecture, and how we employ it.
- **Software design and implementation** presents relevant aspects of the design and implementation, and how Meteor helps realize this.

Part IV Evaluation of Prototype

- **Research Context** is a description of the different settings we tested the prototype in.
- **Observation** reviews the different observations we performed, and what we discovered during those tests.

- **Results from the Second Questionnaire** presents the different questions of the questionnaire and for each a presentation of the answer distribution.

Part V Discussion and Conclusion

- **Discussion** is an evaluation of the results from the previous chapter. It also revisits the research questions presented in chapter 2 and attempts to give answers to them.
- **Conclusion** presents a brief summary of how the project went and what we draw from it.
- **Future Work** is the final chapter of the thesis. It presents our recommendations for future development and research.

2 Methodology

This section describes the various methods used throughout the study. It begins with a description of the elicitation of the research questions through the Goal Question Metrics approach(GQM) used to guide and finally evaluate the study. The data generation methods used for evaluation and design are also described in this section. The section continues with describing how the design and creation research strategy was used to produce and evaluate the software artefact produced through this study.

2.1 Research questions and approach

The Goal Question Metric approach was chosen as a guide to shape the research questions for this project. Working from the top down, the GQM approach endeavours to shape concrete research questions and measurable metrics for each question from one or several conceptual goals. A general description of this approach is presented in Figure 2.1, together with examples. The goals are defined by finding each object of analysis, the issue or aspect to be examined, the purpose of each goal and the point of view from which the goal is evaluated. A set of research questions are then formulated to specify how these goals can be achieved. Lastly, each research question is associated with one or several metrics representing different sets of data which will help answer the question. The metrics are data can be both subjective and objective [5].

Goal	**Purpose** **Issue** **Object (process)** **Viewpoint**	**Improve** **the timeliness of** **change request processing** **from the project manager's viewpoint**
Question	**What is the current change request processing speed?**	
Metrics	**Average cycle time** **Standard deviation** **% cases outside of the upper limit**	
Question	**Is the performance of the process improving?**	
Metrics	$\frac{\text{Current average cycle time}}{\text{Baseline average cycle time}} * 100$ **Subjective rating of manager's satisfaction**	

Figure 2.1: Goal Question Metric approach [5]

The GQM approach is particularly suited to define and evaluate quality or productivity improvement methods within an organization with process-specific questions and related metrics. However, the approach is also flexible enough for it to be used in an exploratory study like the one which forms the basis of this thesis. An informal way of formulating the purpose of this study is to observe and evaluate user behaviour, learning outcome and other effects

through a piece of software, more specifically a game. The GQM approach is a way to structure the different aspects of this study, as well as finding concrete and comparable metrics to evaluate it. The following subsection further discusses the way we used the GQM approach, as well as the resulting goals, research questions and metrics.

2.1.1 Research Questions

The two research goals defined in the introduction of this thesis, and presented in the context of the GQM can be seen in Table 2.1. They create the foundation for the research questions we wish to answer. The first goal aims to establish a background for the design of the game by looking at existing solutions and previous research done within the relevant areas. Firstly identifying what concepts the target group should learn. Secondly to identify which of these concepts should be implemented into a game and thirdly, a discussion of the technologies such a game should employ. The research questions elicited from the first goal are presented in Table 2.2. The second goal is more concerned with exploring the effect of using the game in a realistic environment. The discussed aspects were: If games are a good learning platform for the age group, if the current curriculum and teaching methods are successful, and finally what the effects of teaching personal finance through a game could be. The research questions are presented in Table 2.3. The metrics used to answer the different questions will, due to the exploratory nature of many of the questions, consist of both quantitative and qualitative data.

Goal 1	To explore if or how a game based approach can teach children aged 12-16 how to handle their personal finance.
Goal 2	To explore the effect of teaching children aged 12 - 16 about personal finance through computer games.

Table 2.1: Research goals

Number	Research Question	Metrics
RQ 1.1	Which concepts regarding personal finance should children aged 12-16 learn?	Literature review, interviews
RQ 1.2	Which concepts of personal finance are feasible to teach through computer games?	Results from testing the prototype
RQ 1.3	Which technology is most suitable for teaching children aged 12 - 16 about personal finance?	Preliminary research, results from testing the prototype

Table 2.2: Research questions and metrics for goal 1

Number	Research Question	Metrics
RQ 2.1	Are computer games a good learning platform for children aged 12 - 16?	Literature review, interview/questionnaire
RQ 2.2	What is the learning effect of the teaching curriculum of personal finance on current platforms at schools today?	Interviews, questionnaire
RQ 2.3	What is the effect of teaching the personal finance curriculum through a game?	Questionnaire, Testing of the prototype

Table 2.3: Research questions and metrics for goal 2

2.2 Research strategy

The study is based around the development and testing of a game, and thus the *design and creation strategy* was chosen as the underlying research strategy. This research strategy focuses on developing so-called artefacts. They can be constructs, models and methods, but also instantiations of these. The latter often results in a software artefact. What separates the design and creation research strategy from simply demonstrating technical prowess is the ability to contribute to knowledge as well as displaying academic characteristics like analysis, explanation, justification and critical evaluation. The software artefact can either be the main focus of the research, a vehicle for something else or a tangible end-product of a project where the focus is on the actual development process [49].

The design and creation process is a problem solving approach which is divided into five steps: Awareness, suggestion, development, evaluation and conclusion [71]. A visualization of the approach can be seen in Figure 2.2. The term circumscription is the discovery of constraint knowledge about theories

gained through detection and analysis of contradictions when things do not work according to theory [43]. This process is not meant to be rigid, and the researchers are encouraged to view this as an iterative process where feedback in the evaluation phase helps both reevaluate the problem and make a more detailed solution. The software artefact, in this case a game, will primarily be a vehicle for exploring how the students potentially learn and become more motivated to learn more about personal finance. A way to ensure that the knowledge incorporated into the game is relevant for the students will be to use the teaching curriculum as a base, as well as speaking to professionals with relevant background. This will be further explored in Part II.

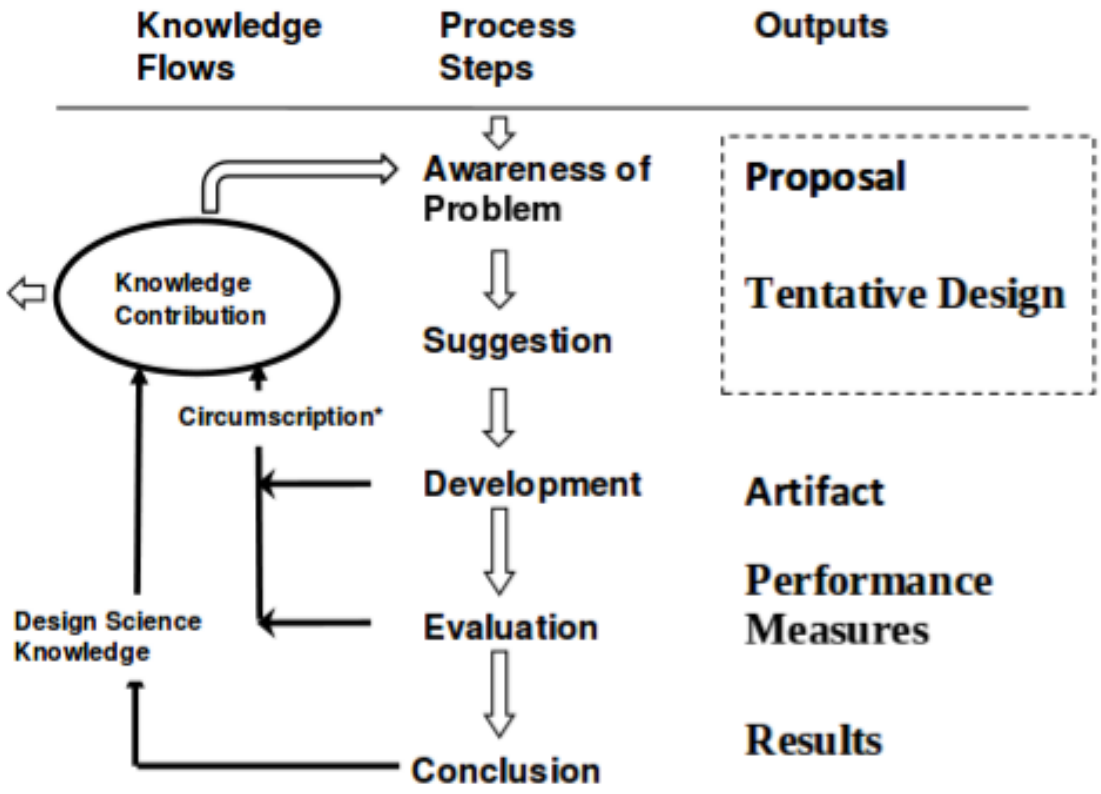


Figure 2.2: Design Science Research Process Model [71]

- **Awareness** is is both the recognition and description of the problem. This can come from studying existing literature, from industry or government initiatives, or from interviewing users who express the need for a solution to a problem.
- **Suggestion** is the transformation from an idea to a solution of the problem. The suggestion phase is typically subject for several iterations, as the awareness of the problem is increased and previous solutions evaluated.
- **Develoment** is the implementation of the solution. This can be done in a number of ways and it depends on the software artefact proposed in the suggestion phase.
- **Evaluation** examines the artefact developed in the previous phase and evaluates its worth based on a certain set of criteria, as well as deviations from earlier expectations.
- **Conclusion** is the phase where the results from the entire design process are collected and structured, and the knowledge gained from the process is identified.

2.3 Our process

This section describes the process of developing the game, the choices we made during development and a justification for those choices. It begins with describing the preliminary research, followed by an introduction to the development of the game. To be able to evaluate the game we will need to collect different types of data, and this is the topic of the next subsection. Finally, there is a section concerning how we will deal with data properties like bias and other kinds of distortion.

2.3.1 Preliminary research

As mentioned in the introductory chapter of this thesis, we landed on the subject of game-based learning and personal finance after reading about the subject in media. To establish what has been done of research within this field, we will proceed with an informal literature review. The purpose of a literature review is to gain knowledge about the literature published in the research field. The literature review, along with interviews with professionals in the industry and educational system, would create the foundation for the research

goals described in the next subsection. Both the literature review and the interviews will aim to map out existing initiatives, potential technology, and later help answering research questions formulated in the suggestion phase.

2.3.2 Development

To be able to meet our research goals, it was clear that we needed a software artefact we could test on our target group, i.e. students at the age of 12-16. The design and the development of the software artefact was based on the preliminary research, as well as feedback from users testing earlier iterations. We decided early on that we wanted an approach which allowed us to make changes as we gathered more information on the subject and received insight and feedback on earlier versions. We opted for an iterative approach and employed prototyping to reach a minimum viable product. From there, we could expand on functionality as our research revealed what elements to include in the artefact.

2.3.3 Evaluation approach

The nature of the software artefact and by extension this study demanded that we take a varied evaluation approach. The evaluation of a game, as with any interactive application, is not only concerned with increasing efficiency of a certain automated task. It is also interesting to evaluate aspects such as fun and immersion, especially since this directly affects motivation [42]. We wanted to see if the players experienced any perceived learning and if they actually improved in the skills presented by the game. To gather the data required for the type of evaluation we wanted, we decided to use questionnaires and observation.

Observation

Observation is a data gathering method which can potentially generate large amounts of unstructured data. It can also be both time-consuming and resource demanding. It does, however, offer the advantage of insight and nuances into the user-software context which might be impossible to gain by using other data generation methods [59].

We wished to observe the game used in a natural setting. However, for the game to be used in a completely realistic setting, there would have to be an actual educational setting where the students were taught about personal finance. Knowing the exact time when this was going to happen and plan accordingly was not possible in this study, as the test time slot is limited

to a specific time of year depending on delivery of the thesis. Regardless of this limitation, we wanted to observe user reactions and interactions with the game. Therefore, we would conduct controlled observations of playthroughs of the game in settings that were comfortable to the user. There was not much equipment required for the type of data gathering, as the game should be playable on any device which runs a web browser.

Performing controlled observations has the benefit of being more predictable than an observation in the field, and it does offer user insight and reactions if done correctly. There are, however, several factors that we will be unable to observe, like the spontaneous socializing often occurring in a classroom setting and how the game will be integrated into the existing educational frame. To simulate this, we set up a similar setting during a Skype-session where students would be playing while communicating over the Internet. During the observation, one of us would act as an instructor or teacher, available for questions and facilitate thought processes if it should be necessary.

Interviews

Our interviews were semi-structured. We opted for this form to be able to pursue interesting topics that may surface as the interviewee responds to the questions, but still following an agenda. They would serve as one of the main sources of information for how to design the game.

Questionnaires

We formulated two questionnaires for this study: The first for laying the groundwork for the design of the game and to learn more about the target group's current knowledge about finance, and the second one to evaluate the game. The first questionnaire consisted of questions regarding the respondents' knowledge of their own finance, their parents' finance and thoughts about their own finance in the future. For the second questionnaire we wanted to collect information about previous encounters with serious games and gaming habits as well as information about their feelings around our game and games like it. Both questionnaires had questions which gave demographic data. Using questionnaires to get information about the users' opinions about the game allowed us to easily compare the results because of the quantitative nature of some of the data produced by the questionnaires. Some data can be harder to compare, and this will be have to be interpreted and structured manually.

The questionnaire concerning user experience and motivation was based on

Research Questions 2.1 and 2.3. It was also inspired by the the EGameFlow scale for measuring enjoyment of e-learning games [20]. The questions were formulated as statements with a four-stage scale with the end labels ”strongly disagree” and ”strongly agree”. The neutral option often used in questionnaires was omitted to force an opinion from the respondents. There is always a risk of bias when using a Likert scale, in particular since the scale is not perceived as even. Cohen et. al states that it is false to infer that the intensity of feeling between strongly disagree and disagree is equivalent to the intensity of feeling between other consecutive categories on the Likert scale [7]. This must be taken into account when evaluating the results. The questionnaire was centered around the learning aspect of the game, as well as the immersion aspect. It was those two sections of the EGameFlow we took inspiration from. Specifically, EGameFlow inspired the questions concerning enjoyment, concentration and engagement as well as a question about further use of this type of learning method and how much they felt they learned from it. We also chose to ask the respondents specifically about different aspects of the game, rather than using the general wording of the EGameFlow questions. Considering the fact that the respondents would be 12-16 year olds, we wanted to be as clear as possible to ensure that all respondents understood the questions. Another reason to be specific was to see how much the respondents learned about the different aspects of personal finance included in the game.

2.3.4 Potential distortion of data

The data gathering methods mentioned in the above subsections results in both quantitative and qualitative data. When collecting and evaluating these data, there are aspects one needs to be aware of to be able to analyze the data as objectively and realistic as possible. In particular there are five concepts which need to be addressed [59].

Reliability

The reliability or consistency of a method describes how well the results can be reproduced given the same circumstances. Different methods certainly differ in how reliable they are. For instance, carefully controlled experiments have high reliability, while observing users in their natural setting will have a lower reliability. User interaction generally has a tendency to have lower reliability than experiments done on software, with biological samples and so on.

The observations will be performed in a more or less controlled environment: Some tests will be conducted one test subject at the time, and the same tasks will be performed by every test subject, given enough time. One problem is that the tests are confined to a limited amount of time, and there would be instances where we are unable to perform all the tasks. One test would be performed on subjects simultaneously. This could result in more unknown factors because of the increased user-to-test leader interaction, and interaction between users. Observation bias is something that also could affect the results, and we need to keep this in mind when taking notes during the observation. The tests performed by the test subjects by themselves at their leisure had more of a problem with reliability. The circumstances in which the test subjects perform the testing will be impossible to control, and therefore difficult to replicate with certainty. The interviews we will conduct will be semi-structured, so it will be possible to stray from the intended questions, and the answers will depend on the interviewer and interviewee's impulses.

Scope

Scope defines how much findings of an evaluation study can be generalized. For instance, methods which predict perfect and error-free behaviour are not applicable for novices using learning to use the system which the method is measuring.

The study is limited to the test subjects we would able to acquire during the test phase, and these are not necessarily a general representation of the demography of potential test subjects. Most test subjects would be from cities in Norway or from the home town of the researchers. We would try to distribute the game in such a way that other users can test it, and therefore potentially broaden the scope. When in secondary school, the pupils have not yet chosen whether to take a vocational education or proceed with general studies. This could benefit us in our testing because we would be able to test on children with a wider range of backgrounds and interests. There would also be a difference in how much the users know about personal finance depending on age and how much they have been taught previously to testing. This is something we need to consider when interpreting the data. The users willing to test the game could also be generally more positive to the game, while the users who are less motivated will abstain from testing. This will distort the result, giving it a potentially positive bias and making it harder to draw conclusions from the results. In an educational setting, students do not necessarily have the option to abstain from the teaching method.

Validity

The validity of an evaluation study describes if the method measures what it is intended to measure. This encompasses both the method itself and the way it is performed. If the goal of an evaluation study is to find out how users use a product in their home, it would be inappropriate to conduct a laboratory study where the product was used.

Considering the fact that we will not be testing the game in a classroom situation where the game typically would be played, does lower the validity of the evaluation study. Ideally, the game should be in a learning context where the students first would learn about elements of personal finance. They would then use their acquired knowledge to succeed in the game. However, it could be argued that there are some common aspects of the observation and a real-life scenario. In the observation, the test leader acts as an expert on the subject, and is available for any questions if they should arise. In addition, a different learning situation could be proposed: The students could learn about personal finance earlier on, and the game could be played as part of the homework. In that case, the tests would have higher validity, as the test situation would be closer to the actual usage situation.

Bias

Bias is a phenomenon that occurs when the results of an evaluation study are distorted. A computer science with a specialization in design student might be more sensitive to certain design flaws or personal preferences that will reflect onto the results. Bias may be difficult to detect because the researchers themselves could be biased and not deem certain behaviour important. The result could be that the researchers pick out the data they think are important. In addition, researchers may distort results while conducting the research. In interviews, the interviewee's response may be affected by tone of the researchers voice, facial expression or phrasing of the question.

There is most certainly a potential for bias in all of the evaluation methods. For the observation, we must take great care to observe all kinds of signals from the test subjects, and take good notes. We must be careful to read too much or too little into things that might happen during the observation. For the questionnaire, there might be a bias from the respondent to answer positively because they already opted in to test the game. In addition, there might be a bias against answering the most extreme on the questionnaires(strongly agree/strongly disagree).

Ecological validity

Ecological validity is a measurement for how the environment in which the research is performed may influence or even distort the results. Laboratories are very different from a natural setting like the user's home, and therefore have low ecological validity. The opposite applies as well: The user's natural setting has a high ecological validity. Ecological validity is also affected when participants are aware of being studied. This is sometimes called the Hawthorne effect [49]. A participant may act upon other factors than just the study being conducted, or may experience results that are not actually present. The latter is called the Placebo effect.

The students will be aware that they are being studied during the observation, and one must assume that they alter their behaviour to appease us in some way. They may be more inclined to answer positively, and this is one of the reasons we decided to distribute the game and a questionnaire. We will compare the results and see if there are large differences between the two sets of tests subjects.

2.3.5 Ethical issues

A few ethical issues may arise when we conduct our research. These are mostly related to how the collected data will be handled, and what kind of data needs to be collected. We will not have to gather any data that allows the users to be identified, but we will want to collect data like gender and age to be able to say something about the demographics and tendencies in different groups. However, there might be a need for contacting willing participants who wish to help us conduct further studies, preferably by e-mail. This information will not be published. When performing the observations, we will inform the participants about the information we wish to gather, guarantee their anonymity and tell them that they can withdraw after the observation has started if it feels uncomfortable in any way.

2.3.6 Practical issues

The largest practical issue of this study will be to find schools willing to distribute or actively participate. It may also be an issue to organize the distributed study, and to get enough participants. The time of testing for this project will be around whole day tests, exams and end of term, which might give the teachers and students less incentive to participate. We will have to contact widely to get enough respondents to be able to draw some conclusions with some degree of certainty.

We have presented the hypothesis that Norwegian youth do not have enough knowledge of personal finance, as well as the accompanying research goal, questions and metrics. The rest of this thesis will attempt to find out if a digital game can contribute to teaching them how to handle their own personal finance. We will also try to establish what effects using a game will have on the children's perceived learning. The development of the game will be done by using the design and creation research strategy.

Part II

Preliminary research

The objective of this part is to present the information gathered in the preliminary phase of the project. The first chapter gives an overview of relevant learning theory and other initiatives teaching children personal economy. This part also includes an examination of relevant technology. Lastly, the part presents the first questionnaire given to examine what children know about personal finance.

3 Games and learning

This literature review aims to map out existing research on the topic and draw out the elements which are essential to a successful and motivating game: Learning characteristics, how these can be applied in games and play, and finally, how video games can realize the learning potential. The chapter ends with a discussion of different technologies which could be used as a facilitator of learning through games. We did not find any research done on finance-themed games in education when performing this literature review.

3.1 Learning characteristics

Learning is defined by the Oxford dictionary as ”knowledge acquired through study, experience, or being taught”. The learning progress often follows a learning curve over time. Thus, the learning progress is a process which in turn produces changes in the target and those changes are relatively permanent [58].

Is all learning defined as equal? Could there be a difference between the classical cramming without retention, and learning by putting new knowledge into existing knowledge, potentially altering the frames in which the existing knowledge resides? The fact that these two ways of learning are more or less viewed as the same in educational institutions are the fundament for ”how children fail”, according to author and teacher John Holt [24]. He differentiates between these two types of learning, calling the latter ”true learning”. The other is more or less repetition and manipulation of the same symbols without any context. Holt also points to another important factor as to why children fail to attain knowledge: That they are bored, and the boredom is closely related to confusion. Why do we perform these tasks? What is the real world usage? A learning situation needs to be clear about the context for the students to be active and engaged.

A study comparing groups of students in three different learning environments found that boredom was frequently associated with poor learning, while frustration was less associated with poor learning [3]. Confusion was also a common emotion. The study showed that the learner went through a state of intense thought during learning. It also implied that boredom was the one of the cognitive-affected states which was the closest to being a non-transitory âĂIJmoodâĂİ. Once a student is bored, it appeared to be difficult to transition out of boredom. On the other hand, frustration appeared to be a natural part of a cognitive processing activity, if it was not caused by events outside the learnerâĂŹs control, such as a program bug.

Vygotsky argues in ”The role of play in development” that play is a way for children and adolescents to test ideas, develop new skills and participate in previously untested social roles [72]. It is a way to mimic concepts and thus develop abstract thoughts, but these can also be transferred into real situations, as the actor understands it. The playful situation does not arise from nowhere. It is planted into the child’s mind by something external. In other words, play is a way for children to acquire knowledge, even if the knowledge has basis in the understanding of the player. If the knowledge to be learned is fully understood by the player, play can be an immersing and engaging way of using this knowledge in new situations.

3.2 Learning through games

A game can be described as play placed in a system with certain characteristics and restrictions. Salen and Zimmerman define a game as, "A system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome" [57]. Using games as an organized way of facilitating learning is not an idea that has emerged along with the success of video games, or even the last hundred years. Plato said: "No compulsory learning can remain in the soul(...) In teaching, train them by a kind of game, and you will be able to see more clearly the natural bent of each" [53]. In "What makes things fun to learn?", Thomas Malone presents different aspects vital to good and engaging games. These aspects apply to all kinds of games, not just digital games.

Challenge

Malone points at four different factors which together ensure that the outcome of a game is uncertain, a deciding factor for a game to be challenging: Variable difficulty level, multiple level goals, hidden information and randomness [42].

Clear goals are important for motivation. Without a goal, or "a clear, quantifiable outcome", the game ceases to be a game. Short term goals seem to be more motivating than long term goals when it comes to interest and performance [4]. Malone also suggests that there can be other aspects of goals that affect motivation, such as the player's ability to associate with the context of the goal or if the goal is a part of an intrinsic fantasy. Further variation can be achieved by having both fixed goals and emerging goals.

If there is no uncertainty to whether the player will reach a goal or not, there is no challenge. Together with hidden information and randomness, the game experience can be much more challenging and engaging.

A variable difficulty level makes the game more accessible to players with different skills. Variable difficulty level can also promote improvement in the game. If the player masters a difficulty level he did not previously master, the player has improved some skill to make him better at playing the game.

Malone also describes the difference between extrinsic and intrinsic motivation and connects it to challenges faced when designing a learning game. Learning games can be extrinsically motivated in the form that the user will get to use what they learn when faced with a challenge needing the achieved skill in the real world. However, the users might not see this outcome when playing the game and therefore not be motivated by it.

Fantasy

The American Heritage Dictionary defines fantasy as, ”mental images of things not present to the senses or within the actual experience of the person involved” [9]. Fantasy can be divided into two categories: Intrinsic fantasy is when the skills of the player influences the fantasy in the game that again is connected to the player. Extrinsic fantasy is fantasy where only the players skill affects the fantasy. For example whether an answer is right or wrong [42]. The fantasy element can have cognitive aspects: The fantasy can reveal how knowledge can be applied in new settings. It can also be part of the skill learning, and the player must later transfer the knowledge to a real-world situation. Malone argues that the intrinsic fantasy is the more engaging fantasy.

Curiosity

Curiosity can be evoked by providing information which is novel, but not incomprehensible. Optimally, the learner should have expectations about what will happen. Sometimes, those expectations will not be met.

Sensory curiosity is the use of audio and visual effects to capture the learners attention. Cognitive curiosity describes how it motivates the player to want to learn more by leaving out information, leaving contradicting information and compiling knowledge.

3.2.1 Digital game based learning

There have been many experiments conducted on the motivational effects and learning effects of digital games in educational settings. Most of these experiments report positive outcomes [12] [25] [6]. Some studies emphasise the importance of the features of the game for it to promote learning and motivation [14].

Squire points out the difference between e-learning and games, and how e-learning has a reputation for being dull and ineffective. On the other hand, games are reputed to be immersive and fun [61]. He does not question the fact that games might be used to support learning, but rather how this can be done. He further argues that the history of educational gaming suggests that the media which does not fit into the social organization might be abandoned. The secondary school pupils questioned the introduction of a commercial game, in this case the computer game Civilization III, into the classroom, especially when it took a long time to get into the game play [18]. He argues therefore that games are not necessarily a âĂIJsilver bulletâĂİ

for all audiences, and so the teacher must be able to offer other kinds of education. Different students also enjoy different kinds of games: Learning through failure is a way of forcing through knowledge, but not all students enjoy difficult games. For them, the rejection of the game might have been perceived as an evaluation of their value as a student, rather than a valuable learning experience. He also points out that for games to be brought into the schools successfully, the environment needs to be ready for it: There must be a good educational system which supports the curricular innovation built on the properties that make games compelling for the games to flourish.

Keeping a game fresh and interesting can be an important aspect of design. Through the results of a quasi-experiment and using the web-based student response system Kahoot! [39], Wang argues that key points for keeping a game fresh and replayable are many-faceted and includes competitive nature, social components, immediate feedback, visuals and audio, randomness, modifiability, ground for creativity to blossom in addition to being relevant [73].

A study comparing two high school classes compared the effect of a computer game based education to a traditional approach [50]. The subject taught was computer science, and both classes followed the same curriculum. The design of the game deliberately avoided role-playing gender and violence bias. The game was a knowledge game taking place in a maze, and it had both knowledge building elements as well as traditional game play elements. Students with previous experience with computer games indicate a more positive attitude to the educational game. However, this did not impact the actual learning outcome. The study also indicated that the gaming approach was both more effective in promoting knowledge, and also more motivational. The study was done on adolescents, who can be harder to motivate. The game was also suggested to be used in other areas than computer science. The game was designed to be a short-term intervention in class. There seemed to be a preference to more sophisticated game experiences, when asking the students for improvements to the game.

Mark Prensky argues that the key to learning is keeping the learner motivated and that this is a feature many computer games have [54]. He argues further that this connection makes it natural to try to combine learning and computer games. One reason for computer games being able to keep the player motivated might be that most games have a clear goal of what the user is going to achieve.

3.3 Exploration of technology

Different factors were examined when determining what kind of technology to use to develop the prototype. To be able to go through fast iterations of development it was important that we chose a technology that we were familiar with or was easy to become familiar with. Since we were to develop a game we examined what technology was used in different games similar to what we wanted to achieve.

3.3.1 Unity

Unity is a popular cross-platform game engine designed to make it easy to create games for several platforms by targeting different API's [65]. Pia had some experience with it from the subject Experts In Teamwork [48]. Using Unity would mean to create a game directed towards one specific platform. Since we wanted the game to be easily accessible, this was not ideal.

3.3.2 Duolingo

Duolingo is a successful learning application for teaching language [29]. Both the web page and the ios and android applications are apps we wanted to take inspiration from as we personaly find them fun to play and educational.

After some research we found that the Duolingo is made with a large variety of technologies [44]. Because this is a page with a lot of users world wide, their needs for stability and good back-end solutions are greater than ours. They use Python for most of the back-end and different Javascript libraries and frameworks for the front-end. Since our needs for a back-end were still quite limited we decided to start with the front-end technology and from there on extend our application after what was needed. As can be seen in Chapter 7 we started out with only Javascript, CSS and HTML before extending to use the framework Meteor.

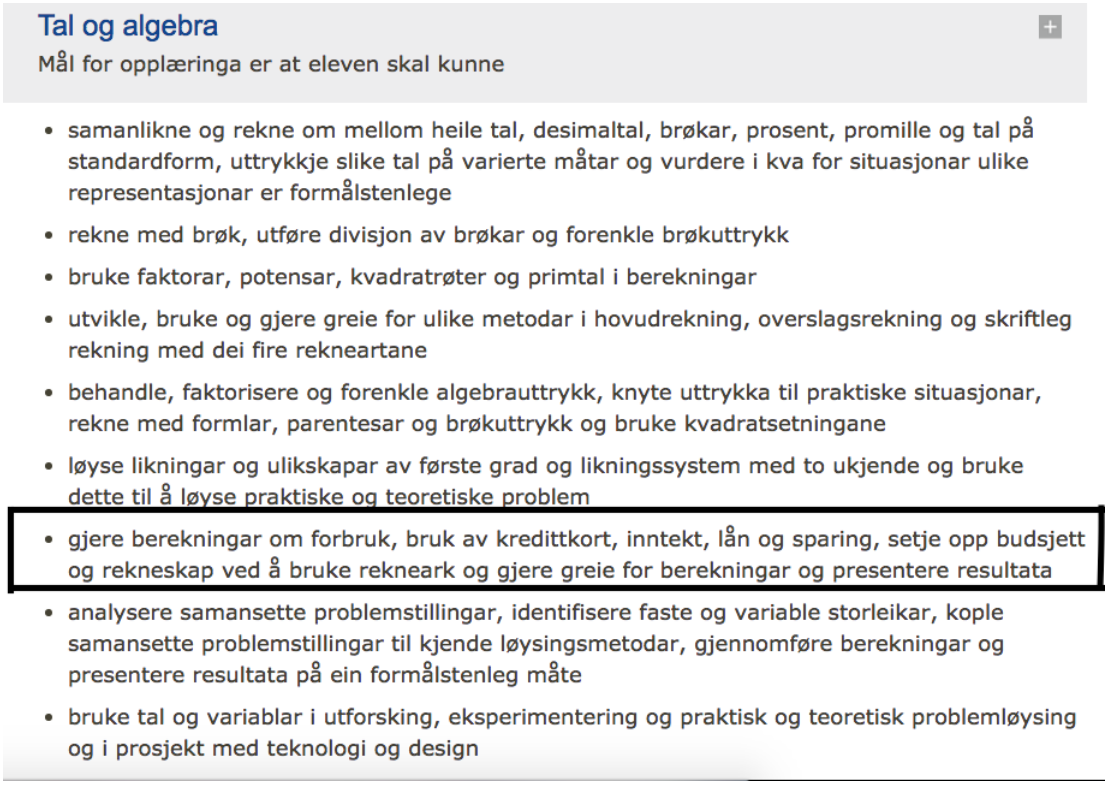
Learning through games is more or less a structuring of play, and can be converted into something educational as well as motivating. Most of the discussed literature agree that games, and in particular digital games are a good way to facilitate learning, but the games need to address factors which are important for both successful learning and successful games. Malone's "What makes games fun to learn" sums up many elements revisited throughout the literature, and the points he makes is vital to educational game design. Short term interventions seem to be successful. The players need clear goals and motivation to actually play the game. The game in itself should be intuitive and easy to understand if it is to act as a short term intervention, but even replayable and more complex game can be alienating if they are too hard to master. The presence of a teacher is also pointed out as an important success factor, as the need for more information may arise during the time the game is used. The classroom of today is ready for games which utilize the technology already present.

4 Related Work

To get a better understanding of the themes children need to learn about we explored other existing learning initiatives concerning personal finance. In addition to this, we explored the relevant curriculum in Norwegian schools. The results of this exploration are presented in this chapter.

4.1 Curriculum

To get familiar with how personal finance is taught in education today, we examined the curriculum in Norwegian schools. There we found that personal finance aspects are mainly taught in secondary school. This is when the children are 12 - 16 years old. This made us focus our game towards children in secondary school and the rest of our work was aimed towards children of secondary school age. The relevant themes are covered by the math curriculum found at Utdanningsdirektoratets web pages [70]. The relevant parts of the curriculum can be seen in Figure 4.1.



Tal og algebra

Mål for opplæringa er at eleven skal kunne

- samanlikne og rekne om mellom heile tal, desimaltal, brøkar, prosent, promille og tal på standardform, uttrykkje slike tal på varierte måtar og vurdere i kva for situasjonar ulike representasjonar er formålstenlege
- rekne med brøk, utføre divisjon av brøkar og forenkle brøkuttrykk
- bruke faktorar, potensar, kvadratrøter og primtal i berekningar
- utvikle, bruke og gjere greie for ulike metodar i hovudrekning, overslagsrekning og skriftleg rekning med dei fire rekneartane
- behandle, faktorisere og forenkle algebrauttrykk, knyte uttrykka til praktiske situasjonar, rekne med formlar, parentesar og brøkuttrykk og bruke kvadratsetningane
- løyse likningar og ulikskapar av første grad og likningssystem med to ukjende og bruke dette til å løyse praktiske og teoretiske problem
- gjere berekningar om forbruk, bruk av kredittkort, inntekt, lån og sparing, setje opp budsjett og rekneskap ved å bruke rekneark og gjere greie for berekningar og presentere resultata
- analysere samansette problemstillingar, identifisere faste og variable storleikar, kople samansette problemstillingar til kjende løysingsmetodar, gjennomføre berekningar og presentere resultata på ein formålstenleg måte
- bruke tal og variablar i utforsking, eksperimentering og praktisk og teoretisk problemløysing og i prosjekt med teknologi og design

Figure 4.1: Excerpt from the secondary curriculum with the relevant goal marked

4.1.1 Themes taught in Rosenborg school

The official documentation of the curriculum in the Norwegian schools is mainly presented as bullet points on free and publicly available information network. Table 4.1 presents the aspects covered at Rosenborg school, and in what year they are taught.

Grade	Theme
8.	Budgeting, Simple accounting, The difference between cash, cards, checks etc, Wages, Currencies, Taxes
9.	VAT, Difference between piecework incentive pay and provision based salary, vacation money
10.	Savings, Loans, Interest, credit card payment

Table 4.1: Themes taught per year in secondary school

4.2 Existing initiatives

A recurring theme throughout the conversations we had in Chapter 5 showed an agreement that children do not know enough about personal finance when they begin handling their own money. The professionals we spoke to showed enthusiasm when we explained our idea. They confirmed the idea that there is need for something to teach our children how to handle their own personal finance. Even though it is a part of the school curriculum, the children do not understand how to handle their personal finance.

Also confirming that this is an unsolved challenge in our society is the variety of other initiatives trying to increase awareness of aspects connected to personal finance targeting children. Below we will give a short overview of some of these initiatives.

4.2.1 Å sette bo

Å sette bo is an initiative some municipalities have for children when they are 14-16 years old. In this project the secondary school pupils have to find and "apply" for a job they find in the paper or on the Internet, for instance at Finn.no [17]. They then create a life based on the job they choose and what family they think they will have. Often the schools cooperate with banks

visiting the school to inform about the things you have to know when you are starting a life of your own.

4.2.2 Sjef i eget liv

Sjef i eget liv [27] is an initiative created by Husbanken [26] in collaboration with Ungt Entreprenørskap [69], Nav [45], Finans Norge [15], and Papirbredden karrierenettverk [51]. This initiative aims to create awareness amongst youth about budgeting and prospective expenses. It shows what basic expenses cost in reality, and calculates how long it will take for the user to save up enough money to get a house mortgage by using a budget made by the user. When the user edits the budget, a house on the bottom of the screen moves further away or closer to show how long it will be before the user has saved up enough money to get a loan to buy it. The user also gets an overview of the percentage of the user's income spent in the different categories. Figure 4.2 shows a screenshot from the web page.

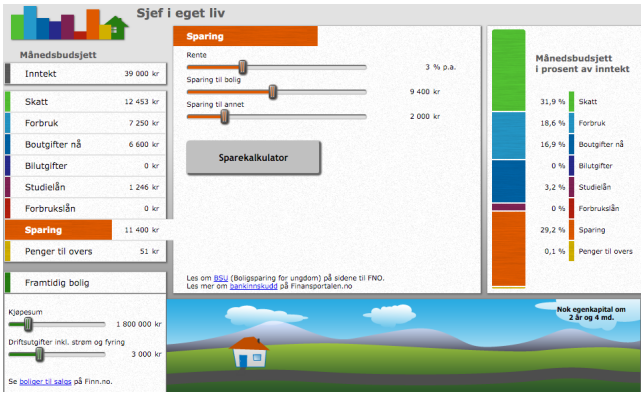


Figure 4.2: Sjef i eget liv

4.2.3 Økonomilappen

Økonomilappen is a quiz initiative created by Finans Norge [15] and Forbrukerombudet [19]. The player gets questions and tasks based on either general personal finances, or you can narrow it down to different topics like consumer rights and loans. This initiative is mainly directed at young adults and older, and aims to enlighten the public of their consumer rights and topics related to personal finance. The web page also contains different calculators to give the users an impression of what they have to do to save up for larger purchases like a flat or a car. It also contains articles with information about

what you have to consider when entering different stages in life. Finally, there is a page with information of what to consider when planning to buy a house, how saving works and how credit card loans and other types of loans work.

4.2.4 Pengeby

Pengeby [52] is a game aimed for younger children aged from five to nine years old. In the game the children play characters living in the city of Pengeby. To be able to buy furniture and other things for their virtual room the children have to earn silver and gold coins. They earn those by helping out in the local post office or the local farm. They can also gather apples to make juice from and sell. During the game the children get questions about different themes. They can also travel with a time machine to different times and learn about different concepts of history. Figure 4.3 shows the start screen of the game.

Figure 4.3: Pengeby

4.2.5 Lærepenger

The last initiative to be presented is a website created to build awareness amongst children aged 10-11 about personal finance: “Lærepenger.” [10]. It was created by DNB [11] in cooperation with Norwegian Red cross [46]. The initiative aims to increase the amount of personal finance taught in schools and functions as a support tool for some of the current curriculum. It has videos of families from Spain, Poland, and Sweden explaining how they manage their personal finance. In addition to this there are five “lærepenger” with different tasks in each to teach children the value of money and how to manage their own money.

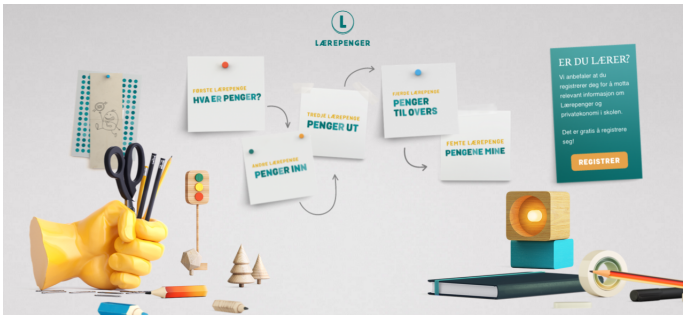


Figure 4.4: Lærepenger

4.3 Available technology

The use of tablets in Norwegian education has increased. The first test project was conducted in 2011 [16]. In 2016 the use of tablets have become widespread. A quick search on the Internet shows plenty of results; newpaper arcticles [64] [23] and blog posts showing schools using tablets [2] [21]. Despite this widespread use, the research done in Norwegian schools on this area is limited.

The schools not using tablets have computers available for the children. Either the children have their own computer, or they have computers available for sharing. At Rosenborg school, where we got in contact with a math teacher willing to help us during our project, all of the children had their own personal computer.

The Bradford Networks did a large study questioning IT and networking professionals representing colleges/universities and K-12 school districts in the US and UK, receiving responses from over 500 institutions [66]. They found that there is a wide acceptance of at least some level of "Bring your own device" (BYOD) across all educational institutions. Technologies that students bring to school are very diverse. The devices are not just for personal use, they are also being integrated into the classroom. The institutions who are concerned about BYOD are uncertain about how to manage network visibility and control.

Children do not know enough about personal finance and we have decided to focus the rest of the project towards children in secondary school. There exists a number of initiatives directed towards enlightening the Norwegian population and especially children of personal finances. All of these try to raise awareness of the importance of being in control of your own personal finance. We want our game to be an addition or a substitute of the methods already used when teaching personal finance, unlike many of the existing initiatives out there. This meant that we from here on had a focus towards the content of the curriculum.

5 Interviews and Questionnaire

This chapter presents the information gathered from the interviews that were performed. The questionnaire distributed to gain a deeper understanding of the problem and gather ideas for gameplay and functionality will also be presented.

5.1 Results from Interviews

The curriculum bullet points presented in Figure 4.1 were not detailed enough to get a complete picture of what the target group were currently learning about the subject. We therefore decided to gather more information. We interviewed two employees at Sparebanken Midt-Norge (SMN) [60] working with an initiative where employees from the bank visit schools to teach personal finance. We also spoke with representatives from Ungt Entreprenørskap (UE), a pro-bono organazation which, among other things, gives children of all ages guidance about personal finance and career choices. Lastly, we cooperated with a mathematics teacher at Rosenborg school [56] who gave us insight into the teaching situation at his school, and gave us the opportunity to test our prototype on some of his students. The prototype test is described in Part IV.

5.1.1 Sparebanken Midt-Norge

Sparebanken Midt-Norge has cooperated with Ungt Entreprenørskap in a project called "Økonomi og karrierevalg", or finance and career choice. The project is aimed at students in the 8th-10th grade, and is derived from the project "Å sette bo", described in Section 4.2.1. They informed us that the competitive aspect of the project was important, and they experienced much excitement among the students, even though the project is paper-based. They pointed out that students this age have a poor concept of what items and services cost, and that predefined expenses would be preferable. They also use unexpected expenses in this project. They said it is important to let the students use their own priorities and interests in some way, especially when discussing choice of occupation and choices in the game.

5.1.2 Ungt Entreprenørskap

To get more information about Økonomi and karrierevalg and examine what other concepts UE has involving finance we met with two representatives from the leadership of UE Trondheim. They told us about what they consider to be the challenges when teaching secondary school pupils about personal finance. They especially pointed out the fact that secondary school pupils are unrealistic in their perception of personal finance. Their impression was that secondary school pupils in general do not know enough about personal finance and need to learn budgeting, how taxes work, what pension is and how insurances work. They told us that because of the children's lack of knowledge it is important to teach them the different concepts by explaining

them thorough. UE's experience was that children usually get motivated by interventions in the traditional teaching setting. They also advised us to speak to school representatives to get more information. One of the interviewees told us a story about her son. The son was eleven and had asked to buy something. When his mother said that she does not have the money he responded: "But you do have a card?" This shows a limited understanding that earning money gives you money in your bank account that you then can use.

5.1.3 Teacher

The Rosenborg school teacher gave us a detailed overview of the themes taught through secondary school at his school. He also explained how his class work through the curriculum. He explained that they mostly use regular classroom activities with him presenting the material, and the children solving tasks from their textbooks. He also confirmed that this type of teaching is common throughout the school and in general, and that he has seen few examples of other ways of teaching personal finance. He was also positive to focusing more on what he described as "life knowledge", and that the choice of theme could in itself be a motivating factor. He pointed out that the fact that traditional ÂtÂtblackboard-teaching" still is the most prevalent teaching method could also be used to our advantage. Especially 8th graders are easily impressionable and tend to hype each other up, and their enthusiasm for variation could make them motivate each other. He also said that including familiar life elements would create engagement, such as adding options for having a pet.

5.2 Results of Questionnaire

Studies targeting this aspect of the mathematics curriculum have not been performed in Norwegian schools. Programme for International Student Assessment(PISA) has a framework which allows an assessment of financial literacy, but Norway does not participate in this part of PISA. This makes an assessment of the results of the existing curriculum difficult. We decided to get more direct insight into the target group's knowledge level than could be provided through the interviews we performed with representatives from Ungt Entreprenørskap, Sparebank 1 and the teacher. To be able to answer Research Question 2.2, we distributed a questionnaire to make an attempt at mapping the knowledge level of our target group.

This section begins by presenting the demographics of the respondents and

questions about the respondents' current personal finance. The demographic questions are relevant for the scope of the questionnaire and how the data is interpreted. Following is a part about the respondents' view of their parents' finance. Finally, there is a section about the respondents' finance in the future. The questionnaire will be presented in Appendix A. For the purpose of this report, the relevant figures have been translated, and some data has been altered slightly to be able to quantify it. The meaning of the data has not been altered, even though the wording has. Where more complex qualitative data has been altered, there will be a summary of the findings without attempting to quantify the data into graphs. The raw data which has been altered in this presentation are presented unchanged in Appendix B.

5.2.1 Demography

The questionnaire had a total of 46 respondents. The first questions concerned age, gender and which school the respondents attend. The difference between children aged 12 and 16 can be quite significant, and this, along with the other demographic questions, will affect the way the data is interpreted. As seen in Figure 5.1, the majority of respondents were girls. Figure 5.2 shows that most of the respondents were between 13 and 15 years old, which is expected, as 8th graders start the year they turn 13, and the 10th graders leave school the year they turn 16. Most of the respondents are from schools in Hedmark, and the rest of the respondents come from schools in Sør-Trøndelag and Vestfold, see Figure 5.3. This distribution, as well as the number of respondents, means that this questionnaire is not representative for all Norwegian children between 12 and 16, and so there can not be drawn any definitive conclusions. However, this questionnaire can be indicative of tendencies, and should only be viewed as such.

5.2.2 Respondents' finance

The next part concerns the respondents' relationship to their own finance. The first question is about the income level of the respondents. Comparing the answers to how the respondents' answered the rest of the question could indicate if there is any correlation between income level and insight into their own and others' personal finance. The responses show there is a wide range of income level. The question about what kind of work they do for their income, see Figure 5.5, shows that a majority earn their money by doing work around the house. There is also a total of 26,1 percent who either work and get allowance or earn their money by just working. The income level does in most cases match the amount of work put into it, but not in all cases.

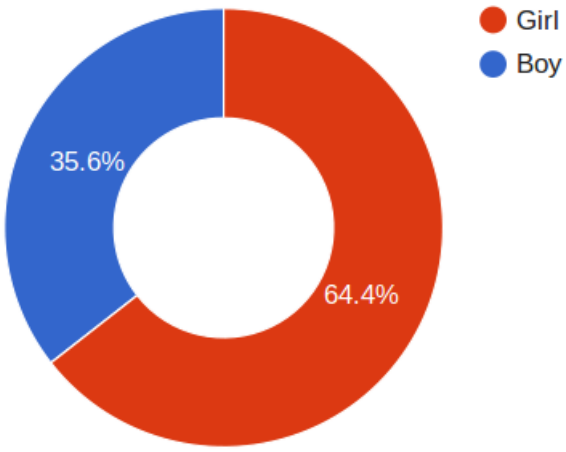


Figure 5.1: Gender distribution

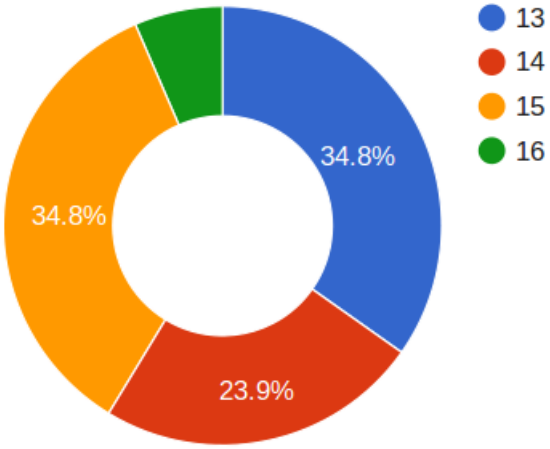


Figure 5.2: Age distribution

16 percent of the respondents who earn 200 NOK or less a month say they work. They are 54,3 percent of the total. There were no questions about working hours or pay in this questionnaire, and so there is no real foundation for discussing this further. Of the 15,2 percent who earn more than 800 NOK, 1/3 earn their money without working for it.

The question about what the respondents spend money on has not been processed to fit into quantifiable data. The tendency is that the respondents spend money on food, mobile phone subscription, social events, grooming products, clothes and games, but few produce a complete list. The respondents

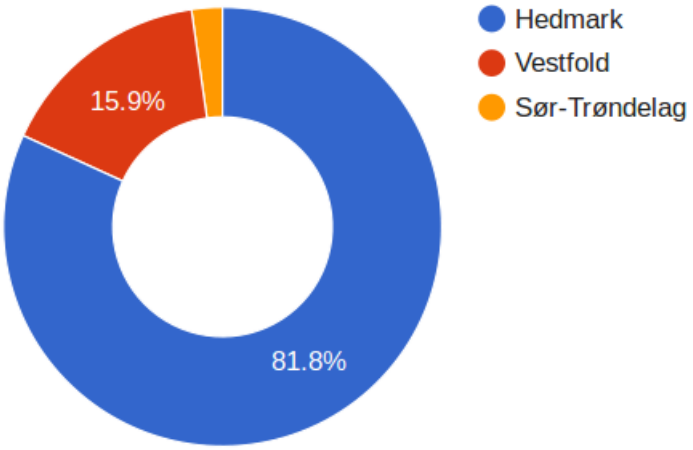


Figure 5.3: County distribution

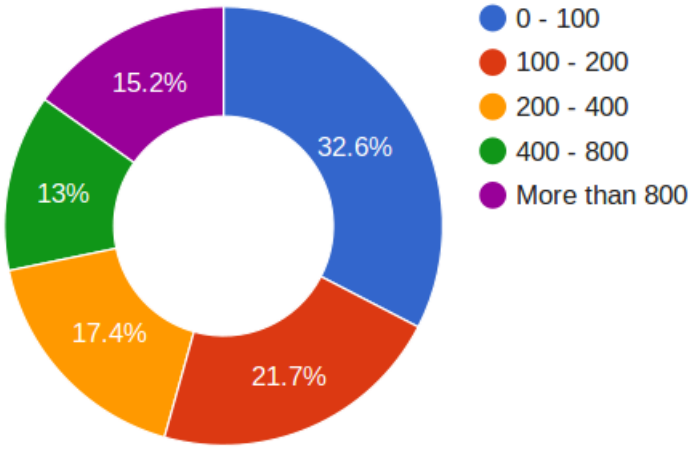


Figure 5.4: How much money do you earn per month?

answer 1-2 expenses on average.

According to a reference budget made by the National Institute for Consumer Research(SIFO), a girl between 14 and 17 costs 5085 NOK in individual expenses per month, while a boy between 14 and 17 costs 5345 NOK [8]. Even though this budget is an average budget and will vary from family to family, Figure 5.6 suggests that the respondents have a varied opinion about how must they cost their parents. The largest group, 26,1 percent, believe they cost their parents 500-1000 NOK.

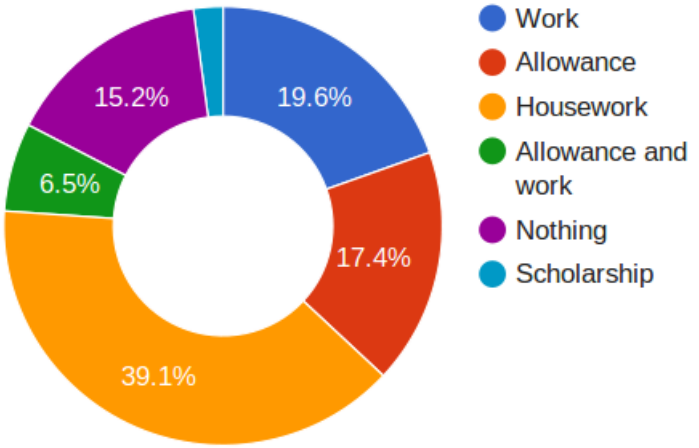


Figure 5.5: How do you earn your money?

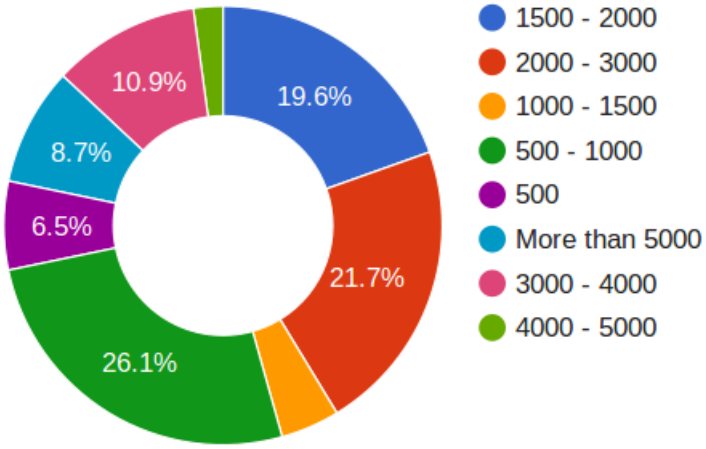


Figure 5.6: How much do you think your parents spend on you each month?

5.2.3 Parents' finance

The first question in this section is in a way related to the demographic questions in the first section, as it concerns the occupation of the respondents' parents. The answers present a good variation of occupation, which suggests that the respondents come from families with varying income.

All of the respondents could answer if they are renting or owning their current residence, see Figure 5.7. They were also given the option "I don't know", shown in Appendix A.

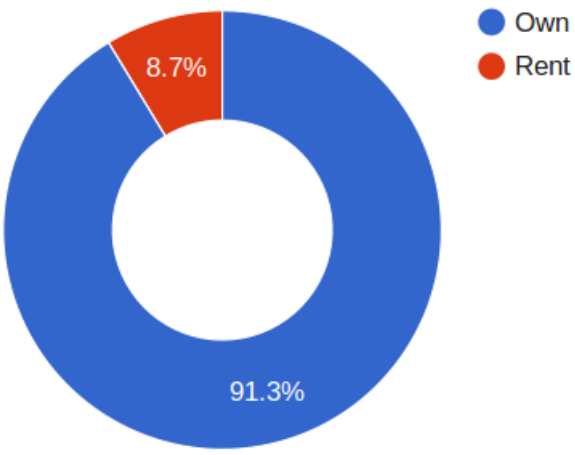


Figure 5.7: Do you own or rent your house?

The next question asks what the respondents think their parents spend money on. The SIFO reference budget has been used as a baseline for what a complete budget should include, but we believe that some of the budget items are more important, and thus the respondent should include them in their answers. The important budget items are: Food/Drink, Clothing/Shoes, Entertainment/Hobbies, Transport, Rent/Loan and Electricity. Electricity can be included in the rent, so if they have mentioned rent and not electricity, they might get a full score if they have a good list otherwise. The score scale is as follows: 0-2 correct answers gives rank 3, 3-4 answers gives rank 2 and 5-6 correct answers give rank 1. Rank 3 has a larger range than the rest of them, but only because it includes the situations where the respondents cannot think of any of the six. The result can be seen in Figure 5.8. In general, there is some variation in what kind of budget items the respondents have included in their answer. Some have included taxes as a part of the budget, which indicates they lack understanding of gross and net salary. Others have answered both rent and loan expenses without mentioning if one is for a permanent residence and the other is for something else. Whether they have neglected to mention this detail or simply do not understand the difference, is impossible to say from these answers. Figure 5.8 show that a majority are ranked number two. Rank three and one have almost the same distribution, but there is no correlation between a good score and age, as rank 1 is spread over the entire age range, and the same with rank three. There is also no correlation between earning money by working and answering well on this question. There is a majority of the respondents who work who are ranked third in their response on this question.

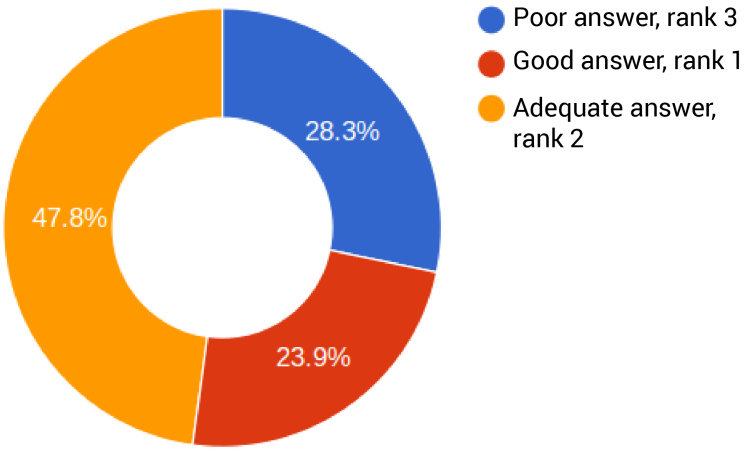


Figure 5.8: What do your parents spend money on?

The follow-up question concerned how the respondent thought their parents divided their income between the previously mentioned budget items. The question in itself is in hindsight a difficult one, because it is more or less useless to the respondent who have answered poorly in the previous question. It seemed that it was difficult to understand as well, and we will therefore spend little time dwelling on the results of the ones who clearly misunderstood the question or answered poorly on the previous question. There are examples of attempts to place a percentage of the parents' income on each of the budget items. However, there are few examples of well estimated percentages, if SIFO's reference budget is the guide. Food and potentially rent or loans are the posts which will consume a lot of the income, but almost none of the respondent seem to realize this. In short, the way the question was formulated, and the format the respondents had to answer in, may have affected the time spent on the question and gives distorted data because of that. If there is some interpretation to be drawn from this, it is that the respondents are unsure about budgeting and percentage calculations in general.

5.2.4 Respondents' finance in the future

The final section of the questionnaire present two statements about the respondents' finance in the future and a free text question.

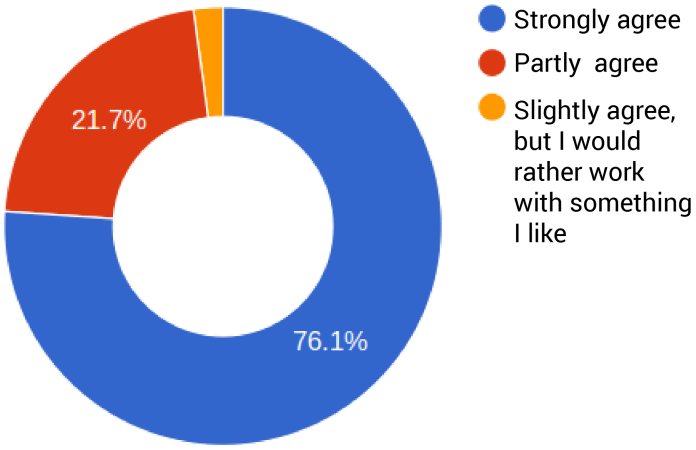


Figure 5.9: Money will be important for me in the future.

The statement presented in Figure 5.9 asks about the importance of money for the respondents. All of the respondents say that money will be important to them in some degree. One respondent says he would prefer to work with something that interests him.

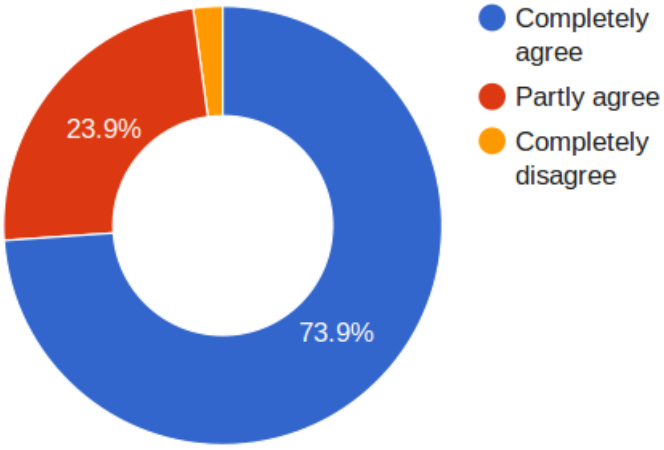


Figure 5.10: I want to own a house when I grow up.

The second statement, presented in Figure 5.10, asks about the respondents' desire to own a house of their own. A majority agrees wholly, while 23,9 percent partly agrees with this statement. A small minority completely disagrees.

The final question asks the respondents what they think is necessary to do be able to buy a house. Most respondents include money in their answer, and almost 50 percent mention having a good education and a job that pays well. However, few mention saving money over time or applying for a loan which they later will have to pay back.

The results from the interviews indicate that there is a large potential for games to enter the classroom when teaching of personal finance, and that previous attempts to engage the students have been successful. Fulfilling the curriculum should be the primary focus, as it is a deciding factor for whether the game is incorporated into the educational setting or not. We should focus on making the fantasy relatable, introducing choices and scenarios that are relevant for the students today, and will be relevant in the future. The results of the questionnaire suggests that even though budgeting is covered by the 8th grade curriculum, there is no indication that the older respondents know more about budgeting than the youngest respondents. The majority are, however, interested in buying their own house and having enough money to fill their needs, so there is an indication of motivation to learn the skills required.

Part III

Design and development

In this part an overview of the process of designing and developing the game is presented. This includes the game play, the technology used, the implementation and the architecture of the game.

6 Game Design

In this chapter an overview of the game play and design choices elicited during the suggestion phases of the project will be given. Functionality that was proposed, but not included in the prototype for reasons like time constraints, technical issues or that it was not promoting our goal with the game will also be presented.

6.1 Overview of the game play

The information we gathered during our interviews mentioned in Chapter 4 indicated that our game should focus on teaching the value of money. We received indications through our research that children do not have a realistic view of what it means to maintain a personal finance. The interviews we conducted pointed towards budgeting as one of the most important skills. This was also reflected in the current curriculum. We decided to base the design of the game around that skill. The game prototype was thus designed to simulate budgeting, and afterwards handling expenses during a fictional month, creating a fantasy that should be relatable for most users. The goal was to create a game where the player gets the feeling of what it is like to be an adult by handling challenges grown ups handle every day and to learn to think ahead and take into account situations which could arise.

6.1.1 End goal

When determining the goal of the game several aspects were discussed: Would it be motivating enough to see whether or not you have spent more money on a budget item than you initially budgeted? Should we build the game with sub-goals during the game play?

As a measurement of how well the game went, we began discussing a system giving the player a score based on different factors. How many of the budget items matched what they actually spent? Did they budget all their money? Did they budget anything for savings? We did, unfortunately, not spend enough time to make a good score calculation within the time frame for this project, and we started discussing this aspect of the game too late in the process. In the end, we landed on the decision that we would present all the available information on the end screen, see 6.7. If the player has spent more money than budgeted, the player will receive a pop-up warning him about that. If the player is successful in budgeting all his money, he will receive a pop-up congratulating him. The end goal is thus to avoid spending more money than the player has available. The information displayed on the summary screen allows for the players to perform a more thorough evaluation of the differences between the budget and the expense list.

6.1.2 Game play

The following sections describe the different parts of the game play. It progresses chronologically through a game, while explaining all of the different aspects.

Starting the game

The game begins by displaying a dialogue box which tells the player to choose different factors that will affect their finance. The players decisions, or skill to choose a sensible lifestyle, will thus affect the intrinsic fantasy of the game, creating a more engaging fantasy. These decisions include occupation, housing situation, if the player watches TV, uses the Internet, wants to own a car or wants to own a pet. In addition, the player gets to choose whether or not he wants to pay for insurance.

The player is asked to pretend they are adults throughout the game and that their decisions should be based on the life they want to live. The dialogue box the user is faced with can be seen in Figure 6.1. Choosing a grand lifestyle with low income would perhaps show low economical skills, but adjusting these choices also creates a more or less challenging game, which in itself could be motivating.

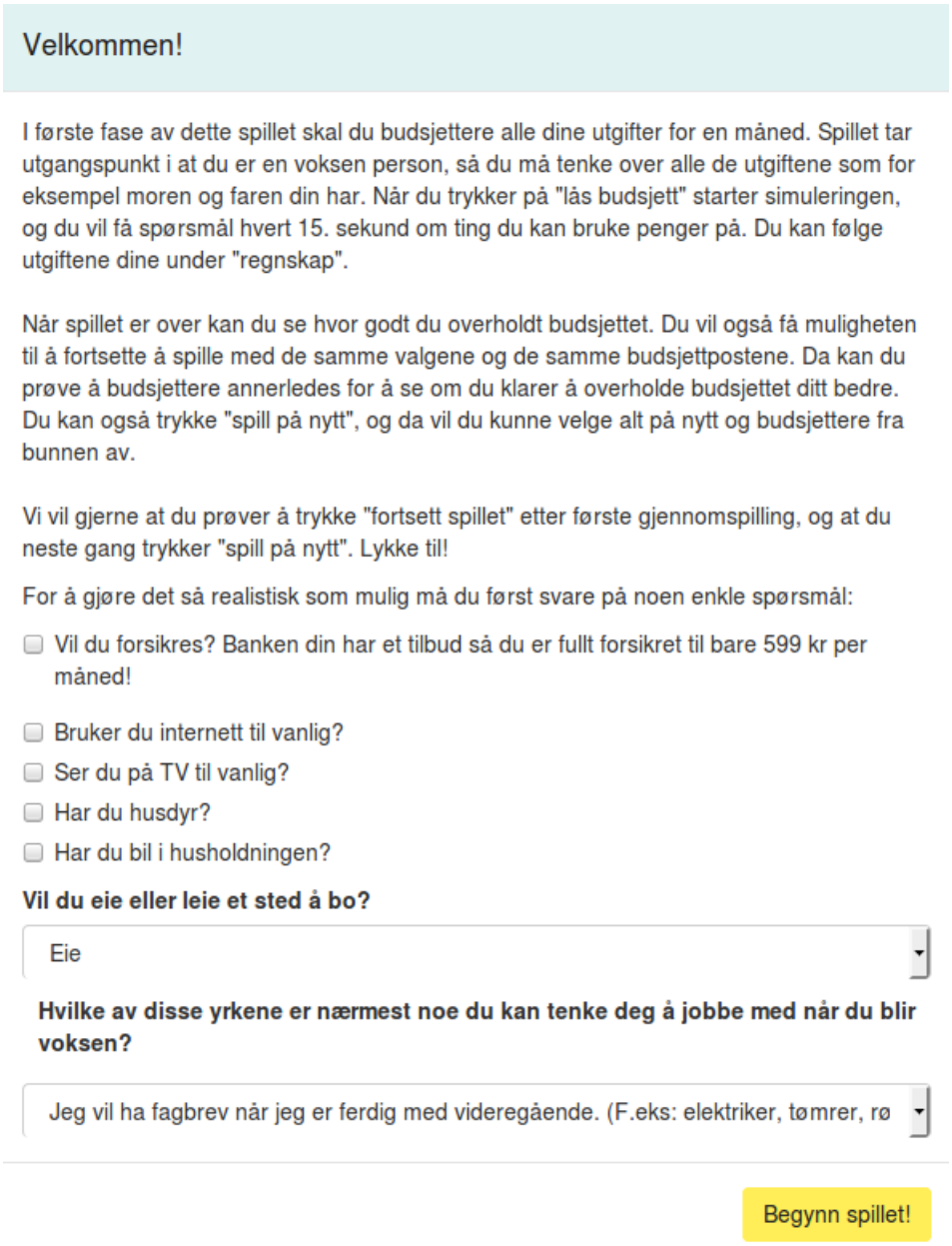


Figure 6.1: The start dialogue

Budgeting

The players first task is to create a budget, see Figure 6.2. The budget will have some mandatory expenses based on the choices the player made when faced with the start dialogue, and these cannot be removed. If the player

chose to own a car or a pet, there will also be an option to sell them and get refunded the mandatory expenses associated with them. The budget item associated with car or pet will also be removed. All budget items are associated with a category which makes it easier to compare actual expenses to the budget items.

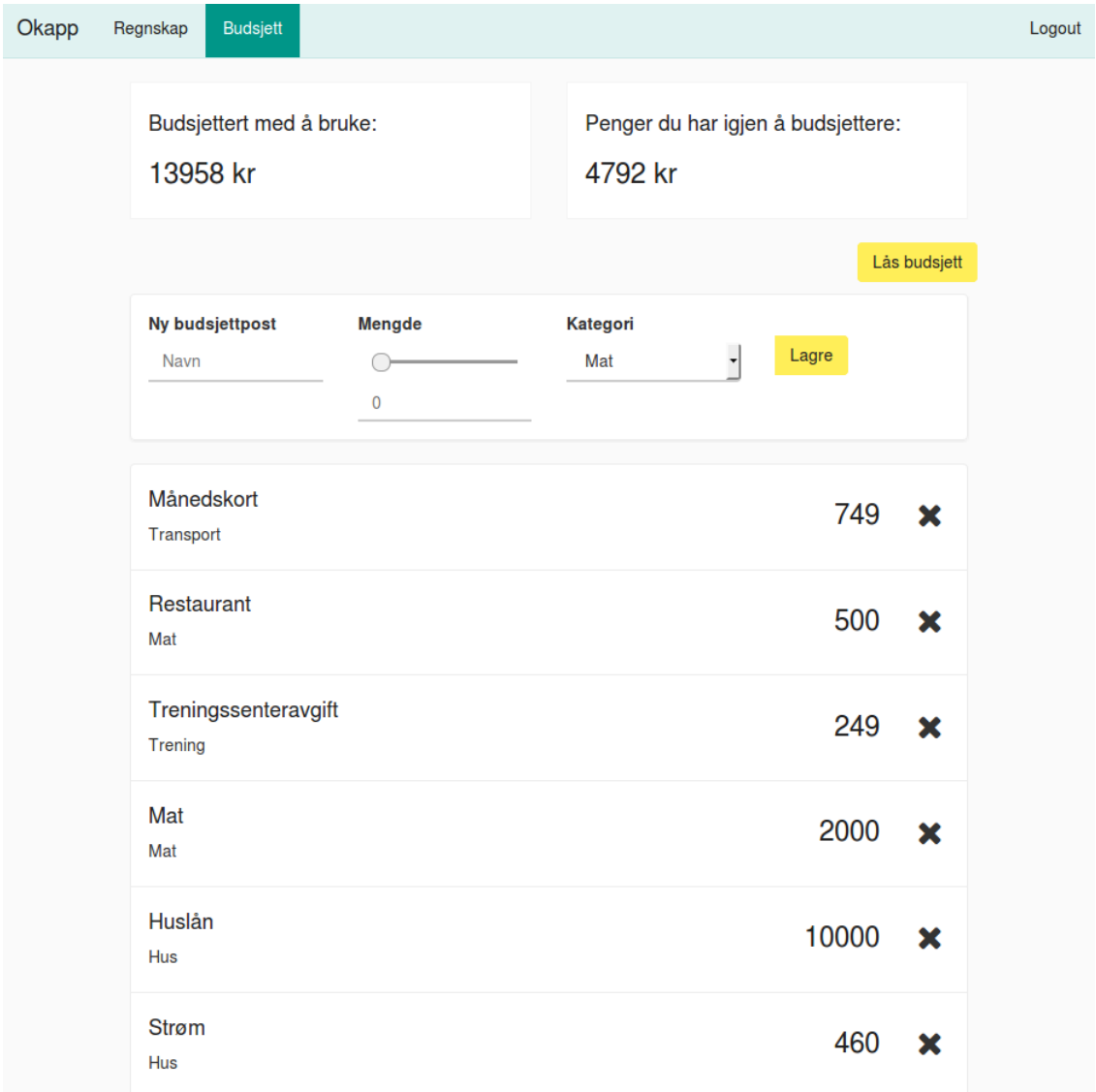


Figure 6.2: The budget screen

When the budget is finished, the user ”locks” it to begin the simulation. The design of the game is based on the fact that you cannot alter your budget while the month is ”running”.

Simulation

When the budget is locked, the ”time” starts running. The player must choose to buy different goods or services, or decline them, and ultimately face the potential consequences of those choices. Examples of these decisions can be seen in the Figures 6.3 and 6.4.

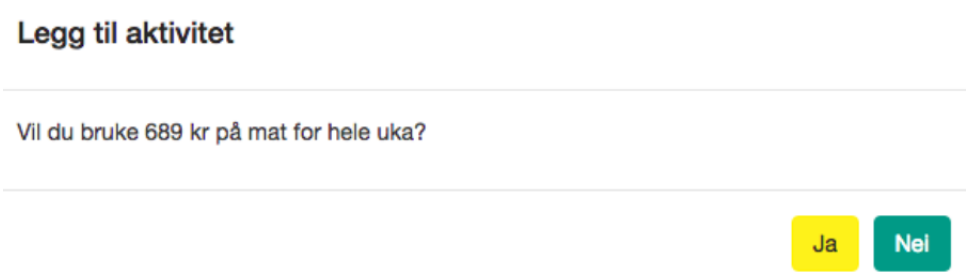


Figure 6.3: Example of the activities given as a choice to the user

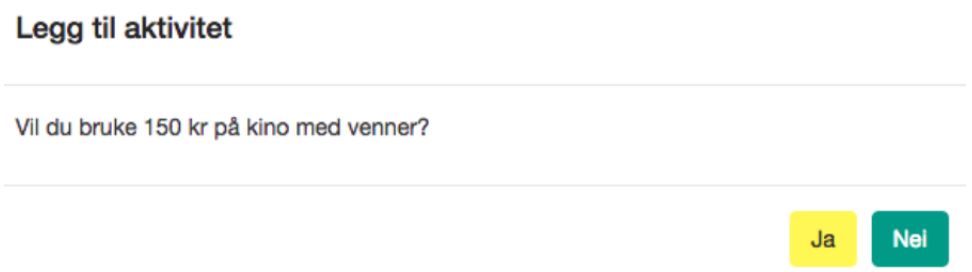


Figure 6.4: Example of another activity

Consequences

Some of the activities have associated consequences, which have a random chance of happening if you choose not to buy certain goods or services. It is random whether or not a consequence happens. This game mechanic is incorporated into the game to give the player some motivation to actually think their choices through, as well as giving the feeling of uncertainty and peaking their curiosity. We want the player to consider their actual needs in relation to the money they have, and not just save money without any regards for the consequences. For example, if the player chooses not to buy food for the entire week all at once, he might end up spending more money on

food because he goes to the grocery store while hungry. Another example of a consequence might be that the player gets sick and have to pay for antibiotics and a doctors appointment if he does not buy a winter jacket, see Figure 6.5. Using consequences was also an opportunity to use humor as a motivating effect.

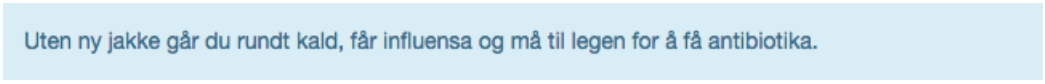


Figure 6.5: The consequence for not buying a jacket

End game

After a certain amount of activities, a number which can only be adjusted behind the scenes for now, the month is finished. The user then gets an overview showing their budget side by side with all of their expenses. This can be seen in Figure 6.6. They also get a short summary of the money they have spent and their remaining balance (See Figure 6.7). If they have money left they get an invitation to budget all of it the next month. If they have spent more money than they have they get debt that needs to be paid the next month. To pay this debt they have two options, to take an unsecured loan or pay with a credit card. These are the same option, but we included them both for the possibility of testing whether the children know it is the same thing or not and what their attitudes toward them are.

Continue playing

To be able to measure if the player improves at budgeting and handling his finance in the game, they have the possibility of simulating a new month with the same parameters as they chose in the beginning. If they have money left from last month they get extra money to budget.

Restart the game

The player can also start the game again to see if choosing another profession, changing housing situation or skipping luxuries will make it easier or harder to budget and keep to the budget during the simulation.

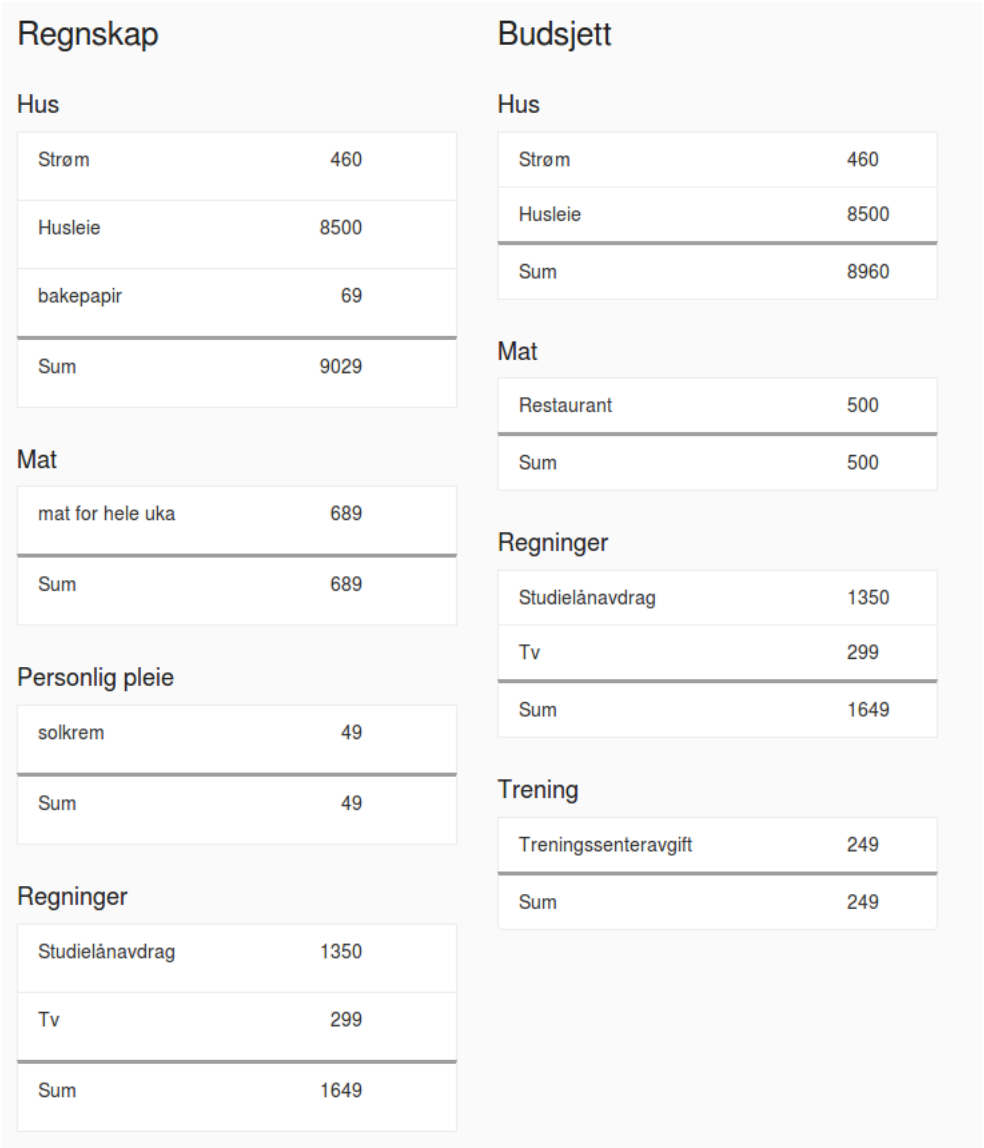


Figure 6.6: The budget vs. the expenses

6.2 Scrapped features

In this section we will give a short overview of game elements that were discussed during the suggestion phases of the project, but were ultimately left out from the prototype of the game. In this section we describe how the game could be extended.

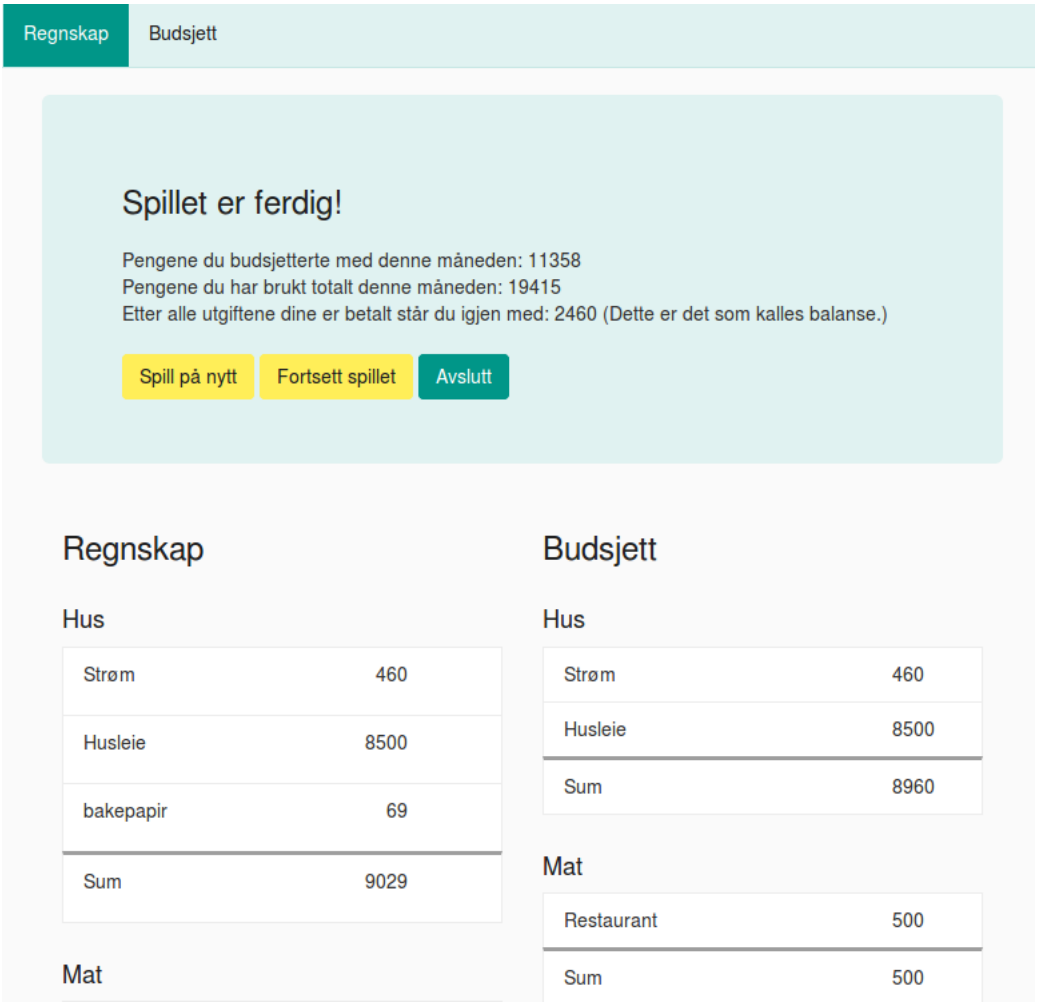


Figure 6.7: Game summary

6.2.1 Avatar

People play games in different ways: Some players choose to immerse themselves in the fantasy. Others optimize their game play purely for numbers and statistics. In the game, the goal is to become better at budgeting, not playing the game without considering real life situations and just saving money. To prevent this we discussed introducing an avatar. The avatar would get hungry if the player spent little money on food. It would also get sad if no time is spent with friends. This was not prioritized in the early iterations as tests showed most children made realistic choices and immersed themselves into the fantasy. This, along with time constraints, resulted in this feature being left out.

6.2.2 Poor finance state

One idea we discussed for the game play, but did not proceed with was to give the player a bad starting point. Thus, the goal of the game would be to get a bad personal finance on the right track again. However, we decided that this would be a situation less known to the test subjects. If the game was to be expanded, however, this has the potential to be a harder difficulty mode.

6.2.3 Social media

We came up with elements that could make a great game very early in the suggestion phases. One of the things we thought of was the social media aspect. This could create awareness about the theme and the game outside the classroom. A high score list would be an interesting part of the social media aspect, but we did not finalize a way to objectively evaluate a playthrough with one simple score.

6.2.4 Consequences

The concept of consequences could have been expanded to encompass even more advanced aspects of life. For instance, if a person has debt, it can be harder to get a new loan. Bills left unpaid will increase in size. Things like that could result in an interesting and complex game, but for the purpose of this study, we decided to make a smaller scale game. We did include consequences in a small scale, an example of one of these can be seen in Figure 6.5

6.2.5 Real life choices

A game is only a game, and there will always be elements one can improve on and add to make the simulation as realistic as possible. If we just look at elements concerning housing situation, there are a plethora of elements which will affect the players finance: How many people are living in the household? What kind of house does the player live in? Where in the country does the player live? Occupation is another aspect which could have been expanded. We decided to include only a few elements for simplicity and for the game not to be one long form to fill in. We also wanted the elements to be relatable for the players.

The prototype we tested was a simple game with a focus on tasks needed in real life to handle your personal finance well. The players have to budget the money they have, and then they have to handle expenses during a fictional month. After a month, they get to see how it went and either start the game all over or continue to the next month. When continuing, they have to adjust their budget and take measures in order to keep their finance stable.

7 Choice of technology

This chapter will give a description of the technologies used to create the game.

7.1 Installation

We wanted to make our game easily accessible, such as other concepts like for instance the game Kahoot! [39]. To do this we decided to create it on a web platform. This makes no need for an installation on the players device and makes the game accessible on any device with a browser.

7.2 Javascript framework

Meteor.js [33] is an open source web framework allowing for rapid development of prototypes, and this suited our needs mentioned in Chapter 2. The framework allows for writing Javascript both on the client side and the server side [67]. It utilizes principles of reactivity both on the server and the client, and it uses ”data on the wire”. This means that the server does not send HTML-pages, but data that the client renders [30]. As many of the newer Javascript frameworks, Meteor has a large community of developers. This makes it easy to get help with problems and gives the possibility of contributing to the framework itself. When downloading the Meteor framework, it comes wrapped with MongoDB as its default database complete and it is ready to be used without any more work. A more detailed view of how Meteor works with examples of how we have applied it will be given in Chapter 8 and Chapter 9.

7.3 Database

MongoDB is an open source NoSQL [13] document-oriented database. MongoDB obviates the need for an object relational mapping [35]. A document database is a type of NoSQL database, created to have a more natural way of grouping data without the strict rules of relational databases. This makes the communication between our application and the database simple to set up. All we have to do to communicate between the application and the database is to create a collection on the server side of the application. A figure of the code lines creating a collection on the server is in Figure 7.1. This example shows the only server side collection we use, which is the User-collection managed by the accounts-base package explained in Section 9.1.

```
8   Accounts.onCreateUser(function(options, user) {
9       return user;
10  })
```

Figure 7.1: The user collection initiated and returned to client when it is created

7.4 Digital Ocean

Digital Ocean is a service providing cloud infrastructure through virtual servers available to their users [28]. We can therefore create a user, create a droplet (what they call their virtual servers;) run a few commands and have the game out on a public server, making it easy to distribute the game to users. We do not need to use time maintaining the infrastructure and can prioritize working on our prototype instead.

7.5 Meteor up

Meteor up is a command line tool created to simplify the deployment of meteor applications to a server [63]. In our case, we used a droplet from Digital Ocean.

8 Software Architecture

This chapter gives an overview of the Meteor Architecture. It will also provide an explanation of how the architecture of our game artifact is affected by this and finally an overview of the architecture.

8.1 Meteor Architecture

Meteor is built to easily apply reactive programming methods to your web application. Reactive programming is a paradigm oriented around the data flow of the application. In Meteor, this is utilized by the view automatically updating when the data behind the view changes.

Instead of the common REST-ful endpoints on the server and the client sending HTTP-calls to it, Meteor uses what they call *distributed data protocol* to communicate between the server and the client [62]. It handles remote procedure calls so the clients can invoke methods on the server and also notifies the clients when data changes on the server. To be able to do this, Meteor applications ”live” on both the server and the client in contrast to traditional applications that exist on the server. This concept is what Meteor calls ”database everywhere.” This is possible because Meteor creates a database instance on the client called ”minimongo” which holds a subset of the database, saved on the client [22] (see Figure 8.1).

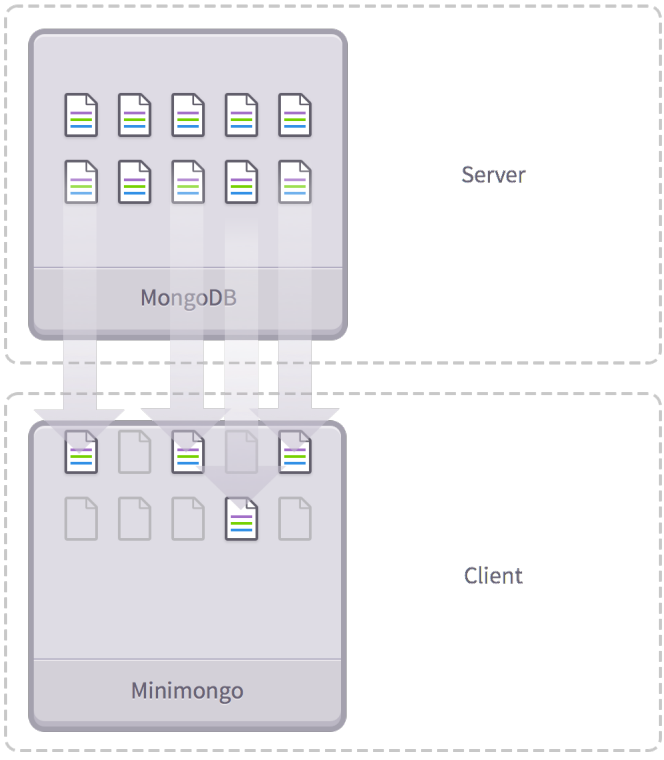


Figure 8.1: Meteor architecture overview [22]

8.2 Publish/Subscribe

The data being saved on the client's minimongo database depends on the clients subscriptions. The client subscribes to the data it wants to listen to on the server. In our application the clients subscribe to the "user" data. Figure 8.2 shows how the client subscribes to its user data given that the user is logged in.

```
var user = Meteor.user();

if (Meteor.userId()) {
    Meteor.subscribe('user');
```

Figure 8.2: Subscribing to the user data on the client

The data exposed to the clients from the server depends on what the server publishes. The data of the connected user is the only data exposed to each user. The code snippet enabling this can be seen in Figure 8.3. This enables the automation of the server notifying the clients when any data has changed and the view can be updated accordingly.

```
Meteor.publish('user', function() {
    if(this.userId){
        return Meteor.users.find(this.userId);
    }
});
```

Figure 8.3: Publishing the user data on the server

8.3 Overview of our architecture

We have taken advantage of Meteors publish/subscribe-pattern by publishing the user objects to the clients as shown in Figure 8.3. Activities and consequences belonging to each user are saved on the client's minimongo instance and not on the server. In addition, the user object has the activities and budget items that this user has executed or saved on the server. This is to avoid concurrency trouble.

Concurrency issues were also avoided by having the ”game time,” stored on the clients. To present the user with activities every 15 seconds we used a Meteor-method to set an interval. Keeping these intervals on the server would create problems when several players played at the same time.

Activities on the client is a ”pool” of all the activities available for the user, and this pool depends on the choices the user has made earlier. For example, if a user has said no to owning a car, one of the activities available to the user is whether or not the user wants to buy a bus card or a bike. Since each user should have different pools of activities available and the pools will never be large, we store them on the clients. In addition to this, most of the activities should not be presented several times during a game. Activities are therefore removed from the activity pool after they have been presented to the user. Another benefit of having the activities saved on the client is avoiding unnecessary queries to the server when showing the activities to the user.

9 Software design and implementation

In this chapter a detailed overview of the implementation of our game artefact will be given. In addition, the built in functionality Meteor has provided us with and how we have applied it will be described.

9.1 Meteor functionality

The accounts-base package

As mentioned earlier, the user objects are the only objects stored on the server. To manage the user objects, Meteor uses a package called the accounts-base package [34]. This is a built in feature in Meteor giving user account functionality. This means that we can access the users. We can get the state of the user by calling Meteor.userId() or Meteor.user() on the client.

Sessions

Meteor sessions are a reactive way of storing a global object of data on the client [32]. When these sessions are updated, the templates depending on them are also updated. We used sessions for most of the client side variables likely to be changed during the game. A random activity from the activity pool is chosen each time the main logic runs. We use a session variable to store this round's randomly chosen activity. This makes the panel displaying the activity to the user show the correct activity for each round. The code setting the random activity and the count being used to hold control over how many times the user has been presented with a new activity is shown in Figure 9.1.

```
var shownActivities = function() {
    var count = Session.get('count');
    Session.set('count', count + 1);
    Session.set('randomActivity',
        Random.choice(Activities.find().fetch()));
    Session.set('consequence',
        Random.choice(Consequenses.find().fetch()));
```

Figure 9.1: Setting the session variables holding the random activity and the count

Every run there is also a check of whether or not to choose a consequence. Each activity has a consequence, but some of them have no value. This is because not all of the activities gives a consequence if the player says no. For instance, to choose not to buy a coffee in the canteen will not yield a consequence. How this looks when the activities are initiated can be seen in the Figure 9.2.

Sessions are also used to save this round's chosen consequence, the balance of the player, and how much money the player has spent. All of the choices the user makes in the beginning is saved in session variables. Lastly, we use

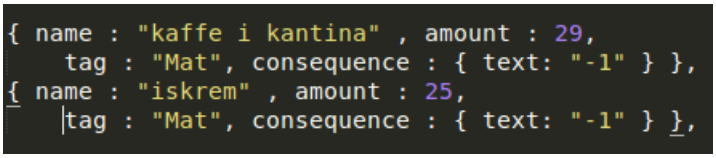


Figure 9.2: Initiation of two of the activities without consequences

session variables to keep track of whether or not the game interval is set or not and when to start the game. The game interval is to start when the player is finished with the budget, when it has not been started before and is not in the middle of a game. The code doing these checks can be seen in Figure 9.3.

```
if(Session.get('budgetLocked') && Session.equals('count', 0)
    && Session.equals('intervalOn', true)) {
    var interval = Meteor.setInterval(shownActivities, 15000);
}
```

Figure 9.3: The check starting the game interval

Methods

Meteor methods are methods on the server that the client can invoke remotely [31]. We have methods for every action editing the user object: Adding budget items and activities, editing and deleting them. The method for adding a new budget item to the player can be seen in Figure 9.4.

```
newBudgetPost: function(options) {
    //Create new budgetpost
    console.log("Inserting budpost in user with ID: " + this.userId);
    console.log(options.newBudPost);

    Meteor.users.update(
        this.userId,
    {
        $push: { budgetposts:
            {_id: options._id, name: options.name,
                amount: options.amount, tag: options.tag} }

    }, function(error, result){
        if(error){
            console.log("Something went wrong!");
        } else {
            console.log(result)
        }
    });
},
```

Figure 9.4: Method for adding a new budget item

Part IV

Evaluation of prototype

The objective of this part is to present the findings done from testing the prototype. Observations and answers to the second questionnaire will be presented.

10 Research context

This chapter presents the research contexts in which the prototype testing was performed. The first part of the chapter describes the research contexts of the two field studies and our questionnaires outside the field studies were performed, i.e. a description of the location, a description of the test and difficulties we may have encountered.

We tested our game in three different settings. The first two contexts were similar in the way the observation was conducted, differing mainly in how extensive the testing was. The Skype session tested social aspects of the gaming experience in addition to the test procedure performed at Kodeklubben and Rosenborg skole. The last subsection describes how the questionnaire was performed.

10.1 Kodeklubben

Kodeklubben is an initiative from Lær Kidsa Koding [40] where children can learn how to code in mainly Python, Java or Scratch depending on age and programming skills. The goal of this initiative is to create a good foundation for becoming digital users and fuel the interest for programming at an early age. The test was performed at Realfagsbygget on Gløshaugen. We did not use any equipment except for a test computer and another computer to take notes while the test was performed. The test was performed just outside the classroom where the course was held. The course was held in the evening, making the probability for interruption minimal, as teaching had ended for the day. The version of the game that we tested did not have all the functionality of the finished prototype, but the observation still provided some valuable insight, especially concerning future development and immersion.

The test subject was asked to play through the game once, and to answer the preliminary questionnaire orally prior to the playthrough.

Due to the fact that the game was still a work in progress, we discovered bugs during the testing that made it difficult to run a full test. This was especially true for evaluating the learning aspect of the game, as the end game screen was not implemented at that time. The results of this particular observation should therefore focus on other aspects of the game that were discovered during this observation.

10.2 Rosenborg school

Rosenborg school is an elementary- and secondary school in Trondheim located near Kristiansten fortress. We were allowed to visit during a mathematics lesson of two times 45 minutes in 8th grade to test the game on the students while the teacher held the lecture. Before testing, we presented the study to the class, describing the study and our assurance of anonymity and asked for volunteers. The test was performed in a sound proof group room adjoined with the classroom, which made for easy access when we needed new test subjects.

The test equipment setup was the same as in the test at Kodeklubben.

The test sessions began with the test subjects answering questions about what they know about personal finance, if they had any experience with game based learning and what they thought about it. The test subjects were then asked to play through the game twice with the same choices, making alterations to the budget as they went along and saw how their actual use differed from the budgeted expenses. They were also asked to point out big differences between the budget and the expenses. If they had time, they would be asked to play through the game a third time. This time they would choose occupation, living situation etc. once more, and they would have the opportunity to try out different alternatives.

After the test, we would have a brief discussion, visiting questions concerning perceived learning.

The class was required to relocate between the two 45 minute sessions. This left less time for testing. In addition, the fire alarm went off almost as soon as we had set up our equipment, reducing the first 45 minutes we had to around 20 minutes. The shortening of the session resulted in fewer test subjects in this test. The group room had a window into the classroom. This did not seem like much of a problem during the time the teacher had the room, but we experienced some visual disturbances towards the end of the session. The test subject was placed with his back towards the window, and did not seem to register the disturbance. We used a Macbook Pro as the test machine. In hindsight, it may have been better to supply the test subject with a mouse instead of the touch pad, as there was some confusion about how to scroll and click. However, this was not a major issue.

10.3 Skype session

Skype is an application which allows video and voice conversations and conferences over the Internet. It was used to facilitate a test in which students were playing the game simultaneously and interacting with each other whilst being observed by the test leader. The goal of this observation was to see if there could be observed any beneficial results when the participants played the game at the same time. We would also get general feedback and results in the questionnaire distributed together with the game. One test subject opted to just use sound. This was not questioned, as it would not make much difference in terms of communication. Everyone participating in the test could see and hear all the other participants, including the test leader, but the test leader could not see their screens. All participants were communicating from their destination of choice, attempting to create an environment where the

test subjects felt most at ease even though they would be aware that they were under observation. They were also using their own computers and other equipment. The test leader used pen and paper to be able to take notes and at the same time talk to the test subjects without making noise from using the keyboard.

The test subjects were asked to play the game once, then choose the option of playing again with the same configuration and budget items. After that, they were asked to start a new game with new configurations.

The session would end with a distribution of the questionnaire, which the test subjects were encouraged to take after the session.

There is always a risk of technology failing, and especially Voice-over-IP seem to have high fail rate because it relies on so many factors. However, it was easier than meeting the test subjects face to face, and we also had other solutions ready should all have failed.

10.4 Questionnaire

The game was distributed to the Rosenborg school class we previously co-operated with, other known schools, people we knew were in the target age group, the test subjects in the Skype-session and people who had left their contact info in the first questionnaire, stating that they were willing to help us in testing the prototype.

11 Observation

This chapter presents the results we got from the observation sessions. They are presented in the order they were conducted and per session.

11.1 Kodeklubben

The test was performed on one test subject, a boy. We had discussed some aspects of personal finance with him before the testing of the game, and he was rather quick to revisit those aspects and plot them into the budget. He asked if his proposed budget items were valid, such as going on an adventure with his family or saving for something big and undefined. During the simulation of the monthly expenses, he asked if there were any consequences if he opted not to use money on bills, birthday presents and other things. He displayed anticipation and slight anxiousness when declining expenses. He spent time on every expense considering if he would be interested in spending money on the expense in question.

11.2 Rosenborg skole

The test was performed on three test subjects during the mathematics session, one girl and two boys. When the teacher asked for volunteers, almost the entire class raised their hand and showed apparent interest. All three of the selected test subjects spent some time getting acquainted with the user interface, as there were concepts that they were unsure of. Expressions like ”Money left to budget” and ”Money already budgeted” did not seem to be obvious to any of the test subjects, and so there was some explanation required from the test leader. The first test subject seemed a bit more withdrawn than the two others. This might just be due to the test subjects personality, but it did result in fewer questions about the user interface, more internal pondering, and more time spent in the budgeting phase of the game. We pointed out to all the test subjects that they were encouraged to think aloud, but the success of this technique relies on the test subject being able to overcome his or her shyness. This was less of a problem with the two remaining test subjects. The budgeting phase of the game was generally the phase which took the most explaining and the most time for the test subjects to get through. After the initial budgeting phase, they caught on quickly, and the following budget phases took less time to finish.

11.2.1 Test subject 1: Boy

The first test subject chose to pay for insurance, to own a car and to work as an electrician. He found out that a cabin trip was worth budgeting for every month, and started making budget item associated with such a trip. There were also several items dedicated to children, like sweets on Saturday evening

and activities for children. The items were edited to include the entire family after some deliberation. He also included a item for petrol and café visits. Finally, when he couldn't come up with more items, he added a savings item. When he was ready to lock the budget and start the simulation of a month of expenses, he received a brief explanation of what accounting means. During the simulation, he picked mostly necessary expenses like food, but he also chose to buy plants for the garden. At the end of the simulation he had a lot of money left to spend on the next month. He did a new playthrough with the same budget, and he attempted to rearrange some of the money where he had spent more than he had budgeted. He was able to place more of the money into budget items the second time he budgeted. At the end of the observation, he said that he liked playing games for learning. He also said that he felt that he learned something from this game, even if it was a bit difficult to come up with budget items in the beginning.

11.2.2 Test subject 2: Girl

The second test subject started with choosing the category lawyer or doctor as her desired profession. She chose not to own a car nor pets, but she chose to pay for insurance. She was quick to remember that food was an important budget item, and made a monthly estimate which came close to the baseline we had used during testing. She also used the drop down menu for tags to get ideas for budget items, and made items accordingly. She argued aloud for the necessity for a post for unexpected expenses after finding it in the drop-down menu. She landed on the decision to make an item for unexpected expenses. She also decided to save a lot of money, but without stating a concrete savings goal. Due to the fact that she had so much money from choosing a well-paying profession, she struggled to place all the money into the budget. She decided which expenses to spend money on based on personal preferences, avoiding buying the PS4 game that was suggested. However, she opted to use money on social events and looked at the budget for reference when deciding to spend money. She made few alterations to her budget, and said she felt that it worked well with the budget she had made.

11.2.3 Test subject 3: Boy

Our final test subject at this location chose a career as a musician or an artist, to own a car and to pay for insurance. He made a few budget items before realizing that he had forgotten all about food. He estimated 1000 NOK per month, and he looked at the tags drop down for ideas. When he felt that he was done, he put the rest of his money in a savings post. During the

simulation, he received a bill for some water damage. He was insured, and so the actual cost of the bill was reduced by 70 percent. He also tried to choose expenses based on his needs and interests. His income was low to begin with, and so he ended up in debt when the month was over. To manage the debt, he did some restructuring of the budget. He also expressed the wish to sell his car, since he saw how much it would cost him to own it, not including petrol expenses. This was not part of the functionality at that point, but it was implemented later. He proceeded to choose expenses based on personal preferences during the next simulation, and even did some active role-playing: He had declined an offer to buy a membership at a gym, and the resulting consequence was that he became overweight. He then proceeded to decline sugary foods, stating that "I can't eat that. I am overweight and in need of a change in lifestyle." At the end of the game, he had less debt than before.

11.3 Skype session

The Skype session test was performed on three test subjects simultaneously, all of them boys. They all knew each other from before, and they were used to play computer games together. The session began with one of the test subjects reading the text in the pop-up aloud for the others. One of the test subjects said that insurance would be a good idea, and it seemed like they all agreed on that. Even though they talked amongst themselves throughout the game, much of the banter seemed to be just noise. The result was that even though the test leader explained aspects of the game and the user interface, a lot of the information had to be repeated. One of the test subject had allocated more money than he had available and said that he could use a website like Finn.no[17] for buying and selling used furniture to lower the costs of household appliances. He seemed to agree with himself that this was a good way to save money. The test subjects worked in different tempo, and if one of the slower test subjects had questions, they attempted to answer their questions without turning to the test leader for help. One of the test subject had decided to try his luck without insurance, and the reaction was clear when he had to replace everything from a break-in. The other test subjects laughed at his misfortune, and the general atmosphere in the session became very high-spirited. The test subjects bantered while playing and egged each other on, and they mostly seemed to choose expenses which reflected their interests and consumer habits. When the test subject without insurance ended his first round, he decided to sell the car to alleviate his debt, and he asked for advice as to whether or not he should pay off his debt by using his credit card or taking a unsecured loan. One of the other test subjects

warned him against that, telling him that he had heard that it was a bad idea to use the two options when paying off debt. After the test subjects had played through the mandatory rounds, one of the test subjects said he wanted to play it again, saying he wanted to see how much money he could save if he refrained from spending any money. At the end of the session, the test subject was given the questionnaire to answer at their leisure, without the test leader's interference.

12 Results from second questionnaire

The following sections describe the data collected from the different data gathering methods. Screenshots from some of the observation sessions will be presented, as well as the results from all sessions.

We received eight responses in total from our second questionnaire. Three of the respondents were the same as the subjects from Skype observation session described in Section 10.3. These are included in the overall results, since the test subjects answered the questionnaire without being observed, minimizing the Hawthorne effect [49].

The questionnaire was mainly a measure to establish the perceived learning of the game in order to answer RQ 2.3. We also asked a question to explore whether a digital game is a good learning platform for this group. In addition, we asked if they play learning games regularly and if the test subjects believe they learn well by playing games. To see the overall motivational effect we asked the respondents if they would want to play similar games about other topics as well. All of the questions in the questionnaire were asked in Norwegian and are here translated to English.

12.1 Demographic results

The ages of pupils in secondary school range from 12 to 16 years. They start the year they turn 13 and finish the year they turn 16. We have got respondents from all grades with a slight overweight of 13-year-olds in this questionnaire. This can be seen in Figure 12.1.

Most of the respondents of this questionnaire were boys, displayed in Figure 12.2. This would have evened out if the results from Rosenborg school had been collected in time, since the division of the class in question was half girls and half boys. Because of the low number of respondents on this questionnaire there is limited value in speculating on gender specific behaviour.

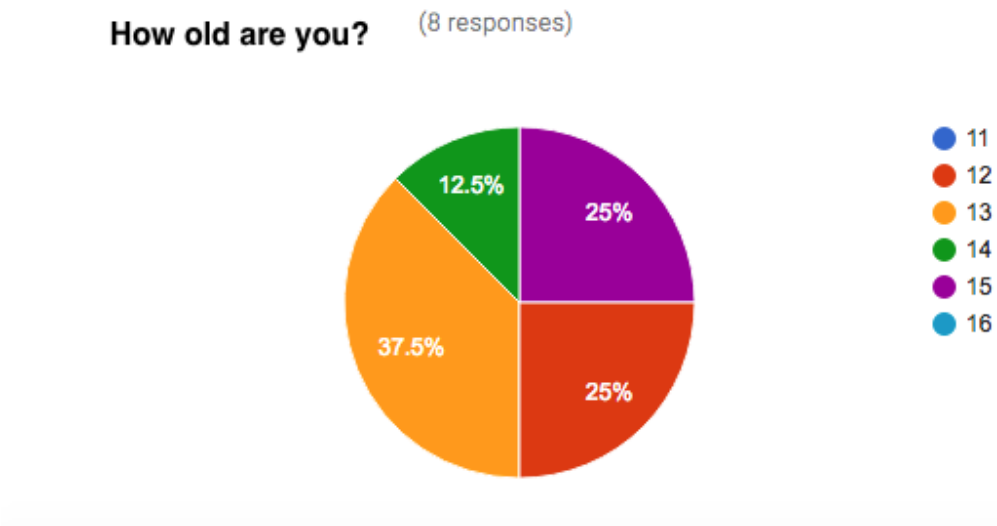


Figure 12.1: Age of the respondents

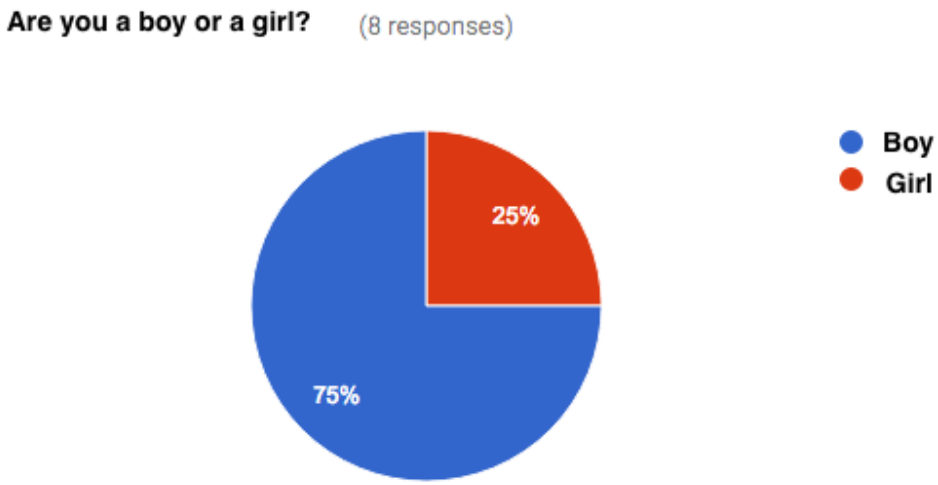


Figure 12.2: Gender of the respondents

12.2 Relation to learning games

To determine the respondents' previous experience with games we asked if they play games regularly. To answer they had to tick boxes with alternatives to what type of games they play. The alternatives were computer games, video games, smart phone games and none. All of the respondents played games regularly and over half of them play several types of games as can be seen in Figure 12.3.

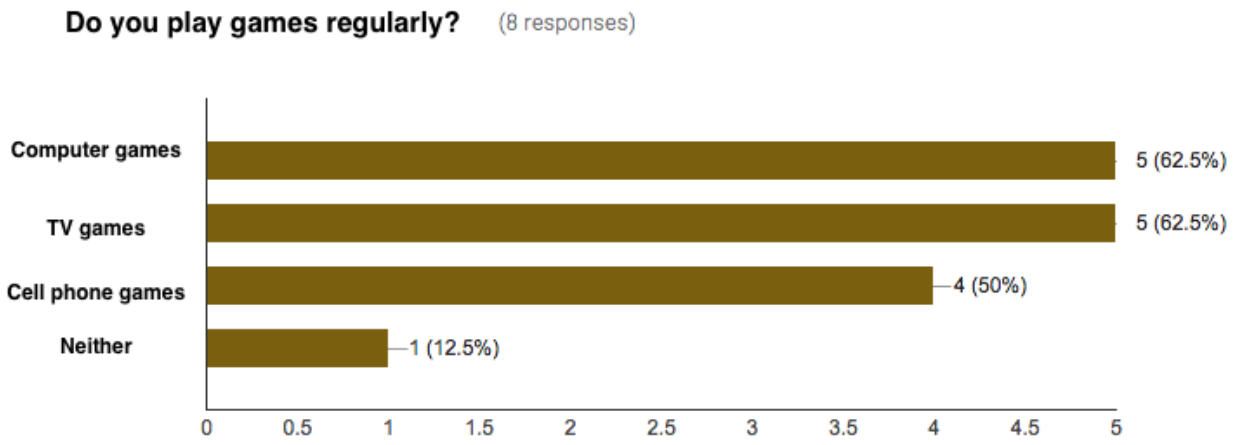


Figure 12.3: Do you play games regularly?

To gather information about games popular among children we also asked a question where they could tell us which learning games they have played. All of the answers of this questionnaire can be seen in Appendix C. In addition to this, to explore how computer games influence the children's perceived learning we asked them if they learn well when playing computer games. These answers can be seen in Figure 12.4. The answers show that all children agree to some extent to learning well when playing computer games.

We also asked a question to see if the children had an interest in playing similar games about other topics than finance, this could give some indication whether or not the children themselves think games has a good learning effect. The answers to this can be seen in Figure 12.5. A problem with this question is that the respondents might not have their learning interest in mind when answering, but simply thought about getting to play games in class and could therefore be biased in a direction.

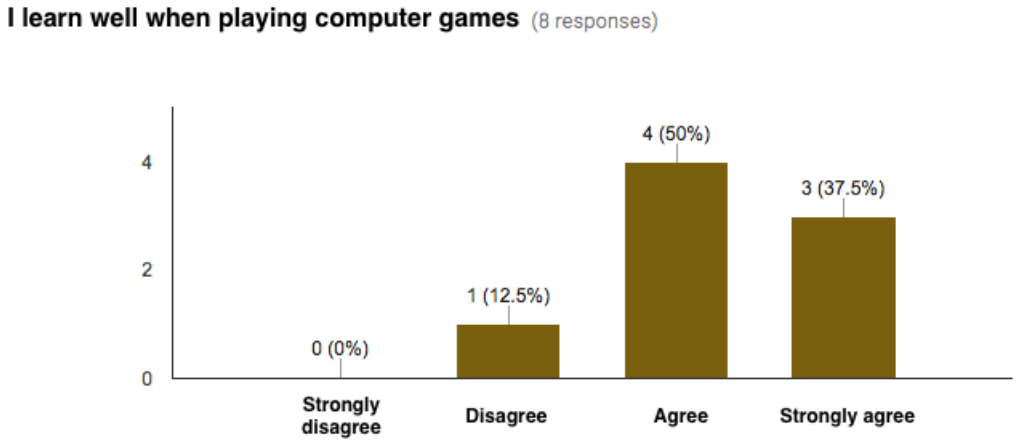


Figure 12.4: Do you learn well when playing games?

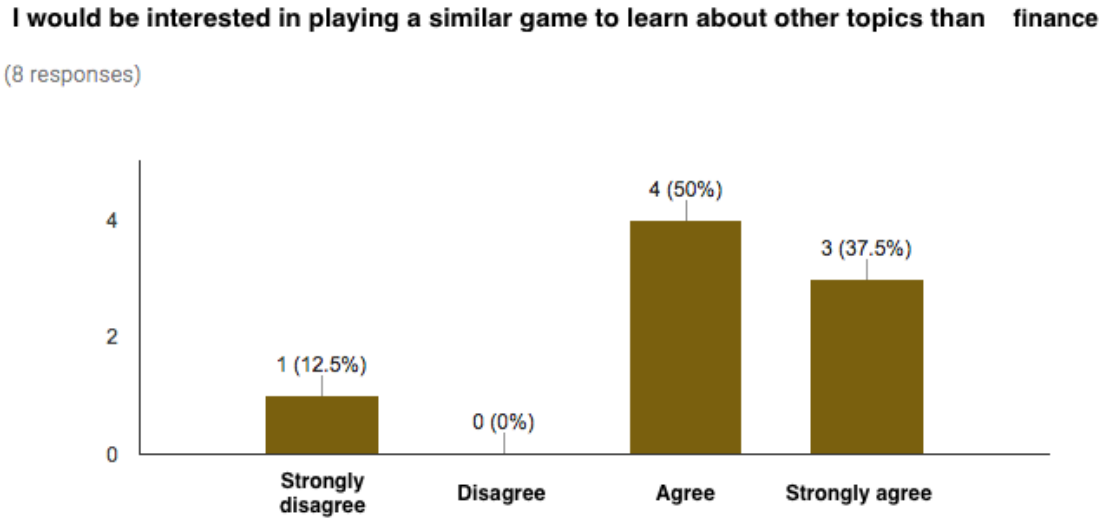


Figure 12.5: Would you be interested in playing a similar type of game about other subjects

To establish if each respondent had previous experience with learning games we asked if they had played it before. Almost all of the respondents had, as can be seen in Figure 12.6

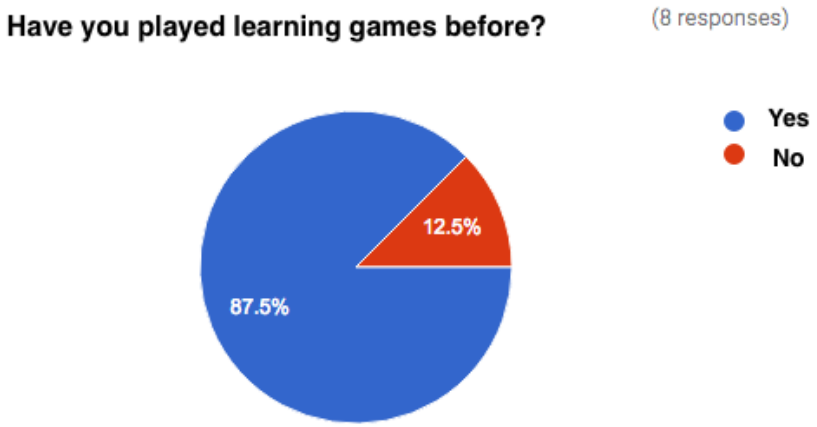


Figure 12.6: Have you played learning games before?

12.3 Perceived learning

To get information of the perceived learning the respondents achieved after playing the game we presented them with statements regarding each of the concepts the game is meant to teach. These can be seen in Table 12.1. These were answered on a scale with four alternatives from "Strongly disagree" to "Strongly agree".

I became better at budgeting after playing the game
I learned something about what expenses an adult has
I became more aware of my occupation influencing how much money I can spend
I learned something about insurances after playing the game
I learned to not use more money than I earn
I learn well by playing computer games
After playing the game I will be better to handle my own personal finance in the future

Table 12.1: Statements regarding perceived learning

I became better at budgeting after playing the game

This question was asked to establish the perceived learning of budgeting. The answers were well distributed all over the scale with an overweight of "strongly agree," and "agree", see Figure 12.7. This indicated that our game has some positive effect on the budgeting skills of the players.

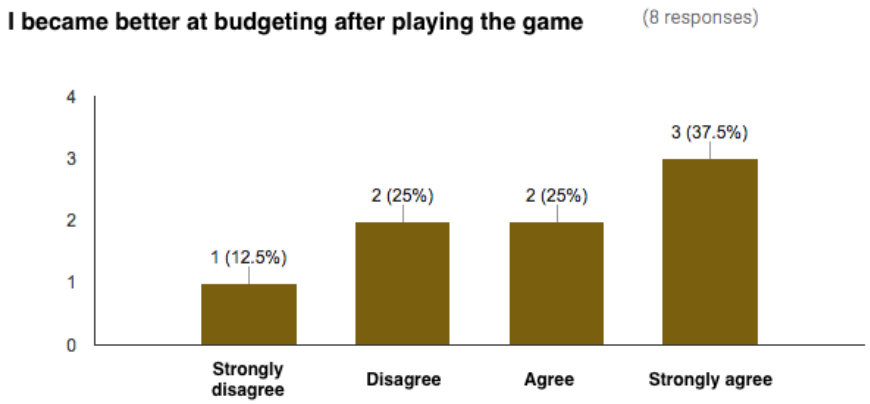


Figure 12.7: Did you become better to budget after playing the game?

I learned something about what expenses an adult has

The next statement presented to the respondents referred to expenses. As explained earlier, we wanted to raise awareness about the concept of cost levels and what expenses an adult has. The answers, shown in Figure 12.8 were spread with an overweight of "agree". Since we do not know what random expenses the players have been given, it might be that they had really bad luck and only got "small" expenses like "buying a chocolate." This would not promote any learning about adult expenses.

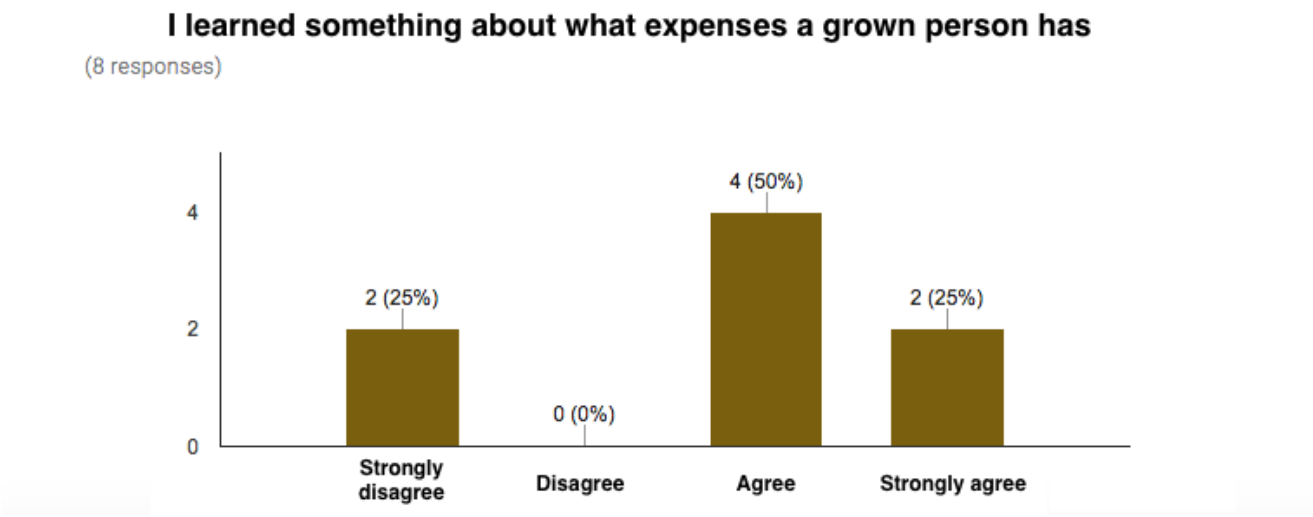


Figure 12.8: Did you learn anything about what expenses an adult have

I became more aware of my occupation influencing how much money I can spend

One important aspect of finance is choosing an occupation. Before starting this project we found it obvious that your occupation affects your income and therefore how much money you can spend. Since it turned out that young people do not know too much about personal finance we were not sure this was something as obvious to them. The respondents were therefore asked whether or not they became more aware of the effect their occupation has on how much money they can spend. Here there is an overweight of "Strongly agree" answers, see Figure 12.9.

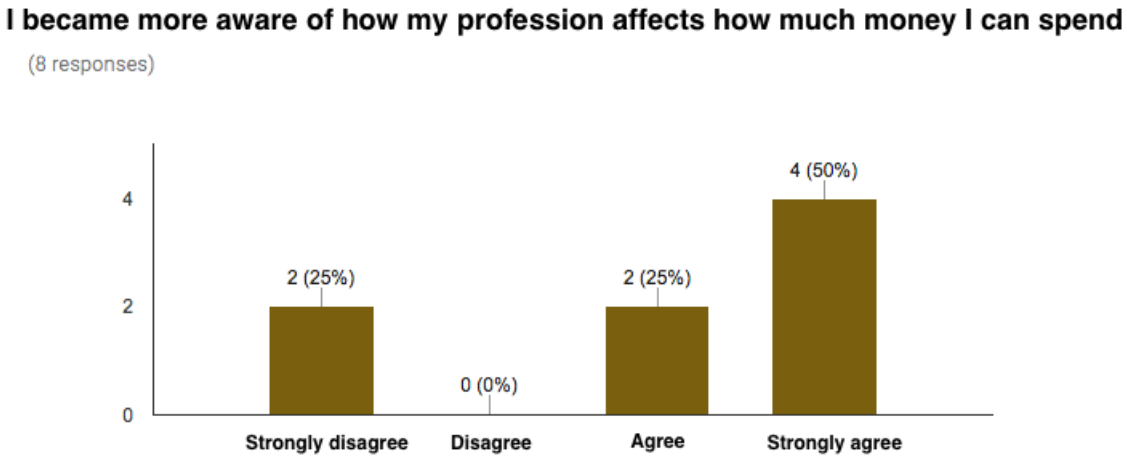


Figure 12.9: Did you learn anything about how your profession influence the money you can spend?

I learned something about insurances after playing the game

We chose to include the concept of insurances in the game. To know what effect this had the respondents were asked if they learned anything about insurances. Once again, the overweight of the answers were on "Strongly agree", see Figure 12.10.

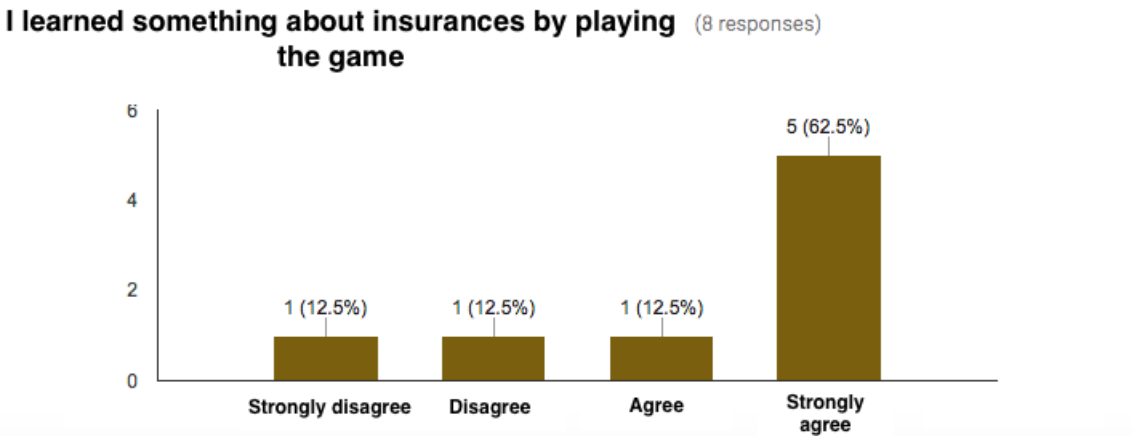


Figure 12.10: Did you learn something about insurances when playing the game?

I learned to not spend more money than I earn

We wanted the game to teach the value of money. The most important "rule" is not to spend more money than you earn. Here the answers were more widespread than the two questions before. There were as many "Strongly disagreeing" as there were "Agree." Since we do not know how lucky the players were there is no guarantee that they did not choose professions earning more than the average, got no unexpected expenses and chose not to spend a lot of money. If the players were so lucky as not to be challenged, they would not learn much from the game.

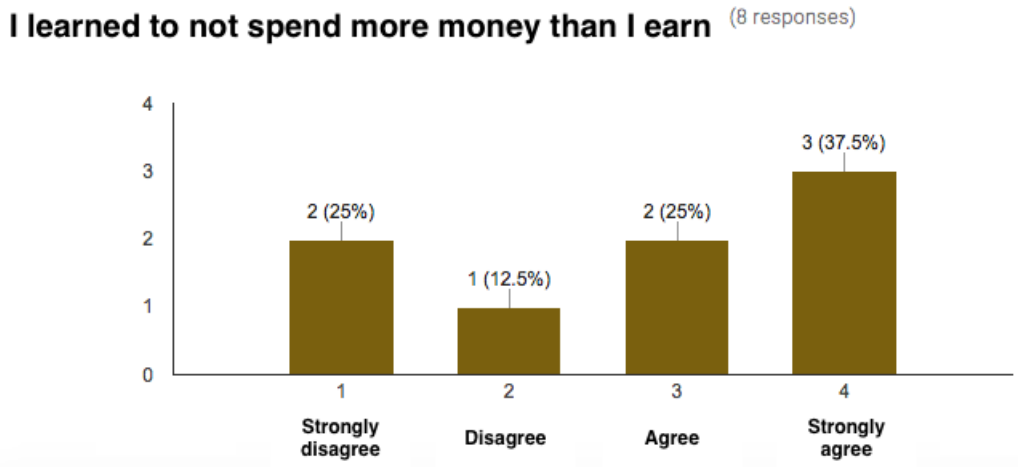


Figure 12.11: Did you learn anything about not spending more money than you have?

After playing the game I will be better to handle my own personal finance in the future

To get an overall concept of whether the respondents feel the game will help them with their understanding of personal finance and be useful in the future this question was asked. The answer showed one person absolutely disagreeing and most of the respondents to agree at some level, see Figure 12.12.

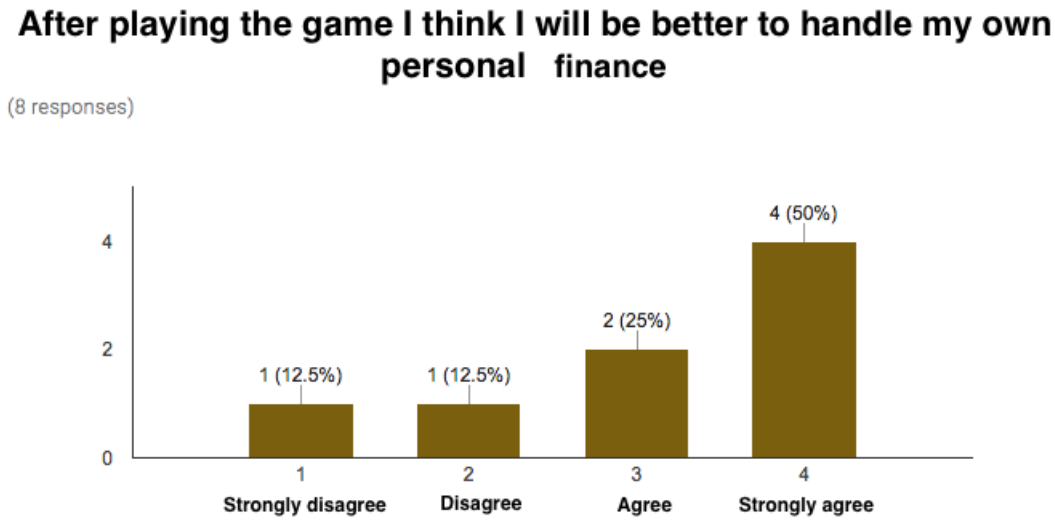


Figure 12.12: Do you think you will be better to budget in the future?

12.4 Game enjoyment

The statements regarding game enjoyment was added as a means of estimating how well the motivational factors of playing the game worked. In Table 12.2 these statements can be seen. As in the previous section all of the answers will be presented one by one question. As well as in the questions about perceived learning, an overweight of respondents "Agree" and "Strongly agree" to all of the statements regarding game enjoyment.

Playing this game made me want to learn more about personal finance
I had fun when playing the game
I concentrated well when playing the game
I was committed when playing the game

Table 12.2: Statements regarding game enjoyment

Playing this game made me want to learn more about personal finance

To establish if playing this game inspired the players to learn more about personal finance we asked the respondents to state how much they agreed to this statement on the same scale from "Strongly disagreed" to "Strongly agree." Most of the respondents were motivated to learn more, as can be seen in Figure 12.13.

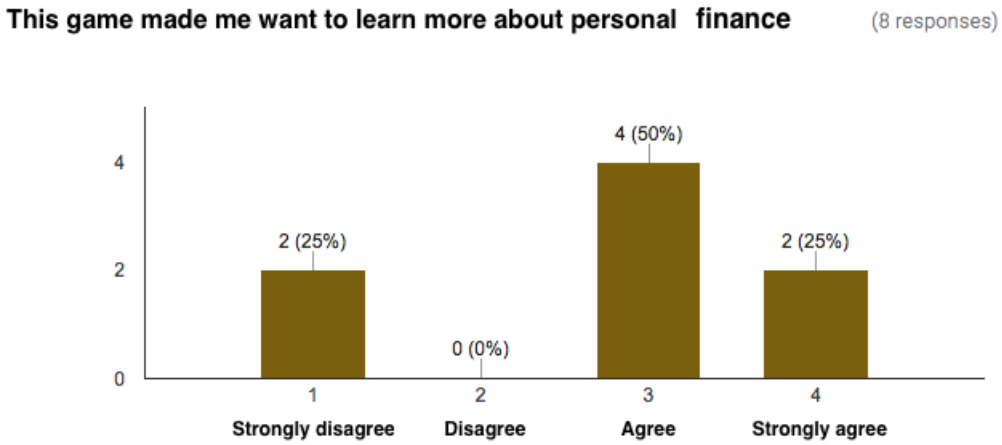


Figure 12.13: Did playing the game make you want to learn more about personal finance?

I had fun when playing the game

To establish the entertainment value of the game we asked the respondents to state if the agreed to having fun when playing the game. The answers can be seen in Figure 12.14. A majority of the respondents agreed to some extent.

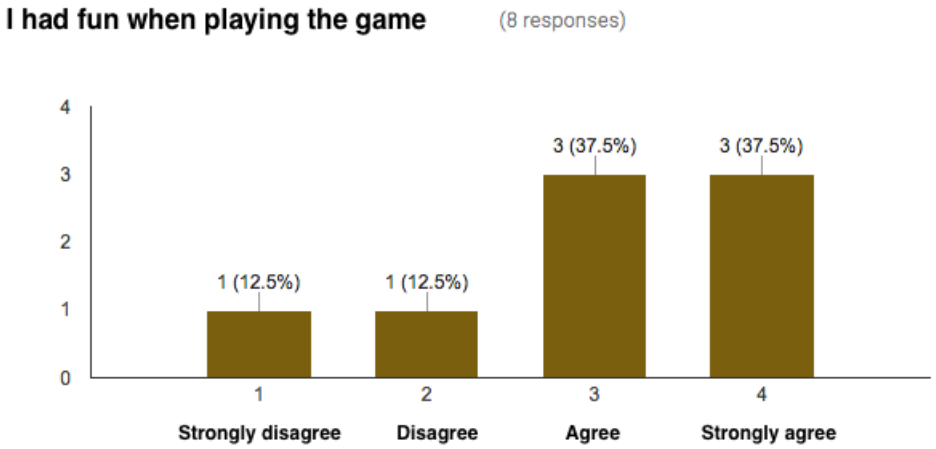


Figure 12.14: Did you have fun when playing the game?

I concentrated well when playing the game

To explore how engaging playing the game was and how immersed the players became we asked them whether or not they felt concentrated and engaged when playing the game. Answers to these questions can be seen in Figure 12.15 and Figure 12.16.

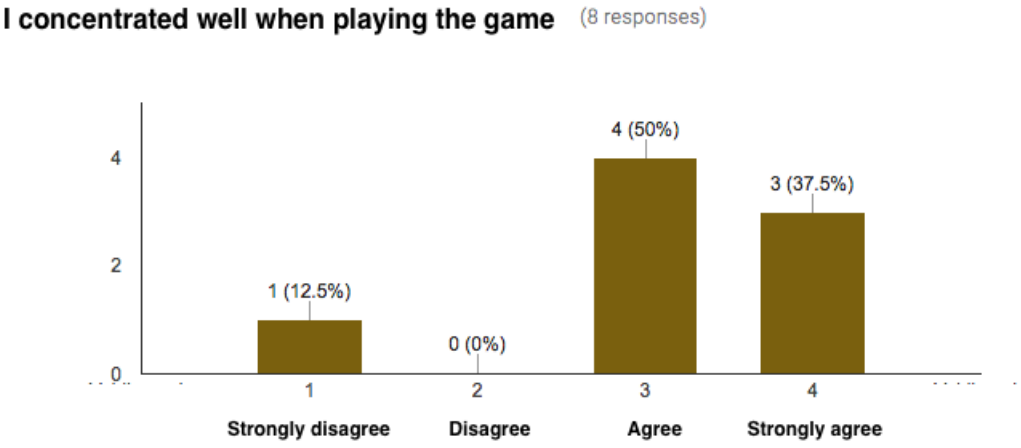


Figure 12.15: Did you feel concentrated when playing the game?

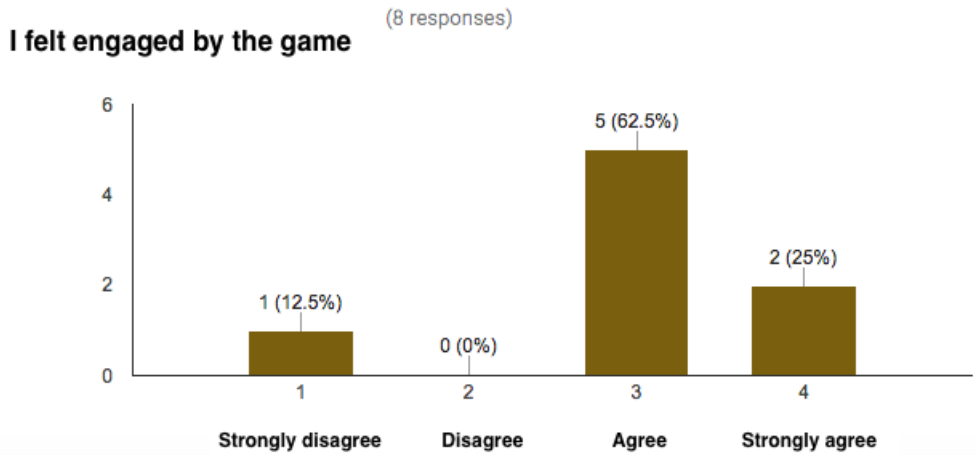


Figure 12.16: Did you feel engaged when playing the game?

Part V

Discussion and conclusion

In this part our thoughts about the findings obtained when evaluating the prototypes will be presented. The data will also be analyzed. The conclusion will be presented and an overview of future work will be given. Future work includes what we would have done, given more resources.

13 Discussion

The goal of this chapter is to answer the research questions elicited in Chapter 2 by summarizing our findings. The first section presents to what degree a computer game is suited to teach our test group personal finance. It also describes what elements should influence the design of the game. The next section will discuss effects observed when testing the prototype. The final sections will discuss the data set and interpretation, and an overall reflection.

13.1 Designing the game

The first research goal was to find elements which would create the outline for the design of the prototype. The associated research questions are listed in Table 13.1), and the following subsection will address each of these in turn and use results from the preliminary study to answer them.

Number	Research Question	Metrics
RQ 1.1	Which concepts of/regarding personal finance should children aged 12-16 learn?	Literature study, interviews
RQ 1.2	Which concepts of personal finance are feasible to teach through computer games?	Literature study of relevant technologies, results from testing the prototype
RQ 1.3	Which technology is most suitable for teaching children aged 12-16 about personal finance?	Interviews, questionnaire, results from testing the prototype

Table 13.1: Research questions and metrics for goal 1

13.1.1 RQ 1.1: Relevant elements of personal finance

Our starting point for designing the game prototype was the current mathematics curriculum, in particular the parts concerning personal finance. The curriculum is of course made with the intention of teaching school children relevant information about personal finance. Nevertheless, after the interviews we had performed, some questions did arise: Is the information presented in the best possible way? Is the information relevant enough? Do the children see the real-life applicability?

The representatives at Sparebanken Midt-Norge(SMN) point out that the most important thing to do initially is to increase the awareness of the value of money, how to budget money, handle money, and to get a realistic view of what items and services of everyday life cost. Budgeting and managing expenses is thus a very important skill. Considering the fact that 67,4% of the respondents in the preliminary questionnaire stated that they earn more than 100 NOK each month, handling this money in a sensible fashion and having a realistic view of costs seems like a necessary skill to learn.

There is certainly potential for altering the curriculum to be more engaging. Cooperation with external actors who benefit from children learning about personal finance is a good start to make the education relevant. Including choices of occupation and appealing to the students' interests are also pointed out as important motivating factors by SMN and Ungt Entreprenørskap(UE), and this is confirmed through the testing of our prototype: The test subjects were quick to base their choices on personal wishes and interests when deciding what to spend money on, how to budget and which occupation to choose.

13.1.2 RQ 1.2: Teaching through computer games

All elements suggested by SMN and UE could probably be incorporated into a game. However, we can only answer this research question based on our experiences with the game prototype and the elements incorporated there.

There is a lot of potential when it comes to budgeting. It is an important skill for the target group, as previously mentioned, and the observations showed that it was a skill the test subjects understood the value of and could relate to. In addition, budgeting is the primary focus of the related initiative "Sjef i eget liv", enforcing our belief that budgeting is a skill that is well suited for digital games. The questionnaire accompanying the prototype and presented in Section 12 indicated that the test subjects perceive increased knowledge about budgeting as well. The observations showed that the test subjects were engaged in the game, and most felt that they learned something. An intervention in the classroom is also pointed out by our interviewees as a

motivating factor for the students, which could lead to increased motivation and immersion.

The value of money is related to budgeting, but the test subjects seem to respond well to being presented with typical expenses. Some seem surprised that certain things cost as much as they do, and especially unexpected expenses seemed to make an impact on the test subjects, both as a challenging factor and a talking point when socializing.

13.1.3 RQ 1.3: Technology choices

Children today grow up with smart phones and tablets. This can be used as an advantage in education. Tablets and laptops are available in most Norwegian schools, and students often have their own personal device, as presented in Chapter 4. The teachers also know how to use this technology, so few resources will be spent training them to use the equipment. Easy set-up and a familiar environment also makes it easier to integrate into the education setting, the use of this game as a short-term intervention in class would be useful and practical if the teacher knows what the game has to offer. Using a web application means no installation of software, which would have been necessary if Unity had been used instead. The observations showed that there was no obstruction for the test subjects to use computers to complete the task, other than a slight difficulty from one of the test subjects at Rosenborg school who had not used a Mac before. This highlights the importance of a familiar environment. This is no longer a challenge, as the game was uploaded on Digital Ocean after this test and the test subjects can use their own devices.

13.1.4 Other Observations

The observations indicated that it would be necessary to have a teacher, guide or mentor present during the session to ask about concepts. With a presentation of the concepts relevant for the game however, much of the need for assistance could be reduced.

It seemed from the observations at Rosenborg school that the test subjects did not have a concept of "personal finance" and the skills related to this. The term "personal finance" was not explicitly linked to tasks like budgeting and expense estimation, which the 8th graders should have been taught during the course of the year. When asked about the specific tasks, they confirmed that they were familiar with the terms and the tasks. Without reading too much into this, it could seem that there is some disconnect between the actual skills and their real-world significance. Or they might just not know what the term "personal finance" means for them.

13.2 Effects of the game

The second and final goal of the thesis was to explore the effects of using a a game to teach our target group personal finance. The associated research questions are once again listed below and will be answered in the following subsections.

Number	Research Question	Metrics
RQ 2.1	Are computer games a good learning platform for children aged 12-16?	Literature study, interview/questionnaire
RQ 2.2	What is the learning effect of the teaching curriculum of personal finance on current platforms at schools today?	Literature study, interviews, questionnaire
RQ 2.3	What is the effect of teaching the personal finance curriculum through a game?	Literature study, interview

Table 13.2: Research questions and metrics for goal 2

13.2.1 RQ 2.1: Computer games as a learning platform

Most of the studies presented in Chapter 3 conclude that educational games have some degree of learning effect depending on different factors. Squire points out through his study on the same target group as ours that the students must understand why the game is introduced as an educational supplement [61]. The fact that a game is successful commercially does not imply that it will be successful in an educational context. Malone states that the fantasy is crucial for the player to be engaged and to learn the maximum amount possible from the game playthrough [42].

All of the respondents in our second questionnaire had played video games before, either on computers, game consoles or mobile platforms, and were positive to the idea of playing games as a part of their education.

The students at Rosenborg school seemed very enthusiastic when asked if they wanted to participate in the testing of the prototype. If this was enthusiasm directed towards the game or just an excuse to not follow the normal schedule, it still showed that an intervention in class could create a new-found enthusiasm and talking points for the students.

13.2.2 RQ 2.2: Learning effect of personal finance today

Statistics show that a large group of young Norwegians have dept [38], and this does reflect that the education has been unsuccessful. Chapter 5 indicates that the target group does not have sufficient knowledge about personal finance. Even though all respondents should have been through budgeting, the knowledge level was low and not consistent with how old the respondens were. The interviews with UE and SMN also emphasize that there is a need to alter the way things are done in school today.

13.2.3 RQ 2.3: Effect of teaching personal finance through a game

The second questionnaire showed that most of the respondent felt that they learned something after playing the game, and also became motivated to play similar serious games. Observation from the Skype session and the Rosenborg school session revealed enthusiasm, motivation to immerse oneself into the fantasy and role play and social interaction. Unexpected expenses was as mentioned a source of both frustration and curiosity, and it also prompted social interaction in the observation done over Skype. The Skype session also revealed that the test subjects were eager to help each other should one fall behind and in debt, potentially distributing knowledge they already possessed.

13.3 Evaluation of data set

The following section presents an evaluation of the results of testing the game prototype, focusing on scope, bias and validity.

Our data set is not large enough to generalize our findings. When beginning our cooperation with Ole Morten, the teacher at Rosenborg school, we believed it possible to distribute the game to at least all of his pupils. This meant we would have 30 respondents. Because of reasons unknown to us, we did not get respondents from Rosenborg before the deadline of this thesis. 8 respondents are indicative at best. It is thus difficult to say if the game would work well in a educational setting and promote learning on a general basis. However, the test subjects at Rosenborg, who did not answer a questionnaire but did discuss the essence of many of the questions, also seemed positive to using educational games like the one we presented and felt like they learned something from playing the game. The observations also showed that the

ones who got into debt during the game managed to handle the debt and reduce it during the replays. Even though the evaluation method is not the same, the sentiment seemed like the same as the questionnaire.

Naturally, there is a large possibility for bias when the developers interpret the findings of the observations, which is partly why we conducted the questionnaire and made sure that the test subject who took part in the questionnaire were unobserved when they answered it. That way we could compare our results of the observation and the questionnaire and confirm that they reflect the same sentiment.

The validity of the study is debatable, as the prototype has not been tested in a classroom or another typical educational setting. However, the tests have looked at the social interaction between students, even though it has not been in a classroom. A further study would do well to try this out in a more complete educational setting, but this relies on the test being performed when the students learn about personal finance.

13.4 Evaluation of project

All in all, this project has been informative. A lot of time was spent trying to understand the problem areas and determining how to approach our hypothesis of children not knowing enough of personal finance and the thought that a game would be a good measure to solve this problem. We believe we can conclude that it is a problem that Norwegian youth do not have enough knowledge of personal finance and that the education of the subject given in schools needs to be revised.

When it comes to the second part of whether or not a game is the right way to solve this problem the answers are a bit more unresolved. Because of the lack of respondents to play our game and the lack of time to create further iterations of it we cannot say anything for certain. The enthusiasm we have met when telling others of our idea indicates that it has potential. The results from the second questionnaire, observations and interviews also indicate that a game may be a good solution.

If we were to start this project over again we would have done a larger effort to distribute the game. We would contact more teachers to get test subjects and devoted more time to observations and entire classes playing the game. We relied on the teacher we cooperated with to distribute it and when that did not happen in time, it was too late to make new arrangements with other schools. We sent out the game with instructions to schools, but we might have had more luck by calling around to schools and creating small flyers to distribute.

Even though the data set is small, we have observed a mainly positive attitude towards the game, both before and after playing through it. We started out basing the project on the curriculum regarding personal finance, this might not be the best starting point and it is certainly not the only one. We started building upon an already established base; the curriculum in secondary school. This starting point was chosen due to the schools already playing an important role in education of personal finance. We are happy with the project and the results, but if we were to do it again we would have ensured that a larger amount of test subjects had played our game so the results could have been more conclusive.

14 Conclusion

This chapter presents a short overview of the project, the process and how each of the research questions were answered. In addition to this, a summary of the answers will be given.

In this project the design and creation process was used to create an artefact to find answers to two research goals. We wanted to explore if or how a game based approach can teach teenagers aged 12-16 how to handle their personal finance. We also wanted to explore what the effect of teaching teenagers aged 12-16 about personal finance through computer games.

To answer these questions research questions addressing different aspects of the two research goals were formulated.

RQ 1.1: Which concepts of/regarding personal finance should children aged 12-16 learn?

To answer this question we interviewed a teacher, representatives from Sparebanken Midt-Norge working with initiatives directed towards secondary schools and high schools. We also interviewed representatives at Ungt Entreprenørskap working with Sparebanken on an initiative called "Økonomi og karriereveiledning." These interviews steered us in the direction of the curriculum in secondary school. We decided that the curriculum should form the basis of what the target group should learn. In addition, the interviewees stressed that using the target group's own interests and personal motivation were important to make an engaging game.

We examined existing projects regarding personal finance directed towards children of all ages. These had different focus, but they all attempted to raise awareness of personal finance and money. The interviews and existing initiatives told us that secondary school pupils do not have enough knowledge of what personal finance actually is and that budgeting is an important skill to have when handling their finance.

RQ 1.2: Which concepts of personal finance are feasible to teach through computer games

Testing of the prototype indicated that all of the concepts we chose to include in the game were feasible to teach through a game. These included budgeting and an overall awareness raising of what personal finance is. This was done by creating a simulation of a real situation of a month with expenses the player has to consider and unforeseen things that could happen, just as they do in real life. In addition to this, we included the concept of insurance and different wages. The wages depending on what profession the player choose.

RQ 1.3: Which technology is most suitable for teaching children aged 12-16 about personal finance

We examined different types of technology, such as the game engine Unity when deciding of what to use when developing the game. Our examination steered us towards a technology permitting the game to be played at all platforms. To create a game easily accessible we chose web based technology, so that it could be played on all devices with web browser. We found this to be successful because it made testing and distribution easy, and the test subjects did not have to install any software.

RQ 2.1: Are computer games a good learning platform for children aged 12-16

To answer this question research done on game based learning was examined. This research concludes to a large extent that computer games is a good platform for learning to people of all ages. We looked at research regarding using traditional games and computer games for learning and both seemed to have good learning effects.

In the second questionnaire we asked the respondents about how well they learn from computer games. The answers indicated that computer games are a platform children in secondary school are familiar with. The children also believe they learn well from computer games.

Observations of children playing the game showed that the players learned through playing the game. They made different, what we believe to be better, choices when playing the game a second time. As long as the game is motivational, a computer game is a good learning platform for this age group.

RQ 2.2: What is the learning effect of the curriculum of personal finance in current platforms at schools today?

We performed a questionnaire to establish the knowledge of personal finances amongst secondary school pupils. It showed that the knowledge was highly randomized. Some of the 48 respondents had some knowledge of what personal finances involves and what things cost. The questionnaire revealed that the respondents were quite far from the reality in determining what things cost for a grown up and what a family needs to take into consideration regarding their personal finances.

Most of the interviewees and everyone we have spoken to about our assignment showed engagement in the subject and confirmed our thoughts of Norwegian youth not knowing enough about personal finances. The fact that there exists such a large number of initiatives aiming to teach personal

finances indicates that we and the people we have interviewed are not the only one recognizing this problem.

RQ 2.3: What is the effect of teaching personal finance through a game?

Our observations and the individual testing of our game indicates that it might have a positive effect to teach personal finance through a game, but because of the low number of respondents this cannot be established for certain.

Digital games are a tool that could improve the educational situation. The education of personal finance in Norwegian schools is an area with great potential. The current education does not keep young Norwegians out of debt and there is need for an upgrade. We believe that this upgrade should include the use of computer games. We do believe this thesis gives an indication that further testing of using a computer game in the education of personal finance in secondary school is needed.

15 Future Work

The objective of this chapter is to present our thoughts for future work on this project. An overview of the direction we believe the research, and further development should take will be presented.

15.1 Further development and improvement

The prototype has potential to be a more extensive game. The following subsection describes the key functionality we think should be further explored and potentially implemented. Some of these overlap with the functionality that were left out, see Section 6.2.

- **Score:** One of the least finished aspects of the prototype is the ability to calculate a score for how well the player did as a whole. One of the main reasons this was omitted was because we did not find a good way to do this within the given time frame, see Chapter 6. If this could be implemented, this could be used in other functionality as well.

- **Missions during the game:** For the game to encompass more aspects of personal finance and contribute to scorekeeping, one could implement secondary objective. These objectives could be small tasks concerning other parts of the curriculum which could be less obvious to integrate into the main game play, for example "calculate how long it would take to repay a loan of 20000 given a downpayment of 3000 each month and an interest of 5% per year." The secondary goals could also be related to other parts of the players personal finance, such as saving up money for a house. Fulfillment of these goals could increase the final score of the game.

- **High score list:** Integrating some form of social or competitive aspect in the game was discussed for the initial version of the prototype. The social aspects of the game highlighted in Chapter 11 indicates that implementing a high score list could be a motivational factor, as this would act as a discussion point. However, adding a competitive element to the game could also lead to the players optimizing their way of playing the game, omitting the role-playing aspect in favour of a higher score.

- **More customization:** The choices in the beginning of the game hints at a potential for customizing the starting point more. Perhaps it is more expensive to own a house in the cities? Are there expenses you will get as a girl, but not as a boy? Can you have a family? Presenting the player for more choices and ways to immerse themselves will potentially motivate for more sessions, as the observations in Chapter 11 hinted at. A long and tedious start screen is not necessarily the best way to introduce more choice, so other ways of making these choices should be discussed.

- **Clearer user interface:** Some of the user interface did require some explanation from the test leaders during the observation, especially concerning the concepts of ”Budgeted money” and ”Money left to budget”. The wording or way those numbers were represented could have been discussed more, and potentially made clearer. In addition, there could have been a prompt for the users to visit the ”expenses” tab when the simulation started. Not everyone understood that they could visit the tab to follow the expenses.

- **Graphical representations:** A suggestion we visited when making the summary screen of the game was to present the data graphically. We did not have the time to implement this, but it could serve as an easier way to compare the budget and the expenses.

- **Administrative view:** To make the game easily modifiable and more focused towards classroom learning one idea is to create an admin interface so that the teachers can modify the game to their needs. This would make it possible to change what elements included and focused on depending on the current curriculum.

15.2 Testing

The number of respondents were not sufficient to be able to generalize our findings to the entire age group, and so the first stage in further testing should be to test the prototype further. A good statistical foundation is vital when evaluating the different aspects of the game, and what alterations to make to produce a better product.

To ensure good validity in the testing process, we believe that some of the testing should focus on testing the prototype in an educational setting, i.e. when the teacher decide to teach the relevant part of the curriculum. How and when teachers in secondary school teach the aspects of personal finance varies and the tests should be distributed over all three grades. Another benefit of performing such a test is to compare the results with a class which uses the traditional way of teaching. A test or a questionnaire could then be distributed after the relevant part of the curriculum is taught, measuring perceived knowledge, motivation, immersion and knowledge retention.

15.3 Other recommendations

The game prototype covers only parts of the curriculum. For the game to be more attractive to the older part of the target group, more challenging game play should be included. As the game stands now, it serves best as a short-term intervention. However, there should be a dialogue with the teachers willing to employ this game so the game does not seem misplaced or unmotivated.

There is much potential in expanding the prototype, both with more engaging gameplay and including other parts of the curriculum or other aspects of personal finance which economists suggest. Testing can also be done more extensively and with higher validity if the game is placed in an educational context.

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A Questions from first questionnaire

Ungdomsskoleelevers forhold til økonomi

Vi vil gjerne finne ut av hvilket forhold ungdomsskoleelever har til økonomi. Vi vil vite noe om din økonomi og hvordan du tror en voksen persons økonomi er. Det spiller ingen rolle om du er helt sikker på svarene. Vi ønsker å vite hva du tror er riktig. Vi setter pris på at du tar deg tid til å svare ordentlig på alle spørsmålene, slik at vi får et realistisk bilde av ditt forhold til økonomi.

*Må fylles ut

Er du gutt eller jente? *

- ○ Gutt
- ○ Jente

Hvor gammel er du? *

- ○ 12
- ○ 13
- ○ 14
- ○ 15
- ○ 16

Hvilken skole går du på? *

Svaret ditt

Hvor tjener du gjennomsnittlig i måneden? *

Her kan det være penger du får fordi du jobber eller fordi du får ukepenger fra foreldrene dine.

- 0 - 100
- 100 - 200
- 200 - 400
- 400 - 800
- Mer enn 800

Hvilke utgifter har du? *

Hva bruker du penger på i løpet av en måned og hvor mye bruker du?

Svaret ditt

Hva tjener du penger på?

Jobber du for pengene du tjener eller får du ukepenger?

Svaret ditt

Hvor mye penger tror du foreldrene dine bruker på deg totalt i måneden? *

Dette inkluderer alt av utgifter, både ukepenger, mat, klær, fritidsaktiviteter etc.

- ○ 500
- ○ 500 - 1000
- ○ 1000 - 1500
- ○ 1500 - 2000
- ○ 2000 - 3000
- ○ 3000 - 4000
- ○ 4000 - 5000
- ○ Mer enn 5000

Hva vet du om dine foreldres økonomi?

Vi vil gjerne vite hva du vet/tror om dine foreldres økonomi. Ta utgangspunkt i en av foreldrene dine når du svarer.

Hvilket yrke har forelderen du valgte? *

Hvis du ikke vet tittelen så bare skriv det forelderen din jobber med.

Long answer text

Eier eller leier dere stedet dere bor? *

Dersom man har kjøpt stedet man bor så eier man, hvis ikke så leier man.

- ○ Eier
- ○ Leier
- ○ Aner ikke

Dersom du skulle tatt over økonomien til den forelderen du valgte en måned, hvilke utgifter ville du hatt? *

Lat som om du skal sette opp et budsjett for den neste måneden som forelderen dine skal følge. Hvilke utgifter må det inneholde?

Long answer text

Hvor stor prosentandel av inntekten ville du brukt på de forskjellige utgiftene som du satte opp i forrige spørsmål? *

Hvor mange prosent bruker forelderen din på mat i måneden, hus, etc.?

Long answer text

Din økonomi i fremtiden

Vi er ute etter dine tanker om din egen fremtid. Hva som er viktig for deg når det kommer til ting som vil påvirke økonomien din.

Lønn er viktig for meg i fremtiden *

Hvor enig er du i denne påstanden?

- ○ Helt enig
- ○ Delvis enig
- ○ Delvis uenig
- ○ Helt uenig

Jeg vil kjøpe min egen bolig *

Hvor enig er du i denne påstanden?

- ○ Helt enig
- ○ Delvis enig
- ○ Delvis uenig
- ○ Helt uenig

Hva tror du må til for at man kan kjøpe sin egen bolig? *

Long answer text

Vil du hjelpe oss videre som tester?

Vi vil etterhvert trenge personer som har lyst til å teste spillet vi lager, eventuelt hjelpe oss ved å svare på flere spørsmål. Dersom du syns dette høres gøy ut kan du skrive ned navn og epost eller et telefonnummer vi kan nå deg på.

Short answer text

B Textual answers from first questionnaire

Hvilke utgifter har du? (46 responses)

Ingen
Ingen
Ingen
Alt mulig, 900kr
Ikke noe
Mat og ting jeg trenger
Kebab, lipgloss og kantine ca 400
Mye går til bøker, men så er det mye jeg sparer opp til.
Null
Klær og fritid
Klær, sminke, 200
Klær, sminke, godteri og aktiviteter med venner
500
Mat, elektroniske ting
Ingenting
Jeg bruker i gjennpmsnitt ca 100 kr i uka på klær/sminke/mat osv
Mat og ca 100 kroner
Mobilabenomang, klær osv.
Bruker ikke, sparer måneder maks
Klær sminke sminkefjerner
Jeg er ute med venner
Klær og mat

Jeg bruker nesten ikke, men hvis jeg er med noen venner eller noe sånt på shopping så kan det hende jeg kjøper meg noe.
Mat, ca 200 kr i månden.
Ikke mye, kanskje til spill og noen ganger til klær
Sparer
Jeg bruker penger på mat og jeg bruker sirka 100 kr i uka.
Har ikke brukt noe i det siste, sparer opp til noe.
Kantine mat og noen ganger spill
Pleier ikke å bruke så mye penger. Går på kino inneblant.. Ca 200 kr.
Jeg bruker ikke penger så mye så 100,-
Jeg bruker penger på klær og opplevelser, men ikke alle pengene er tjent opp de har jeg fått av foreldrene mine.
Mat, drikke, klær, buss, nærmere 600kr
Mat, ca. 100 kr
Mat 200kr
Klær og sminke, 2000kr
0
Lefse, 450kr
mat 50 kr
Dama og spill/egne interesser som jeg plutselig vil like/får interesse for.
Bensin og andre deler kanskje bruker rundt 2000 i månden
Bruker ikke penger fordi mor og far passer på pengene mine
Klær: 200-300 kr Mat og godsaker: 50 kr
Noen ganger klær og da er det ca. 500-1000
Sminke, klær, mat 150kr
Sminke klær mat 150 kroner

Dersom du skulle tatt over økonomien til den forelderen du valgte en måned, hvilke utgifter ville du hatt?

(46 responses)

Vet ikke
Vet ikke
Aner ikke
Aner ikke
Veit ikke
Regninger Mat Klær Forskjellige nødvendigheter Hobby
Mat, regninger, dyr, klær, disel (transport), praktiske ting, barn og helse
Lån, mat, klær, mobilregning, ukepenger, strøm
-Mat -Klær -Nødvendige ekstrakostnader som reparasjon -Strøm -Vann (både kaldt og varmt) -Småtteri som ting til hygiene -Unødvendige ting som er koselige -Bil og ting til bilen -Gaver og andre ting man gir bort -Hus (eks. Lån)
Lån, forsikringer, mat, bil, telefoner, kommunale utgifter og fritidsaktiviter.
Mat, telefon, trening, bil, hus, strøm
Husleie, huslån, strøm, internett, tv
Mat, klær, husleie, lån, forsikring, bensin, fritidsaktiviteter og andre hendelser som eventuelt forekommer i denne måneden
Strøm, vann
Mat, klær
Mat, klær, hus, bil, regninger,

Mat Regninger Annet
Fritidsaktiviter, klær, mat, ukelønn, egne intresser.
Mat drikke strøm vann Osv
Ned betaling av hus lån og normale utgifter
Klær: 200 - 400 kr Bensin: 300/400 kr Mat: 2000 kr
Mat og klær
Pappa Bil Mat Klær Forsikring Regninger Strøm Barn Hund
Mat, elektrisitet, vann, nettverk, bil, forsikring, klær

Til mat og klær
Mat Bensin Hus Klær Sparing Idrett Vann Strøm Skatt Og mer
Mat, regninger, bensin, klær, møndespenger, sparing og annet
Jobbe, være glad mot kunder
Strøm vann mat klær bensin
Hus, bil, strøm, vann, klær, mat og vi skal ka det gøy i blandt.
Mat, klær, strømm, vann, skatt, idrett
Mat, klær, vann, strøm, skatt, idrett, hus
Idrettutgiftene mine, mat og strøm
1000kr til mat 500kr til fritidsaktivitet 2000kr til bensin 5009kr til varmt vann 4000kr til strøm
Mat, strøm, boligsted, vann, regninger på forskjellige ting
Jeg ville ha brukt penger på strøm mat og klær.
Mat, bil, hus, ukepenger og klær
Mat, drikke, hus, nett, bil, barn, hobbyer.
Vann, strøm, mat, reginger og de bruker litt på meg.
Strøm, barnehage, klær, nett,vann,mat, skatter, taekwon-do, bil,disel,nrk-lisens, gjeld

Hunden vår, søsteren min og meg, vi skal ha mat og drikke, det samme skal dem ha. Vi trenger strøm og vann, og klær og utgifter til idretter.
Mat, hus, strøm, skatt OSV.
Mat Klær Strøm Bensin Regninger Div Lommepenger
Mat Klær Transport Bensin Regninger Diverse Strøm
Mat. Bil. Korps. Husleie. Skatt.
Mat Kosmetikk Klær Vann Kloakk Strøm Netflix Fritidsaktiviter Sparing Lefser

C Questions from second questionnaire

Hva var dine erfaringer med spillet?

Her kommer det noen kontrollspørsmål om din opplevelse med spillet. Vi setter veldig pris på at dere hjalp oss og at dere tar dere tid til å svare ordentlig på spørsmålene. På forhånd takk for hjelpen!

* Required

Er du gutt eller jente? *

- ○ Gutt
- ○ Jente

Hvor gammel er du *

- ○ 11
- ○ 12
- ○ 13
- ○ 14
- ○ 15
- ○ 16

Spiller du spill regelmessig? *

- [ ] Dataspill
- [ ] TV-spill
- [ ] Mobilspill
- [ ] Ingen av delene

Har du spilt spill der målet er å lære noe før?

- ○ Ja
- ○ Nei

Hvis du svarte ja på det forrige spørsmålet: Hva slags spill har det vært?

Your answer

Jeg ble bedre til å budsjettere etter å ha spilt spillet *

	1	2	3	4	
Veldig uenig	○	○	○	○	Veldig enig

Jeg lærte noe om hvilke utgifter en voksen person har av å spille spillet *

	1	2	3	4	
Veldig uenig	○	○	○	○	Veldig enig

Jeg ble mer klar over at yrket mitt påvirker hvor mye penger jeg kan bruke *

	1	2	3	4	
Veldig uenig	○	○	○	○	Veldig enig

Jeg lærte noe om forsikringer av å spille spillet *

	1	2	3	4	
Veldig uenig	○	○	○	○	Veldig enig

Jeg lærte å ikke bruke mer penger enn jeg tjener *

	1	2	3	4	
Veldig uenig	○	○	○	○	Veldig enig

Jeg lærer godt av å spille dataspill *

	1	2	3	4	
Veldig uenig	○	○	○	○	Veldig enig

Etter å ha spilt spillet tror jeg at jeg i fremtiden vil være flinkere til å håndtere min egne personlige økonomi *

	1	2	3	4	
Veldig uenig	○	○	○	○	Veldig enig

Dette spillet gjorde at jeg vil lære mer om personlig økonomi *

	1	2	3	4	
Veldig uenig	○	○	○	○	Veldig enig

Jeg hadde det gøy da jeg spilte spillet *

	1	2	3	4	
Veldig uenig	○	○	○	○	Veldig enig

Jeg konsentrerte meg godt da jeg spilte *

	1	2	3	4	
Veldig uenig	○	○	○	○	Veldig enig

Jeg ble engasjert av spillet *

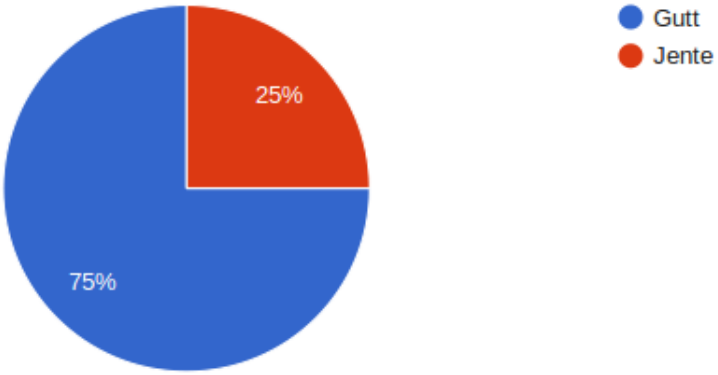
	1	2	3	4	
Veldig uenig	○	○	○	○	Veldig enig

Jeg kunne tenkt meg å spille lignende spill for å lære om andre emner enn økonomi også *

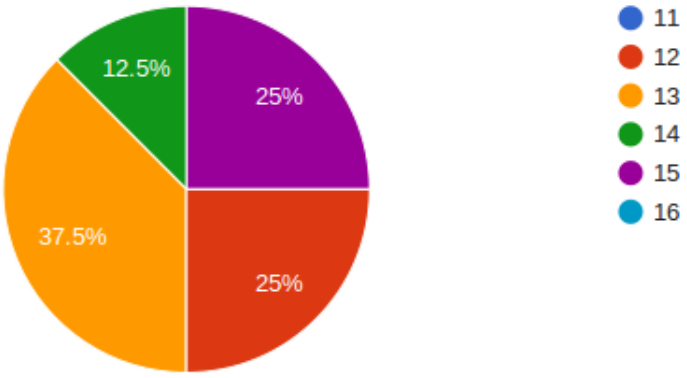
	1	2	3	4	
Veldig uenig	○	○	○	○	Veldig enig

D Answers from second questionnaire

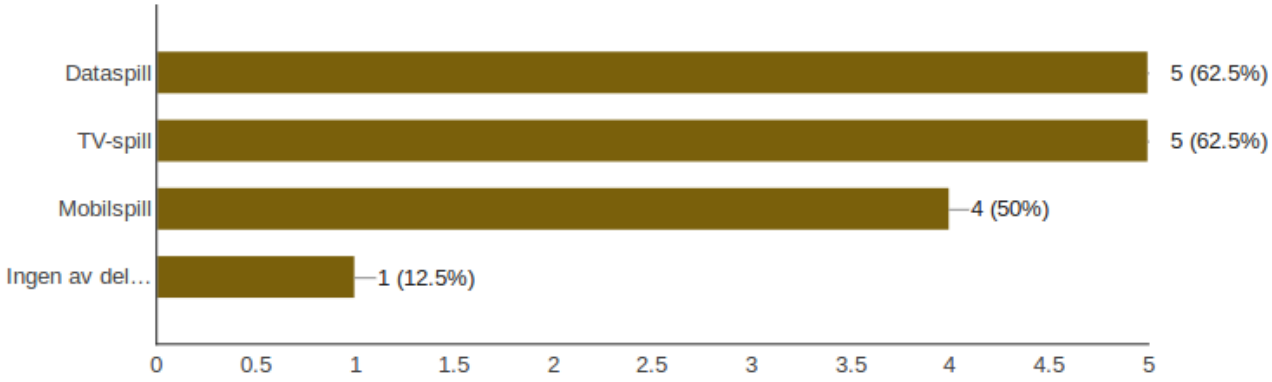
Er du gutt eller jente? (8 responses)



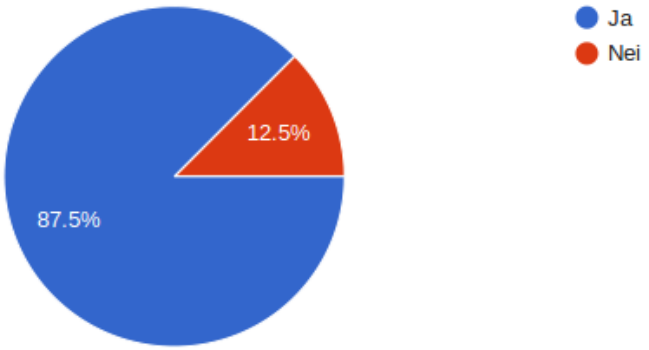
Hvor gammel er du (8 responses)



Spiller du spill regelmessig? (8 responses)



Har du spilt spill der målet er å lære noe før? (8 responses)

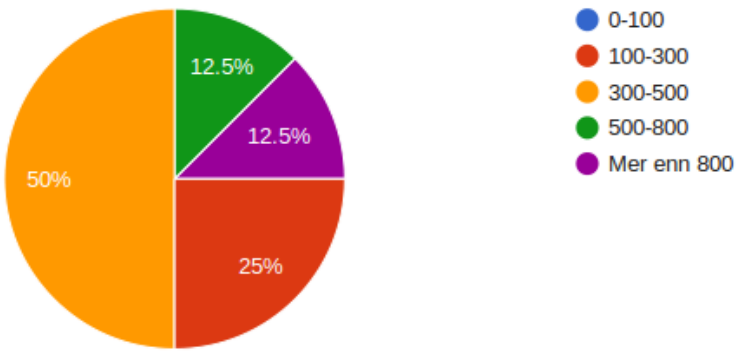


Hvis du svarte ja på det forrige spørsmålet: Hva slags spill har det vært?

(7 responses)

Byen
Byen
Byen
Spill på pc der man lærer språk og matte
les og lær, diverse quiz-spill
Sims
Quis-spill som Trivia Crack

Hvor mye penger tjener du gjennomsnittlig i måneden? (8 responses)

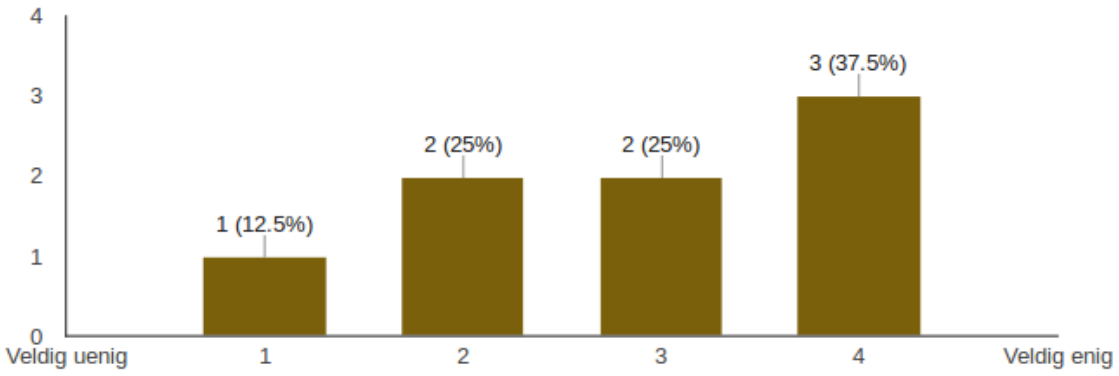


Hvis du svarte ja på det forrige spørsmålet: Hva slags spill har det vært?

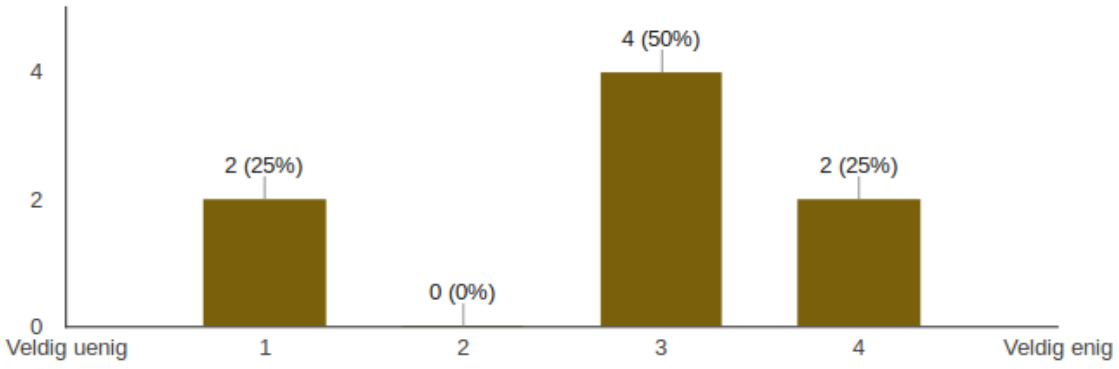
(7 responses)

Byen
Byen
Byen
Spill på pc der man lærer språk og matte
les og lær, diverse quiz-spill
Sims
Quis-spill som Trivia Crack

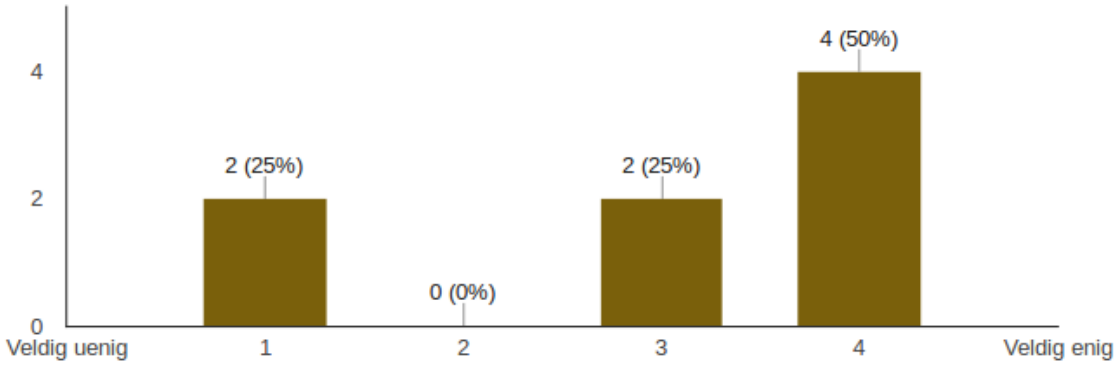
Jeg ble bedre til å budsjettere etter å ha spilt spillet (8 responses)



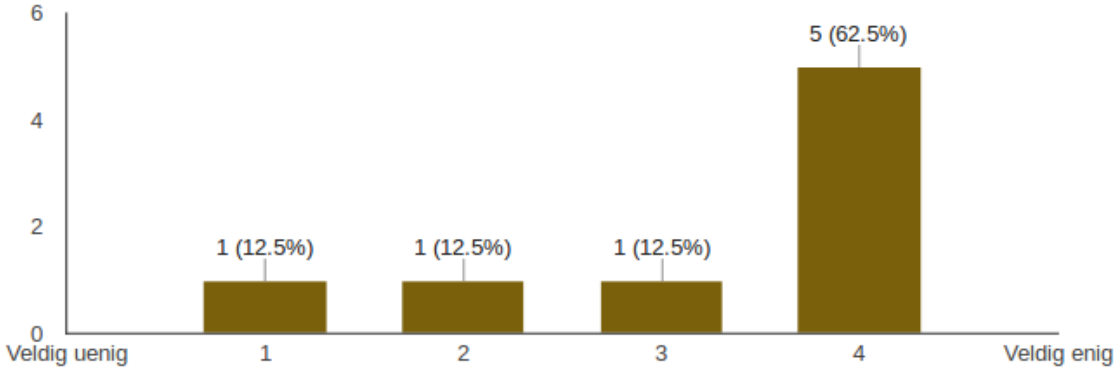
Jeg lærte noe om hvilke utgifter en voksen person har av å spille spillet
(8 responses)



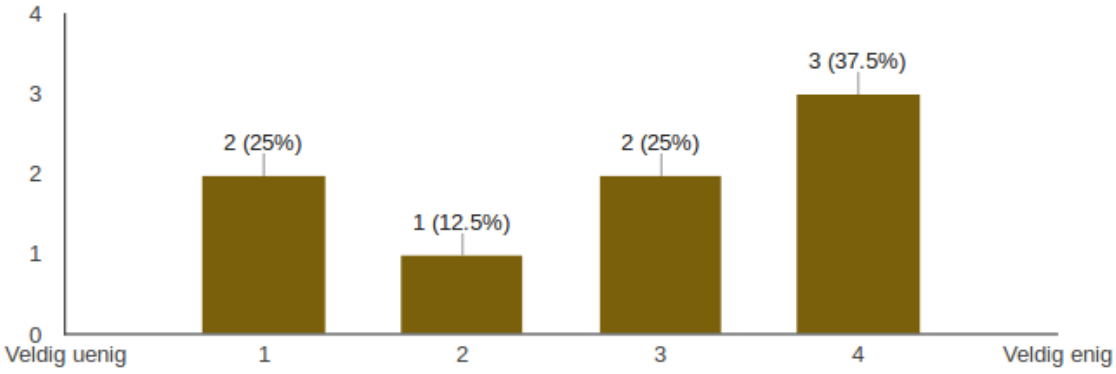
Jeg ble mer klar over at yrket mitt påvirker hvor mye penger jeg kan bruke
(8 responses)



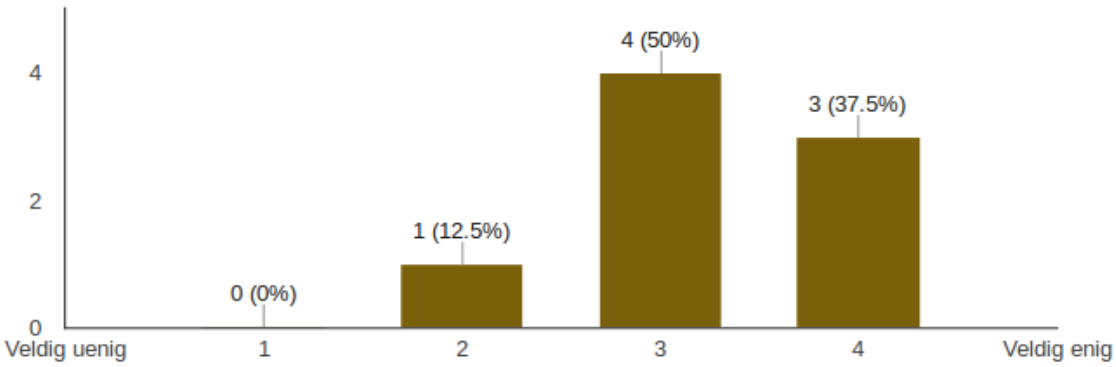
Jeg lærte noe om forsikringer av å spille spillet (8 responses)



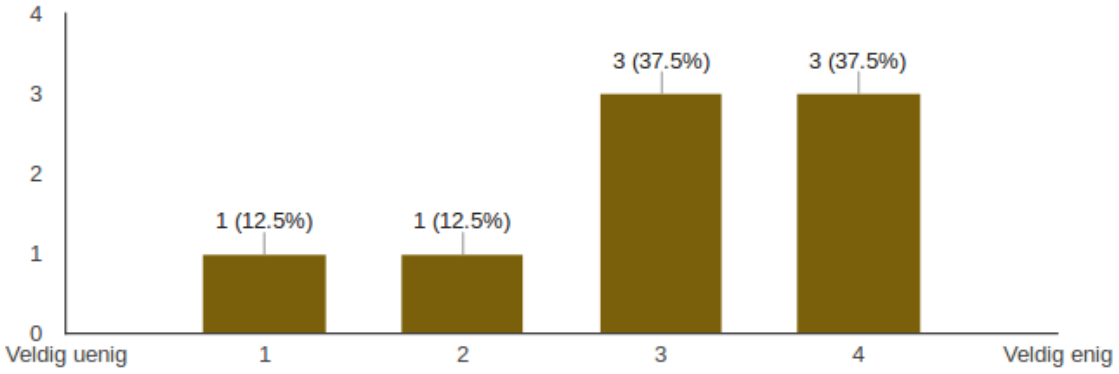
Jeg lærte å ikke bruke mer penger enn jeg tjener (8 responses)



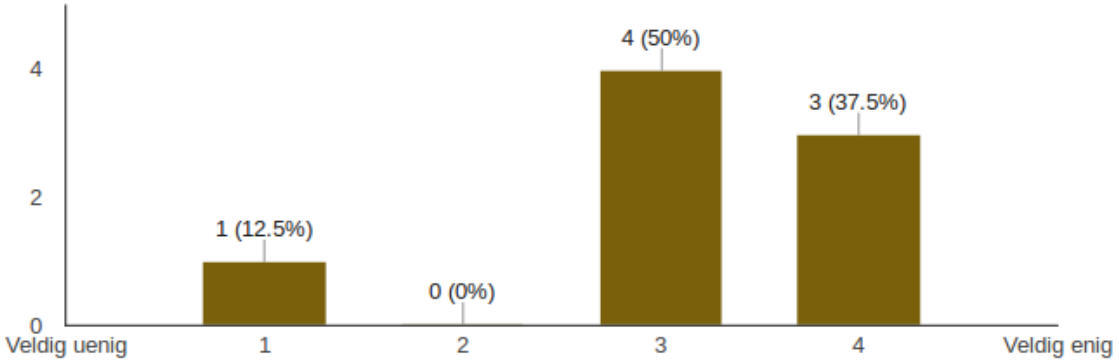
Jeg lærer godt av å spille dataspill (8 responses)



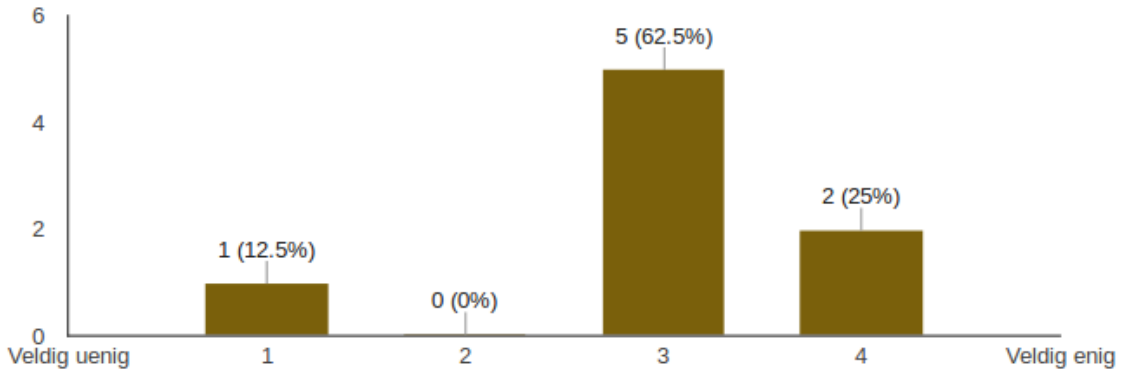
Jeg hadde det gøy da jeg spilte spillet (8 responses)



Jeg konsentrerte meg godt da jeg spilte (8 responses)



Jeg ble engasjert av spillet (8 responses)



Jeg kunne tenkt meg å spille lignende spill for å lære om andre emner enn økonomi også

(8 responses)