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A Prototype using Gamification to Motivate a
Greater Study Effort

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Abstract

The aim of this thesis was to design a system which uses gamification to motivate study effort in the long term. Gamification is widely used to create engagement among people. Yet, the use has often been limited to single or short-term settings. There is a lack of knowledge on how to design gamification for maintained motivation over longer periods of time. The system was designed for students at the degree program Bachelor of Science in Informatics at NTNU, campus Gløshaugen, with a focus on them wanting to use the system throughout the life cycle of a bachelor's degree.

The design was built upon a literature review of how gamification facilitates short-term and long-term motivation. Furthermore, user investigations consisting of a questionnaire and workshop were conducted to help define user requirements for the system. Finally, a prototype of mockups implementing the user requirements was created and evaluated.

The prototype presents a successful skeleton of a system implementing gamification for long-term motivation of study effort. Results showed that nine out of ten thought the system would motivate them in the long term and that nine out of ten thought they would want to use the system over a period of three years.

Keywords: gamification, long-term motivation, intrinsic motivation, study effort, co-design, prototype

Sammendrag

Målet med denne oppgaven var å designe et system som bruker spillifisering for å motivere til en høyere studieinnsats over lengre tid. Bruken av spillifisering er særlig utbredt i forbindelse med å skape engasjement blant mennesker. Til nå har denne bruken ofte vært begrenset til enkle og kortsiktige settinger. Kunnskapen om hvordan man skal designe spillifisering for å skape vedvarende motivasjon over en lengre periode er mangelfull. Systemet er designet for studenter som studerer Bachelor Informatikk ved NTNU, campus Gløshaugen, og fokuserer på at studentene skal ønske å bruke systemet over alle tre årene av en bachelorgrad.

Designet er basert på kunnskap funnet i en litteraturstudie som omhandlet hvordan spillifisering fasiliterer korttids- og langtidsmotivasjon. Videre har det blitt utført brukerundersøkelser, via en spørreundersøkelse og workshop, som hjelp til å definere brukerkravene til systemet. Til slutt ble en prototype, bestående av skjermbilder som implementerer brukerkravene, laget og evaluert.

Prototypen presenterer en suksessfull ramme for et system som implementerer spillifisering for langtidsmotivasjon av studieinnsats. Resultatene viste at ni av ti trodde systemet kom til å motivere dem over lengre tid, og ni av ti trodde de kom til å bruke systemet over en treårsperiode.

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Glossary

co-design A design approach where the user is seen as a partner instead of a subject, participating in the design process. P. 3, 10, 47

Cognitive Evaluation Theory A mini-theory of the Self-Determination Theory, concerning what facilitates intrinsic motivation (Ryan and Deci, 2000a). P. 22

design and creation A research strategy. An iterative process where one is learning through building an IT artifact (Oates, 2005). P. 5, 6

Eight Golden Rules of Interface Design Eight rules to ensure usability (Shneiderman et al., 2016). P. 81, 95

extrinsic motivation The desire to achieve an outcome for performing an activity. P. 1, 2, 21–25, 27, 39, 40, 77, 105–107

flashcard A card with questions, phrases etc. on the front and an explanation on the back. P. 81, 82, 88, 89, 91–93, 101, 103

game design elements Elements that are characteristic to games. P. 2, 15, 17, 18, 24, 26, 27, 92, 105–108

gamification The use of game design elements in non-game contexts (Deterding, Dixon, et al., 2011, p. 10). P. 2–5, 8, 10, 15–18, 23, 27, 31–33, 39–41, 45, 47, 49, 54, 55, 57, 62, 63, 68, 77, 89, 99, 102, 105, 106

Informatics The degree program Bachelor of Science in Informatics at NTNU campus Gløshaugen. P. 2–5, 8–10, 45, 47, 49, 51–54, 76, 102, 106

intrinsic motivation The interest and pure enjoyment of doing an activity. P. 1, 3, 15, 21, 22, 24–27, 39, 40, 76, 92, 105

learning outcomes Minimum knowledge, skills and general competence a student should possess after completing the degree program Bachelor of Science in Informatics. P. 53, 54, 76, 79, 89, 93–96

Likert scale A scale stating the degree of agreement. P. 49

low-fidelity prototype A simple, and often sketched, prototype. P. 3, 4, 45, 46, 79, 106

Octalysis A gamification framework analyzing and building strategies on what makes a game fun (Chou, 2015). P. 12, 27, 46–48, 51, 73–75, 77, 89, 92

Online The student association of Informatics. P. 52, 80, 96, 100, 102, 103

Organismic Integration Theory A mini-theory of the Self-Determination Theory, concering different degrees of extrinsic motivation (Ryan and Deci, 2000a). P. 22

personas Fictitious representations of possible users of a system. P. 3, 47, 51, 52, 76, 77, 107

player centered design process An iterative design process focused on creating player engagement (Kumar and Herger, 2013). P. 45, 48, 51, 108

prototyping An iterative development process of creating a prototype, conducted before the final production (Vliet, 2007). P. 44

Self-Determination Theory A theory of extrinsic and intrinsic motivation, stating autonomy, competence and relatedness as critical needs for self-motivation (Deci and Ryan, 1985). P. 21, 105

Studiebarometeret A national student survey conducted by NOKUT (NOKUT, 2017). P. 1, 7, 10, 13, 54, 75, 76

System Usability Scale A questionnaire of Likert scale questions, giving a global view of subjective assessments of usability (Brooke et al., 1996). P. 49

taxonomy of intrinsic motivations for learning A taxonomy of what makes a learning environment fun (Malone and Lepper, 1987). P. 26, 39, 76, 105

usability testing A process of testing to what extent the system meets the usability criteria, using the target group as test subjects. P. 6, 8, 46, 48, 49, 89, 99, 102, 106, 107

Acronyms

CET Cognitive Evaluation Theory. P. 22

NSD Norsk senter for forskningsdata/Norwegian Centre for Research Data. P. 13

OIT Organismic Integration Theory. P. 22, 25

SDT Self-Determination Theory. P. 21–24, 26, 39, 105

SUS System Usability Scale. P. 49, 89, 93, 99, 102, 106

1 | Introduction

This introduction presents the motivation, research goals and questions, research contributions, scope and structure of this thesis.

1.1 Motivation

Statistics from the national student survey, Studiebarometeret (NOKUT, 2017), revealed that second year students on the degree program Bachelor of Science in Informatics at NTNU campus Gløshaugen (hereinafter Informatics), in 2016 self-reported an average of spending 34 hours per week on learning activities. On a scale from 1 to 5, where 5 is strongly agree, they scored 3.8 when asked to what extent they were motivated for working on their studies. These numbers are equivalent to the average of all bachelor degrees in informatics and computer science in Norway. Yet, they perceived their study effort as low. When asked to what extent they agreed on being a hardworking student, they scored 2.9 out of 5 whereas the average was 3.5. The reason for this low score is unknown, but an explanation might be NTNU's recommendation of spending minimum 40 hours per week on studies. Even though they are motivated for working on their studies, they should also be motivated to work harder. The reason for this is the psychological need of feeling competent, which comes from mastering challenges and is important to facilitate long-term motivation (Deci and Ryan, 1985), and hence keep up the motivation for the life cycle of a bachelor's degree. In this regard, the motivation for a high study effort itself is crucial.

Motivation can be either extrinsic or intrinsic (Deci and Ryan, 1985), and intrinsic motivation is found to be more long-lasting. Extrinsic motivation refers to gaining some type of outcome for performing an activity whereas intrinsic motivation refers to the pure enjoyment of performing the activity. Motivation can be defined as "... a private, unobservable psychological, neural, and biological process that serves as an antecedent cause to the publically observable behavior that is engagement. " (Christenson, Reschly and Wylie, 2012, p. 151). This definition is important in the understanding of why motivation often coincide with engagement in the subject of games. In general, games have the effect of creating so-

cial interaction, entertain and delight people (Egenfeldt-Nielsen, Smith and Tosca, 2015). Statistics from the Norwegian media barometer in 2016 (Statistics Norway, 2016) show that 35 percent of all Norwegians play digital games on an average day. For persons aged 16-24 the number is as high as 55 percent. Therefore, separating game elements from their original environment to be used in new settings is a phenomenon seen especially in the context of increased user experience. People enjoy playing games and they tend to have an engaging effect. Loyalty programs in marketing (Zichermann and Linder, 2010), or in more recent times the use of the game-based platform Kahoot! in lectures (Kahoot!, 2018) are just a few examples. This trend has led to several new terms being introduced such as "funware", "playful design" and "gamification". Gamification however, has become the common household term for the emerging trend (Deterding, Dixon, et al., 2011), and education is among the sectors trying to adapt to it.

The current state of the engaging effect of gamification in online programs was recently systematically reviewed (Looyestyn et al., 2017). The review included both the engagement of people in single settings and sustained engagement over a period of time. Even though the review was not directly targeting the subject of education, it included several online programs used in education and gives an overall insight into its engaging effect. The review revealed gamification having a positive effect in short-term or single settings whereas studies have given mixed results in long-term settings. The presented reason for the mixed results is that engagement will decrease over time due to elements often used in gamification trigger extrinsic motivation. It is pointed out that there is a lack of research on how to implement gamification for engagement in long-term settings. In comparison with the review of online programs, another previous study specifically targeted on the application of gamification in education (Dicheva et al., 2015) showed similar results. The study consisted of reviewing other studies and revealed that most of the authors had concluded with a positive attitude towards the concept of gamification, and that it had the potential to improve learning as long as it was well-designed. The review recommended that further research should be aimed more towards the motivational aspects of the single game design elements rather than the overall engaging effect. In light of the earlier stated definition of motivation, the suggestion of further research makes sense, as motivation is the fundamental to the observable behavior of engagement.

Computer Science educators are mainly the early adapters of gamification (Dicheva et al., 2015), and from my experience as a fifth year student of Informatics, I can confirm that several professors have included gamification in lectures and exercises during my education. One reason for this might be that increased student engagement is seen as a key success factor in education. Yet, the cases have been limited to single courses or situations. There are no elements of gamification on the overall study program even though we know there are aspects, such as study effort, that have the potential of being improved. The explanation might be the lack of knowledge, as described above, on how to implement gamification to maintain motivation in long-term settings. The main motivation of this thesis is to contribute knowledge to this field, with a focus on improving the study effort at Informatics. Personal motivations include being an Informatics student myself, having experienced low motivation for study effort especially during the last semester of my second year.

1.2 Goals and Research Questions

Research goal 1: Knowledge contribution on how gamification facilitates extrinsic and intrinsic motivation.

RQ1: How does gamification facilitate motivation?

Research goal 2: Design and evaluate a prototype for a system that applies gamification to motivate students' study effort at Informatics.

RQ2: Which user requirements should be included in a system using gamification, designed to motivate a greater study effort at Informatics?

RQ3: What should a system implementing the user requirements in RQ2 look like?

1.3 Contributions

- A study and discussion of how gamification facilitates motivation, especially in the long term. This included reviewing literature and analyzing how the applications Kahoot!, DuoLingo, Hold and HabitBull have implemented gamification. Presented in chapter 3 - Literature Review, chapter 4 - State of the Art and chapter 5 Discussion.

- User investigations with students of Informatics, on how they prefer the implementation of gamification. The investigations included making personas, gathering existing information, carrying out a questionnaire and co-design in a workshop. Presented in chapter 7 - Iteration 1.

- A low-fidelity prototype proposing how to implement gamification on the overall study of Informatics with a focus on study effort. Presented in chapter 8 - Iteration 2 and 9 - Iteration 3.

- Evaluation and discussion of the prototype's effect on motivation among students of Informatics. Presented in chapter 8 - Iteration 2 and 9 - Iteration 3.

1.4 Scope

This thesis planned to conduct a study on how gamification facilitates motivation, and use the findings to implement a system. This initial plan was redefined, as these ambitions were too optimistic. The literature review was time consuming because much of the literature was in the field of psychology. As a student studying Informatics, understanding

the essence in these psychology research articles was challenging. This thesis also carried out a questionnaire, and familiarizing myself with how to do statistics was also more time consuming than scheduled. The scope was narrowed down to include a low-fidelity prototype instead of an implemented system. The target group were students of Informatics, but with a main focus on third year students, who were the ones representing the scores of a low study effort. User investigations were limited to study generalizations and not individual cases.

1.5   Thesis Structure

Chapter 1 presents the motivation, research questions, contributions, scope and structure of this thesis.

Chapter 2 describes the used research methodology.

Chapter 3 presents the findings of the literature review.

Chapter 4 presents a state of the art, analyzing how gamification is implemented in the applications Kahoot!, DuoLingo, Hold and HabitBull.

Chapter 5 carries out a discussion of the findings in chapter 3 and 4. This discussion comes between research goal 1 and 2, and was necessary to continue with research goal 2.

Chapter 6 describes the used development methodology.

Chapter 7, 8 and 9 each represent an iteration in the chosen development process. A discussion is carried out at the end of each iteration.

Chapter 10 brings a conclusion including answering the research questions, limitations and a suggestion for further work.

2 | Research Methodology

The research methodology was based on the research process components described in Oates (2005). The followed process is highlighted with dark in figure 2.1. To begin with, research questions were defined by the presented motivation in chapter 1.1. The conceptual framework, which refers to how one chooses to think about a research topic, was clarified through the definition of motivation and gamification in chapters 1.1 and 3.1. Justifications of the chosen research strategy and data generation methods are presented below.

Oates (2005) has gathered six common research strategies used in the research of information systems, see figure 2.1. They serve different purposes, and one appropriate strategy should be chosen for each research question. Action research and ethnography were beyond the scope of this thesis, as the researcher must take place in the field, which is very time consuming. Neither was it in the nature of this thesis to conduct an experiment. The goals were to understand how gamification facilitates motivation and designing a prototype. The issue, which is also stated in the motivation, is that there is a lack of systems implementing gamification for long-term settings. Consequently, survey and case study were also excluded because there was no system to study or ask questions about yet. Learning through building an IT artifact such as a prototype, is a primary activity in design science research (Vaishnavi and Kuechler, 2004). Therefore, the strategy design and creation was chosen to answer RQ3. Design and creation is a process covering all phases from being aware of a problem to concluding with a solution. RQ1 and RQ2 therefore became natural parts of the early phases of the design and creation process, as these questions were aimed to gain knowledge needed to build the prototype.

Since students at Informatics had no experience with an existing system implementing gamification on the overall study, interviews, observations and questionnaires were eliminated as data generation methods to answer RQ1. Instead, a traditional literature review was carried out since a significant amount of relevant literature was available. RQ2 was centered around investigating users, and all data generation methods were possible options. Nevertheless, questionnaire was chosen rather than interviews and observations, for the reason of being less time consuming when wanting to gather data from a bigger group of people. A downside of this choice was accepting the risk of missing out on in-depth details. In addition to the questionnaire, secondary data from a previous survey was collected and a design workshop with students was carried out to help answer RQ2. Data genera-

tion for RQ3 mostly consisted of researcher-generated documents. As a part of usability testing when evaluating the prototype, thoroughly explained in chapter 6.5, two types of questionnaires were given to test subjects afterwards concerning answering RQ3. Because of the data's nature, both quantitative and qualitative analyses were conducted.

Detailed descriptions of how the strategies and methods were carried out are presented in the following sections.
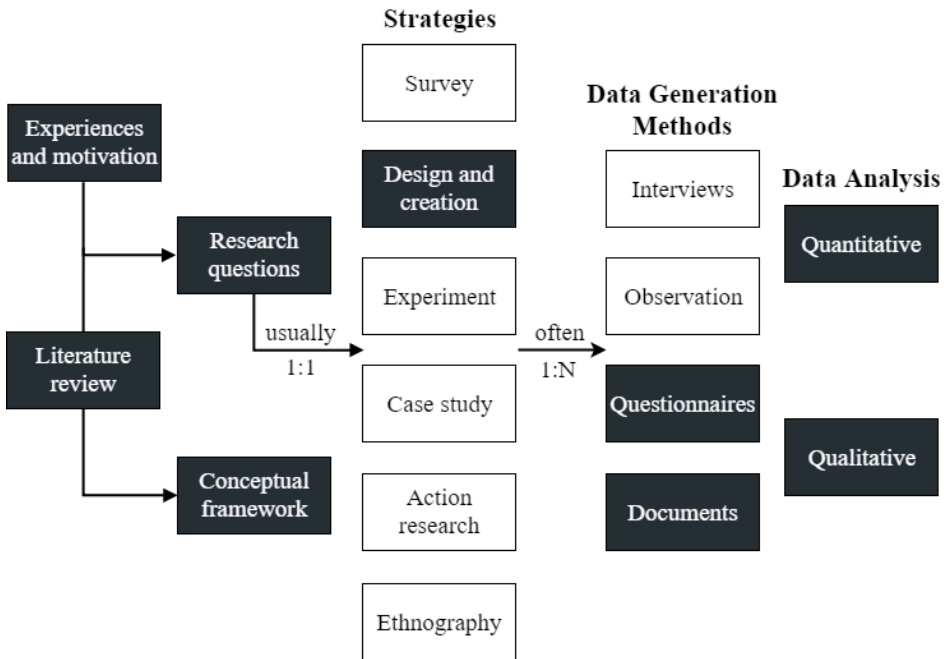
Figure 2.1: Research Process, adapted from Oates (2005, p. 33)

2.1 Design and Creation

Design and creation consists of an iterative process, shown in figure 2.2. The first step consists of the awareness of a problem, suggestion refers to the process from being aware of the problem to having a tentative idea for a solution, development is the further development and implementation of the tentative idea, evaluation refers to evaluating the artifact and conclusion is the end of the research cycle or finale of the research effort (Vaishnavi and Kuechler, 2004). The output column in figure 2.2 shows how the process relates to this thesis.
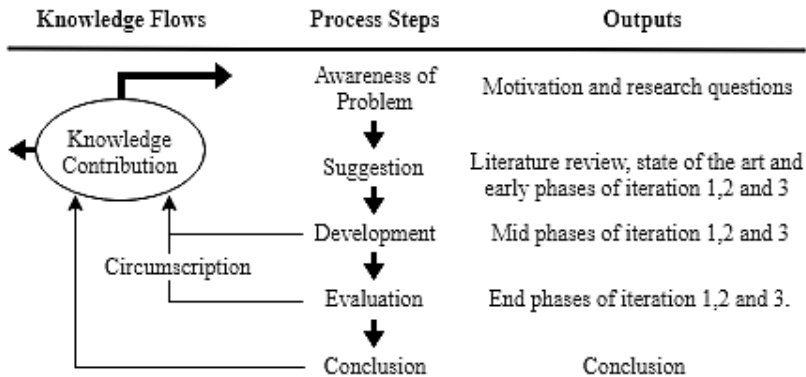
Figure 2.2: Design and Creation Process Model, adapted from Vaishnavi and Kuechler (2004, p. 8)

2.2 Data Generation Methods

As stated, data generation methods included carrying out questionnaires and collecting documents, both found documents and researcher-generated documents (Oates, 2005). On the subject of found documents, publications were searched for as part of a literature review and secondary data from a previous survey called Studiebarometeret (NOKUT, 2017) was gathered. As for generated documents, a workshop was organized creating mostly non-textual data in the form of posters and the final prototype consisted of researcher generated mockups.

2.2.1 Literature Review

A literature review can be traditional or systematic. The latter refers to a rigorous study, using different types of search systems to find all available scientific literature relevant for the research topic (Kitchenham, 2004). A systematic review is more time consuming compared to a traditional literature review and one has to consider the added value for the extra time. Conducting a systematic review would have been the best option if the whole scope of this thesis was to do a literature review, as it would have increased credibility. In this thesis, the review was supposed to be a preparatory activity for the primary task of designing a system. A systematic literature review would in this case have given a small added value for significantly more work, and would not have been expedient as there would be little time left for the remaining research. Therefore, a traditional literature review was chosen, using only the search engine Google Scholar and the university library. Google Scholar may not have found all publications, but since it sorts the results by citations, it helped finding the most important publications needed to create a solid basis for the further

design research.

Table 2.1 shows examples of words that were searched for with the associated number of hits. General terms such as "gamification" and "intrinsic extrinsic motivation", usually gave many hits and therefore the number of citations were critical when picking a starting point. For example, "intrinsic extrinsic motivation" resulted in especially two theories looking relevant, where the one (Vallerand, 1997) had 3117 citations and the second (Ryan and Deci, 2000a) had 11475 citations, and so the second one became a choice for further in-depth investigations. More specific terms such as "self determination theory", sometimes gave unexpected many hits, and a combination of terms such as "'Self determination theory' gamification education", was needed to get satisfying results. Reference lists and cited by lists often gave inspiration on terms to search for. Besides from books, only accepted peer-reviewed articles were included to ensure reliability.

Table 2.1: Examples of Search Terms and Hits in the Literature Review

Examples of Search Terms	**Number of Hits**
gamification	17 100
intrinsic extrinsic motivation	218 000
self determination theory	3 510 000
"Self determination theory" gamification education	2120

2.2.2 Questionnaires

Three questionnaires were handed out to the students at Informatics. The last two questionnaires were carried out in conjunction with usability testing, and these are further elaborated in the chapter 6.5 - Development Methodology. The first questionnaire (hereinafter referred to as "the questionnaire") aimed to become familiar with the students' attitudes towards gamification in relation to study effort. The questionnaire was self-administered (Oates, 2005), meaning that I was not present when the respondents completed the questionnaire. This choice was made to give respondents the opportunity to answer whenever suited and lower the threshold to give genuine answers, as some may feel pressure to give pleasing answers when the researcher is present. The questionnaire is found in appendix A.

Design

The questions covered gamification in relation to study effort, and how students found different described systems motivating and useful. Study effort was broken down into the overview of actual time spent, efficient use of time, increasing the use of time spent and spending time helping others. The questionnaire was divided into sections where some questions generated factual data and the majority of the questions generated data of

opinions. Questions considering factual demographic data were placed at the end of the questionnaire (Oates, 2005).

Factual data questions consisted of closed questions and the other questions included both closed and open questions. This was to not exclude possible wide ranges of opinions by letting the respondent write their thoughts. Closed questions mainly followed two structures; questions with predefined answers, and scale questions on the format "To what extent..", see figures 2.3 and 2.4. Open questions were answered in a one line space, to give the respondent the impression of long answers not being required. Despite that, no limit was set for those who had answers of many words, and so the questionnaire would avoid frustration towards both too little space or too much space. Besides these, the questionnaire contained one quantity question, where the respondent could write any number between 0-168 to describe the amount of hours they worked within a week. The questionnaire was pretested by the supervisor and pilot-tested by two students studying Informatics on beforehand to check time and wording.

Figure 2.3: Example of a Question with Predefined Answers

Figure 2.4: Example of a Scale Question

Sample

Informatics enroll approximately 150 students annually (NTNU, 2018a). To target the class of students who represented the low study effort in Studiebarometeret (NOKUT, 2017), the population was set to 150, where dropouts were not taken into account.

An optimal sample would use a confidence level of 95% and +/-5% margin of error, and would have been 108 respondents in this case (Krejcie and Morgan, 1970). However, the confidence level should reflect the need for the true mean to be within the margin of error range (Albert and Tullis, 2013). When studying user experience and general sentiments of students, a confidence level of 80% - 90% normally is sufficient (Sauro, 2015), and the use of 90% is most standard (Albert and Tullis, 2013). Budget, time and resources was also taken into account when choosing a sample. When considering resources, 50 students of the target class were having an excursion trip and sought to collect money for that purpose. With support from the institute, these 50 students could be used as a sample, securing a response rate close to 100%.

With a population of 150, confidence level of 90% and a sample of 50, the margin of error became +/-10% (SurveyMonkey, 2018), which was satisfying considering the aim of making generalizations of the students' opinions.

Validity and reliability

Content validity refers to whether the questions cover the domain to be investigated (Oates, 2005). In this case, the domain was to identify current study effort and the students' opinions of implementing gamification into study effort as a motivational factor. Consequently, questions were formulated to cover this domain.

Construct validity refers to whether the questions measure what they are supposed to measure (Oates, 2005). To verify construct validity, a part of the questionnaire was compared to Studiebarometeret (NOKUT, 2017), and other parts were seen in light of findings from the workshop elaborated in the next section. In retrospect, some of the closed questions were unfortunately ambiguous and difficult to interpret such as "Do you attend lectures?". This problem was handled by not putting too much emphasis on the questions concerned.

Reliability refers to if the questionnaire would give same results when repeated (Oates, 2005). Even though reliability is important, it was less critical in this thesis since no theory or hypothesis was investigated. Hence, little attention was brought into testing reliability.

2.2.3 Workshop

As a part of co-design, thoroughly explained in chapter 6.4, a workshop was carried out to help define the user requirements in RQ2. The workshop consisted of a design sprint with activities adapted from Google Ventures' Design Sprint (GV, 2016), shown in table 2.2. The participants included 16 students who answered the questionnaire and they were divided into groups of four. Each group had a decision maker, who had one extra vote

when decisions had to be made. In the end, each group had one poster of a solution to how gamification could be implemented in study effort, that was presented to all.

Table 2.2: Workshop Activities

Activity	Description
Presentation of master thesis	The presentation was held to help participants understand their contributions. It consisted of an introduction of the thesis' motivation and a short summary of findings from the literature review and questionnaire.
Discussion of topic	To help participants achieve the correct mindset, a discussion in each group was carried out. The focus of the discussion was to find problems related to study effort.
How Might We-notes	How Might We-notes was a task where participants on their own, in silence, rewrote problems as opportunities. When the time was up, notes were presented for the rest of the group, and notes were grouped together in categories. At the end, the group voted for the most interesting category to continue with.
Writing down ideas	Short lightning demos were held of applications presented in chapter 4 - State of the Art. Notes were taken of what was pleasant, and as many ideas as possible were written down by all participants. In the end, the best ideas were circled.
Crazy 8	A large sheet of paper was divided into eight squares. The participants got one minute per square to draw an idea from the former activity. After eight ideas were drawn, they were presented to the rest of the group to inspire each other.
3 frames solution	Based on all the inspiration, each participant drew a full solution in three frames on a poster. When the posters were finished, each poster was presented for the group. At the end of each presentation, participants put green stickers on aspects they liked with the solution. In the end, the group voted for the best solution.
Presentation	The four remaining posters were presented for all participants in the workshop.

2.3 Quantitative Data Analysis

A statistical analysis was conducted on the quantitative data to find central tendencies. The data consisted of nominal data which had no numeric value, and ordinal data which had a numeric ordered value. However, numbers were only ranked on a scale of "To what

extent..", and it is not given how much more e.g. 4 is than 3. In theory, this sets a limit for arithmetical operations, and only the median and mode are accepted when describing central tendencies. Nevertheless, studies have shown that parametric statistics can be used on scale data as well without drawing wrong conclusions (Norman, 2010).

To find central tendencies the median was calculated. In addition, the mean with standard deviation was calculated. This was to get more specific numbers to state whether opinions were leaning more towards a lower or higher number of the median. Besides from this, a quantitative counting of frequencies was conducted on qualitative data, concerning what motivated students in their everyday life of studying. The nominal data is presented in pie charts, and ordinal data is presented in tables and bar charts.

2.4 Qualitative Data Analysis

Qualitative analysis was conducted on data gathered from the workshop and the open questions in the questionnaire. Categories of game characteristics presented in chapter 3 - Literature Review, and the Octalysis framework described in chapter 3.7, were used as a base to conduct the qualitative analysis of the documents generated during the workshop.

The majority of the open questions in the questionnaire were follow-up questions to closed questions. The answers of these open questions were sorted into categories of negative, neutral and positive, depending on the respondents' answers on how motivating they found the described system. Answers of 1 and 2 were interpreted as a negative opinion, 3 was interpreted as neutral, and 4 and 5 were interpreted as having a positive attitude towards the described system. Lastly, themes were looked for in the categories to find explanations to why the respondents found the system motivating or not.

Themes were also looked for in open questions that were not linked to any closed questions. Mostly, there was a wide range of opinions and answers which made it difficult to pinpoint specific themes. In these cases, comments that represent the essence of opinions are rendered in a simplified version together with a selection of original examples. Lastly, when respondents were asked what motivates them in their everyday studies, specific themes were easier to categorize which enabled the opportunity for frequency counting.

2.5 Ethical and Practical Issues

Ethical issues were concerned with giving participants the right not to participate, right to withdraw, right to give informed consent, right to anonymity and right to confidentiality (Oates, 2005). Information about the project's aim, confidentiality, voluntary participation and other practical issues was handed out to the participants in advance of both the

questionnaire and workshop. Participants had to give their consent before joining, see appendix B. Google Forms (Google, 2018a) was used to host the questionnaire, and since they are gathering IP addresses, the questionnaire was reported and approved by the Norwegian Centre for Research Data (NSD, 2017). The same also applied to the workshop because the final presentations were video taped. NSD approvals are found in appendix C. Even though participants of the questionnaire and workshop were properly informed, participants of the secondary data gathered from Studiebarometeret (NOKUT, 2017) were not informed that their data were used in this particular thesis. However, the data is public and does not include any identifiable information and therefore including the data in this thesis was proceeded. Since the questionnaire was self-administered it was not suitable for handicaps. This issue came to my awareness afterwards, and whether the research has excluded participants or not for this reason, is unknown. Lastly, data from the questionnaire was stored on Google's cloud, which implies that I took a choice to trust Google on keeping the information safe from unwanted access.

Practical issues mainly referred to the execution of the questionnaire. Answers may have been affected by participants being in different environments when responding. Since the questionnaire was self-administered, it was not possible to ensure that participants were not doing other tasks while answering the questionnaire or that no misunderstanding occurred. The results of this thesis would not put any humans at risk or danger, and therefore the existence of this issue was just accepted but not dealt with. Video taping of the presentations in the workshop was done to help remind the essence of the solutions. A technical error occurred with the sound and it was difficult to understand what was said afterwards. However, I encouraged participants to write explanations on their posters as well. By listening to the tapes several times, in combination with the explanations on the posters, I was able to understand the presented solutions. Still, the exact explanation of solutions may be somewhat inaccurate.

In February 2018, new statistics from Studiebarometeret became public and showed a better score of the perceived study effort. Even though new numbers were published, the main focus has been on statistics published in 2017, when I started writing this thesis. Nevertheless, the new score of perceived study effort was 3.4 out of 5 and still below average. The reported time spent on studies per week was 32 hours, which was less then the year before. These results make the findings of this thesis still relevant for future work.

3 | Literature Review

This chapter presents the findings of the literature review that was carried out. The concepts studied are gamification, game design elements, extrinsic and intrinsic motivation, and how these relate to each other.

3.1 Defining Gamification

Even though gamification has developed into the umbrella term for separating game elements to be used in new settings (Deterding, Sicart, et al., 2011), there has not been established a common definition of the term (Deterding, Dixon, et al., 2011). There are however several cases of definitions made in a variety of studies. This thesis did not attempt to contribute with one more, but rather examined some definitions that might be suited in this context. This was to get a better insight into the concept and creating a common understanding for the people involved. A selection of applicable definitions is shown below.

"A process of enhancing a service with affordances for gameful experiences in order to support user's overall value creation." (Huotari and Hamari, 2012, p. 19)

"The process of game-thinking and game mechanics to engage users and solve problems." (Zichermann and Cunningham, 2011, p. xiv)

"Gamification is the use of game design elements in non-game contexts." (Deterding, Dixon, et al., 2011, p. 10)

The first definition is centered around the goal of gamification and not the use of game elements which is justified by the lack of a common definition of game elements. The author of the second definition claims that it can be applied to solve any problem linked to

influencing motivation and behavior, and describes it as both flexible and powerful. The authors of the third definition conducted an in-depth study of the term's origin, and the definition is based on similar concepts and the term's precursors.

It was highly relevant to explore and identify different game elements linked to motivation in this thesis and therefore the first definition (Huotari and Hamari, 2012) was least suited, because of its focus around the goal and not the game elements itself. The second one (Zichermann and Cunningham, 2011) was more suitable, but it includes both engaging an audience and solving a problem. The focus of this thesis was to motivate a greater study effort, but that does not mean that the study effort was a problem, only that it could be improved. Thus the second definition became too broad. The last definition (Deterding, Dixon, et al., 2011) was the most appropriate one considering the scope and focus, and it gave space to explore the different game elements with more focus on motivation. Based on these arguments, the last definition was chosen. The definition is further outlined in their study (Deterding, Dixon, et al., 2011), by dividing it into the four categories; game, element, design and non-game context.

Game

It is emphasized that gamification is related to games and not play (Deterding, Dixon, et al., 2011). Play is referred to as an improvised expressive behavior whereas games are referred to as play but with rules and competition to reach a goal.

Element

In their paper, Deterding, Dixon, et al. (2011) also stresses the fact of not having a clear definition of game elements. A proposal is made of restricting the term "game element" to those elements that are characteristic to games, but what defines those characteristics is open for debate.

Design

Design refers to the game design of the elements, and these elements can be divided into levels of abstraction, see table 3.1 (Deterding, Dixon, et al., 2011). The levels range from concrete levels on top of the table to abstract levels at the bottom.

Non-Game Contexts

Non-game contexts is referred to as any context, not limited to a specific usage or purpose other than not including the context of games (Deterding, Dixon, et al., 2011).

Table 3.1: Design Levels of Abstraction, adapted from Deterding, Dixon, et al. (2011, p. 12)

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

3.2 The Dimension of Gamification

As already stated, there is a difference between gaming and playing. In addition, there is a difference between gaming as a whole or in parts, where whole refers to full-fledged games and parts refers to non full-fledged games.

Figure 3.1 (Deterding, Dixon, et al., 2011) shows the dimension between playing and gaming, and that each of those can be done as a whole or in parts. It is important to note that gamification only refers to implementing game elements and not a game as a whole.

The figure also coincide gamification with gameful design. To explain, Deterding, Dixon, et al. (2011) systematize and distinguish between gamefulness, gameful interaction and gameful design. Gamefulness are the experiential and behavioral features of a game, gameful interaction refers to artifacts enabling those features and gameful design is designing for gamefulness. Gamification than refers to when the strategy of using game design elements in gameful design is applied.
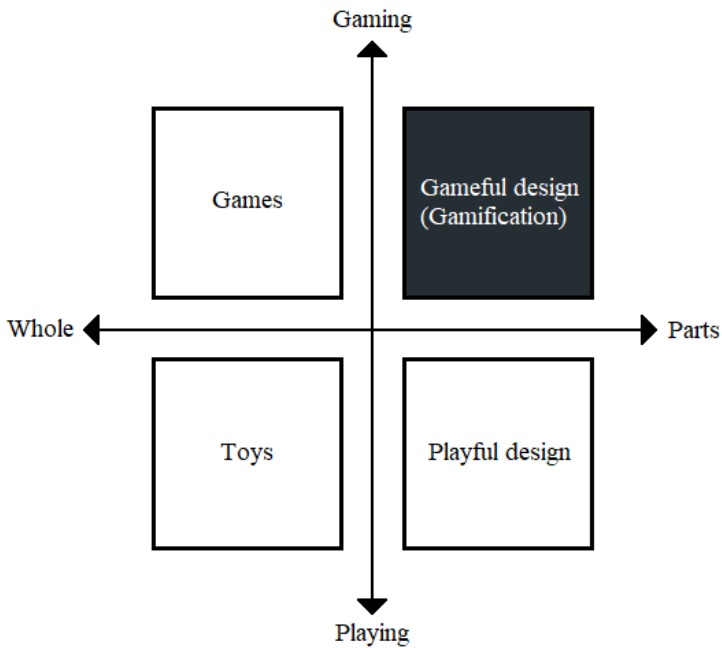
Figure 3.1: Gamification in a Gaming-Playing and Whole-Parts Dimension, adapted from Deterding, Dixon, et al. (2011, p. 13)

3.3 Game Design Elements

The chosen definition of gamification emphasizes the use of game design elements. To be able to design a prototype with game designed elements, there was a need to clarify what the game design elements are.

As already stated, there was no clear definition of game elements other than being restricted to the elements characteristic to games (Deterding, Dixon, et al., 2011). In that regard, game characteristics were searched for. Whitton (2009) has defined ten game characteristics, shown in table 3.2, that commonly occur in the literature of defining games. Based on the explanation of game elements, these characteristics could be treated as a definition of game elements.

Tables 3.3 and 3.4 show the game elements placed in the different levels of abstraction of design, first stated in table 3.1. This was to identify the design efforts required when making the prototype, as abstract elements need more design effort. The right column justifies the placement of the elements and is based on their description in Whitton (2009).

Table 3.2: Ten Defining Characteristics of Games, adapted from Whitton (2009, p. 23)

Characteristic	Definition
Competition	The goal is to achieve an outcome that is superior to others.
Challenge	Tasks require effort and are non-trivial.
Exploration	There is a context-sensitive environment that can be investigated.
Fantasy	Existence of a make-believe environment, characters or narrative.
Goals	There are explicit aims and objectives.
Interaction	An action will change the state of play and generate feedback.
Outcomes	There are measurable results from game play (e.g. scoring).
People	Other individuals take part.
Rules	The activity is bounded by artificial constraints.
Safety	The activity has no consequence in the real world.

Table 3.3: Game Elements Placed in Levels of Abstraction

Level	Elements	Justification
Game interface design patterns	Outcomes	Concrete components whose mechanism is to measure the degree to which a goal has been achieved.
Game design patterns and mechanics	Rules	Consists of a set of instructions and constraints that reoccur throughout the game. The rules can vary from game to game. They can be given as a book in advance, written into the design of the game or it can be codes of conduct within the game.
	Interaction	A pattern where a player's actions influence the state of the game and gets feedback to decide their next action. A reoccurring event but the actions can vary from simple to complex.
	People	People taking part in the actions of the game is a reoccurring event, but the people and their strategies varies depending on who is joining. Games can be multi-player or single-player, and simultaneous or turn-based. In multi-player, people can compete or work towards a common goal.

Table 3.4: Game Elements Placed in Levels of Abstraction, continued

Level	Elements	Justification
Game design principles and heuristics	Goals	Used as example in the original table. Content varies in each context, but has some guidelines. The goals must let the player know why they play and how to reach the goal. The goals can be overall main goals or subgoals, and predefined or defined during playing.
	Competition	Content varies in each context, but has some guidelines. There must be a measurable outcome and an activity where the aim is to win by getting a better result than others or yourself. Competition can be implemented in real-time or at different times.
Game models	Exploration	Not restricted to guidelines other than giving the player the opportunity to explore an environment. Exploration can be done in psychical, virtual but actual or imaginary locations, or on other interfaces of the game such as controls in a video game. Details in an exploratory world may vary to a great extent.
	Challenge	Used as example in the original table. Challenges are not restricted to a guideline on how to be implemented. They can be any task, mental, physical or social, that requires effort to achieve and has some value, and they can vary from simple to complex. The perceived difficulty level is often individual.
	Fantasy	Used as example in the original table. Not restricted to a guideline. It can be implemented as locations, characters, stories, dialogs or it can be up to the player's own imagination. Actions and characters inhabit the same fantasy game, where fantasy refers to anything not being real.
Game design methods	Safety	A practice consisting of the game to be developed not giving any consequences in the real world.

3.4   Intrinsic and Extrinsic Motivation

Motivation can be intrinsic or extrinsic (Ryan and Deci, 2000a). While the first mentioned refers to actions caused by people's interests and enjoyment, the second one refers to actions performed to achieve a desired outcome such as a reward. This section introduces one of the theories explaining intrinsic and extrinsic motivation.

3.4.1   Self-Determination Theory

In the research of motivation in psychology, different theories have been formed to systematically distinguish between the types of motivation. The Self-Determination Theory (SDT; Deci and Ryan, 1985) is one of them, and is centered around the extent of self-determination by humans. The more self-determined an action is, the more intrinsic motivation is present. The theory sees the human as a growing organism whose motivation can be facilitated or blocked by a social environment. The theory clarifies which cognitive and social development needs that are critical for self-motivation and what encourages those development processes. The stated psychological needs are competence, relatedness and autonomy (Ryan and Deci, 2000b).

3.4.2   Basic Psychological Needs

The Handbook of Self-Determination Research (Deci and Ryan, 2002) describes the three needs. *Relatedness* refers to people's need of feeling a belongingness and connection to other individuals or one's community. If an individual's behavior and actions will be valued by someone to whom they can relate to, it can be an extrinsic motivator to actually take a certain action. *Competence* refers to the feeling of being effective and confident. People seek these feelings, as it gives a sense of achievement and is triggered when a person has the skills to master any challenges in their environment. *Autonomy* refers to an individual's feelings of their behavior stemming from own interests and integrated values without external influence. Since relatedness and competence are both externally controlled, these two needs will according to the SDT only give external motivation and not make a person's actions completely self-motivated or self-determined. Therefore autonomy is the third basic need for self-motivation, as autonomy is not externally controlled and entirely intrinsic.

3.4.3   Facilitating Needs

To describe the theory in relation to circumscribed domains, SDT is specified in several mini-theories where two of them specifically concern facilitating intrinsic and extrinsic

motivation; the Organismic Integration Theory (OIT) and the Cognitive Evaluation Theory (CET).

OIT is centered around facilitating extrinsic motivation. The social environment sets expectations and restrictions to our behavior and roles, and therefore people mostly behave out of extrinsic motivation. OIT consists of a taxonomy shown in figure 3.2 (Ryan and Deci, 2000a). The taxonomy specifies a third regulatory style or state of mind, namely amotivation, which refers to having no intension to act. Extrinsic motivation is divided into four degrees; external regulation, introjection, identification and integration. The degrees refer to which extent an activity is autonomous and accepted as self-determined. The levels are ascending from left to right and intrinsic motivation is found on the very right. Associated processes describe how activities relate to the types of motivation and perceived locus of causality describes how the degrees are perceived by the human. To achieve a specified degree of external motivation one should try to meet the associated processes.

CET concerns facilitating intrinsic motivation and specifies factors in a social environment that can produce intrinsic motivation (Ryan and Deci, 2000a). Autonomy is the most important and unfortunately the most difficult need to facilitate. Autonomy must come from the human itself. A summary of studies have, however, shown that the locus of causality can change in both directions (Deci and Ryan, 1985). Even though competence and relatedness are extrinsic motivators, facilitating them in good ways will make actions be perceived as more intrinsic. Extrinsic motivation with low degrees of autonomy can be turned into high degrees of autonomy and vice versa. One should try to avoid turning initially intrinsic motivation into extrinsic motivation. Choice and positive feedback were found to increase the level of autonomy in extrinsic motivation whereas rewards, deadlines and surveillance were undermining intrinsic motivation.

3.4.4 Long-Term and Short-Term Motivation

Since extrinsic motivation varies in degrees of autonomy, SDT separates between autonomous and controlled motivation (Deci and Ryan, 2008). Autonomous motivation consist of intrinsic motivation and the types of extrinsic motivations which feels at least somewhat internal, thus the degrees of identification and integration in the OIT taxonomy, figure 3.2. Controlled motivation refers to the last two degrees of external motivation, namely introjection and external regulation. Autonomous motivation will vitalize energy, whereas controlled motivation will drain energy. Autonomous motivation does not only embrace greater psychological health, but also gives a more long-term endurance and better performance on heuristic activities. Even though intrinsic motivation is the most important for self-motivation, both types of motivations have their qualities. Controlled motivation can create a wanted behavior, and is easier to facilitate. However, controlled motivation is not long lasting, thus one has to consider what matters most in the context of use. For the taxonomy of OIT in figure 3.2, this means that one can expect a longer lasting motivation the closer to the right a motivation is positioned.
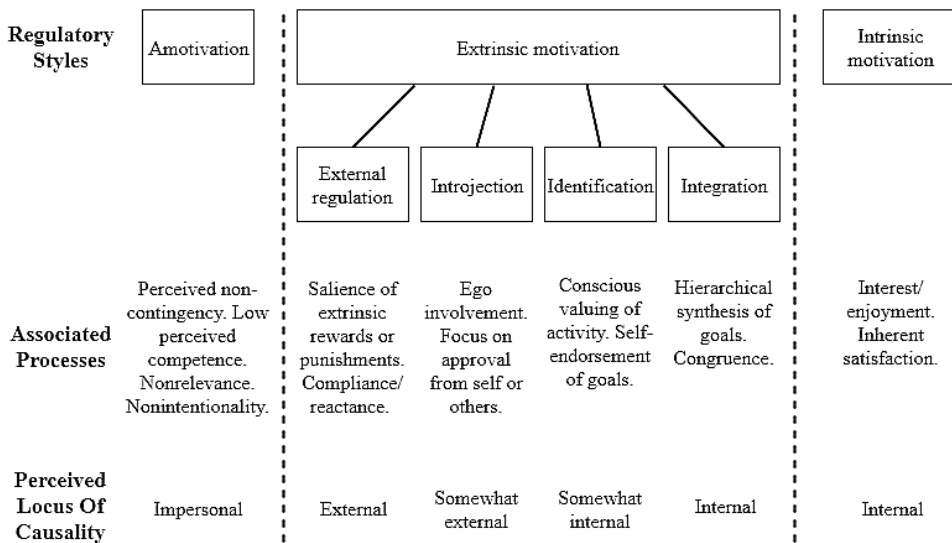
Figure 3.2: A Taxonomy of Human Motivation, adapted from Ryan and Deci (2000a, p. 61)

3.4.5 Applying the Self-Determination Theory

SDT is not the only theory defining intrinsic and extrinsic motivation. For instance, the Hierarchical Model (Vallerand, 1997) also distinguish between amotivation, intrinsic- and extrinsic motivation and there are many similarities. SDT has been criticized for dividing the levels into only domain and causality, and not indicating how motivations are integrated into a broader scope that involves situational motivation like the Hierarchical Model does (Vallerand, 2000). Situational motivation refers to an individual's experience when they are currently engaging in an activity. A focus on short-term and long-term motivation was more relevant in relation to a bachelor's degree than motivation in current situations, and so SDT was sufficient enough to understand and argue motivational effects in long-term and short-term settings.

Using SDT to understand motivation in gamification is also supported by Landers et al. (2015), who reviewed different motivational and learning theories in psychology that could be linked to gamification. They highlight SDT as one promising direction, its importance to the study of gamification and that the theory has been explored and supported in gaming literature. They argue that gamification can utilize both intrinsic and extrinsic motivators to change behavior in students, and exemplify several studies where it is proven that the psychological needs have been supported through gamification.

3.5 Self-Determination in Game Design Elements

This section describes how the identified game design elements are enhancing extrinsic or intrinsic motivation, based on the SDT.

Competition

People are more interested in some activities when there is a competition going on, such as in sports. The competition itself, trying to win or avoid losing, is extrinsically motivating (Deci and Ryan, 1985). Pressure and being controlled by competitors being better undermines intrinsic motivation. Still, the feeling of competence when achieving tasks and relatedness to other participants in the form of social interaction enhances intrinsic motivation, and could move the locus of causality towards internal in competitions.

Challenge

Challenges differ from competitions in that they are more centered around the competence of an individual and requires some effort of achievements and must be of value. The perceived competence one is gaining from challenges must exist within the context of some perceived self-determination to facilitate intrinsic motivation (Deci and Ryan, 1985). In addition to that, the challenges must be optimal, meaning not too easy or difficult, e.g. a known structure but a new task. In fact, individuals who are not controlled in any way will seek optimal challenges themselves all the time, and as competence increases, new optimal challenges are looked for to conquer. If, however, the challenge is not optimal and the perceived competence does not exist within a context of perceived self-determination, the challenge will only enhance extrinsic motivation.

Exploration

The desire to explore, discover, understand and know is an intrinsic tendency to the human (Deci and Ryan, 1985). This curiosity and interest is energizing, seen in conditions such as learning environments. Even though the desire to explore in itself is intrinsic, it is crucial that players understand the environment to not block any motivation (Ryan and Deci, 2000a).

Fantasy

Fantasy is emotional appealing and provides color and background to a game (Whitton, 2009). The nature of fantasy is to facilitate intrinsic motivation as it makes gaming fun, but like exploration it is particular important for the player to understand the environment to not block motivation (Ryan and Deci, 2000a). Also, there are aspects that may be emotional repulsive such as a chronic belief of not achieving a desired outcome (Deci and Ryan, 1985).

Goals

Goals can range from easy to difficult, vague to specific and from extrinsic to intrinsic (Deci and Ryan, 1985). Goals that are difficult to reach make people perform better, but

also reduces intrinsic motivation and satisfaction subsequently (Deci and Ryan, 1985). The degree of intrinsic motivation in a goal depends on how the individual is willing to adapt the goal as its own (Ryan and Deci, 2000a). When fear of consequences of not reaching a goal is the primary motivator, it is on the external degree of extrinsic motivation in the OIT taxonomy. If the goal congruence with own values, it is on the level of integration. When the performance or activity itself is of interest such as a close relationship, the goal is entirely intrinsic.

Interaction

Social interaction is for some people the motivation itself for playing a game (Whitton, 2009), and social interaction may facilitate relatedness. Feedback is a big part of interaction, and even though relatedness often is an extrinsic motivator, positive feedback evoking the feeling of competence has shown to be intrinsically motivating. This is especially if the feedback is given during an activity (Deci and Ryan, 1985).

Outcomes

Outcomes are the definition itself of extrinsic motivation (Ryan and Deci, 2000b). The degree of extrinsic motivation depends on the type of outcome. For instance, physical objects, status among a group or guilt are the most extrinsic motivators whereas other social-contextual events that lead to a feeling of competence are more intrinsically motivating. Studies have shown that there is a relation between performance and rewards (Deci and Ryan, 1985). Studies have shown that awards, toys, food, prizes and avoidance of punishment all diminish intrinsic motivation. This was especially when it was given to someone doing an initially intrinsic motivated activity, but then became extrinsic motivated when rewards were on the table (Deci and Ryan, 1985). However, unexpected rewards showed to not diminish intrinsic motivation.

People

People are perhaps the most important facilitator for relatedness within extrinsic motivation. Without people, there is no community, opponents, team players or oneself. People can also be important for facilitating intrinsic motivation, since people are needed to achieve for example close relationships.

Rules

Intrinsic motivation is being diminished when people are being controlled (Deci and Ryan, 1985). Deadlines is such an example. People who are doing an activity with a deadline are less intrinsically motivated when doing the activity compared to no deadline. Free-choice is essential to enhance intrinsic motivation, and therefore rules can be an obstacle because they often are constraints and enhance extrinsic motivation.

Safety

Safety is important and there should not be any negative consequences. For instance, depression is believed to be related to people's experience of amotivation (Deci and Ryan,

1985), and therefore one should be careful not to trigger amotivation. Another example is that controlled motivation can bring forward a wanted behavior (Deci and Ryan, 2008), and bad behavior should not be triggered.

3.6 Taxonomy of Intrinsic Motivations for Learning

Malone (1981) summarized several studies, dated some decades back but still relevant, of what makes a computer game fun. A general framework of heuristics for designing enjoyable interfaces was made, including challenges, fantasy and curiosity. Later, the framework was expanded into a taxonomy of intrinsic motivations for learning (Malone and Lepper, 1987). It was made out of an interest of designing intrinsically motivating learning environments, with a focus on fun rather than being educational. The taxonomy is of interest in this thesis as it helps identifying intrinsically motivating game design elements in addition to SDT. The taxonomy consist of the four individual motivations; challenge, curiosity, fantasy and control, and the three interpersonal motivations; cooperation, competition and recognition.

As already stated, challenges must be optimal. To achieve this, Malone and Lepper (1987) stresses the need for goals and uncertain outcomes. Goals must preferably have a personal meaning, and the chance of reaching it must be uncertain. The feeling of a personalized goal can be accomplished through communicating its functional utility of learning, social relevance or relevance in forms of an imaginary context. Variable difficulty levels, multiple levels of goals, hidden information and randomness are the techniques proposed to create uncertain outcomes. Also, performance feedback and self-esteem are important components to make a challenge optimal. It is stated that feedback will be most intrinsically motivating when it is clear, given frequently, constructive and encouraging.

Curiosity is the most direct intrinsic motivation for learning, and is divided into sensory curiosity and cognitive curiosity. The former refers to the changes in the environment that evokes the sensory curiosity such as light and sounds. The latter refers to the knowledge structures, and if people think they are missing completeness and consistency, curiosity can be stimulated.

Control makes people find computer games captivating. Contingency, choice and power is what makes an environment empowering. This means that the outcomes must be dependent on the player's actions, there must be high levels of choice, and outcomes of the choices must differ to an extent so the choice is perceived as having a powerful effect.

Fantasy is the last individual motivation because fantasy may satisfy an emotional need. In that manner, it is important that the fantasy is emotional appealing. In addition, to let the player better understand new information, the use of metaphors can help relate this new information to past knowledge.

Cooperation, competition and recognition are considered as interpersonal motivations be-

cause they depend on other people. For cooperation and competition, it is suggested that they have the most intrinsic effect when the players are dependent on each other to complete the tasks. As for recognition, a person's achievement must be visible for others to recognize it.

3.7 Octalysis: A Framework for Gamification

Octalysis is a gamification framework made to analyze and build strategies on what makes a game fun. The framework is relevant because it helps identify more detailed game design elements and how these can be implemented to create a balance between intrinsic and extrinsic motivation. It consist of eight core drives, presented in figure 3.3 and described in table 3.5. The core drives motivates us towards certain activities. Chou (2015) also presents two versions of the octagon, where one is divided into the left brain and right brain, and the other into white hat gamification and black hat gamification, shown in figure 3.4. He specifies that this division is just for symbolic aspects and not true brain science. The left brain side, he explains, has a tendency of being based on extrinsic motivation whereas the right brain side has a tendency of being based on intrinsic motivation. The core drives in the white hat gamification are considered as positive motivations and the black hat gamification are seen as possible negative motivations. He further explains that black hat motivations are not necessarily bad. It can be used for malice and manipulation, which often leaves the player with a bad feeling or it can be used for positive, productive and healthy results.

Chou (2015) further outlines that there are four experience phases of a game. These consists of discovery, on-boarding, scaffolding and end-game. Discovery is when people first discover the product and why they want to try it. On-boarding is when people become familiar with the rules, options, mechanics and win state of the game. Scaffolding is when the gamers use the rules to achieve the win-state. End-game is when the players have done all that can be done, but are still engaged with the product by doing it over again. When using Octalysis, these four experience phases can be used to analyze which gamification elements that exists in the system. As one walks through the phases, elements are placed in the correct core. Good and engaging systems include at least one of the core drives. When having a complete Octalysis octagon with all elements placed, Octalysis helps to identify how strongly game mechanics appeal to the core drives. This is done by assigning a score between 0-10, based on personal judgment, data and experience flow. Each number is squared and the eight scores are added up. This will give a final Octalysis score. Based on the score, the sides of the octagon will expand or retract. The closer one side is to cross the inside octagon the weaker the gamification is on that area.

Table 3.5: Core Drives in the Octalysis Framework

Core Drive	Description
Epic meaning & calling	A player believes to be part of something greater than themselves or was chosen to do something special. An example is devoting a lot of time in maintaining something for a community. An other example is "beginner's luck".
Development & accomplishment	A drive of making progress, developing skills and overcoming challenges. An example is receiving points.
Empowerment of creativity & feedback	A creative process where users have to repeatedly figure out things and try new combinations. People need to express creativity, see the results of it, receive feedback and respond in turn. An example is Lego.
Ownership & possession	Users are motivated when they feel they own something. Often they want to make what they own even better or more. An example is customizing an avatar.
Social influence & relatedness	A drive that includes all social elements that drive people, such as mentorship, acceptance, social responses, companionship, being closer to people or places, competition and envy. An example is when a friend is amazing at some skill and you are driven to reach that same level.
Scarcity & impatience	A drive of wanting something that one cannot have. This is a drive because it makes people think about what they cannot have until they have it. An example is when one has to come back to the game in two hours to receive a reward.
Unpredictability & curiosity	The drive of wanting to find out what will happen next, which is a drive that constantly engages the brain until one finds out. An example is a lottery program.
Loss & avoidance	A drive of avoiding that something negative will happen. An example is admitting that the effort and time spent on a game was useless because you are quitting.
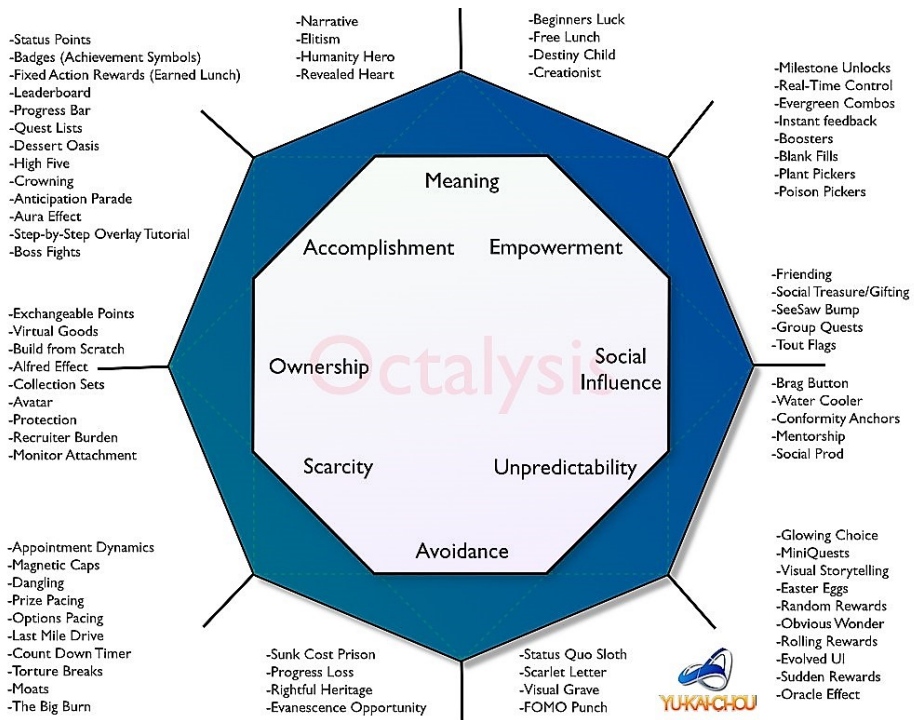
Figure 3.3: The Gamification Framework Octalysis, reproduced from Chou (2015) with permission
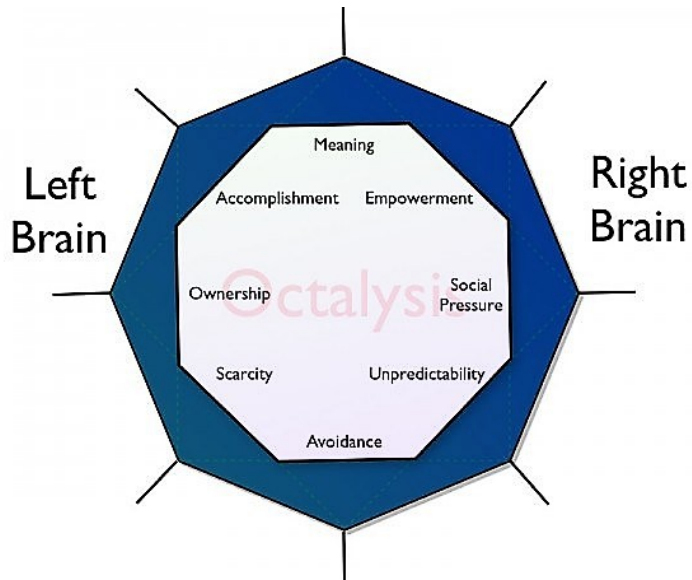
(a) Left and Right Brain Division
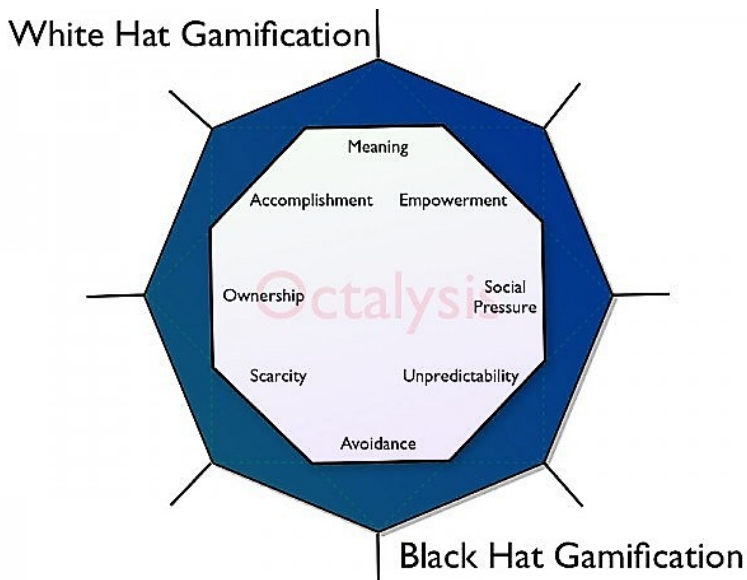
(b) White and Black Hat Gamification Division

Figure 3.4: Octalysis Divisions, reproduced from Chou (2015) with permission

4 | State of the Art

Applications using gamification were explored for inspiration, and access to an Android phone resulted in applications being searched for in Google Play (Google, 2018b). Desktop applications were also an option, but the main criterion was to investigate both top rated and poor rated applications and Google Play served this purpose. For variety, a second criterion was to find at least one application in a different category than education. Included are Kahoot! (Kahoot!, 2018), DuoLingo (DuoLingo, 2018) and Hold (Hold, 2018) in the category of education, and HabitBull (HabitBull, 2014) in the category of productivity. Kahoot! and DuoLingo were ranked as top two in their category (last checked February 13, 2018), with a rating of 4.2 and 4.7 stars out of 5. Hold was rated to 2.5. HabitBull had a rating of 4.5 and was also found on the top list. The following sections introduce the applications with descriptions and tables of how gamification is implemented. The descriptions and tables are based on how the applications were in January 2018, and some may have been updated since then.

4.1 Kahoot!

Kahoot! (Kahoot!, 2018) is a game based learning-platform consisting of multiple choice quizzes, see figure 4.1a and 4.1b, which especially encourages educators to use the application in classrooms and for homework. The player can freely attend quizzes or receive a pin code to attend a specific quiz. Kahoot! can be considered as a type of gamification when used in education, but one can also choose to play with friends for fun.
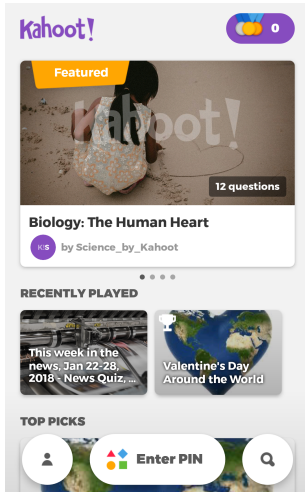
(a) Main Page
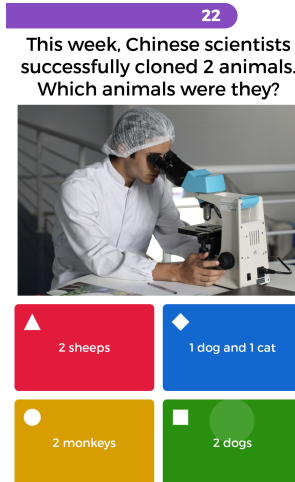
(b) Multiple Choice

(c) Scoreboard
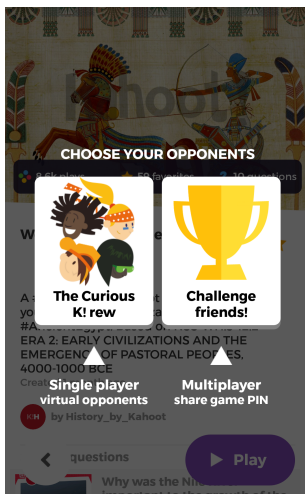
(d) Opponents
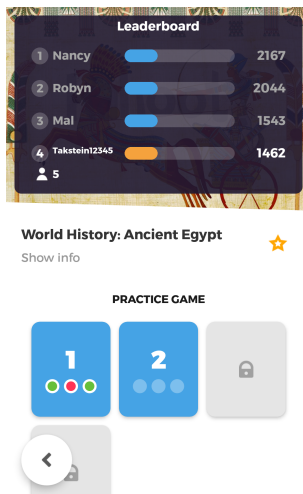
(e) Unlock Next Round
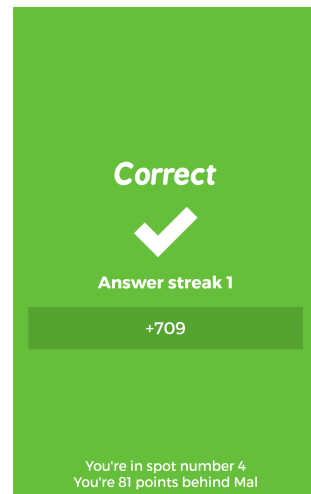
(f) Instant Feedback

Figure 4.1: Kahoot!, screen shots captured January 18, 2018

Table 4.1: Gamification in Kahoot!

Characteristic	Implementation
Competition	Competition is implemented through adding points and letting the users compete against each other to get the highest score in a quiz. Each round, the scores are shown in a scoreboard, see figure 4.1c. The player can also compete against oneself through a ghost mode.
Challenge	One can challenge friends or choose to compete against virtual opponents to challenge oneself, see figure 4.1d.
Exploration	On the main page, quizzes in different categories can be explored, see figure 4.1a.
Fantasy	When not playing with friends or attending a quiz through a pin code, Kahoot! has implemented a fantasy world of virtual friends.
Goals	The main goal is to gain new knowledge. This is done through trying to win the quiz. A medal is received if a player wins, which can be seen as a subgoal. Also, there are rounds in each quiz, and a round must be finished before unlocking the next which is also a subgoal, see figure 4.1e.
Interaction	Feedback is given after each question on whether the answer was correct or not, in addition to uplifting words, see figure 4.1f. An updated scoreboard is also shown between each question.
Outcomes	Kahoot! uses scorings, medals and other general game statistics as outcomes. The highscore list may give players social status.
People	One can choose to play with people in a class, friends or oneself.
Rules	Rules are mainly related to the play of the quiz. Players who answer correct and fast gain more points.
Safety	People may gain knowledge which is some type of consequence in the real world. When Kahoot! is used for education, another consequence is that it takes up time from the lecture. Kahoot! does, however, not put any people at risk.

4.2   DuoLingo

DuoLingo (DuoLingo, 2018) is a language-learning platform. The user has to complete several quizzes that increase in difficulty, see figure 4.2c. For inspiration on what gamification can look like in desktop version, the figures present the desktop version of DuoLingo.
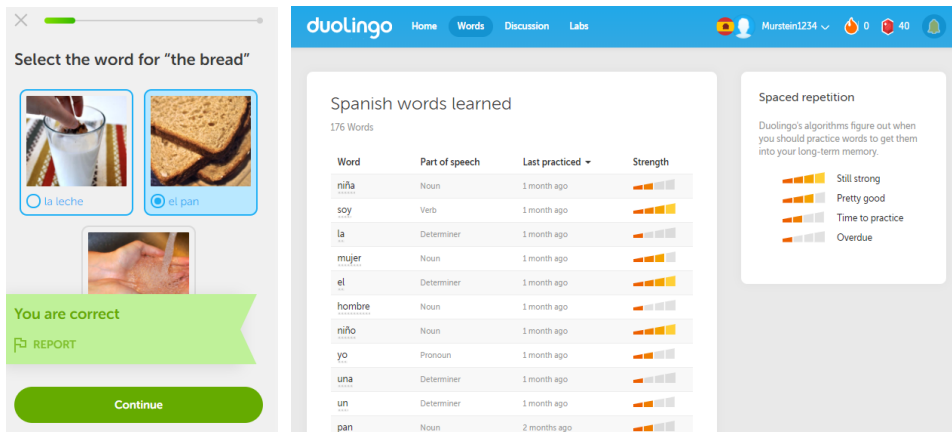
(a) Quiz

(b) Spaced Repetition Learning
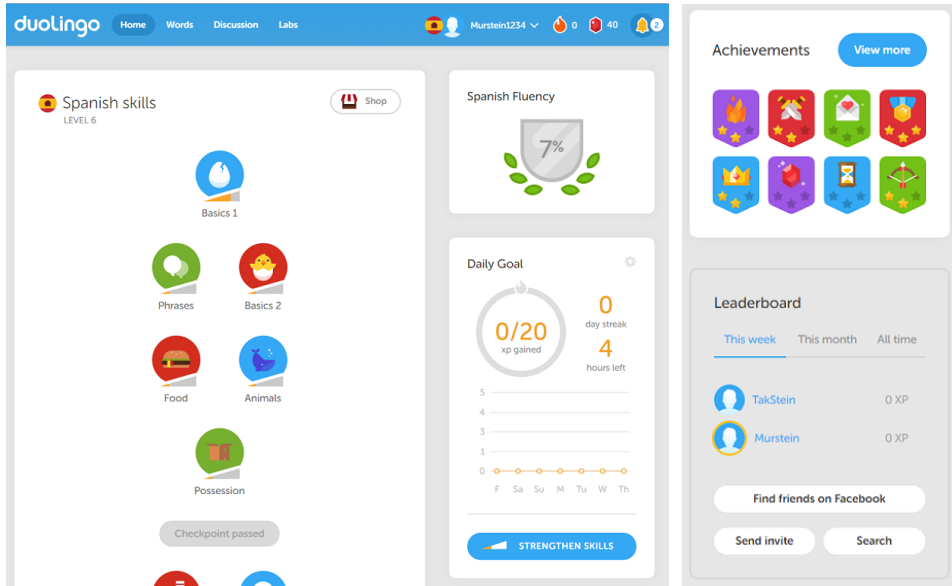
(c) Challenges, Progress Bars and Streak

(d) Achievements and Leaderboard

Figure 4.2: DuoLingo, screen shots captured January 18, 2018

Table 4.2: Gamification in DuoLingo

Characteristic	Implementation
Competition	Learners are gaining experience points, which are shown in a leaderboard of DuoLingo friends, see figure 4.2d. Learners are competing against each other for weekly, monthly and all time score.
Challenge	Learners are challenged with quizzes which are divided into categories of skills, see figure 4.2a and 4.2c. Quizzes increase in difficulty level. DuoLingo uses spaced repetition learning, meaning they keep track of when one is about to forget a word, see figure 4.2b. The learner is encouraged to practice weak words. Learners are also challenged to try to get achievements, such as getting a 30 days streak, see figure 4.2d.
Exploration	Learners can explore learned words, see figure 4.2b. Clicking on a word gives more detailed information. There is also a discussion tab, where players can explore discussion threads of interest.
Fantasy	There is no fantasy implemented in DuoLingo.
Goals	The main goal is to learn a language fluently. Subgoals include mastering the categories of skills, and gaining achievements such as receiving daily experience points to keep up the streak.
Interaction	Instant feedback is given during a quiz. Other interactions include updated progress bars, leaderboard and strength of words as well as discussions with other learners.
Outcomes	Learning a new language is the main outcome. Learners are incentivized with achievements and experience points along the way. In addition, the player may gain social status from the implemented leaderboard.
People	One can choose to follow friends in DuoLingo, which are those who appear in the leaderboard.
Rules	The player must master a skill to be able to practice the next one. Other rules are related to requirements for getting an achievement.
Safety	Learning a new language definitely has a positive consequence in the real world. The application is not putting any humans at risk.

4.3 Hold

Hold (Hold, 2018) is a mobile application helping students to focus on school, through giving rewards when not using the phone. When the phone is not used for 20 minutes within the university property, the user gets 10 points, see figure 4.3a. When the user has enough points, these can be traded into rewards in the store, see figure 4.3b.
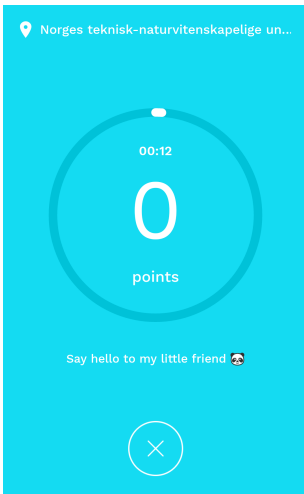
(a) 20 Minutes Timer
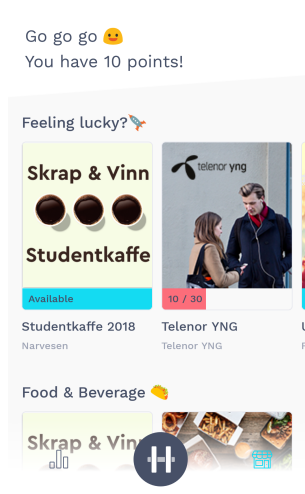
(b) Store
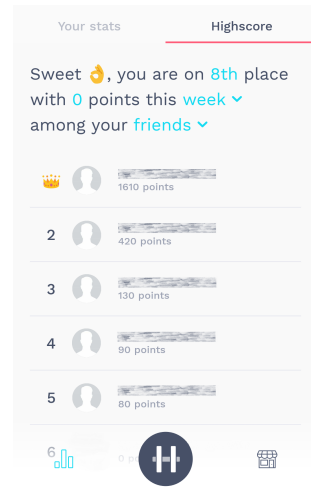
(c) Highscore List

(d) Levels and Points
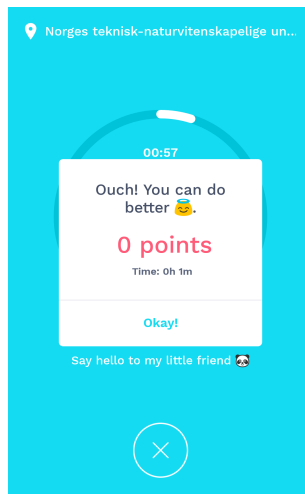
(e) Encouraging Feedback
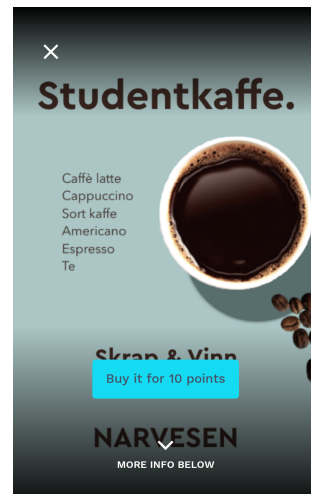
(f) Coupon

Figure 4.3: Hold, screen shots captured January 18, 2018

Table 4.3: Gamification in Hold

Characteristic	Implementation
Competition	Hold uses a highscore list that displays your own points and the points of Facebook friends, see figure 4.3c. There is no option to remove oneself from the list.
Challenge	The main challenge in Hold is to not use the phone to gain points. Points can be used to buy rewards, but in addition to that, the application keeps track of total gained points which are used to level up. So a sub-challenge is to try leveling up, see figure 4.3d.
Exploration	There is an opportunity to look around in the shop to see what can be bought for points, see figure 4.3b. There is no other typical world or environment to be explored.
Fantasy	There is no fantasy implemented.
Goals	The main goal is to not use the phone while working with studies. To reach the main goal there are subgoals on the way of not using the phone every 20 minutes, earning points and leveling up.
Interaction	The progress bar keeps increasing during a challenge, see figure 4.3a. If a challenge is failed, a message with encouraging words pops up saying "You can do better", see figure 4.3e. Other interactions include levels and the highscore list being updated when gaining points.
Outcomes	Hold is based on gaining rewards as an outcome, see coupon in figure 4.3f. In addition, reaching the top of the highscore list may give social status.
People	Scores are being compared to Facebook friends, see figure 4.3c.
Rules	Rules include gaining 10 points when not using the phone for 20 minutes. This means that the applications decides whether you have earned rewards or not.
Safety	The application has a consequence in the real world, as points can be treated into real rewards. The goal is to not use the phone to concentrate on school work. If this is the actual case, students may become more efficient in real life.

4.4 HabitBull

HabitBull (HabitBull, 2014) is an application to keep track of habits and routines in a calendar, see figure 4.4a. The application helps to cut bad habits or add new positive habits. Goals are customized by the user, see figure 4.4b.

(a) Successful Days

(b) Customize Goals

(c) Statistics

(d) Discussion Forums

(e) Quotes

(f) Encouraging Feedback
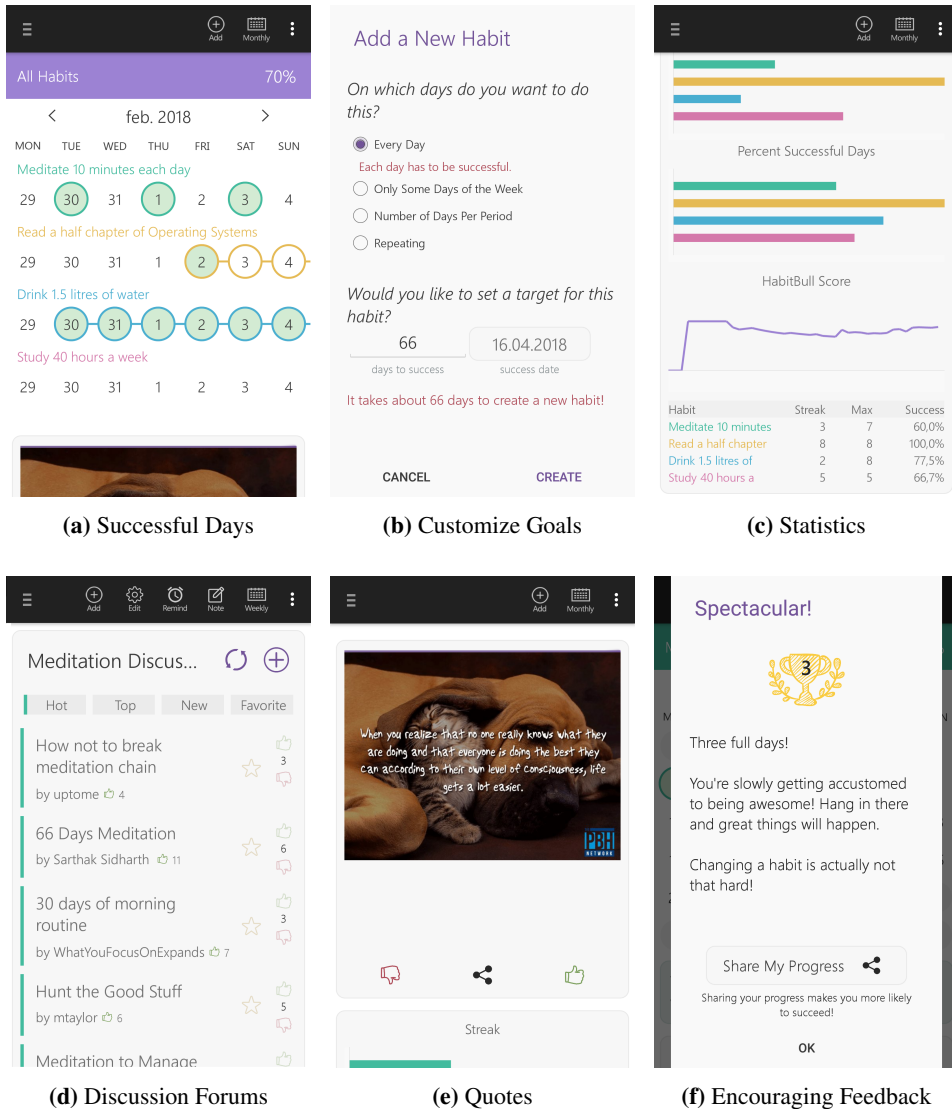
Figure 4.4: HabitBull, screen shots captured January 18, 2018

Table 4.4: Gamification in HabitBull

Characteristic	Implementation
Competition	Users of HabitBull are only competing against oneself through trying to beat the maximum streak, see figure 4.4c.
Challenge	The challenge in HabitBull is to get rid off, change or add a habit within a time limit. Successful days are shown in a calendar, see figure 4.4a.
Exploration	There exists a discussion forum where interesting threads can be explored, see figure 4.4d. Daily quotes are seen on the main page which can be up or down voted, see figure 4.4e. If it is down voted, a new quote is given and this way quotes can be explored.
Fantasy	There is no fantasy implemented.
Goals	The main goal is to get rid off, change or add a habit. The goal can be customized, see figure 4.4b. There are also subgoals of trying to beat your own streaks and try to get a highest possible success rate, see figure 4.4c.
Interaction	Successful days must be checked off in the calendar. This will change the state of the success rate and streak. Uplifting messages are given on ongoing streaks, see figure 4.4f.
Outcomes	The outcome is a percentage score of how well one is doing. The user can also brag through sharing progress, see figure 4.4f, and data can be exported to be used in other programs.
People	There are no people involved other than oneself.
Rules	There are no rules implemented other than the restrictions set by yourself when customizing the goal.
Safety	Change in habits have real life consequences. Hopefully people strive to change habits for positive reasons and there are most likely no risks attached to using this application.

5 | Discussion

RQ1 asked how gamification facilitates motivation. This question was important to discuss before developing the prototype so that it could be taken into account when making any decisions.

According to SDT, competition is an entirely external motivation. The feeling of relatedness and competence that comes from a competition may, however, surpass the facilitation of extrinsic motivation. A study (Looyestyn et al., 2017) revealed that there is preliminary evidence that leaderboards are the most effective way of creating an engagement of the elements often used in gamification. The reason being, is that one can easier relate leaderboards to real life than e.g. badges lacking a meaning. Unlike SDT, the taxonomy of intrinsic motivations for learning does claim that competition in fact also is an intrinsic motivator. All applications studied in chapter 4 implements competition. Yet, there is a significant difference between the ones with high ratings and Hold. In Kahoot! and DuoLingo, opponents are chosen by the user and not predefined as in Hold, and in HabitBull the only competitor is yourself. Even though relatedness and competence helps make extrinsic motivation more intrinsic, it seems that giving the player a sense of control also is a key success factor.

Seeking optimal challenges is inherent to the human and an intrinsic motivator (Deci and Ryan, 1985). Yet, some guidelines should be followed to not diminish intrinsic motivation. As Malone and Lepper (1987) states, there must be a goal with an uncertain outcome. These could be levels that increase in difficulty, which is seen in DuoLingo. In Kahoot! and HabitBull, the difficulty level is self-determined, which gives the human more control and would according to SDT be more intrinsically motivating than predefined goals. HabitBull may have the best chance of letting the individual adapt to the goal as its own, because the goals are set by themselves. Despite that, some feeling of adaption should occur in DuoLingo and Kahoot! as well, because it is the user's own choice to download the application. The difficulty level in Hold never changes, so the challenge is not optimal.

Performance feedback is also important for a challenge to be optimal, and is found to be frequently given during interaction in all applications. It is in the nature of Kahoot! and DuoLingo to learn something new, and therefore the feedback in these applications are more intrinsically motivating as they are targeting competence. Feedback can be positive

or negative, during or after an activity, from the game itself or from others. However, given during an activity targeting competence, seems to be the most intrinsic.

The studied applications have little or no fantasy and exploration implemented. It is important that the environment is not too difficult to understand if one chooses to implement those, to not block motivation. It is an advantage to understand the players competence to accomplish an optimal level of complexity in the environment. Also, the fantasy must be emotionally appealing, and using techniques such as colors can be useful to achieve the desired effect (Valdez and Mehrabian, 1994).

Outcomes are given in the form of points in all applications. In Kahoot! and DuoLingo one also receives virtual achievements and medals. Hold is the only application where one can exchange the points into coupons that can be used in real life. All of these outcomes are extrinsically motivating. Even so, a large-scale study (Denny, 2013) has provided empirical evidence on the positive effects of badges as an outcome. A badge system was added to an already existing system used by students to generate and answer multiple-choice questions. A group of 516 students getting badges as achievements were compared to a group of 515 students not receiving badges. The study confirmed badges having a positive motivational effect and that students getting badges were answering 22% more questions than students not getting badges. Denny (2013) stresses that even though a reward system had a positive motivational effect, the students also had some intrinsic value in answering the questions, as students without badges already answered four times of what was required. This shows that even though outcomes are extrinsically motivating, they can have a positive effect.

Rules are most likely to enhance extrinsic motivation, as these control what the user is allowed to do. In games, rules are often necessary but in gamification one can try to avoid having too many rules. This is to let the user have a free-choice and a feeling of control when the aim is to enhance intrinsic motivation. Nevertheless, some rules are of course important if several people join the same environment. People, whether it is only yourself or others, will probably always be included in gamification. Personalities and the intention of performing actions are individual and what to expect is not always known. Apart from setting some ground rules, one should strive to facilitate a healthy environment where all kinds of people can join without pushing each others motivation down.

Safety is about not having any consequences in the real world, which would be difficult to maintain with gamification, as game elements are put into people's every day life. Gamification will most likely have some kind of effect in the real world. Yet, safety must be preserved by carefully considering how the game elements affect the human. One should try to avoid amotivation for reasons associated to mental health. As already mentioned, amotivation is related to for example depression (Deci and Ryan, 1985). Gamification may also influence physical health such as headaches and loss of energy if it encourages a sedentary life, staring at a screen all day long. It is also important that the system is safe to use in the environment. For instance, a statistical significance has been proved between the release of Pokémon Go and increased accidents (Orland, 2017). This is a typical example of a game causing a lack of attention when walking or driving around. In addition,

the implemented gamification should not encourage a behavior that is against the law or social norms.

From the studied literature it seems that optimal challenges, personalized goals, enhancing curiosity in exploration, having an emotional appealing fantasy, getting positive performance feedback during interaction with the system or with people, are the game design element most likely to create an intrinsic long-term motivation. Outcomes and rules are most likely to enhance extrinsic short-term motivation. Competition on the other hand, is rather more difficult to place, as the found literature contradicts each other. It is less meaningful to discuss safety as a motivational game element. It should be a matter of course that the system is safe to use, and one can expect users losing their motivation to use the system if dangerous situations occur. The literature review was as mentioned traditional, not searching for all existing relevant literature. Hence, this discussion addresses only possible conclusions to how gamification facilitates motivation.

6 | Development Methodology

The development method is the process of analyzing, designing, implementing and testing when creating a system (Oates, 2005). In this thesis the development method was a part of the phases suggestion, development and evaluation in the research strategy, shown in figure 6.1.
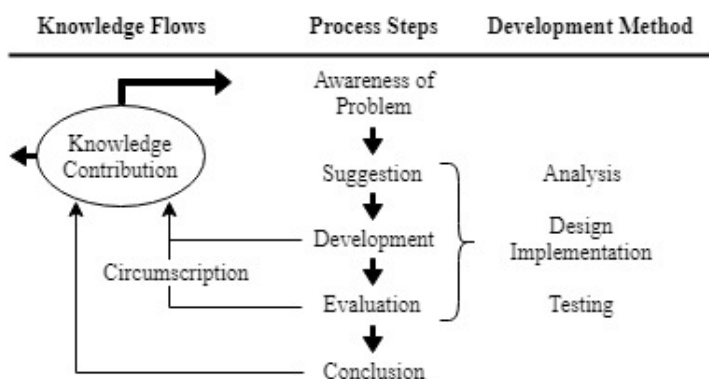
Figure 6.1: Development Method in Research Process, adapted from Vaishnavi and Kuechler (2004, p. 8)

6.1 Software Development Methods

Several software development methods were looked into when deciding an appropriate method for this thesis.

The waterfall model is a plan-driven process, where all process activities are planned and scheduled in advance (Sommerville, 2011). Each activity is separate and finished before the next one starts, hence the name waterfall. User requirements should preferably be final

in the first activity because changes are costly and contain much extra work. On the upside, it is easy to monitor progress because of the process visibility.

Incremental development is a process where an increment of the system is developed at a time and shown to the customer, and the final solution evolves during the process (Sommerville, 2011). Changing user requirements is less costly and it is easier to meet the users needs (Vliet, 2007). The process is less visible and since increments often contain new functionality, refactoring is important for the structure not to degrade over time.

Prototyping is an iterative development process conducted before the final production (Vliet, 2007). Prototypes help clarify user requirements when these are unclear and iterations are traversed quickly at a low cost, making it easy to test usability and detect problems early. However, they can end up with extra features than initially intended which complicates the production. To avoid the pitfall, the number of iterations should be predefined.

Agile methods have evolved from the aforementioned methods and consist of increments being delivered in iterations of 2-3 weeks, where only early iterations are planned. Later iterations depend on the customer's feedback (Vliet, 2007). Methods are more human-focused by means of more user-involvement, team spirit, informal communication and less documentation, and are suited to keep up with todays rapidly evolving software systems.

Research questions, resources and the scope were important factors when choosing a development method. Conducting the first activities in the waterfall model would have been possible in terms of time and resources, but the model is less suited for an intended focus on usability and was consequently not proper for answering the research questions. Incremental development better accommodates usability, and was a possibility. Yet, it requires a continuous availability of the customer, or in this case the end-user, and this was not a resource that could be confirmed. In addition, programming and developing for usability is done in parallel which would have exceeded the possible scope for one master candidate. Prototyping was best suited to meet the urge for usability, as it could help clarify user requirements as well. The number of iterations could be modified to also suit the scope. Access to the target group is like incremental development, a necessity, but to a smaller degree. Prototyping only needs the end-user when increasing usability and not for the system to evolve in itself. Agile methods also accommodates for usability, but is more suited for projects with more resources, such as a whole development team. An agile method would be most appropriate to choose if a real product in the same area as this thesis was to be developed, but for the research purpose of this thesis prototyping was best suited.

6.2 Prototyping

The iterations in the prototyping method consisted of the four phases shown in figure 6.2. Implementation in this context refers to implementing the design into a prototype. Prototypes can be high-fidelity which means being similar to and using the same techniques

as the actual end-product, or they can be low-fidelity which means being simpler, often sketched, and less similar to the end-product. High-fidelity prototypes are more costly than low-fidelity prototypes, but are perceived as more professional (Newman and Landay, 2000). Low-fidelity prototypes offer quicker and cheaper iterations but can be perceived as unprofessional when trying to make a good impression. In spite of that, they are equally good at detecting usability problems (Walker, Takayama and Landay, 2002).

Low-fidelity prototyping was chosen in this thesis to make it through three iterations within the time limit. Having the prototype be perceived as unprofessional was seen as a low-risk in this thesis. This was because the target group studied Informatics and were familiar with the prototyping process. A tool named balsamiq (Studios, 2018) was used to create the prototypes.
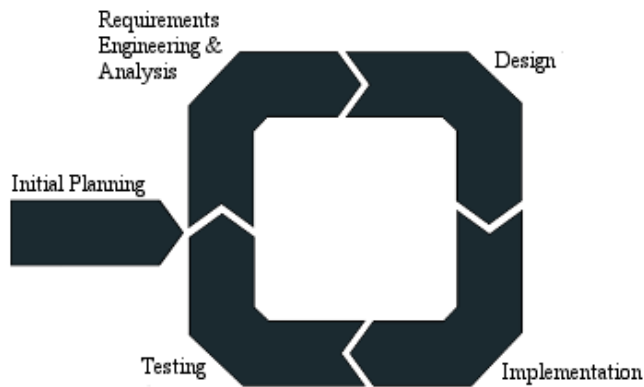
Figure 6.2: Prototyping Iteration

6.3 Player Centered Design Process

Usability and user experience are important when designing to meet users needs (Rogers, Sharp and Preece, 2011). Clarifying the primary objective and user goals are critical, and a user centered design process focuses on how to make the user's goal effective, efficient and satisfying. When designing for gamification, not only is the usability and user experience important but also creating engagement. For this purpose, a player centered design process was applied, which is an extension of the traditional user centered design process (Kumar and Herger, 2013).

The player centered design process aims to also add increased engagement to the users goals (Kumar and Herger, 2013), and sees the user as a player. The process is iterative and consists of a series of steps that are presented in figure 6.3. Like the user centered process, the player is in the very center and everything else is based upon that center. The steps are

described in table 6.1. The right column describes in which prototyping iteration phases, from figure 6.2, the player centered design process steps occurred.

The process is initially business-specific, but it is pointed out that its intention is to be adapted and that the steps are not rigid. In this thesis, the process needed some modifications which are listed as follows:

- In the step of understanding the mission, there was no need to consider the target business outcome. There was no business, in that sense, needing its profits.

- Understanding human motivation was a step already completed in the literature review in chapter 3.

- The step of manage, monitor and measure presupposes a working system. A low-fidelity prototype is not a working system, and this step was limited to analyses using the Octalysis framework and usability testing, in combination with a post usability user questionnaire.
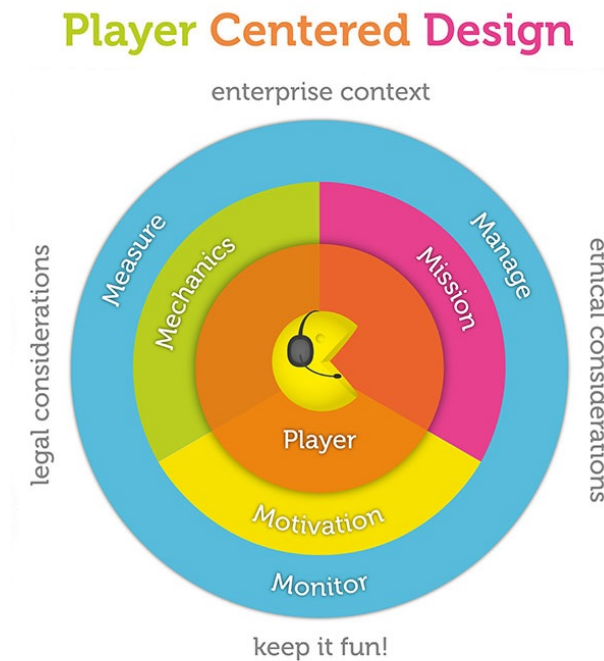
Figure 6.3: Player Centered Design Process, reproduced from Kumar and Herger (2013, p. 29) with permission

Table 6.1: Player Centered Design Process

Step	Description	Iteration Phases
Understand the player	The first step is to know the player through investigating their environment and creating player personas.	Requirements Engineering & Analysis
Understand the mission	The goal of the gamification activity is called a mission. The mission must be effective and this is done through considering the following: understanding the current scenario, understanding the target business outcome and identifying a mission that is specific, measurable, actionable, realistic and timebound.	Requirements Engineering & Analysis
Understand human motivation	Familiarizing yourself with research on motivation to create effective game mechanics.	Already completed in chapter 3 - Literature Review
Apply game mechanics	Applying the game mechanics in a positive flow based on the understanding of the player, mission and human motivation.	Design and Implementation
Manage, Monitor and Measure	Managing expectations with regard to the mission, monitoring the impact of the product on player interaction, delight and motivation, and measuring the effectiveness of the mechanics.	Testing

6.4   Co-Design

Co-creation has been growing in the landscape of human-centered design. In co-creation, the user is seen as a partner instead of a subject, participating in any collective creativity (Sanders and Stappers, 2008). Co-design is a specific instance of co-creation, spanning over the design process of development. Designers are working together with non-experienced designers. Co-design can take place over the whole design process or just parts, but practiced early can make positive, long-term consequences. Co-design can be very useful, because even though for example end-users are not design experts, they are experience experts and know best how the situation is today. To help define the user requirements and increase the understanding of what students at Informatics would expect gamification to look like, a workshop was conducted as part of the first iteration in the development process. Figure 6.4 shows a picture of the workshop before the participants arrived. Chapter 2.2.3 includes a detailed description of how the workshop was carried out.

Afterwards, the design solutions were evaluated using the Octalysis framework. To recap,

each core drive was given a score between 0-10, squared and than added up. The Octalysis tool (Chou, n.d.) was used to implement the scores and creating the octagon. The scores were given according to how many elements they had in each core. For instance, if a solution had two game elements appealing to the core drive of meaning, this core drive got 2 points. The scores were used to compare the solutions against each other.

Figure 6.4: Ready for Workshop

6.5 Usability Testing

Usability testing refers to "..a process that employs people as testing participants who are representative of the target audience to evaluate the degree to which a product meets specific usability criteria" (Rubin and Chisnell, 2008, p. 21). This type of testing was used in iteration 2 and 3, and embodied the step of manage, monitor and measure in the player centered design process, see table 6.1.

The usability tests were formative, meaning they were exploratory (Rubin and Chisnell, 2008). The goal was to identify high-level usability problems such as information references and findability in addition to confirming how well the design supported the users goal of motivating a greater study effort.

The tests were horizontal, meaning that users had to perform tasks communicating the intended work flow of the system and not going in depth of the different functions (Rubin and Chisnell, 2008). This was to let the user get an overall impression of the system. Tasks are presented in chapter 8.3 and were formed as scenarios, since these present the reality and give more reliable results.

The sample size for each test was five people, ten all together, which should uncover most of the usability problems (Nielsen and Landauer, 1993). Participants consisted of fellow students studying Informatics, randomly asked at campus. This choice was made because they were easy accessible, in the target group, however not in third class, and in the intended environment of the system which was realistic.

Before starting the tests, an introduction was held explaining the equipment, what will happen, ensuring them that it is the product and not them who is being tested, and reminding them to think out loud (Rubin and Chisnell, 2008). During the tests, observations were written down in a schema, presented in chapter 8.3. If a problem occurred and the cause was unclear, the participant was asked about the problem after the test, to try to clarify the cause.

In the end of the tests, a System Usability Scale (SUS) schema was handed out, see appendix figure D.1. SUS gives a global view of subjective assessments of usability (Brooke et al., 1996). It consists of ten Likert scale questions which are calculated into a score as follows:

- For each of the questions 1, 3, 5, 7 and 9, calculate the scale position minus 1.

- For each of the questions 2, 4, 6, 8 and 10, calculate 5 minus the scale position.

- Sum all scores and multiply by 2.5.

In addition to the SUS schema, a post usability testing questionnaire was handed out, see appendix table D.1. This questionnaire was specifically aimed at getting the test subjects' opinions of the implemented gamification. The questions were, like the SUS schema, a Likert scale from 1 to 5. Because of the small sample size, no statistical analyzes were conducted on these questionnaires, but they were used to enrich the discussions to a great extent.

The usability testing had some limitations. Since I was alone, I had to serve the role as both test leader and observer. To ease these tasks, the prototype was wire-framed, meaning mockups being clickable on the computer. This way I had my hands free to write the observation schema. However, observations done by only one person could result in a lack of problems being detected. This was a limitation that could not be dealt with and had to be accepted.

6.6 Iteration Activities

To summarize all activities and clarify how they relate to the development method, figure 6.5 shows the activities conducted in all three iterations.

Iteration 1:
- Understand the player
  and mission
  (personas, Internet research,
  questionnaire)
Iteration 2:
- Creating user
  requirements
Iteration 3:
- No action
  (reason described
  in chapter 9)

Iteration 1:
- Workshop
Iteration 2:
- Creating prototype design
Iteration 3:
- Redefining prototype design

Iteration 1:
- Analyse solutions
  with Octalysis
Iteration 2:
- Usability testing
Iteration 3:
- Usability testing

Iteration 1:
- Workshop
Iteration 2:
- Implement prototype
  in balsamiq
Iteration 3:
- Implement redefined
  prototype in balsamiq

Figure 6.5: Iteration Activities

7 | Iteration 1

The main goal of iteration 1 was to gain clarity in the user requirements. The steps consisted of understanding the player and mission as stated in the player centered design process, and carry out a workshop with end-users. There was no testing executed in this iteration, but the evaluation consisted of analyzing workshop contributions using the Octalysis framework described in chapter 3.7.

7.1 Understand the Player and Mission

Several techniques for user investigations were used to understand the player and mission. These included creating personas, doing an Internet research of Informatics and carrying out a questionnaire with the target group.

7.1.1 Personas

Personas are fictitious representations of possible users of the system. These help to create a common understanding and get to know the target group (Pruitt and Adlin, 2010). A data driven approach is the best way to create personas. Primary and secondary data sources can be used when creating data driven personas, where primary data sources refers to directly observing the users. However, if there is limited time, as in this thesis, personas can also be made out of assumptions. This is because any focus on the user is better than none, even though the credibility is weakened. I have been a student at Informatics for almost five years. Through friends and acquaintances in my study, I have observed and gained insight into the different types of people who study Informatics. These observations have naturally not been assembled, structured and stored, and are therefore not data. Nevertheless, investing a lot of time in creating data driven personas when I already had insight would may lead to time being misspent. Therefore, personas were made based on assumptions. After gathering the data from the questionnaire, which is presented in the following chapter, the personas were updated with information about lectures and average time spent on studies.

The tool used to create the personas was Xtensio (Crow, 2018). The personas include general information about their situation, personality types based off the Myers Briggs personality test (The Myers & Briggs Foundation, 2018), goals, frustrations, a simple biography, player type based off Bartle's taxonomy (Bartle, 1996), drives to take action, and preferred device. All personas are based on people studying Informatics. Details which were not directly centered around their student life have been left out because of the lack of relevance. Figure 7.1 shows one of the personas created. The remaining personas are found in appendix E.

7.1.2 Bachelor of Science in Informatics at NTNU Campus Gløshaugen

This section gives an overview of the study program Informatics. The aim of this overview was to get an introduction of the player's environment to gain a better understanding of the player.

Student Association

Informatics has their own student association called Online, which extends the students' opportunities. They put students in contact with employers, give academic support through extra courses in difficult subjects, organize social events and are sponsored by several companies. Online also has their own office open for students to come visit or hang out. In the office there is a store where students can buy chocolate, smoothies and other snacks.

Work Opportunities

According to NTNU's website (NTNU, 2018a), students with a finished bachelor's degree in Informatics can work in small or large businesses as system developers, IT consultants and project managers, or with customer contact and contact with end-users. Even though there are work opportunities with a bachelor's degree, many students also choose to continue with a master's degree. However, there is a though competition, as they are competing against students coming from educational institutions all over Norway. For instance, the master's degree specialized in Software Engineering had 254 applicants and only 20 spots in 2017 (NTNU, 2018d).

Student Exchange

It is possible to do parts of the study program abroad. NTNU says that the IT industry is international by nature, and that international experience is valuable for yourself and future employers (NTNU, 2018b). A year abroad would give students the opportunity to take classes in areas within IT where universities different than NTNU have more competence.

Marion

Xtensio

Age: 19
Occupation: Student at NTNU
Status: Single
Kids: None
Location: Trondheim
Average time spent on studies per week: 30
Attending lectures? Yes, always

Personality

Introvert — Extrovert
Thinking — Feeling
Sensing — Intuition
Judging — Perceiving

Goals

- Get into a master's degree in Informatics.
- Get a job as an IT consultant.
- Become the best version of my self.

Frustrations

- Exams period coming up.
- When two fun things occur at the same time.
- The feeling of not working enough with the studies.

Bio

Marion started at NTNU right after she finished high school. She found her IT classes at high schcool very interesting and that is why she started to study Informatics. She works for the news paper belonging to the line association for Informatics. Getting good grades is important to Marion, because she wants to continue on a master degree after the bachelor degree. In her spare time, Marion plays handball and likes to hang out with friends from both the university and the handball team. Marion feels that she is motivated in trying to get good grades, but since she spent much time on handball and the newspaper, she has not been able to spent so much time at her studies as she wants to keep up with the courses.

Preferred Device

Mobile Phone
Tablet
Laptop
Stationary PC

Drives

Achievement
Fear
Growth
Power
Social

Player Type

- 80% Achiever
- 0% Explorer
- 20% Socializer
- 0% Killer

Figure 7.1: Persona - Marion

Learning Outcomes

Learning outcomes say something about the minimum knowledge, skills and general competence a student should possess after completing a bachelor's degree in Informatics. The learning outcomes are found in Norwegian in appendix F. On the website of Informatics (NTNU, 2018a), courses included in the study program are listed and each course has its own internal learning outcomes. There is no overview of which courses that are linked to the overall learning outcomes.

Studiebarometeret

Studiebarometeret is a national student survey conducted by NOKUT, which maps how students perceive the quality of their study program (NOKUT, 2017). In 2016, published in 2017, the survey had a 30% response rate (45 students) from the second year of Informatics. The survey is divided into different subjects and only some were relevant for this thesis. Overall satisfaction and motivation were the subjects focused on, see statistics in table 7.1. The students were asked to scale to what extent they agree on the different statements. The range is from 1 to 5, where 1 is not agree and 5 is agree. All 45 respondents did not answer all the questions, but the scores presented are the average range of the responses. The score column presents the scores of Informatics and the average column presents the average of all bachelor degrees in informatics and computer science in Norway. In addition to what is shown in the table, the students reported spending an average of 13.3 hours each week on learning activities organized by the institution and 21.1 hours on non-organized academic work.

Table 7.1: Studiebarometeret Results, published in 2017

| ID	Category	Question	Score	Avg.
6.1.A	Overall satisfaction	I am attending the study programme of my first choice	4.0	4.3
6.1.B	Overall satisfaction	I am, all things considered, satisfied with the programme I am currently attending	4.2	4.0
6.1.C	Motivation	I am motivated for working on my studies	3.8	3.8
6.1.D	Motivation	I participate in the organised learning activities that are offered	3.2	3.3
6.1.E	Motivation	I show up well prepared for organised learning activities	2.6	3.2
6.1.F	Motivation	I think of myself as a hardworking student	2.9	3.5

7.1.3 Questionnaire Results

This chapter presents highlights of the results from the questionnaire, conducted on the students at Informatics. Raw and demographic data, and results difficult to interpret as explained in chapter 2.2.2, are found in appendix G.

The aim of the questionnaire was to investigate study effort among students, and their opinions of gamification implemented into study effort. Study effort was split into the four aspects: overview of time spent, efficient use of time, increased use of time and spending time helping fellow students. The questionnaire described different systems of how gamification may take form in those four aspects. Two bars in the same study effort aspect, as seen in figure 7.4 and 7.5, indicate that two types of systems using gamification were described. Students were asked about their opinion of both motivation and usefulness. As mentioned in chapter 2.4, comments were sorted into negative, neutral and positive, based on whether or not they found the described system motivating. Sometimes people in the same group had contradicting opinions in the comments and sometimes a person giving a positive score still had a negative comment. Therefore, contradictions may be found in tables 7.3 - 7.6.

It is discussed in chapter 7.4 that there was a majority of negative opinions towards competition. There was a follow up question in the questionnaire, about whether or not the students would like to be anonymous in a competition. However, since the tendency of students not liking competition was discovered early, it was not prioritized putting the statistics concerning anonymity in pie charts.

Students' Experience of Motivation and Study Effort

Questions reproduced from NOKUT (2017). Raw data found in appendix, table G.1.
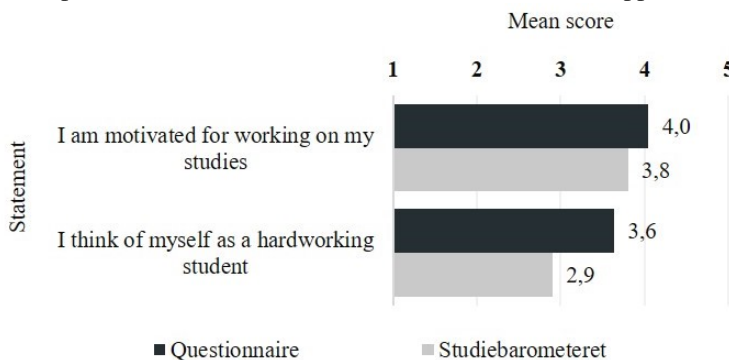

Figure 7.2: Results from the Questionnaire Compared to Result from Studiebarometeret.

Table 7.2: Students' Awareness of Time Spent on Studies

Approximately how many hours per week (on average in the semester) do you spend on your studies?									
(Response distribution)									
1-10	**11-20**	**21-30**	**31-40**	**41-50**	**51-60**	**61-70**	*Mdn*	*M*	*SD*
0	4	16	14	6	3	1	35	35.6	12.3

Based on your previous answer, how sure are you on your estimate of hours spent on average?
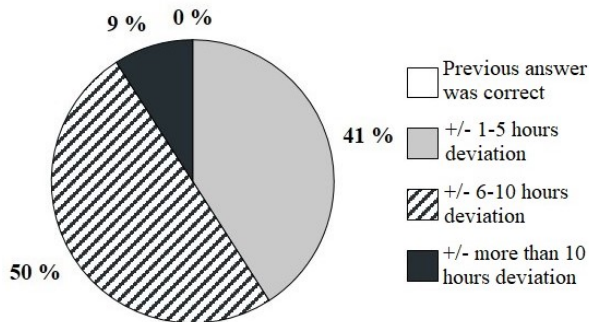
Figure 7.3: Deviation of Estimated Time Spent on Studies

Motivation Scores of the Described Systems

Game design elements used in the described system are shown in the bars. Raw data found in appendix, tables G.2 - G.5.
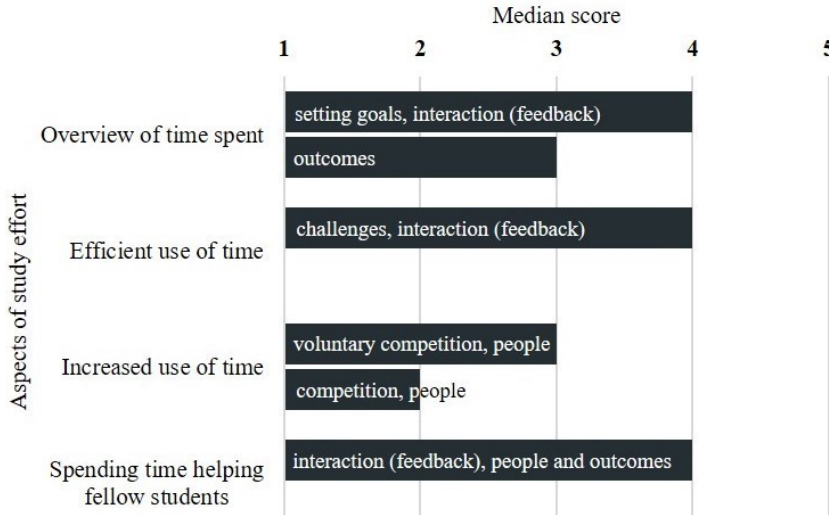
Figure 7.4: Results Comparison of Motivation

Usefulness Scores of the Described Systems

Game design elements used in the described system are shown in the bars. Raw data found in appendix, tables G.2 - G.5.

Figure 7.5: Results Comparison of Usefulness

Table 7.3: Overview of Time Spent - Comments

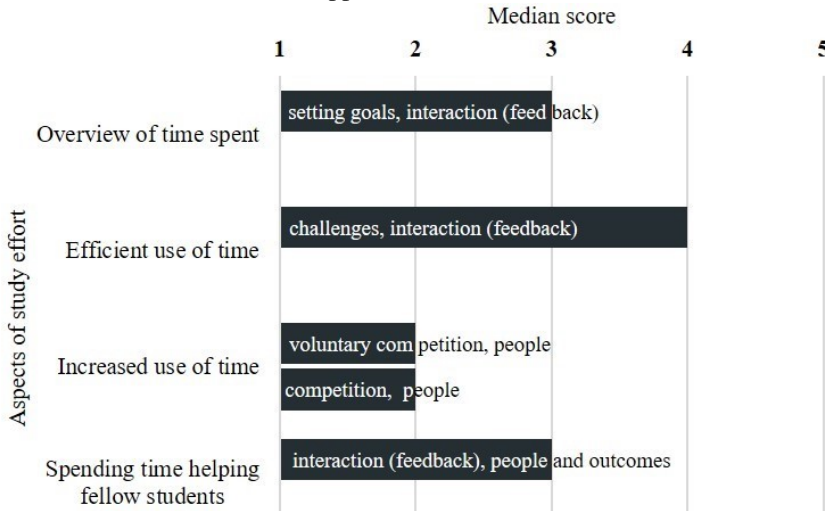| Negative	Neutral	Positive
- Unnecessary hassle - Good habits are more important - Study buddies are more important - Not interested in gamification	- Seems practical - Must be easy to use - Precision is important - Prefer real rewards as in Hold	- Precision is important - Prefer real rewards as in Hold - Already using a similar system - Must offer quick overviews - Must avoid creating pressure - Seems fun - Can motivate others, not me - I already use Toggl

Table 7.4: Efficient Use of Time - Comments

Negative	Neutral	Positive
- Seems unnecessary - Exercises does the same job - Will not be efficient - Want to improve study effort, but skeptical to the system	- Quizzes must be well-formed - Seems useful - Too much work for lecturers	- Seems useful, reasonable, exciting, interesting - Too much work for lecturers - Skeptical to precision - Quizzes must be relevant - Makes it easier to remember details - I like to test myself

Table 7.5: Increased Use of Time - Comments

Negative	Neutral	Positive
- Increases pressure - Destroys the enjoyment of studying - No good measurement of study effort - Creates a bad study environment	- Already a Hold user - Competition is not important - Might work in a joint lecture	- I want to choose own opponents - Motivates trophy hunters - Irritating to collect trophies - Increases study pressure - Might strengthen study environment - Might weaken study environment

Table 7.6: Spending Time Helping Fellow Students - Comments

Negative	Neutral	Positive
- Recognition will not be stimulated - Ratings does not increase motivation - Badges are not motivating - I don't want to help randoms	- I only help friends - I rather spend time on myself - Must provide genuine feedback - Seems helpful - I already get help from friends - Already a user of similar systems	- Good idea - Already a user of similar systems - Badges are not motivating - I want to receive help - I already get help from friends - Seems fun and motivating - Clever, not everyone has many friends - Would have loved this system

Table 7.7: Students' Awareness of Overall Learning Outcomes

Learning goals are listed below. Do you know which of these are included in the degree program of Bachelor Informatics?				
	(Response distribution)			
	Included	**Not included**	**Don't know**	**Correct answers**
Kandidaten har grunnleggende kunnskaper om relevante metoder, arbeidsmåter og god praksis for oppbygging av datasystemer og nettbaserte løsninger.	34	1 (Correct)	9	2.3%
Har kunnskap om relevant lovverk og etiske problemstillinger relatert til utvikling og bruk av informasjon og informasjonsteknologi.	12 (Correct)	15	17	27.3%
Kan jobbe effektivt med verktøy for modellering og konstruksjon av programvare og dokumentasjon.	31 (Correct)	4	9	70.5%
Kandidaten kan identifisere de miljømessige, etiske og økonomiske konsekvenser av informasjonsteknologiske produkter og løsninger og evner å se disse i et livsløpsperspektiv.	5	25 (Correct)	14	56.8%
Kan forstå informasjonsteknologiens rolle og konsekvenser i et samfunnsperspektiv.	17 (Correct)	10	17	38.6%

Table 7.8: Students' Awareness of Learning Outcomes for a Specific Course

Learning outcomes are listed below. Do you know which of these are included in the course TDT4140 - Software Engineering?				
	(Response distribution)			
	Included	**Not included**	**Don't know**	**Correct answers**
Studentene vil få kunnskap om programvareutvikling-konsepter som prosessmodeller, metoder og teknikker for architecture design, testing, planlegging, konfigurasjonsstyring og kvalitetsstyring.	34 (Correct)	2	8	77.3%
Studenten skal være i stand til å benytte aktuelle metoder og teknikker for brukersentrert design av grafiske brukergrensesnitt, samt objekt-orientert konstruksjon av slike.	9	20 (Correct)	15	45.5%
Planlegge og administrere små programvareutviklings-prosjekter og delta som designer / programmerer / tester i større programvareprosjekter.	24 (Correct)	7	13	54.5%
Praktiske ferdigheter i programmering og integrasjonen av ulike komponenter for å sette sammen et større software-produkt.	20	9 (Correct)	15	20.5%
Studentene skal kunne forstå betydningen av programvareutvikling som et yrke. Studentene skal kunne forstå og samtale om komplekse programvareutviklings-prosjekter og tilhørende tekniske og organisatoriske problemstillinger.	17 (Correct)	11	16	38.6%

Table 7.9: Students' Opinions of Learning Outcomes

To what extent..									
(Response distribution)									
	1	**2**	**3**	**4**	**5**	**Don't know**	*Mdn*	*M*	*SD*
..do you think the learning outcomes are clear enough?	0	6	15	16	4	3	3	3.4	0.9
..do you understand when a learning outcome has been reached during your studies?	3	13	14	7	3	4	3	2.9	1.1

Table 7.10: Experiences with Gamification in Education

What experiences do you have with gamification in education?	Examples
- Gamification makes learning fun - Gamification is motivating - Gamification is engaging - Gamification should be implemented more - Competition is not motivating for everybody - Some solutions do not work properly - I like to see my achievements - I pay more attention with kahoot - Kahoot is useful - Kahoot creates both positive and negative pressure - Kahoot is boring and takes up time - Kahoot is good for repetition - Kahoot is good for testing yourself	*"Det kan være gøy og føre til økt læring, men føler også det finnes en del dårlige løsninger som ikke funker."* *"Systemer gjør ofte ting morsommere, men konkurranser er ikke alltid motiverende for alle."* *"Kahoot er morsomt. Men Kahoot kan også gi et lite press om å score bra for eksempel i en forelesning når sidemannen følger med og sammenlikner med deg."* *"Kahoot er en morsom del av undervisning hvor jeg får en pekepinn på om jeg har forstått innhold eller ikke. Utover dette er jeg lite glad i konkurranse med andre, jeg konkurrerer heller mot meg selv for å bli enda bedre. "* *"Positivt, engasjerende. Burde implementeres på flere områder."*

Table 7.11: Experiences with Gamification Outside Education

What experiences do you have with gamification outside education?	Examples
- Gamification is useful - Gamification works sometimes - Increases knowledge - Fun when easy and anonymous - I like rewards - Trophies are motivating - I don't like trophies - Solutions often do not work properly - Not addictive enough - Not exciting in the long term - Sportswatches makes me walk more - Fun to compete against friends with a sportswatch - I like to challenge myself - I like to see progress	*"Jeg føler mange lærer fra spill uten at de merker det selv. Mange har forbedret f.eks sine engelsk-kunnskaper"* *"Det er alltids gøy med gamification, da man føler at man oppnår noe ved å unlocke trophies eller achievements. Dette øker viljen til å gjøre det lille ekstra for å oppnå noe."* *"Brukt til trening, og andre generelle livsmål. Ofte dårlig implementert, er ikke avhengighetsskapnde nok."* *"Ting blir mer gøy når man får "belønninger for det""* *"Jeg har selv brukt fitbit og opplevd at bruken av gamification i begynnelsen er spennende og interessant, men etterhvert så blir man vant til det og kan lettere ignorere det. Da forsvinner poenget. "*

Table 7.12: Motivations in Everyday Studies

What motivates you in your everyday studies?	Frequency
Interesting courses	10
Good results	9
Future job/finished degree	6
Exciting tasks	5
Friends/good learning environment	5
See progress	5
Learning outcomes	4
Clear goals	3
Sense of achievement	3
Engaging lecturers	3
Enter the degree program Master of Science in Informatics	3
Curiosity	2
Sense of fellowship	2
The totality	1
Teamwork	1
Good health	1
Coffee	1
Money	1
Creative opportunities	1
Be the best version of myself	1
Learn techniques from lecturer on how to achieve progress	1

7.2 Workshop Results

Design Solution 1: Motivatica

In Motivatica, see figure 7.6, tasks and assignments for courses must be added in the system manually. When this is done, a course can be chosen in the menu and when the student does not know what to work with, a spin on the wheel of fortune will make the decision. When a task is chosen, the student receives an inspirational quote to work harder. There is also a stopwatch that shows how long the student has been working on the task. The map shows the progress of the task. Points are given based on the position of the map, and the student is being compared to friends. The goal is to win a main prize which friends have bought together. The student who worked the hardest, wins the prize. In addition, points are given for completed tasks. These are shown in the user profile, and points can be used to buy taxi, ice cream, a day off etc.
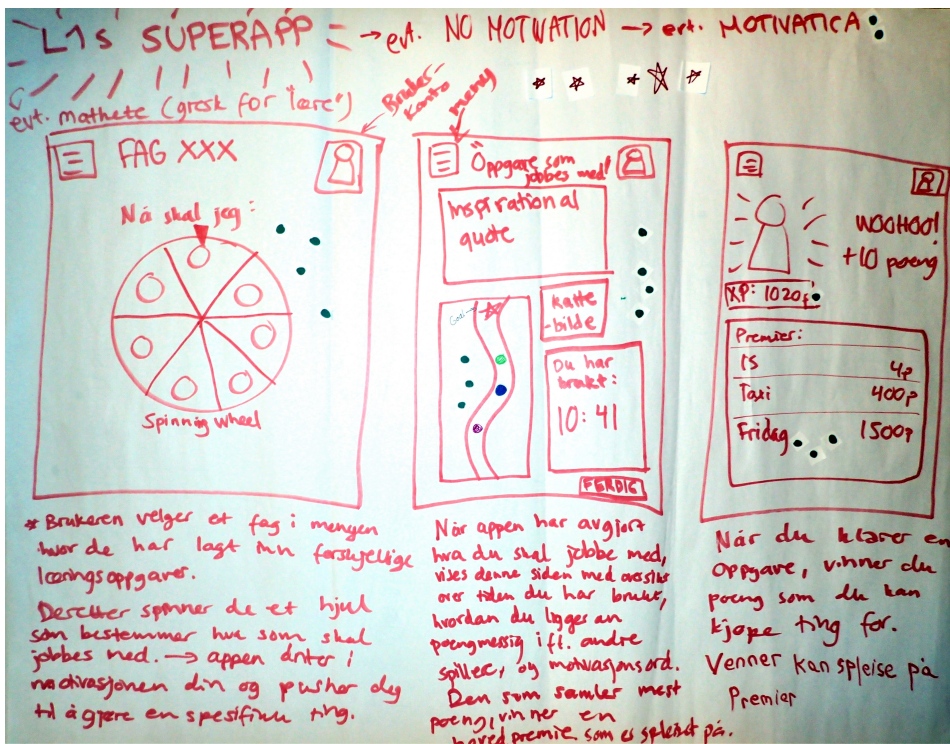

Figure 7.6: Design Solution 1 - Motivatica

Table 7.13: Gamification in Motivatica

Elements	Implementation
Competition	Competing with friends for the main prize. To win, the student has to be the first to complete the task.
Challenge	The student is challenged to complete tasks that are randomly picked.
Exploration	The student can explore what is available in the store.
Fantasy	A virtual wheel of fortune that picks tasks for the user to complete. There is also a map representing a road towards the goal.
Goals	The main goal is the main prize. Another goal is to complete tasks to gain points.
Interaction	When the wheel has spun, the state of the system changes to start a task. The circle on the map will move forward and the experience points on the player profile will increase as the student is gaining points.
Outcomes	The student gets points and a main prize as rewards. Another outcome is gained knowledge.
People	The student can play with friends.
Rules	The main prize must be bought together, and whoever works the hardest wins it.
Safety	As long as the prize is not dangerous, there are no safety issues with using this system.

Design Solution 2: Lydkok

In Lydkok, see figure 7.7, the curriculum is played as an audio book. The screen shows what is read at the moment. In the end of each chapter the student needs to answer questions. If an answer was wrong, the student needs to repeat the chapter. An overview is given of which questions that were answered correct. Further on, the application can be expanded to contain explanations of for example a concept. These explanations can either be implemented in advance or be written by the students themselves. If they are explaining it by themselves, one cannot check whether it is correct or not, but it can be used for reflections at a later stage. There is a person needed to read the entire curriculum. This can be done through hiring someone, or the process can be crowd sourced.
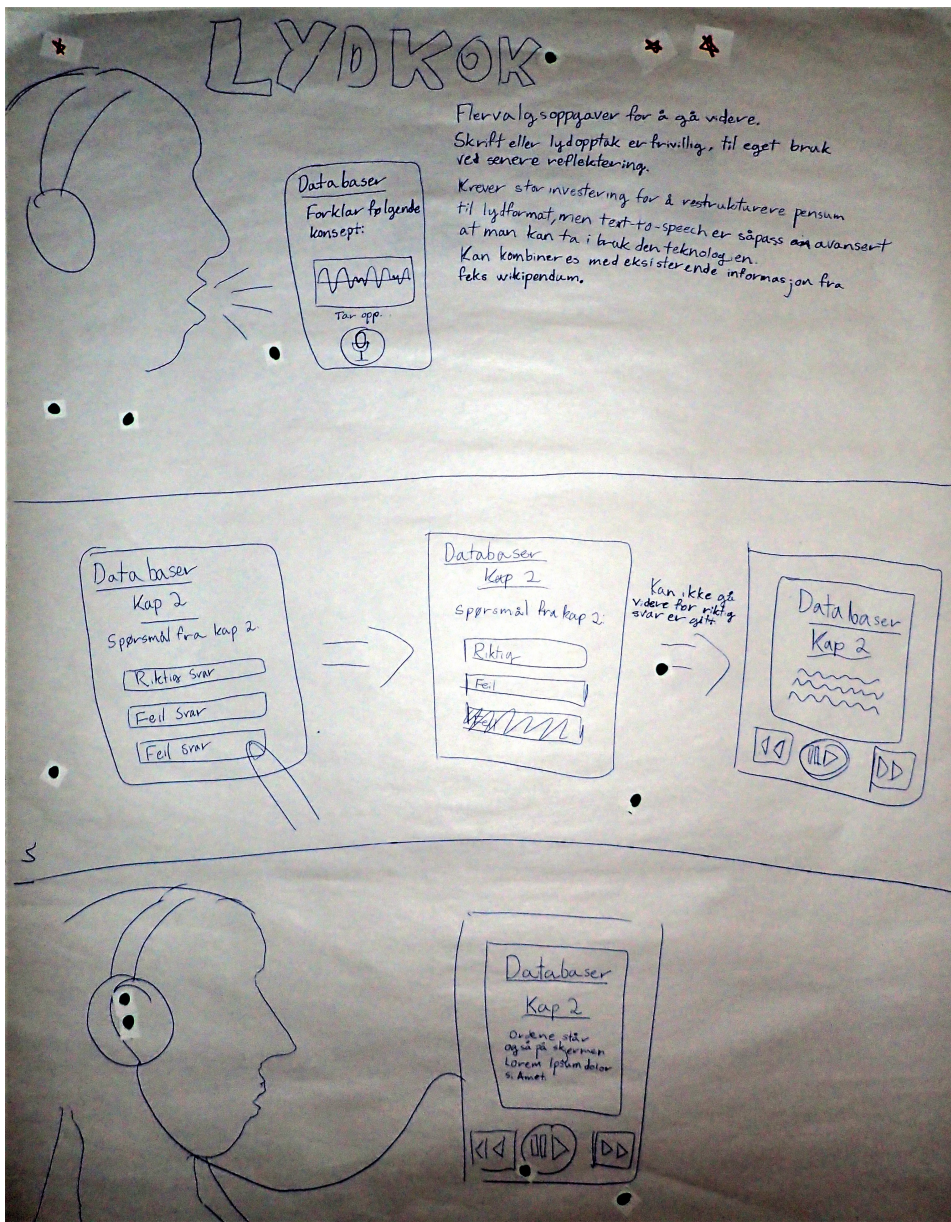
Figure 7.7: Design Solution 2 - Lydkok

Table 7.14: Gamification in Lydkok

Elements	Implementation
Competition	There is no competition implemented.
Challenge	The system challenges the student with a quiz in the end of each chapter.
Exploration	There is no exploration implemented. There is a potential of making crowd sourced resources available. In that case, the student can explore these resources. E.g. an explanation of a concept.
Fantasy	There is no fantasy implemented.
Goals	The goal is to have learned the chapter and to answer the questions correctly.
Interaction	The student is allowed to take the quiz when a chapter is finished. In the quiz, one gets feedback on which answers were right and wrong, and if the chapter must be repeated.
Outcomes	Gained knowledge.
People	The student only plays with oneself.
Rules	If the student fails a test, the chapter must be redone.
Safety	Listening to an audio book may cause a lack of attention in for example traffic.

Design Solution 3: Øvingsportalen

In Øvingsportalen, see figure 7.8, gamification has been implemented in the assignment system for better learning and preparations to the exams. There is an assignment module where students can upload assignments and there is also a shared comment field. The student can get votes for comments, and the most popular comments are placed on top. There is also a resources module, where the student can add resources for an assignment. Examples of such resources are articles found on the Internet or tips about specific pages in the curriculum. The resources can also be voted for, and the best resources will be placed on top. The assignments are related to the exam, and relevant tasks of previous exams are shown for a particular assignment. The system also contains a profile page, where the student can see their uploaded comments and resources. Point are given for taking the time to contribute with comments and resources. Trophies are also given based on what the student has learned in the assignment module. Gained points can be used to buy coffee and such. There is also a statistics page giving an overview of how the student is doing in a course, average grade, and a predicted grade for a particular course based on what the student knows. In addition, students can add goals of their own choice.
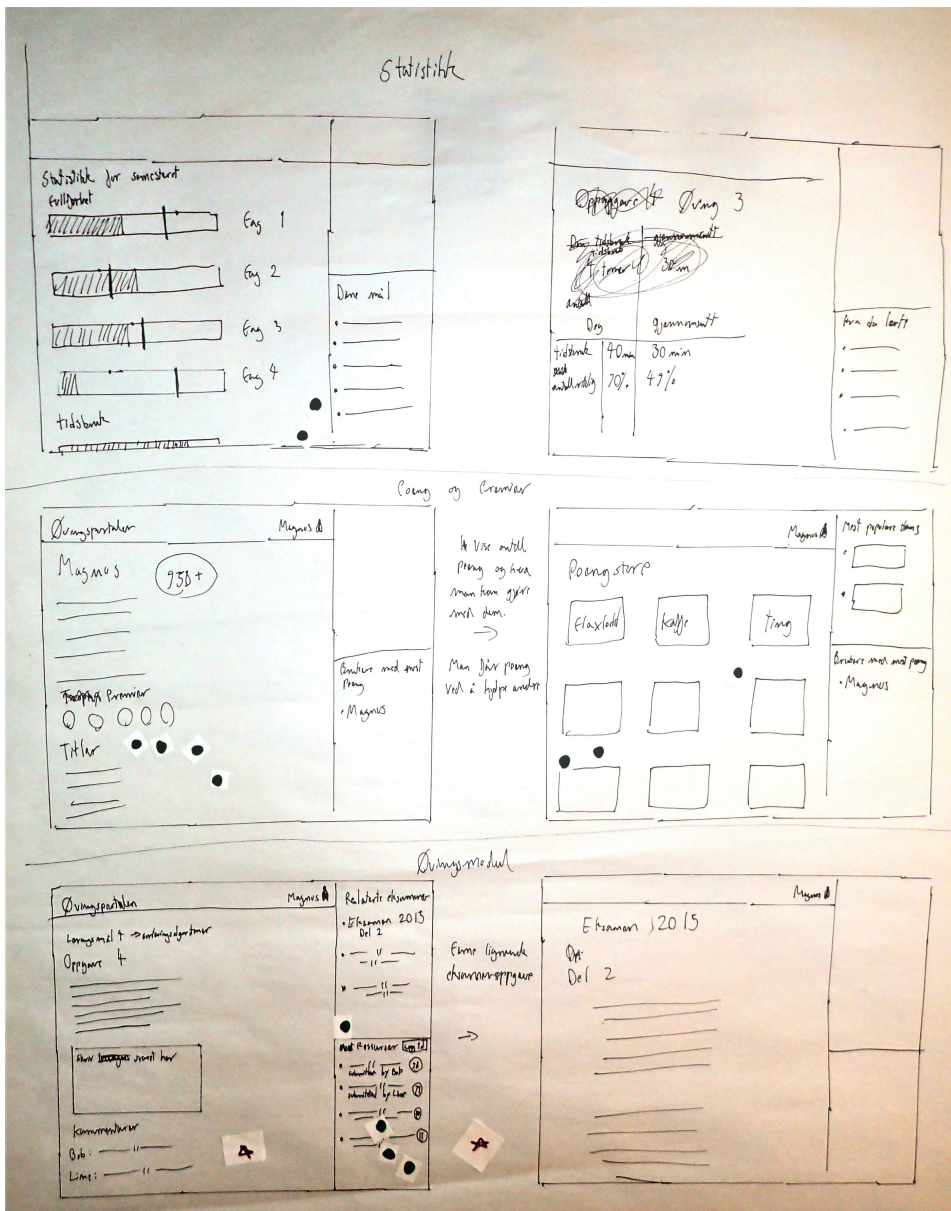
Figure 7.8: Design Solution 3 - Øvingsportalen

Table 7.15: Gamification in Øvingsportalen

Elements	Implementation
Competition	Competition is implemented through trying to get the most votes for the added comments and resources.
Challenge	The system challenges the student through assignments and related exam tasks. The student is challenged to contribute with comments and resources.
Exploration	The student can explore statistics of progress, comments and resources made by others, and what there is to buy in the store.
Fantasy	There is no fantasy implemented.
Goals	The main goal is to complete the assignment. Subgoals include completing previous exams, collecting votes and points. Personal goals may also be set by the student.
Interaction	Progress bars will increase when an assignment is completed. The more votes the student gets, the more points are handed out which can be used in the store.
Outcomes	The student can buy rewards with points. The student gets trophies for finished assignments. Another outcome is gained knowledge.
People	Students will interact with each other through comments, and they are dependent on each other to get votes for own contributions.
Rules	Comments and resources with most votes are placed on top. Points and trophies are only given when the student has contributed with resources or completed assignments.
Safety	There are no dangerous safety issues with using this system.

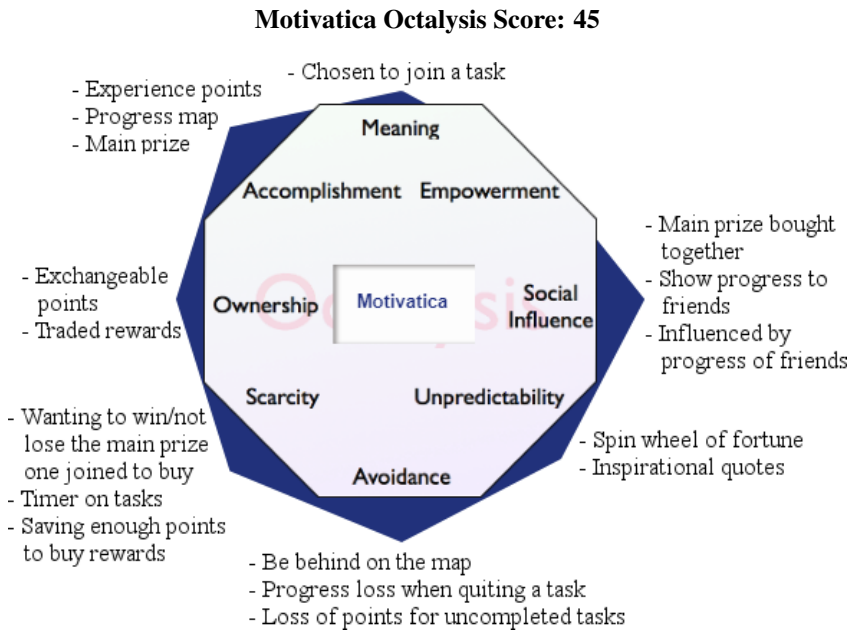**Design Solution 4 - Fists of Brains**

In Fists of Brains, see figure 7.9, the student can track progression of their own and friends' studies, through a fighting game. Each player can choose an animation from a list and play against a friend in class. A checklist containing tasks is written by the players. Each task is worth an attack against the opponent. An example of such a task may be to read five pages in the curriculum book. When a task is done, the student can check the task off the list and the attack is sent. Next, the attack is shown through the animations. The opponent must also read the five pages in the curriculum book to be able to attack back. The point of the game is not so much to win or lose, but rather brag of your own effort.
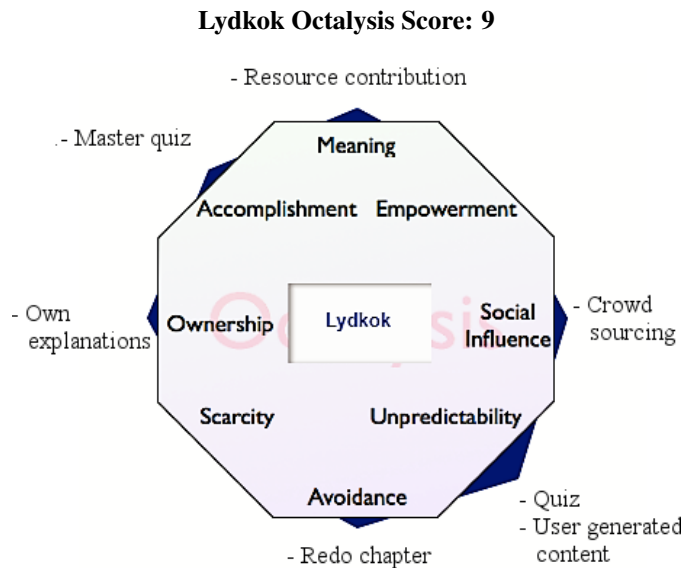
Figure 7.9: Design Solution 4 - Fists of Brains

Table 7.16: Gamification in Fists of Brains

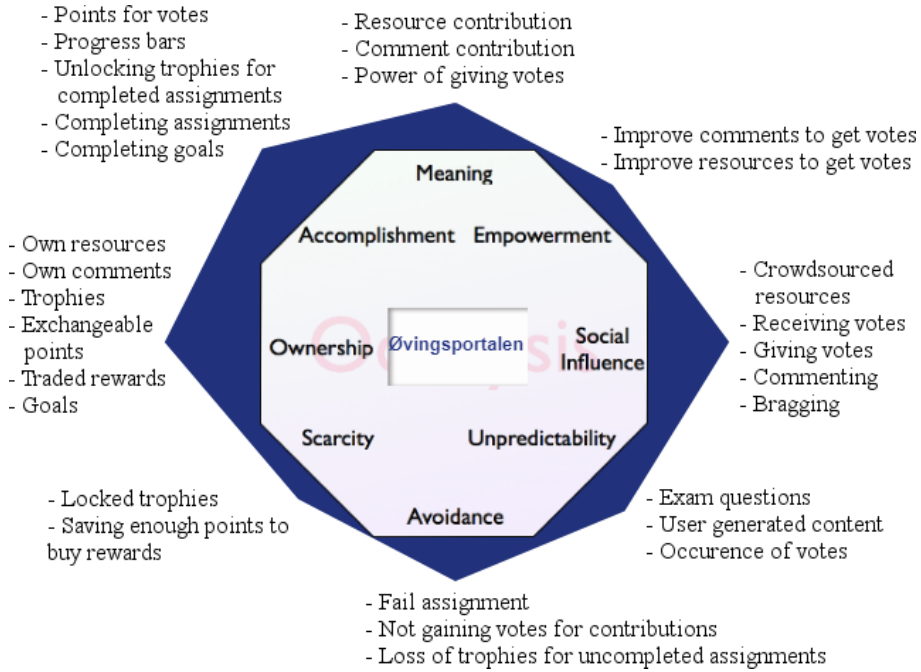| Elements	Implementation
Competition	The student is competing against another fellow student through trying to be the first to check off all the tasks from the todo-list.
Challenge	It is up to fellow students or the student self to be challenged.
Exploration	The student can explore animations to play with from the animation list.
Fantasy	The system has fantasy implemented through using fictional figures or animations that are fighting against each other.
Goals	The goal is to check off the tasks on the todo-list.
Interaction	When one checks off a task, an attack is sent to the opponent.
Outcomes	Points, knowledge and the possibility to show off or brag when working.
People	The student is playing with an opponent.
Rules	The rules are that the player is allowed to check off a task when it is completed. This rule is depending on the honesty of the students playing.
Safety	There are no dangerous safety issues with using this system.

7.3 Evaluation

Motivatica Octalysis Score: 45

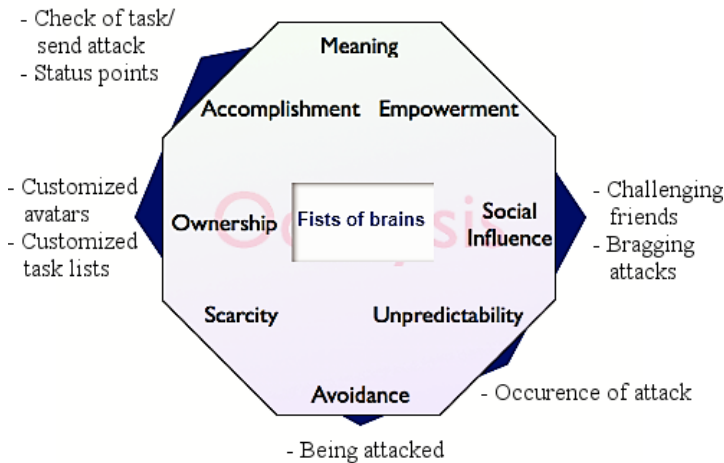- Experience points
- Progress map
- Main prize

- Chosen to join a task

Meaning

Accomplishment Empowerment

- Main prize bought
  together
- Show progress to
  friends
- Influenced by
  progress of friends

- Exchangeable
  points
- Traded rewards

Ownership

Motivatica

Social
Influence

Scarcity

Unpredictability

- Wanting to win/not
  lose the main prize
  one joined to buy
- Timer on tasks
- Saving enough points
  to buy rewards

Avoidance

- Spin wheel of fortune
- Inspirational quotes

- Be behind on the map
- Progress loss when quiting a task
- Loss of points for uncompleted tasks

Figure 7.10: Motivatica Analyzed with Octalysis

Lydkok Octalysis Score: 9

- Resource contribution

.- Master quiz

Meaning

Accomplishment Empowerment

- Own
  explanations

Ownership

Lydkok

Social
Influence

- Crowd
  sourcing

Scarcity

Unpredictability

Avoidance

- Quiz
- User generated
  content

- Redo chapter

Figure 7.11: Lydkok Analyzed with Octalysis

Øvingsportalen Octalysis Score: 121

- Points for votes
- Progress bars
- Unlocking trophies for completed assignments
- Completing assignments
- Completing goals

- Resource contribution
- Comment contribution
- Power of giving votes

- Improve comments to get votes
- Improve resources to get votes

- Own resources
- Own comments
- Trophies
- Exchangeable points
- Traded rewards
- Goals

Meaning

Accomplishment Empowerment

Ownership Øvingsportalen Social Influence

Scarcity Unpredictability

Avoidance

- Crowdsourced resources
- Receiving votes
- Giving votes
- Commenting
- Bragging

- Locked trophies
- Saving enough points to buy rewards

- Exam questions
- User generated content
- Occurence of votes

- Fail assignment
- Not gaining votes for contributions
- Loss of trophies for uncompleted assignments

Figure 7.12: Øvingsportalen Analyzed with Octalysis

Fists of Brains Octalysis Score: 14

- Check of task/ send attack
- Status points

- Customized avatars
- Customized task lists

Meaning

Accomplishment Empowerment

Ownership Fists of brains Social Influence

Scarcity Unpredictability

Avoidance

- Challenging friends
- Bragging attacks

- Occurence of attack

- Being attacked

Figure 7.13: Fists of Brains Analyzed with Octalysis

7.4   Discussion

The first two questions in the questionnaire were identical with those focused on from Studiebarometeret, see figure 7.2. The statistics show a higher average on being motivated and working hard on their studies compared to Studiebarometeret. There may be several reasons for these results. Respondents were third class students and maybe they are working hard with their bachelor thesis. Some are more motivated when the end of the studies is near. Some students may have to redo courses because of the tough competition to get a spot on the master's degree, and consequently perceive their study effort as higher. There are many electives to choose from in third class, and some may work harder because they find their chosen courses more fun. Students may have responded in different contexts as well. There was no check of overlap between respondents of the questionnaire and those answering Studiebarometeret. In hindsight, respondents should have been asked in the questionnaire if they responded to Studiebarometeret, to gain more clarity on these findings. Nonetheless, the perception of being a hardworking student was still significantly lower than their overall motivation, similar to Studiebarometeret.

The questionnaire revealed that students work approximately 35 hours per week, see table 7.2. This result is close to Studiebarometeret. Why they are more motivated for working with their studies than actually working hard, may have its explanations. As already mentioned, the amount of average hours is below the recommended time of 40 hours set by NTNU. More than 50% had estimated a deviation of at least 6 hours, see figure 7.3. This may indicate the students not having a good enough overview of their actual time spent. Students found the system measuring if the study effort was effective, the most useful. Maybe students feel that even though they work 35 hours, their time spent is not effective.

Since efficient use of time scored the highest on usefulness, see figure 7.5, this could be used as a main focus. However, even though they found the other three aspects of study effort less useful than efficient use of time, all the other aspects except from increased use of time, scored equally on motivation on the median score, see figure 7.4. Therefore, if not the main focus, they could take place in a system as well if suitable. Spending more time, encouraged through competition, scored the lowest on both motivation and usefulness. The comments, see table 7.5, showed mainly a negative attitude towards using competition rather than spending more time on studying in itself. Some thought it would increase study pressure and weaken the study environment. If students wanted to be encouraged to work more without competition, the overview of time spent in combination with goals might be sufficient enough.

Some skepticism was showed as well among students being positive or neutral towards overview of time spent, efficient use of time and spending time helping other students, see tables 7.3, 7.4 and 7.6. First of all, precision was important for both the overview of time spent and quizzes. Secondly, the system for overview must be easy and quick to use, and quizzes must be relevant. Lastly, it was pointed out that real rewards were of bigger interest than virtual rewards.

The questionnaire showed the unawareness among students of when learning goals are reached, see tables 7.7, 7.8 and 7.9. As stated in the taxonomy of intrinsic motivations for learning, explained in chapter 3.6, goals should be personalized through enlightening the relevance. In the frequency counting of what motivates students, see table 7.12, interesting courses was mentioned the most. Therefore, it may be an option to use the learning goals to inform the relevance of the courses, so that they become more interesting. Among other things that motivated students were good results, a finished degree, exciting tasks, a good learning environment, seeing progression and learning outcomes. It seems like the students are mostly motivated by seeing their accomplishments.

The personas made clear that most students use their phones but also their laptops in their everyday life. A reason for this might be that they need to use their laptop for their studies. In the questionnaire, several students stated they already use the app Hold, which is described in chapter 4.3. With that being the case, it might be useful to design a desktop version to not exclude students who try to avoid using their phone when studying.

Studiebarometeret revealed that most students at Informatics attend the study of their first choice and are satisfied. For that reason, it can be assumed that some intrinsic motivation for studying already is inherent to most students, which was a promising base. Many positive experiences of gamification were shared as well in the comments, see figure 7.10 and 7.11. From the questionnaire, it became clear that a student had switched over to computer science, and an other student wrote a long text of how he was just depressed and amotivated. These may be the types of students who were not satisfied with their studies, and it may be difficult to target those who in general are not happy with their choice of study.

To summarize, results from the personas, Internet research and questionnaire revealed that the system should measure efficiency of time spent as a main functionality. Overview of time spent and helping others may also take place in the system as secondary functionalities. Assisting the need for challenges with personalized goals and giving performance feedback which enhances competence, should take place as a solid basis. These game elements must somehow be incorporated in the listed functionalities of study effort when creating user requirements.

Solutions from the workshop varied to a great extent. Motivatica and Øvingsportalen, figures 7.10 and 7.12 stood out with getting the best Octalysis score of 42 and 110. They also had the most intrinsically motivating elements according to the left and right brain division. Lydkok and Fists of Brains, figures 7.11 and 7.13, had low scores and little gamification implemented. Øvingsportalen had the best balance between the motivations, and the black and white hat gamification.

Motivatica was heavily weighted on competition compared to Øvingsportalen. The students were given no restrictions to their designs, but the findings from the questionnaire were presented in the beginning. Even though there were many negative opinions about competition in the questionnaire, several of the solutions had implemented it as a game design element. Fists of Brains for example, was a competition in itself. The contradiction

with the questionnaire could be explained by the level of abstraction when designing, see table 3.4 in chapter 3. Students were under a time pressure when designing, and in that case, it is easy to pick ideas which are familiar, such as competition.

Based on that no clarity was gained in the literature review about whether competition enhanced intrinsic or extrinsic motivation, and that there were a great extent of negative opinions towards competition in the questionnaire, Øvingsportalen was the best basis for creating the user requirements. Also, this system was best suited when it comes to meeting the need for tracking efficiency in combination with challenges, personal goals and performance feedback, see table 7.15. In regards of understanding the mission as stated in the player centered design process, this design solution or mission was specific, measurable, actionable, realistic and time-bound. Some elements from the other solutions may, however, be used wherever suitable, see tables 7.13, 7.14 and 7.16. For example, the wheel of fortune taken from Motivatica, as an element of fantasy.

The questionnaire and workshop results revealed a great interest in rewards, especially those of real value. Several students were already using Hold as well. Rewards initially enhances extrinsic motivation, but the great interest should not be overlooked. As long as the system is not exclusively based on rewards, but rather a system which can also exist without the rewards, it may not interrupt the intrinsically motivating effect of the other game elements. The great interest itself makes it worth bringing on the idea for further evaluation.

8 | Iteration 2

The second iteration consisted of defining the user requirements and implementing these in a low-fidelity prototype. An evaluation was done through usability testing and post usability testing questionnaires, as described in chapter 6.5. This chapter concludes with a discussion of the findings which is brought on to the last iteration.

8.1 User Requirements Specification

Tables 8.1 and 8.2 presents the user requirements specification. The tables show the overall functions, IDs and the specific requirements. The requirements specification is based on the discussion in the previous iteration. Normally, each requirement should have a priority but since this is a low-fidelity prototype, there was no need to prioritize as mockups are less time consuming to create than programming.

Table 8.1: User Requirements Specification

Overall Function	ID	Requirement
Overall overview	U1	As a user I want to get an overall overview of study progress
	U2	As a user I want to have an overview of my accomplishments
Course overview	U3	As a user I want to get an overview of course progress
	U4	As a user I want to know progress of specific themes in a course
	U5	As a user I want to know the learning outcomes for courses
	U6	As a user I want to know the relevance of learnings outcomes

Table 8.2: User Requirements Specification, continued

Overall Function	ID	Requirement
Track study sessions	U7	As a user I want to track the time of my study sessions
	U8	As a user I want to know how many hours I have worked in total
	U9	As a user I want to know if a study session was effective by testing what I have learned
Crowd sourcing resources	U10	As a user I want to contribute with resources
	U11	As a user I want to know if my resource contribution was good
	U12	As a user I want to make use of other students' resource contributions
	U13	As a user I want to let other students know if their contribution was good
Helping each other	U14	As a user I want to ask fellow students questions for help
	U15	As a user I want to let others know if their help was good
	U16	As a user I want to answer questions other students need help with
	U17	As a user I want to know if my help was good
	U18	As a user I want to explore questions other people have asked
Personal goals	U19	As a user I want to add personal goals
	U20	As a user I want to check off personal goals
	U21	As a user I want to have an overview over personal goals
Inspiration	U22	As a user I want to receive daily quotes for inspiration
Rewards	U23	As a user I want to get real rewards, such as snacks from the Online store, for good help and resource contributions
	U24	As a user I want to get random rewards
	U25	As a user I want to get rewards for study effort
	U26	As a user I want to explore the types of existing rewards

8.2   Prototype

Screen shots of the main functionality is shown in figures 8.1 - 8.9. The screen shots have red IDs on them, which indicates how the functionality is associated with the user requirements. A complete overview of all screen shots without disrupting IDs are found in appendix H. A description of the system is listed as follows:

- Figure 8.1 shows that the system lets the user add and check off personal goals, get an overview of overall study progress, get an overview of course progress, receive daily quotes, receive daily spins with random rewards and the opportunity to collect rewards, given for received likes on resource contributions.

- Figure 8.2 shows that the system lets the user get an overall overview of the course progress, which is similar to the one showed on the home page. The yellow dot indicates how far the student should have come, based on time left to the exam. Furthermore, the student can track time when studying, and each course has learning outcomes and several themes which can be practiced. The strength of a theme uses spaced repetition learning, and indicates how long it has been since the theme has been practiced. Ideally, all strengths should be green when the exam is near, meaning that all themes are fresh in the student's memory. The column of learning outcomes, next to strength, indicates which learning outcomes that are tagged in tests made by the students.

- Figures 8.3 and 8.4 shows the page of a theme in a course. Here, students can add tests as resource contributions, which are designed as flashcards, and practice tests made by other students. Figure 8.5 shows an example of such a flashcard. Using a hint will serve as seeing the back of the flashcard. Completing a test made by others will give virtual rewards, whereas giving the effort to make a test gives rewards of real value, see figure 8.6. Likes can be given for flashcard decks.

- Figure 8.7 shows a forum where students can ask and answer questions. Rewards are given for answers receiving likes.

- Figure 8.8 shows the store, with two types of currencies; one of virtual value and one of real value.

- Figure 8.9 shows a profile page with overall information.

To help understand the flow of the system and how the functionality works, a page flow chart and textual use cases were created. The page flow chart is shown in figure 8.10 and indicates how one can navigate through the screens. All main pages can be reached from the top menu, and themes and tests are reached from the page called Courses. Table 8.3 shows a use case for the user requirements U7, U8 and U9. The rest of the use cases are found in appendix I, and each overall function in the user requirements table has an associated use case.

The prototype was designed according to the Eight Golden Rules of Interface Design to ensure usability (Shneiderman et al., 2016). The Eight Golden Rules of Interface Design are described in table 8.4 and 8.5, together with an explanation of how the rules were followed in the prototype.
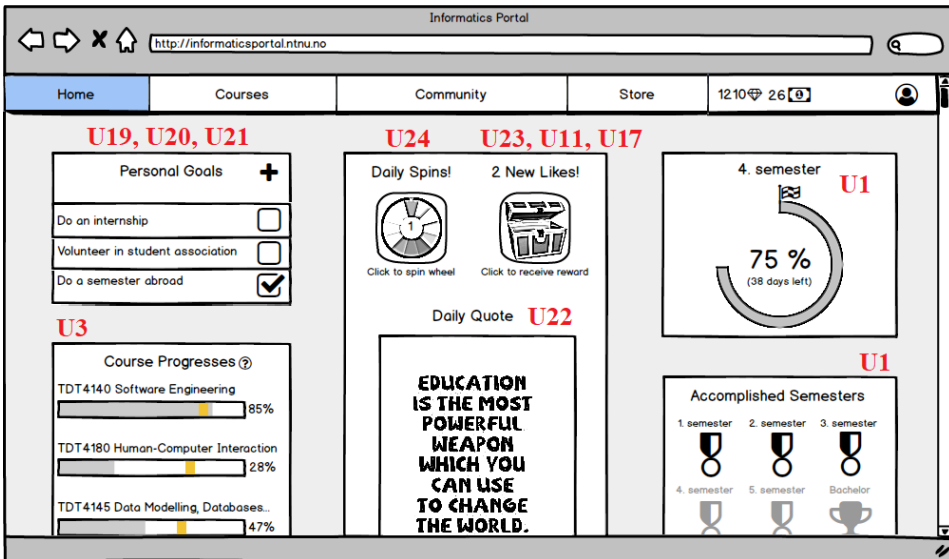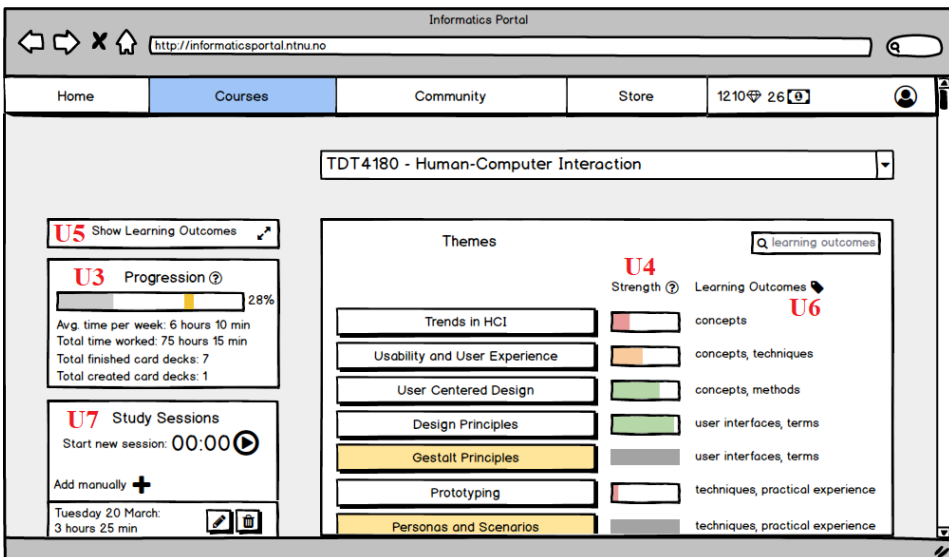

Figure 8.1: Home Page - Iteration 2
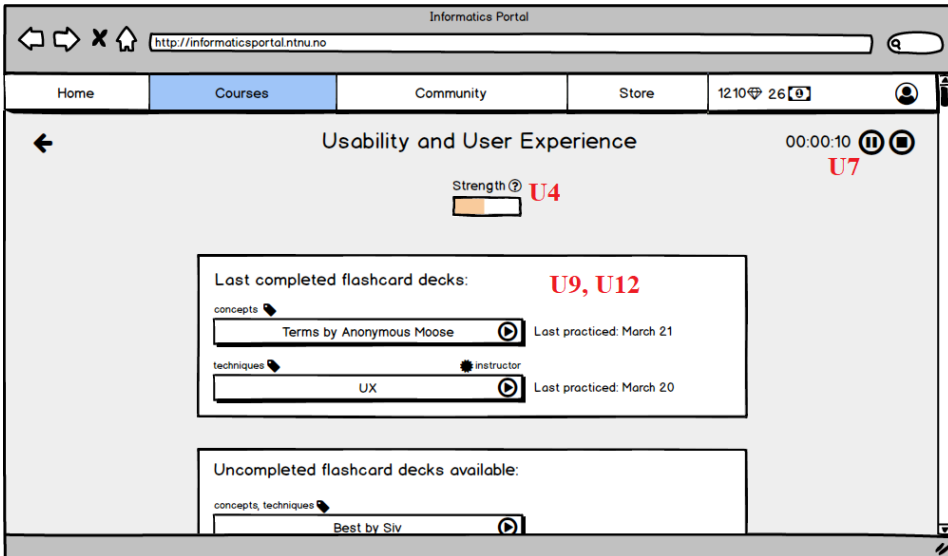

Figure 8.2: Course Page - Iteration 2

Figure 8.3: Theme Page - Iteration 2
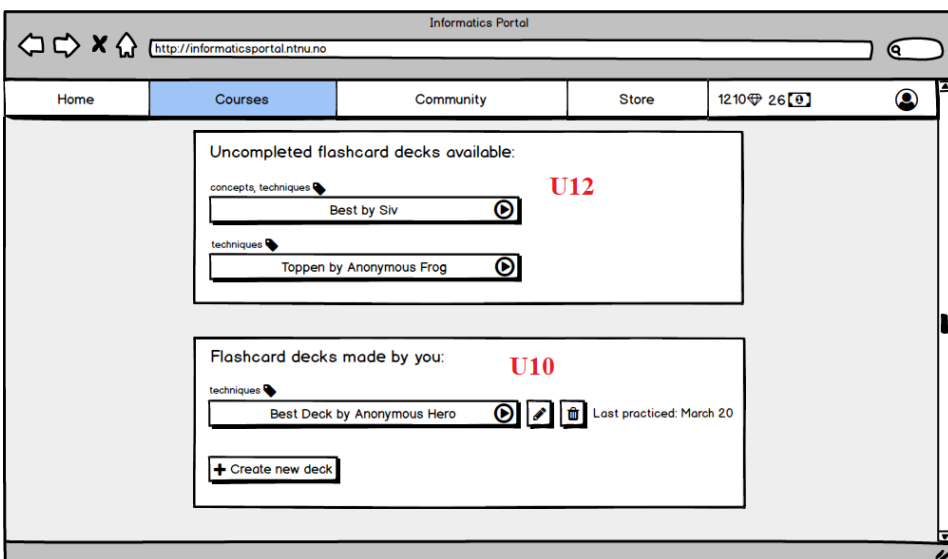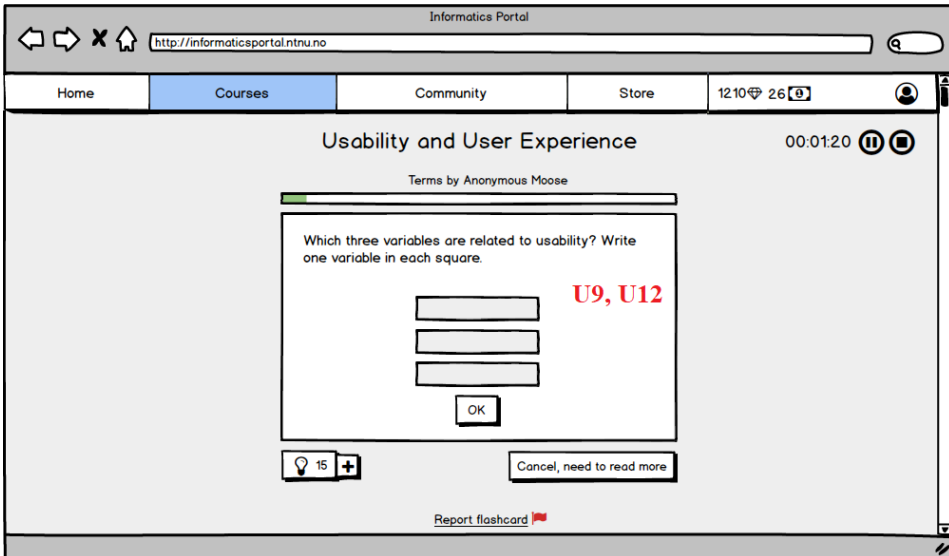

Figure 8.4: Theme Page Scrolled Down - Iteration 2

Figure 8.5: Flashcard - Iteration 2
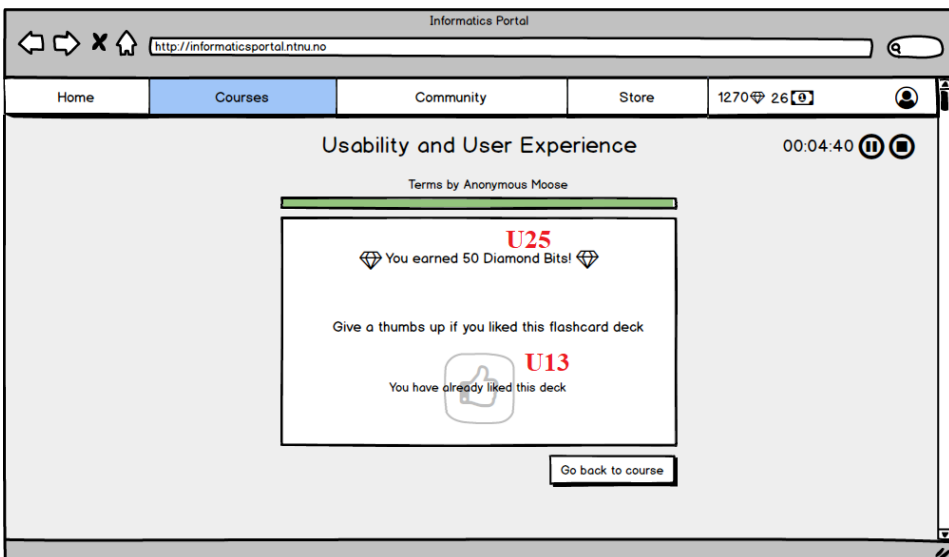
Figure 8.6: Flashcard Deck Completed - Iteration 2
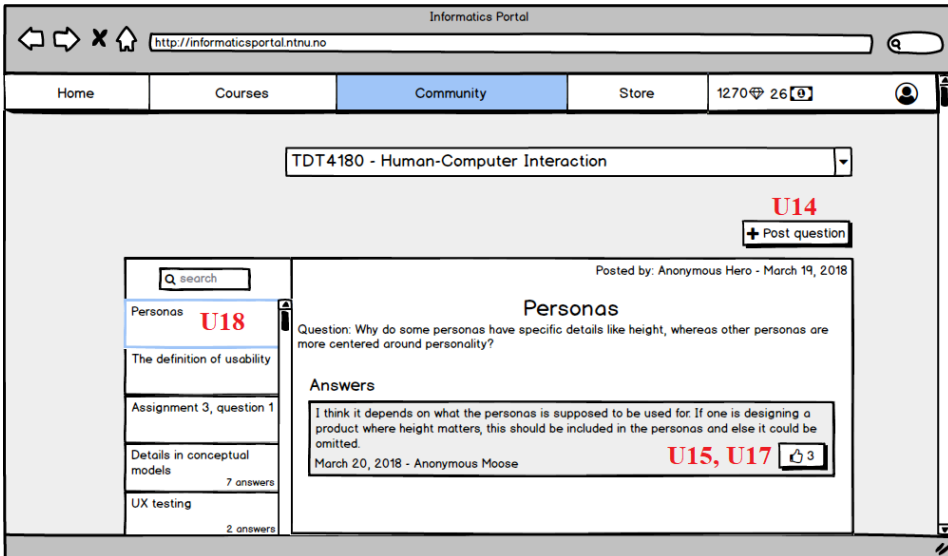
Figure 8.7: Community Page - Iteration 2
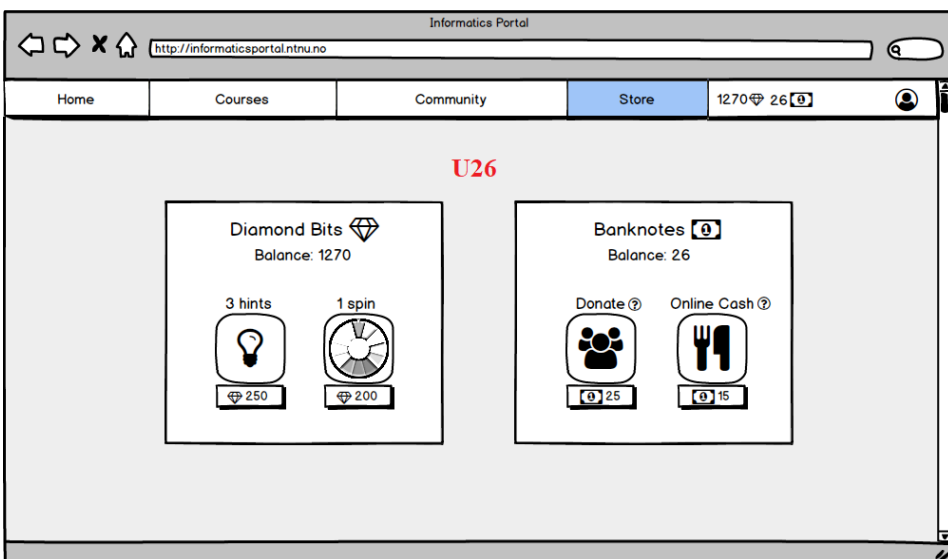
Figure 8.8: Store Page - Iteration 2
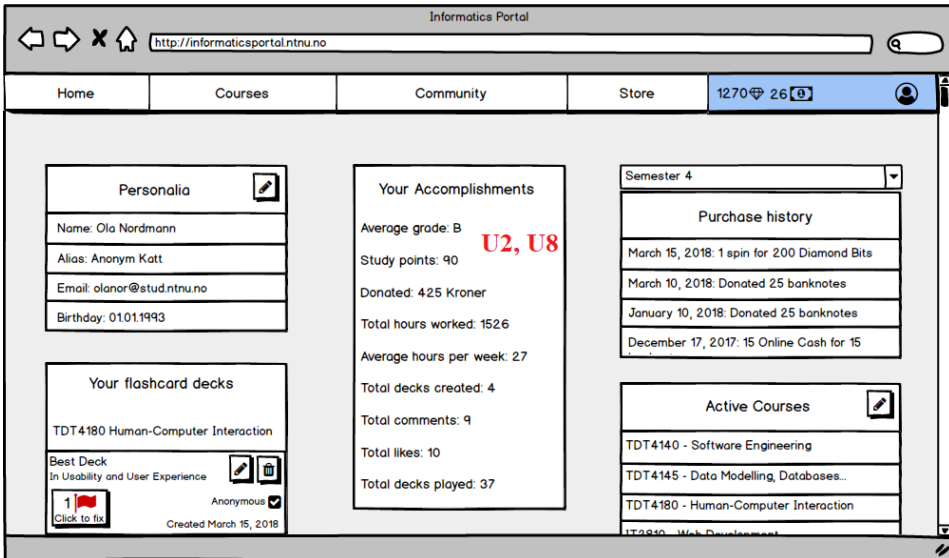
Figure 8.9: Profile Page - Iteration 2
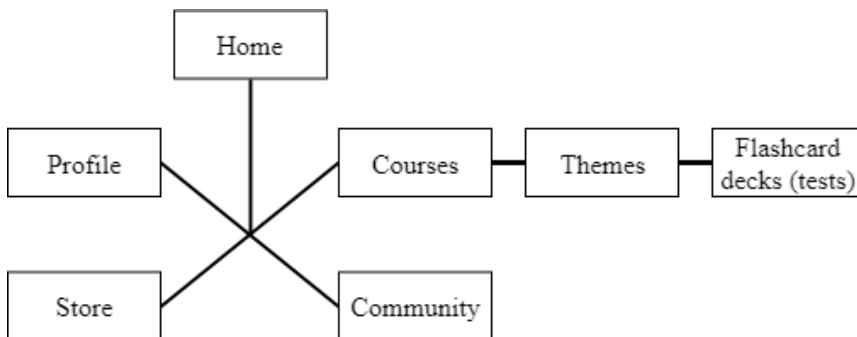
Figure 8.10: Page Flow

Table 8.3: Textual Use Case

ID	U7, U8, U9
Name	Track study session
Description	U7: As a user I want to track the time of my study sessions U8: As a user I want to know how many hours I have worked in total U9: As a user I want to know if a study session was effective by testing what I have learned
Primary Actor	Student
Preconditions	The student must have opened the program. Students or oneself must have added flashcards to practice.
Main Flow	1. Go to Courses. 2. Scroll on timer to see completed study sessions. 3. Start the timer. 4. Read a chapter from the curriculum. 5. Click on the associated theme. 6. Pick a flashcards deck to practice. 7. Complete the test. 8. Stop the timer. 9. Theme progress bar becomes green.
Alternative Flow	1. Go to Profile. 2. See the summarized total amount of hours worked.
Post Condition	Student has tracked working hours and have checked what has been learned during those hours. Manually add/edit study session if student forgot to start/stop the timer.

Table 8.4: Eight Golden Rules of Interface Design (Shneiderman et al., 2016)

Rule	Description	In Prototype
Strive for consistency	Keep a consistent flow of actions in similar situations. Use identical terminology and consistent colors, layout, fonts etc. throughout the system.	Types of information that are similar or suits together are consistently grouped in white boxes. Icons having the same functionality are consistent, such as the exit icon shown in appendix figure H.1b. The course pages and course progression bars all follow the same structure and layout. The colors used in the theme progress bars are consistent with the real world, red is negative whereas green is positive.
Seek universal usability	Keep usability for diverse users. There are expert differences, age ranges, disabilities, international variations and technological diversity.	Some elements are accompanied with a question mark which can be clicked on to get explanations for less experienced users. Shortcuts are implemented for experts, such as clicking on the course progress bar on the home page, figure 8.1. This shortcut will take the user directly to the course instead of using the top menu. Age and language is less important, as most Norwegian and international students know English and are of age 20-40. If the system was to be implemented, it must also apply to those who cannot see or have poor vision.
Offer informative feedback	Confirm the users actions through giving feedback on all user actions. Feedback can be from modest to substantial.	Feedback is implemented in all actions. Examples of modest feedback are the progression bars in figures 8.2 and 8.5. Examples of substantial feedback are the messages for spinning the wheel of fortune or collecting rewards, see appendix figures H.2a and H.2b.
Design dialogs to yield closure	A set of actions should contain an end. The user should be informed when a set of actions is finished to create satisfaction and a sense of relief.	A dialog yielding closure is typical substantial feedback, as seen in appendix figure H.2b. Another example is when a test is finished, see figure 8.6.

Table 8.5: Eight Golden Rules of Interface Design (Shneiderman et al., 2016), continued

Rule	Description	Prototype
Prevent errors	The system should not let the user create critical errors. If there, however, is an error occurring, guide the user to recover from the error.	To ensure validity in the crowd sourced system, users can report tests and leave the creator a comment. If a user gets more than three reports, the test will be removed from the list, see the red flag in appendix figure 8.9. The user then has the chance to fix this through the editing option on the tests or click on the red flag. Buttons which should not be clicked are disabled.
Permit easy reversal of actions	Actions should be reversible whenever possible to prevent anxiety among the users.	If the user starts or stops the timer accidentally, study sessions can be added, removed or edited manually. Personal goals can be unchecked. Tests can also be deleted or edited.
Keep users in control	Users should feel that they are in control of the user interface and that the interface responds to actions.	The system responds to all user actions. All decisions are up to the user, except the prizes for spinning the wheel of fortune.
Reduce short-term memory load	A person can only remember approximately seven chunks of information at the same time. The user interface should avoid the need to remember things from one display to another.	The user's balance is always shown on the top menu. When a test has started, the theme and name of the test is shown on top throughout the process, in case the users wonders which test was started. The number of hints left are also always shown throughout the test. When a test is finished and the user already gave the test a thumbs up, the user is reminded of this.

8.3 Evaluation

Table 8.6 shows the usability testing tasks. Each task is assigned an ID, which is used in the observation schema to identify the associated task. Results from the usability testing are shown in table 8.7. SUS results are shown in table 8.9 and results from the post usability testing questionnaire about the implemented gamification is shown in table 8.10. Figure 8.11 shows the system analyzed with the Octalysis framework.

Table 8.6: Usability Testing Tasks

ID	Description
T1	You want to go to the course page of TDT4180
T2	You are wondering how you are doing in the course TDT4180. Find it out.
T3	You are wondering what Strength means on the course page. Find it out.
T4	You are curious about the learning outcomes in TDT4180. Find them.
T5	You are unsure if you know the concepts as stated in the learning outcomes. You want to know which themes cover those concepts. Find it out.
T6	You want to practice a theme, but before you start, you want to track how much time you are going to use.
T7	You want to practice on Usability and User Experience. Find out what the theme has to offer.
T8	You have already finished a flashcard deck named Terms. However, you want to refresh your knowledge on that flashcard deck.
T9	You are now finished studying, and want to end your tracked session.
T10	You have a question about personas. You want to find out if someone else has asked anything interesting about personas in TDT4180.
T11	You really liked the answer that was given on the question about personas, and want to give it a like.
T12	You are wondering what you can buy for your money. Find it out.
T13	You are wondering how many hours you have worked in total with your studies. Find it out.
T14	Suddenly you got a volunteer position in the student association. Check it off as one of your goals.
T15	You still have a daily spin on the wheel of fortune left. Use it.
T16	You want to collect your reward for getting likes.

Table 8.7: Usability Testing Observation Schema - Iteration 2

Task	Problem	Cause
T2	Tried to scroll down before looking at strength. The progression bar was found on third attempt.	Did not understand what the different progression bars meant.
	Did not look at progression bar right away, but figured it out in the end.	Did not understand what the progression bar meant.
	Did see progression bar, but did not understand that it indicated how one is doing in a course. Tried to click on learning outcomes.	Did not understand the yellow dot, or what the progress bar meant.
T3	Did not understand unless the question mark was clicked.	Thought that it looked like how many flashcard decks that were completed.
	Could not find out what strength meant until two tasks later.	Did not see the header strength at once.
	Thought that strength indicated the strength of the learning outcome.	They are next to each other.
T4	Did not find the correct button. Pressed on the search field.	Thought that the search field looked like a button. The expand icon was not intuitive.
	Tried to click on the header learning outcomes with the tag.	Looked like it could be clicked, since strength could be clicked.
T5	Tried to click on the concepts tag.	Using the search field is usually done as a last solution when trying to find something. Tries to click on everything else first.
T6	Took some time to find the start button.	Did not see the start button.

Table 8.8: Usability Testing Observation Schema - Iteration 2, continued

Task	Problem	Cause
T7	Tried to click on add manually in the session square, but found the right button in the end.	Thought a session was specifically connected to a theme, and that clicking on a session started practicing a theme.
T8	Tried to click on the plus icon when using a hint.	Did not understand what else the plus sign could mean.
T10	Noticed that there was no possibility to add an answer.	As a fault from my side, this function was not implemented.
T12	Tried to click on the money at first, but then found the Store page. Not sure why there are banknotes and diamond bits.	Did not understand the difference between currencies.
T13	Clicks on Home first. Found it on second attempt in the Profile page.	Thought that homepage was some kind of dashboard with all kinds of information. The test person concluded with that "total" statistics were best suited on the Profile page after all.

Additional comments in the end:

"Would prefer that dropdown menus are preset to the most used course."

"This is nice, I work more focused when I know a timer is ticking."

"This was awesome, I really enjoyed using it."

"Cool to see total accomplishments, but it is not as motivating as the other functions."

"Strengths that are not started should be white, not gray."

Table 8.9: SUS Scores - Iteration 2, raw data found in appendix J

Test subject	A	B	C	D	E
Score	77.5	85	87.5	75	82.5

Table 8.10: Post Usability Testing Questionnaire - Iteration 2

How strongly do you agree or disagree with the following statements: (1 = strongly disagree, 5 = strongly agree)					
	\(Response distribution\)				
	1	**2**	**3**	**4**	**5**
I think this system would motivate me in the long term	0	0	1	2	2
I think this system would motivate me in the short term	0	0	0	3	2
I think that I would want to use this system over a period of three years (Bachelor's degree)	0	0	0	4	1
I think that I would use this system only for the rewards	2	2	0	1	0
I like the rewards I can buy with Diamond Bits	0	2	2	0	1
I like the rewards I can buy with Banknotes	0	2	0	2	1
I like the overview of my personal goals	0	0	0	2	3
I like the wheel of fortune	0	2	1	1	1
I like to give and/or receive likes for resource contribution	0	0	1	1	3
I think that I would use the timer to help track my time used on studying	1	0	0	2	2
I think that I would use the flashcards to track if I know what I am supposed to know	0	0	0	0	5
I think that I would use the community page to help and/or receive help from others	0	0	2	0	3
I find this system useful	0	0	0	2	3
I find this system fun	0	0	0	3	2

Informatics Portal Octalysis Score: 260

- Flashcards contribution
- Answer questions in community
- Power of giving likes
- Power of reporting flashcards
- Donate real money
- Personal goals

- Improve flashcard deck to
  receive likes
- Improve answers to receive
  likes
- Find new study strategies
  when failing flashcards
- Instant feedback
- Maximize the outcome of
  gained Diamond Bits

- Semester progress bar
- Medals for completed
  semesters
- Completing personal goals
- Receiving likes
- Course progress bars
- Statistical accomplishments

- Diamond Bits and
  Banknotes
- Traded rewards
- Personal goals
- Flashcard decks
- Posted questions
  and answers
- Collected medals
  for semesters
- Alias name
- Tracked study
  sessions

- Get responses on
  questions
- Answer questions
- Bragging (remove
  anonymous when
  receiving many
  likes)
- Giving likes
- Receiving likes
- Reporting
  flashcards
- Crowdsourced
  resources

Meaning

Accomplishment   Empowerment

Ownership   Informatics port: Social
Influence

Scarcity   Unpredictability

Avoidance

- Torture break on wheel
  of fortune
- Chase or get chased by
  the yellow dot on the
  course progress bar
- Saving enough
  Banknotes and Diamond
  Bits to buy rewards

- Getting reports
- Getting no upvotes
- Lose strength on gained knowledge
- Be behind yellow dot on the course
  progress bars
- Unaccomplished personal goals

- Daily quotes
- Wheel of fortune
- User generated content
- Occurence of likes

Figure 8.11: Informatics Portal Analyzed with Octalysis

8.4 Discussion

The system is mainly based on Øvingsportalen from the workshop. Some elements are modified and some elements are taken from the other solutions. Examples of these are the daily quotes from HabitBull, the spinning wheel from Motivatica, spaced repetition learning from DuoLingo and removing previous exam tasks linked to assignments. The latter was because it would cause a huge amount of work linking each exam task relevant for an assignment. Figure 8.11 shows that there is a balance between the cores of the system. The right and left brain division is just a guideline for how the cores often affect motivation. There are several elements on the extrinsic brain side enhancing intrinsic motivation as well. Examples are creating personal goals, completing personal goals and posting questions and answers. So in addition to a balance between the cores, there is a majority of intrinsically motivating game design elements.

When dividing answers of the post usability test questionnaire into negative (1-2), neutral (3) and positive (4-5), all test subjects thought that the system would motivate them in the short term, and they found the system useful and fun. Four out of five, one neutral, thought that the system would motivate them in the long term as well. All answered that they would use the system over a period of three years. It seems that personal goals and the use of flashcard decks to test themselves were the functions best liked by the test subjects. These are promising results considering the main aim of the system, which is to motivate students to a greater study effort over a period of three years. One test subject was negative towards the timer. To best test efficiency, the flashcards should be used after a study session of reading. However, some might use the flashcards alone for practicing by trying, failing and trying again. There is no harm in using the system differently than intended, as long as the student is learning.

Luckily, four out of five test subjects would not only use the system for the rewards. This supports that the system would be used in the long term, as it is not only extrinsically motivating. There were, however, mixed opinions whether they liked the rewards or not. If none liked the rewards, it could be assumed they did not want to use the system for the rewards at all, and then there would be no point in having the rewards. Three out of five were positive towards the real rewards, and one positive and two neutral for the virtual rewards. With these numbers, it would be useful to get opinions from more test subjects before deciding on whether the rewards are successful or not. The same applies to the wheel of fortune, which also had results too mixed to make final assumptions.

Another type of outcome the test subjects seemed to enjoy, was to receive likes. This may have three explanations. The first, which is already discussed, is the rewards they receive for getting likes. A second explanation may be that they like feedback on what they produce. There is also a chance to give constructive feedback by leaving a comment when reporting a test. The last explanation may be that they just like to be recognized. Either way, the system facilitates for all these motives.

Three out of five would want to use the community page for help, whereas the last two

were neutral. It can be assumed that the existence of the community page at least is not bothering, and that it is helpful for those who want to make use of it. There already exists forums where students can discuss and/or add questions. The need to use several forums can be irritating for the students, and the community page might need to expand in the long term, offering a distinction between discussions, questions and sharing tips.

When a system gets a SUS score above 80.3, the person is likely to recommend the system to a friend (Sauro, 2011). Two of the SUS scores were below 80.3, meaning that there is a potential of improvement on the usability of the system.

In T2, test subjects did not quite understand the progression bar of a course, see table 8.7. The progression bar could be made more prominent, and an all-time visible explanation instead of the question mark might be a better solution. The explanation should also include the yellow dot, gray line and that the progression bar is linked to the specific course.

In T3, strength was also very unclear. Changing the word strength to memory strength may be more intuitive. Like the progression bar, the strength header also needs to be more prominent and outstanding so it is easier to see right away. The separation between strength and learning outcome tags should become more clear, maybe by increasing the space between them.

T4 was confusing because the search field held the text learning outcomes. This text should be changed to search instead of learning outcomes. Also, the expandable function was difficult to understand, and showing the learning outcomes all the time may be better even though it takes up more space. It is a desktop version and scrolling is a low cost to accept for the users to find the learning outcomes. The learning outcomes header above the tags should also change text to Tagged Learning Outcomes. In social media, many tags use the hash tag, which may be more recognizable and consistent to use than an icon of an actual tag. It should also be possible to click on tags which leads to a predefined search field, as several users tried to click on them.

In T6 and T7, not everyone did find the start button to track the study session. This icon can be made bigger and placed more visible. It was also confusing that the timer was only a timer and not the start button for a test, and that the timer was general for all courses and ticking even though a course was switched. To make this more understandable it may be better to move the tracked sessions to the home page and only show that the time is ticking on the course pages.

In T8, not everyone understood that the plus icon next to the hints was to buy more hints. The icon is not really necessary before one runs out of hints, and therefore the icon can be removed and only show when hints are empty. On the community page, there was a mistake made as there was no button to add an answer, which should be added.

In T12, several tried to click on the money before they did see the store tab. The space between the store and money should be larger and also separate the money from the profile tab somehow. Not many understood the difference between the virtual currency and the

currency which had physical value. The name banknotes should be changed. At last, the Home page should change names to Dashboard which is more intuitive considering the functionality.

To summarize, the functionality does not need many changes, and at least not before getting more opinions on the wheel of fortune and rewards. The overall usability could be improved according to the discussed problems above.

9 | Iteration 3

As discussed in chapter 8.4, there was little need for changes in the functionality. Therefore, iteration 3 mainly consisted of changing the design as discussed. Changes are presented in the following section. Furthermore, this chapter includes a second round of evaluation and concludes with a discussion of the findings.

9.1 Redefined Prototype

Changes are marked with red circles in screen shots and described in the list below. Screen shots with all changes without disrupting circles are found in appendix K.

- Figure 9.1, circle 1 shows that "Home" was changed to "Dashboard". In addition, the figure shows that the list of study sessions was moved to the dashboard, see circle 2.

- Figure 9.2 shows that the course page had most changes. For students to understand strength, the name was changed to "Memory Strength", see circle 2. Circle 1 shows an added text explaining the main point of the page.

  Circle 3 shows the search field text being changed to "search for tags".

  In circle 4, the header was changed to "Tagged Learning Outcomes" instead of just "Learning outcomes". Circle 5 shows that the tag icon was replaced with a hash tag. The change to hash tag increases the consistency because hash tags are often used for the same purpose in other platforms.

  Circle 6 shows that one can still start the timer from a course page even though the list of study sessions was moved to the dashboard. This keeps the user in control and reduces the short-time memory load according to the Eight Golden Rules of Interface Design in table 8.5.

  Circle 7 shows that the progress bar on the overall course had many changes. The question mark was removed and explanations were added in an all-time view instead.

Learning outcomes in circle 8, were also changed to always being visible.

- Figure 9.3 shows that the plus icon next to hints has been removed.

- Figure 9.4 shows that a button was added to make it possible to answer questions.

- Figure 9.5 shows a change in the currencies. To make it more understandable that the currency had physical or real-life value, the name was changed to "NOK", see circle 1.

  In addition, instead of having a predefined amount of money, the students could now decide the amount they wanted to spend on charity or in the Online store, see circle 2.

  "Online Cash" was also changed to "Transform to Online Balance", see circle 3, to make sure the student understood that it is transfered into values on the student card which can be used in the Online store.

- Figure 9.6 shows that the name "Your Accomplishments" was changed to "Total Statistics".

  Circle 2 shows that the profile tab was changed to highlight only the icon and not the whole tab. This was to separate the profile and money balance.
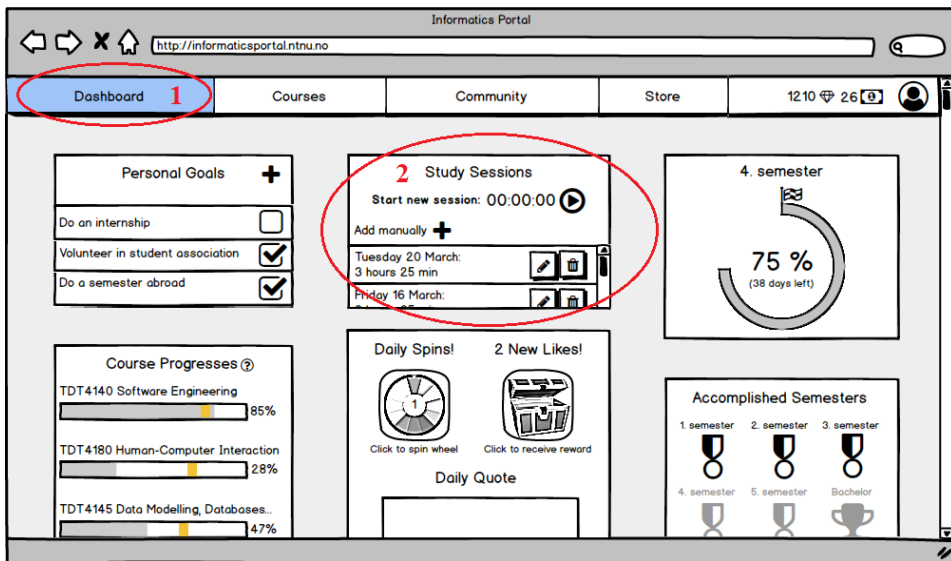
Figure 9.1: Dashboard Page - Iteration 3
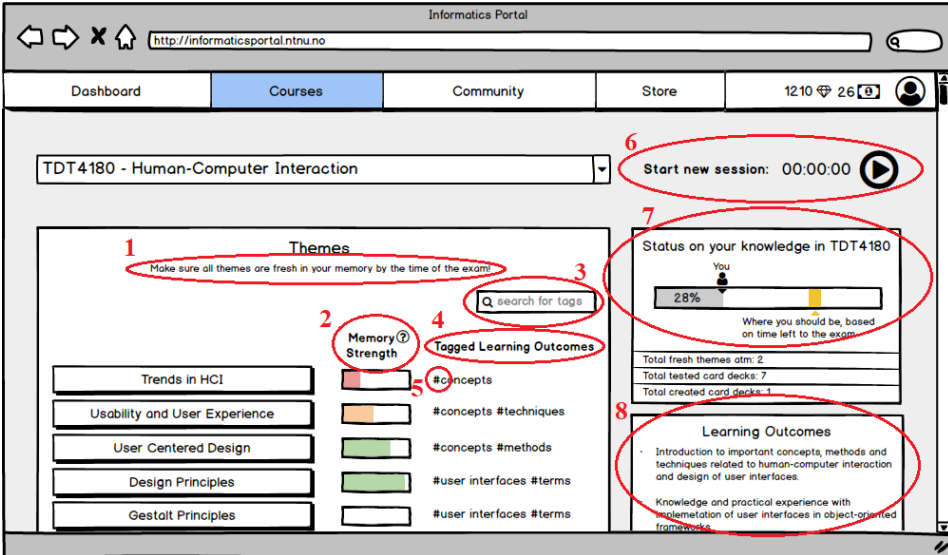
Figure 9.2: Courses Page - Iteration 3
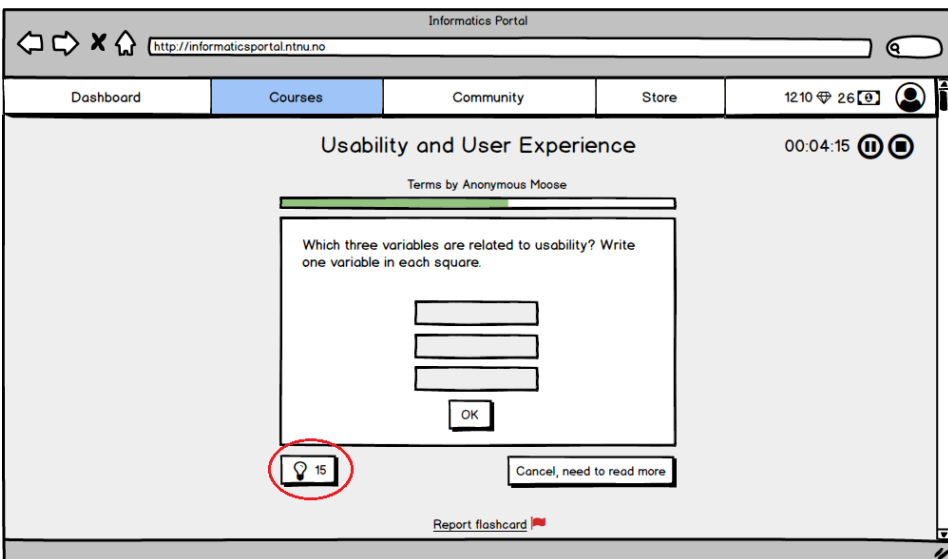
Figure 9.3: Flashcard - Iteration 3
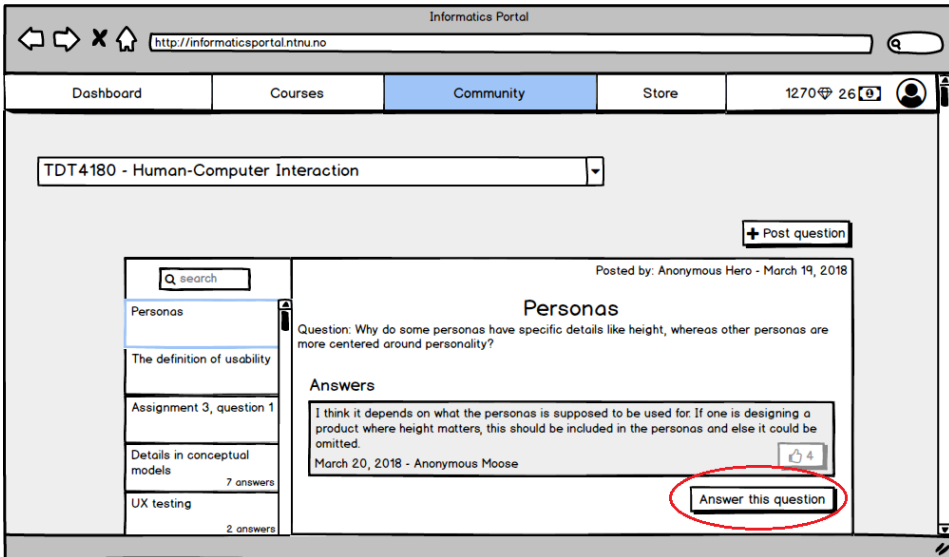
Figure 9.4: Community Page - Iteration 3
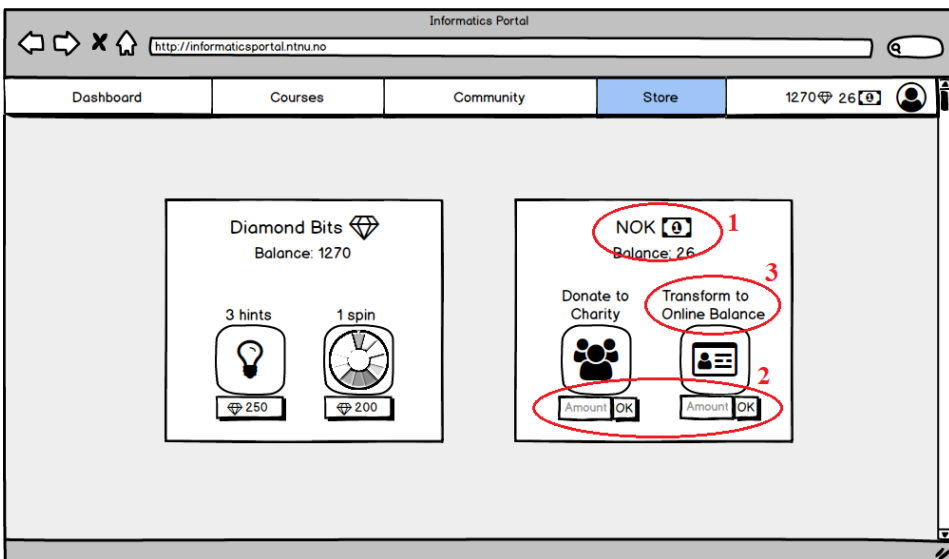
Figure 9.5: Store Page - Iteration 3
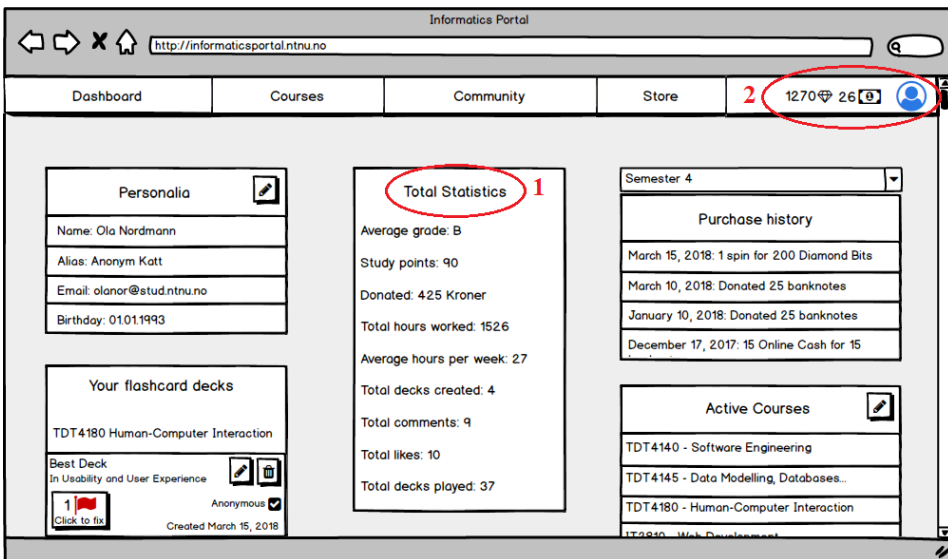
Figure 9.6: Profile Page - Iteration 3

9.2 Evaluation

Usability testing tasks in this iteration were identical to the tasks used in the previous iteration, see table 8.6. SUS results are shown in table 9.1. Results from the usability testing are shown in table 9.2 and results from the post usability testing questionnaire about gamification is shown in table 9.3.

Table 9.1: SUS Scores - Iteration 3, raw data found in appendix L

Test subject	A	B	C	D	E
Score	95	95	70	87.5	95

Table 9.2: Usability Testing Observation Schema - Iteration 3

Task	Problem	Cause
T8	Found hints, but did not understand what the number 15 meant.	No description of the number 15.
T10	Looked at course page first.	Since the question was to find something related to a specified course, it was natural to look at the course page.
T12	Did not understand NOK and "Transform to Online balance".	Looked like real money. Did not know what Online balance was.
T14	Looked at dashboard first, then profile.	More intuitive to have accomplishments on dashboard.
T15	Found the wheel of fortune, but missed an OK button.	Would expect an OK button to confirm and make the window disappear.
T16	Found button on the fifth attempt.	Did not see the button at first on the dashboard, so all other tabs were tried out.

Additional comments in the end:

"It would be cool to save up for something to buy in common, such as a new Nintendo game for the Online office."

"I would like to customize the dashboard to only show what I find interesting."

Table 9.3: Post Usability Testing Questionnaire - Iteration 3

How strongly do you agree or disagree with the following statements: (1 = strongly disagree, 5 = strongly agree)	(Response distribution)				
	1	**2**	**3**	**4**	**5**
I think this system would motivate me in the long term	0	0	0	5	0
I think this system would motivate me in the short term	0	0	0	3	2
I think that I would want to use this system over a period of three years (Bachelor's degree)	0	1	0	2	2
I think that I would use this system only for the rewards	0	3	2	0	0
I like the rewards I can buy with Diamond Bits	1	0	2	2	0
I like the rewards I can buy with NOK	0	1	0	0	4
I like the overview of my personal goals	0	0	1	3	1
I like the wheel of fortune	0	2	0	3	0
I like to give and/or receive likes for resource contribution	0	0	0	2	3
I think that I would use the timer to help track my time used on studying	1	0	0	0	4
I think that I would use the flashcards to track if I know what I am supposed to know	0	0	1	1	3
I think that I would use the community page to help and/or receive help from others	0	0	0	4	1
I find this system useful	0	0	0	2	3
I find this system fun	0	0	0	4	1

9.3   Discussion

A central issue revealed in iteration 2 were the mixed opinions about the rewards and wheel of fortune. In this iteration, there was a greater number of positive opinions of the real and virtual rewards, and the wheel of fortune. All together, the virtual rewards had the lowest score with a rate of 50% positive opinions. The rewards chosen for this system are not final. Further investigations on the type of rewards students may like would be needed. One test subject mentioned after the test that it would be cool to work for a price together, such as a new game for the Nintendo at the Online office. If the rewards were reconsidered, positive opinions towards the wheel of fortune may increase as well. Rewards of real values are, however, dependent on sponsors. This means that the rewards are likely to change during the life cycle of a bachelor's degree, as sponsors may change their mind.

Like the previous iteration, test subjects were positive towards the main focus of the system, which is tracking efficiency through crowd sourced tests. In addition to that, the community page, giving each other credibility and personal goals also had overall good scores. Like iteration 2, one test subject did not want to use the timer. Nevertheless, the timer is not critical for the system to work or use the other main functionality as intended. Therefore, as long as the majority wishes to use the timer it should remain included.

As for motivation, results in this iteration were similar to those of the previous round. All respondents thought that the system would motivate them in the long term which is one more than the previous round. One did not want to use it over a period of three years, which is one less than the previous round. Summarized, the statistics show that nine out of ten would want to use the system over a period of three years and nine out of ten thought they would be motivated in the long term. It is worth noting the lack of reliability in these statistics due to the small sample size. They only give a provisional idea of what the students think of the system. There may also be a lack of validity because of close interactions between the test subject and researcher during usability testing. Test subjects may be polite when answering the post usability testing questionnaire, especially when they know the researcher made the system. Nevertheless, it was mentioned several times that they had to report their exact feelings about the system without being afraid of disappointing the researcher and that responses were shuffled to keep anonymity.

Based on these findings and apart from the discussed reliability and validity, the prototype in this thesis would make a good skeleton for how gamification may be implemented in Informatics at NTNU with an aim of motivating a greater study effort in the long term.

The SUS scores were better in this iteration compared to the previous iteration, which means the usability has increased. Only one score was below 80.3. The usability tests showed less problems, see table 9.2. A reason for this might be that the same tasks were handed out. In the previous iteration, the majority of tasks had usability problems. Therefore, the same tasks were handed out to ensure that the usability problems were solved or improved. The remaining tasks without problems were needed to make an intuitive and

realistic flow through the system. If there was more iterations, new tasks should have been handed out to detect more problems.

One of the usability problems continuing to exist was related to hints in the flashcards, task T8. The plus icon was removed, but there was still an unclarity of what the number meant. A solution to this problem would be to write "Hints left:" before the number as an explanation.

In T10, there was a problem finding the community page from the course page. The wording of the task might have caused this occurring problem because the test subject was asked to find a question to a specific course, when the previous task ended in the course page. Therefore, the test subject started looking around in the course page before finding the community tab. Afterwards, the test subject was asked about this problem but expressed that the tab was intuitive. It was also stated it would be best to preset the course in the community page, to the course one came from in the course page.

In T12, the users were still confused about the currencies and what Online balance meant. "NOK" was perhaps not the right word to use for currency of physical value. In addition, one can question ethical issues with the use of "NOK", as it is not actual money. A new solution to solve this problem might be having traditional points to be traded into virtual rewards, and that Diamond Bits is the currency for physical rewards.

An additional ethical problem came to my awareness, with using virtual currencies to spin the wheel of fortune, and then win prizes with physical values. This is close to gambling, and if it would be possible to buy spins with the currency of real value it would definitely be gambling. Recently, countries have started to make this type of behavior in games illegal (Locklear, 2018). Ethical issues with this implementation must be further investigated before making it final. A solution would be to replace the rewards this applies to in the wheel of fortune. However, this is again partly dependent on available sponsors.

"Your Accomplishments" was already changed in this iteration to "Total Statistics". Yet, in T14, a test subject pointed out that it was confusing that some accomplishments were shown in the profile page and some on the dashboard. Therefore, it would be better to move all accomplishments to the dashboard, even though this would take up more space on the dashboard. Post testing, a student expressed that it would be nice to make the dashboard customized so that only elements of interest were displayed.

In T16, the ability to find the wheel of fortune and rewards decreased when they were moved below the list of study sessions on the dashboard. Other parts with less frequently actions, such as the progress bar of the overall study, should be considered to be moved further down, and bring the wheel of fortune and rewards back on top. Lastly, in T15, a test subject pointed out that it would be more intuitive to have an "OK" button when the wheel of fortune had been spun. This would be an easy fix with high value considering informative feedback as described in the Eight Golden Rules of Interface Design, table 8.4.

10 | Conclusion

The aim of this thesis was to contribute with knowledge on how gamification facilitates motivation. In addition, the aim was to design and evaluate a prototype using gamification, for motivating a greater study effort in the long term on the degree program Bachelor of Science in Informatics at NTNU. This chapter presents the conclusion of this master thesis and consists of answering the research questions, stating limitations and giving suggestions for further work.

10.1 Answering the Research Questions

RQ1: How does gamification facilitate motivation?

To answer RQ1, this thesis conducted a literature review on what gamification is, types of motivation, and how gamification relates to the types of motivation. Gamification was defined as the use of game design elements in non-game contexts. The literature review found ten characteristics of games used to describe the game design elements in the definition of gamification. Furthermore, motivation was divided into extrinsic and intrinsic motivation described by the Self-Determination Theory. The theory was used to identify extrinsic and intrinsic motivations in game design elements. In addition to this, a taxonomy of intrinsic motivations for learning was studied for gaining a greater perspective.

A possible conclusion to RQ1 was discussed in chapter 5. The greater the facilitation is for the psychological needs of relatedness, competence and autonomy in the game design elements, the more it will be perceived as intrinsically motivating. Optimal challenges, adapted goals, curiosity as part of exploration, emotionally appealing fantasy and instant positive performance feedback during interaction seems to be key success elements to enhance the psychological needs. These are the gamification elements facilitating intrinsic motivation. Outcomes were found to motivate a greater performance, but enhance extrinsic motivation. The game design element competition was difficult to place, as the SDT and taxonomy of intrinsic motivations for learning contradicted each other. User investigations aiming to answer RQ2, revealed that there was a majority of negative attitudes towards

the use of competition, and students thought that it would increase pressure, and hence extrinsic motivation.

RQ2: Which user requirements should be included in a system using gamification, designed to motivate a greater study effort at Informatics?

In regards of increasing study effort, user investigations in chapter 7 revealed that students found measuring their efficiency of time spent on studying, most useful. Second place consisted of gaining an overview of time spent and spending time helping others. In a system designed to motivate a greater study effort, these are the three aspects needing a focus in the user requirements. Furthermore, challenges, clear goals and performance feedback were expressed as the most necessary game design elements. In addition, the questionnaire and workshop revealed that rewards, especially of real value, seemed to be of great interest and wanted by a significant amount of students. The user requirements listed in chapter 8.1 derived from these four game design elements incorporated in the three aspects of study effort, and should be included in a system using gamification to motivate a greater study effort at Informatics.

RQ3: What should a system implementing the user requirements in RQ2 look like?

A low-fidelity prototype implementing the user requirements, stated in RQ2, was developed and presented in chapter 8. The prototype was evaluated and then redefined, presented and evaluated a second time in chapter 9. Results showed that nine out of ten thought the system would motivate them in the long term and that nine out of ten thought they would want to use the system over a period of three years. SUS scores revealed that four out of five were likely to recommend the system to a friend. Minor usability issues discussed in chapter 9.3 should be improved, but apart from these issues, the presented prototype makes a good skeleton for what a system implementing the user requirements in RQ2 should look like.

10.2   Limitations

This thesis' objective was quite ambitious, but had to be scaled down to what could be realized within one study year by one master candidate. This resulted in a prototype being developed instead of an implemented system. The prototype portrays an extensive system and only top layer mockups were included, and not mockups of the functionality in depth, such as all steps of creating a new test or different variations of how tests may take form. This is reflected in the high-level defined user requirements and also limited the usability testing to be horizontal.

Due to the time limit, and needing enough time to develop a prototype, some priorities had to be made. Further analysis of potential contradictions between competition and

motivation, indicated by the literature review, was not prioritized. In addition, gathering data for personas presented in chapter 7.1.1 was also not prioritized and limited to being based on personal experiences.

In order to keep a fair length to the questionnaire in respect to respondents, not all game design elements were included in the described systems. Focus was directed at goals, interaction, outcomes, challenges, people and competition whereas fantasy, exploration, safety and rules were excluded. This was also partly due to three of the elements' level of abstractness, see table 3.4. Examples were difficult to come up with when not having a clear context. The exception was rules, which are concrete but not necessary before having a set context. In retrospect, I should have included exploration and fantasy to get a complete picture of the students' opinions of game design elements. Another mistake which came to my awareness afterwards was the exclusion of asking about the daily quotes in the post usability testing questionnaire. This limited the conclusion on whether daily quotes were successful or not.

10.3 Future Work

This thesis consisted of two parts, where the first part studied literature and the second part consisted of designing a system. Both parts can be continued with. This section presents my suggestions for further work.

10.3.1 Extended Literature Review

Concerning the first part of this thesis, a suggestion for future work would be an extended literature review. This is because the studied literature contradicted each other on whether competition facilitates intrinsic or extrinsic motivation. Competition is a game design element widely used in many contexts, and it would be useful with a deeper insight into how it relates to motivation. For example, does there exist any studies of competition being culture dependent, where in some groups competition naturally is more adapted to the human-self than in other groups?

10.3.2 Further Development and Implementation of Prototype

Further development of the prototype will be a natural continuation to work with. This includes making step by step mockups for all functionality and test them vertically, which means letting the user traverse through all layers of a function (Rubin and Chisnell, 2008). In addition to this, there were some minor usability issues in the last evaluation, discussed in chapter 9.3, which could be improved.

There is also a need for an extended research on which rewards to include in the system.

Further investigations with the user and exploring possibilities with sponsors would give a better overview of which rewards could be successful.

At some point, a finale of improving the prototype must be set. Furthermore, it would be natural to start implementation. Since it is an extensive system, a development team might be needed for making the system a reality.

10.3.3   Manage, Monitor and Measure

The last step of the player centered design process is manage, monitor and measure. This means managing the system due to user expectations, monitoring its impact on motivation and measuring the effects of implemented game design elements. For instance, observing users of the system over a few months could give pointers on how the system affects engagement among students. Interviews could give detailed information of what the students think of the game design elements and how they expect the system to evolve. Eventually, it would be ideal to monitor how the product motivates study effort on a class of students over three years.

Bibliography

Albert, William and Thomas Tullis (2013). *Measuring the user experience: collecting, analyzing, and presenting usability metrics*. Newnes.

Bartle, Richard A. (1996). *balsamiq*. URL: http://mud.co.uk/richard/hcds.htm (visited on 05/15/2018).

Brooke, John et al. (1996). "SUS-A quick and dirty usability scale". In: *Usability evaluation in industry* 189.194, pp. 4–7.

Chou, Yu-kai (n.d.). *Octalysis Tool*. URL: http://yukaichou.com/octalysis-tool/ (visited on 04/12/2018).

Chou, Yu-kai (2015). *Octalysis – complete Gamification framework*. URL: http://yukaichou.com/gamification- examples/octalysis- complete- gamification- framework/ (visited on 01/31/2018).

Christenson, Sandra L, Amy L Reschly and Cathy Wylie (2012). *Handbook of research on student engagement*. Springer Science & Business Media.

Crow, Fake (2018). *Xtensio*. URL: https://xtensio.com (visited on 01/20/2018).

Deci, Edward L and Richard M Ryan (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press.

Deci, Edward L and Richard M Ryan (2002). *Handbook of self-determination research*. University Rochester Press.

Deci, Edward L and Richard M Ryan (2008). "Self-determination theory: A macrotheory of human motivation, development, and health." In: *Canadian psychology/Psychologie canadienne* 49.3, p. 182.

Denny, Paul (2013). "The effect of virtual achievements on student engagement". In: *Proceedings of the SIGCHI conference on human factors in computing systems*. ACM, pp. 763–772.

Deterding, Sebastian, Dan Dixon, et al. (2011). "From game design elements to gamefulness: defining gamification". In: *Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments*. ACM, pp. 9–15.

Deterding, Sebastian, Miguel Sicart, et al. (2011). "Gamification. using game-design elements in non-gaming contexts". In: *CHI'11 extended abstracts on human factors in computing systems*. ACM, pp. 2425–2428.

Dicheva, Darina et al. (2015). "Gamification in education: a systematic mapping study". In: *Journal of Educational Technology & Society* 18.3, p. 75.

DuoLingo (2018). *DuoLingo*. URL: https://www.duolingo.com/ (visited on 05/13/2018).

Egenfeldt-Nielsen, Simon, Jonas Heide Smith and Susana Pajares Tosca (2015). *Understanding video games: The essential introduction*. Routledge.

Google (2018a). *Google Forms*. URL: https://docs.google.com/forms (visited on 05/08/2018).

Google (2018b). *Google Play*. URL: https://play.google.com/store (visited on 01/08/2018).

GV (2016). *The Design Sprint*. URL: http://www.gv.com/sprint/ (visited on 04/10/2018).

HabitBull (2014). *HabitBull*. URL: http://www.habitbull.com/ (visited on 05/13/2018).

Hold (2018). *Hold*. URL: https://www.holdstudent.com/ (visited on 05/13/2018).

Huotari, Kai and Juho Hamari (2012). "Defining gamification: a service marketing perspective". In: *Proceeding of the 16th International Academic MindTrek Conference*. ACM, pp. 17–22.

Kahoot! (2018). *What is Kahoot!?* URL: https://kahoot.com/what-is-kahoot/ (visited on 01/08/2018).

Kitchenham, Barbara (2004). "Procedures for performing systematic reviews". In: *Keele, UK, Keele University* 33.2004, pp. 1–26.

Krejcie, Robert V and Daryle W Morgan (1970). "Determining sample size for research activities". In: *Educational and psychological measurement* 30.3, pp. 607–610.

Kumar, Janaki Mythily and Mario Herger (2013). *Gamification at Work: Designing Engaging Business Software*. The Interaction Design Foundation.

Landers, Richard N et al. (2015). "Psychological theory and the gamification of learning". In: *Gamification in education and business*. Springer, pp. 165–186.

Locklear, Mallory (2018). *Loot crates are now illegal in Belgium*. URL: https://www.engadget.com/2018/04/25/loot-crates-illegal-in-belgium/ (visited on 05/22/2018).

Looyestyn, Jemma et al. (2017). "Does gamification increase engagement with online programs? A systematic review". In: *PloS one* 12.3, e0173403.

Malone, Thomas W (1981). "Heuristics for designing enjoyable user interfaces: Lessons from computer games". In: *Proceedings of the 1982 conference on Human factors in computing systems*. ACM, pp. 63–68.

Malone, Thomas W and Mark Lepper (1987). "Making learning fun: A taxonomy of intrinsic motivations for learning". In: 3, pp. 223–253.

Newman, Mark W and James A Landay (2000). "Sitemaps, storyboards, and specifications: a sketch of Web site design practice". In: *Proceedings of the 3rd conference on Designing interactive systems: processes, practices, methods, and techniques*. ACM, pp. 263–274.

Nielsen, Jakob and Thomas K Landauer (1993). "A mathematical model of the finding of usability problems". In: *Proceedings of the INTERACT'93 and CHI'93 conference on Human factors in computing systems*. ACM, pp. 206–213.

NOKUT (2017). *Informatics*. URL: http://studiebarometeret.no/en/student/tidsserie/1150_BIT (visited on 01/10/2018).

Norman, Geoff (2010). "Likert scales, levels of measurement and the "laws" of statistics". In: *Advances in health sciences education* 15.5, pp. 625–632.

NSD (2017). *Norwegian Centre for Research Data*. URL: http://www.nsd.uib.no/nsd/english/index.html (visited on 12/07/2018).

NTNU (2018a). *Informatikk*. URL: https://www.ntnu.no/studier/bit (visited on 01/10/2018).

NTNU (2018b). *Informatikk*. URL: https://www.ntnu.no/studier/bit/utenlands (visited on 01/10/2018).

NTNU (2018c). *Informatikk*. URL: https://www.ntnu.no/studier/bit/laringsmal (visited on 01/10/2018).

NTNU (2018d). *Informatikk - Søk opptak*. URL: https://www.ntnu.no/studier/mit/opptak (visited on 05/25/2018).

Oates, Briony J (2005). *Researching information systems and computing*. Sage.

Orland, Kyle (2017). *Study: Pokémon Go led to increase in traffic deaths, accidents*. URL: https://arstechnica.com/gaming/2017/11/study-pokemon-go-led-to-increase-in-traffic-deaths-accidents/ (visited on 05/26/2018).

Pruitt, John and Tamara Adlin (2010). *The persona lifecycle: keeping people in mind throughout product design*. Elsevier.

Rogers, Yvonne, Helen Sharp and Jenny Preece (2011). *Interaction design: beyond human-computer interaction*. John Wiley & Sons.

Rubin, Jeffrey and Dana Chisnell (2008). *Handbook of usability testing: howto plan, design, and conduct effective tests*. John Wiley & Sons.

Ryan, Richard M and Edward L Deci (2000a). "Intrinsic and extrinsic motivations: Classic definitions and new directions". In: *Contemporary educational psychology* 25.1, pp. 54–67.

Ryan, Richard M and Edward L Deci (2000b). "Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being." In: *American psychologist* 55.1, p. 68.

Sanders, Elizabeth B-N and Pieter Jan Stappers (2008). "Co-creation and the new landscapes of design". In: *Co-design* 4.1, pp. 5–18.

Sauro, Jeff (2011). *Measuring usability with the System Usability Scale (SUS)*. URL: https://measuringu.com/sus/ (visited on 05/19/2018).

Sauro, Jeff (2015). *How confident do you need to be in your research?* URL: https://measuringu.com/confidence-levels/ (visited on 03/28/2018).

Shneiderman, B. et al. (2016). *Designing the User Interface: Strategies for Effective Human-Computer Interaction*. 6th ed. Pearson.

Sommerville, Ian (2011). *Software engineering*. 9th ed. New York: Addison-Wesley.

Statistics Norway (2016). *Norwegian media barometer*. URL: https://www.ssb.no/en/kultur-og-fritid/statistikker/medie (visited on 01/08/2018).

Studios, Balsamiq (2018). *balsamiq*. URL: https://balsamiq.com/ (visited on 05/14/2018).

SurveyMonkey (2018). *Margin of Error Calculator*. URL: https://www.surveymonkey.com/mp/margin-of-error-calculator/ (visited on 03/28/2018).

The Myers & Briggs Foundation (2018). *MBTI Basics*. URL: http://www.myersbriggs.org/my-mbti-personality-type/mbti-basics/ (visited on 01/20/2018).

Vaishnavi, Vijay and William Kuechler (2004). *Design science research in information systems*. URL: http://www.desrist.org/design-research-in-information-systems/ (visited on 02/20/2018).

Valdez, Patricia and Albert Mehrabian (1994). "Effects of color on emotions." In: *Journal of experimental psychology: General* 123.4, p. 394.

Vallerand, Robert J (1997). "Toward a hierarchical model of intrinsic and extrinsic motivation". In: *Advances in experimental social psychology* 29, pp. 271–360.

Vallerand, Robert J (2000). "Deci and Ryan's self-determination theory: A view from the hierarchical model of intrinsic and extrinsic motivation". In: *Psychological Inquiry* 11.4, pp. 312–318.

Vliet, Hans van (2007). *Software engineering: principles and practice*. Vol. 3. Wiley New York.

Walker, Miriam, Leila Takayama and James A Landay (2002). "High-fidelity or low-fidelity, paper or computer? Choosing attributes when testing web prototypes". In: *Proceedings of the human factors and ergonomics society annual meeting*. Vol. 46. 5. SAGE Publications Sage CA: Los Angeles, CA, pp. 661–665.

Whitton, Nicola (2009). *Learning with digital games: A practical guide to engaging students in higher education*. Routledge.

Zichermann, Gabe and Christopher Cunningham (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. " O'Reilly Media, Inc.".

Zichermann, Gabe and Joselin Linder (2010). *Game-based marketing: inspire customer loyalty through rewards, challenges, and contests*. John Wiley & Sons.

A | Student Questionnaire

Gamification av helhetslæring i informatikk

* Required

Studentenes opplevelse av motivasjon og studieinnsats

I hvilken grad er du enig i de følgende påstandene: *
Skala: 1-5 (1 = ikke enig og 5 = helt enig)

	1	2	3	4	5	Vet ikke
Jeg er motivert for studieinnsats	○	○	○	○	○	○
Jeg opplever at min studieinnsats er høy	○	○	○	○	○	○

Figure A.1: Student Questionnaire - Part 1

Studentenes bevissthet rundt bruk av tid på studiet

Omtrent hvor mange timer per uke (i gjennomsnitt i semesteret) bruker du på studiet? *

Skriv kun ett tall og inkluder alt (forelesninger, øvinger, hjelpe andre osv.)

Your answer

Basert på ditt forrige svar, hvor sikker er du på ditt anslag av timer brukt i gjennomsnitt? *

◯ Har full oversikt, forrige svar var korrekt

◯ +/- 1-5 timer avvik

◯ +/- 6-10 timer avvik

◯ +/- mer enn 10 timer avvik

Figure A.2: Student Questionnaire - Part 2

Går du i forelesninger? *

○ Ja

○ Kun noen ganger i semesteret

○ Nei

Hvis du fikk vite at medelever i gjennomsnitt bruker mer tid på studiet enn deg, hva ville du tenkt? *

○ Jeg burde jobbe mer

○ Jeg bryr meg ikke

○ Jeg vil ikke vite slikt

○ Jeg vet ikke hva jeg hadde tenkt

○ Other:

Figure A.3: Student Questionnaire - Part 3

Studentenes tanker rundt studieinnsats og gamification

- Les beskrivelsen av systemet og vennligst svar på spørsmålene.

Beskrivelse: Se for deg et system som lar deg sette opp et mål med antall timer i uka du vil bruke på studiet. Systemet lar deg enkelt loggføre antall timer du bruker på studiet i uka. Systemet gir deg en oversikt over om du har brukt for lite eller nok tid i forhold til målet.

I hvilken grad.. *
Skala: 1-5 (1 = liten grad og 5 = stor grad)

	1	2	3	4	5	Vet ikke
..kan en slik oversikt gi deg bedre bevissthet rundt bruk av tid?	O	O	O	O	O	O
..kan en slik oversikt motivere deg til å gjøre en ekstra innsats? (f.eks. når du ser at målet ikke er nådd)	O	O	O	O	O	O
..er et slikt system nyttig for deg?	O	O	O	O	O	O

Figure A.4: Student Questionnaire - Part 4

Figure A.5: Student Questionnaire - Part 5

Studentenes tanker rundt studieinnsats og gamification

- Les beskrivelsen av systemet og vennligst svar på spørsmålene.

Beskrivelse: Se for deg et system som kan måle effektiv bruk av tid i din studieinnsats. Et eksempel på dette kan være at systemet sjekker om du faktisk har lært noe nytt på tiden du brukte via en quiz. Slik kan systemet vise om arbeidsinnsatsen har gitt deg framgang.

I hvilken grad.. *

Skala: 1-5 (1 = liten grad og 5 = stor grad)

	1	2	3	4	5	Vet ikke
..kan et slikt system gjøre deg mer bevisst på din egen framgang?	○	○	○	○	○	○
..kan et slikt system motivere deg til en mer effektiv arbeidsinnsats?	○	○	○	○	○	○
..er et slikt system nyttig for deg?	○	○	○	○	○	○

Har du noen innspill eller kommentarer til et slikt system? *

Your answer

Figure A.6: Student Questionnaire - Part 6

Studentenes tanker rundt studieinnsats og gamification

- Les beskrivelsen av systemet og vennligst svar på spørsmålene.

Beskrivelse: Se for deg et system som lar deg konkurrere med dine medelever om å øke studieinnsatsen. Konkurransen kan en selv starte og man setter opp et ønsket mål. Målet kan for eksempel være å bruke mest tid på studiet i en uke. Videre skal man kunne invitere sine venner på studiet til å delta.

I hvilken grad.. *
Skala: 1-5 (1 = liten grad og 5 = stor grad)

	1	2	3	4	5	Vet ikke
..kan en slik konkurranse motivere deg til å bruke mer tid på studiet?	○	○	○	○	○	○
..er et slikt system nyttig for deg?	○	○	○	○	○	○

Ville du helst vært anonym i en slik konkurranse? *

○ Ja

○ Nei

○ Vet ikke

○ Other:

Figure A.7: Student Questionnaire - Part 7

Figure A.8: Student Questionnaire - Part 8

Figure A.9: Student Questionnaire - Part 9

● Les beskrivelsen av systemet og vennligst svar på spørsmålene.

Beskrivelse: Se for deg et system der noen kan ta kontakt med deg dersom de trenger hjelp med en oppgave. Etter hjelpen kan de gi deg en form for utmerkelse ("badge", "trophy" o.l) hvis hjelpen var god.

I hvilken grad.. *

Skala: 1-5 (1 = liten grad og 5 = stor grad)

	1	2	3	4	5	Vet ikke
..kan et slikt system gjøre det mer attraktivt for deg å hjelpe andre?	○	○	○	○	○	○
..kan et slikt system motivere deg til å prøve å gi god hjelp?	○	○	○	○	○	○
..er et slikt system nyttig for deg?	○	○	○	○	○	○

Har du noen innspill eller kommentarer til et slikt system? *

Your answer

Figure A.10: Student Questionnaire - Part 10

Studentenes bevissthet rundt læringsmål

Viktig! - For at målingen skal være så nøyaktig som mulig er det ikke lov å bruke noen som helst form for hjelpemiddel til å svare på de neste spørsmålene.

Under er det listet opp noen læringsmål. Vet du hvilke av disse som inngår i studiet bachelor i informatikk? *

	Inngår	Inngår ikke	Vet ikke
Kandidaten har grunnleggende kunnskaper om relevante metoder, arbeidsmåter og god praksis for oppbygging av datasystemer og nettbaserte løsninger.	○	○	○
Har kunnskap om relevant lovverk og etiske problemstillinger relatert til utvikling og bruk av informasjon og informasjonsteknologi.	○	○	○
Kan jobbe effektivt med verktøy for modellering og konstruksjon av programvare og dokumentasjon.	○	○	○
Kandidaten kan identifisere de miljømessige, etiske og økonomiske konsekvenser av informasjonsteknologiske produkter og løsninger og evner å se disse i et livsløpsperspektiv.	○	○	○
Kan forstå informasjonsteknologiens rolle og konsekvenser i et samfunnsperspektiv.	○	○	○

Figure A.11: Student Questionnaire - Part 11

Under er det listet opp noen læringsutbytter. Vet du hvilke av disse som inngår i faget TDT4140 - Programvareutvikling? *

	Inngår	Inngår ikke	Vet ikke
Studentene vil få kunnskap om programvareutvikling-konsepter som prosessmodeller, metoder og teknikker for architecture design, testing, planlegging, konfigurasjonsstyring og kvalitetsstyring.	○	○	○
Studenten skal være i stand til å benytte aktuelle metoder og teknikker for brukersentrert design av grafiske brukergrensesnitt, samt objekt-orientert konstruksjon av slike.	○	○	○
Planlegge og administrere små programvareutviklings-prosjekter og delta som designer / programmerer / tester i større programvareprosjekter.	○	○	○
Praktiske ferdigheter i programmering og integrasjonen av ulike komponenter for å sette sammen et større software-produkt.	○	○	○
Studentene skal kunne forstå betydningen av programvareutvikling som et yrke. Studentene skal kunne forstå og samtale om komplekse programvareutviklings-prosjekter og tilhørende tekniske og organisatoriske problemstillinger.	○	○	○

Figure A.12: Student Questionnaire - Part 12

Studentenes tanker rundt læringsmål

Under er de faktiske læringsmålene til informatikk listet opp. For målingens skyld ber jeg om at dere ikke går tilbake å endrer tidligere svar som omhandler læringsmål. Ta en titt på disse og vennligst svar på spørsmålene.

En student med bachelor i Informatikk har oppfylt disse læringsmålene:

- Kunnskaper -

• Har grunnleggende kunnskap innen matematisk analyse, lineær algebra og diskret matematikk og kunne anvende kunnskapen til å løse konkrete problemer innen informatikk.

• Har grunnleggende forståelse av konstruksjon og virkemåte for moderne datamaskiner og beslektet datateknisk utstyr, kunnskap om konsepter og tilhørende teknikker som er nødvendige for styring av, samarbeid og kommunikasjon mellom datamaskiner.

• Har bred kunnskap om programmering og de teknikkene og verktøyene som brukes i utvikling og kvalitetssikring av programvare. Har kunnskap om etablerte algoritmer og datastrukturer og metodikken for å analysere og effektivisere løsninger.

• Har bred kunnskap om systemutviklingsprosessen og metodikken for utvikling, integrasjon og evaluering av større informasjonsteknologiske systemer. Er godt kjent med begrepsapparat, metoder og teknikker for design og evaluering av grafiske brukergrensesnitt. Har en god forståelse av samspillet mellom informasjonsteknologi og mennesker og organisasjoner.

• Har grunnleggende kunnskaper om datamodellering, databasekonstruksjon og databasehåndteringssystemer som grunnlag for å kunne velge teknologi og implementere løsninger for lagring og forvaltning av data og informasjon.

• Har kunnskap om relevant lovverk og etiske problemstillinger relatert til utvikling og bruk av informasjon og informasjonsteknologi.

Figure A.13: Student Questionnaire - Part 13

- Ferdigheter -

• Kan identifisere, definere og analysere sammensatte datatekniske problemer og kunde- og brukerbehov og kunne spesifisere, designe, implementere og evaluere datatekniske løsninger.

• Kan jobbe effektivt med verktøy for modellering og konstruksjon av programvare og dokumentasjon.

• Kan finne frem til og ha faglige forutsetninger for å benytte seg av eksisterende programvare og rammeverk.

- Generell kompetanse -

• Kan kommunisere skriftlig og muntlig om eget fag og faglige problemstillinger og løsninger både ovenfor profesjonelle og ikke-spesialister/sluttbrukere.

• Kan fornye og omstille seg faglig, herunder kunne utvikle sin faglige kompetanse på eget initiativ.

• Kan forstå informasjonsteknologiens rolle og konsekvenser i et samfunnsperspektiv.

Figure A.14: Student Questionnaire - Part 14

I hvilken grad.. *
Skala: 1-5 (1 = liten grad og 5 = stor grad)

	1	2	3	4	5	Vet ikke
..synes du læringsmålene er tydelige nok?	○	○	○	○	○	○
..forstår du når et læringsmål er oppnådd i løpet av studie?	○	○	○	○	○	○

Figure A.15: Student Questionnaire - Part 15

Studentenes tanker rundt motivasjon og gamification

Hva slags erfaringer eller opplevelser har du med gamification i utdanningssammenheng fra før? *

Dette spørsmålet er åpent, her er det lov å skrive hva som helst (følelser, hendelser, ideer osv.). Et eksempel kan være en opplevelse av da du brukte kahoot.

Your answer

Hva slags erfaringer eller opplevelser har du med gamification utenom utdanningssammenheng fra før? *

Dette spørsmålet er åpent, her er det lov å skrive hva som helst (følelser, hendelser, ideer osv.). Et eksempel kan være en erfaring du fikk da du brukte fitbit.

Your answer

Hva gir deg motivasjon i din studiehverdag? *

Dette spørsmålet er åpent, her er det lov å skrive hva som helst.

Your answer

Figure A.16: Student Questionnaire - Part 16

Generell informasjon

Tar du en bachelor i informatikk ved NTNU? *

○ Ja

○ Nei

Hvilket år ved studiet er du i nå? *

○ 1. året

○ 2. året

○ 3. året

○ Other: _____

Kjønn? *

○ Mann

○ Kvinne

○ Other: _____

Figure A.17: Student Questionnaire - Part 17

B | Consent Forms

Gamification av helhetslæring i informatikk

Hei og velkommen til denne spørreundersøkelsen!

Jeg skriver en masteroppgave i informatikk ved NTNU som omhandler gamification av helhetslæring i et studieprogram. Gamification betyr å bruke spillelementer i andre sammenhenger enn nettopp spill. Studieprogrammet jeg har valgt å fokusere på er informatikk bachelor. I den forbindelse ønsker jeg å finne ut litt generelt om studentenes tanker angående studieinnsats og gamification. Spørreundersøkelsen tar omtrent ca. 15 minutter.

Alle personopplysninger vil bli behandlet konfidensielt. Personopplysningene vil ikke gjøre deltakeren identifiserbar for de involverte i prosjektet. Google kan ha tilgang til IP-adressen til deltakeren. Deltakeren vil ikke kunne gjenkjennes i publisjon. Prosjektet skal etter planen avsluttes 1. juni 2018 og analysen av dataene vil bli publisert i masteroppgaven.

Det er frivillig å delta i studien, og du kan når som helst avbryte uten å oppgi noen grunn. Dersom du har spørsmål til studien, ta kontakt med

Daphne Leebeek (masterstudent) på epost: daphnel@stud.ntnu.no eller
Guttorm Sindre (veileder) på epost: guttorm.sindre@ntnu.no

Studien er meldt til Personvernombudet for forskning, NSD - Norsk senter for forskningsdata AS.

* Required

Vennligst oppgi ditt samtykke før du begynner: *

☐ Jeg har mottatt informasjon om studien, og er villig til å delta.

Figure B.1: Consent Form for Student Questionnaire

Forespørsel om deltakelse i forskningsprosjektet

Gamification av helhetslæring i informatikk

Bakgrunn og formål
Jeg skriver en masteroppgave i informatikk ved NTNU som omhandler gamification av helhetslæring i et studieprogram. Gamification betyr å bruke spillelementer i andre sammenhenger enn nettopp spill. Studieprogrammet jeg har valgt å fokusere på er informatikk bachelor. I masteroppgaven skal det lages et designforslag til hvordan gamification kan implementeres, og i den forbindelse ønsker jeg å ha en design workshop med målgruppen for å bli klokere på hvordan en bruker ser for seg et slikt system.

Hva innebærer deltakelse i studien?
Deltakelse i studien innebærer at man er med på en design workshop hvor det skal utformes forslag til hvordan gamification kan designes i et system laget for informatikk. Workshopen varer i tre timer. Den siste halvtimen skal designforslag presenteres og det vil bli tatt videoopptak av dette for å kunne se tilbake på presentasjonen om nødvendig. Designforslagene vil bli brukt som forskningsmateriale i masteroppgaven.

Hva skjer med informasjonen om deg?
Alle personopplysninger vil bli behandlet konfidensielt. Datamaterialet er ikke tilgjengelig for andre enn masterstudenten. Opptak lagres på personlig datamaskin, sikret med passord og i et låsbart rom. Deltakeren vil ikke kunne gjenkjennes i publikasjon. Prosjektet skal etter planen avsluttes 1. juni 2018 og datamaterialet vil etter denne datoen bli slettet.

Frivillig deltakelse
Det er frivillig å delta i studien, og du kan når som helst trekke ditt samtykke uten å oppgi noen grunn. Dersom du trekker deg, vil designforslag ikke benyttes i studien og videoopptak slettes.

Dersom du ønsker å delta eller har spørsmål til studien, ta kontakt med

Daphne Leebeek (masterstudent) på epost: daphnel@stud.ntnu.no eller
Guttorm Sindre (veileder) på epost: guttorm.sindre@ntnu.no

Studien er meldt til Personvernombudet for forskning, NSD - Norsk senter for forskningsdata AS.

Samtykke til deltakelse i studien

Jeg har mottatt informasjon om studien, og er villig til å delta

----
(Signert av prosjektdeltaker, dato)

Figure B.2: Consent Form for Workshop

C | NSD Approvals

Guttorm Sindre
Sem Sælandsvei 7-9
7491 TRONDHEIM

| Vår dato: 07.12.2017 | Vår ref: 57302 / 3 / HIT | Deres dato: | Deres ref: |

Forenklet vurdering fra NSD Personvernombudet for forskning

Vi viser til melding om behandling av personopplysninger, mottatt 20.11.2017.
Meldingen gjelder prosjektet:

57302	Spillifisering av helhetslæring i et studieprogram.
Behandlingsansvarlig	NTNU, ved institusjonens øverste leder
Daglig ansvarlig	Guttorm Sindre
Student	Daphne Leebeek

Vurdering

Etter gjennomgang av opplysningene i meldeskjemaet med vedlegg, vurderer vi at prosjektet er omfattet av personopplysningsloven § 31. Personopplysningene som blir samlet inn er ikke sensitive, prosjektet er samtykkebasert og har lav personvernulempe. Prosjektet har derfor fått en forenklet vurdering. Du kan gå i gang med prosjektet. Du har selvstendig ansvar for å følge vilkårene under og sette deg inn i veiledningen i dette brevet.

Figure C.1: NSD Approval 1 - Part 1

Vilkår for vår vurdering

Vår anbefaling forutsetter at du gjennomfører prosjektet i tråd med:

- opplysningene gitt i meldeskjemaet
- krav til informert samtykke
- at du ikke innhenter sensitive opplysninger
- veiledning i dette brevet
- NTNU sine retningslinjer for datasikkerhet

Veiledning

Krav til informert samtykke

Utvalget skal få skriftlig og/eller muntlig informasjon om prosjektet og samtykke til deltakelse. Informasjon må minst omfatte:

- at NTNU er behandlingsansvarlig institusjon for prosjektet
- daglig ansvarlig (eventuelt student og veileders) sine kontaktopplysninger
- prosjektets formål og hva opplysningene skal brukes til

Dokumentet er elektronisk produsert og godkjent ved NSDs rutiner for elektronisk godkjenning.

NSD – Norsk senter for forskningsdata AS   Harald Hårfagres gate 29   Tel: +47-55 58 21 17   nsd@nsd.no   Org.nr. 985 321 884
NSD – Norwegian Centre for Research Data   NO-5007 Bergen, NORWAY   Faks: +47-55 58 96 50   www.nsd.no

Figure C.2: NSD Approval 1 - Part 2

- hvilke opplysninger som skal innhentes og hvordan opplysningene innhentes
- når prosjektet skal avsluttes og når personopplysningene skal anonymiseres/slettes

På nettsidene våre finner du mer informasjon og en veiledende mal for informasjonsskriv.

Forskningsetiske retningslinjer
Sett deg inn i forskningsetiske retningslinjer.

Meld fra hvis du gjør vesentlige endringer i prosjektet
Dersom prosjektet endrer seg, kan det være nødvendig å sende inn endringsmelding. På våre nettsider finner du svar på hvilke endringer du må melde, samt endringsskjema.

Opplysninger om prosjektet blir lagt ut på våre nettsider og i Meldingsarkivet
Vi har lagt ut opplysninger om prosjektet på nettsidene våre. Alle våre institusjoner har også tilgang til egne prosjekter i Meldingsarkivet.

Vi tar kontakt om status for behandling av personopplysninger ved prosjektslutt
Ved prosjektslutt 01.06.2018 vil vi ta kontakt for å avklare status for behandlingen av personopplysninger.

Gjelder dette ditt prosjekt?

Dersom du skal bruke databehandler
Dersom du skal bruke databehandler (ekstern transkriberingsassistent/spørreskjemaleverandør) må du inngå en databehandleravtale med vedkommende. For råd om hva databehandleravtalen bør inneholde, se Datatilsynets veileder.

Hvis utvalget har taushetsplikt
Vi minner om at noen grupper (f.eks. opplærings- og helsepersonell/forvaltningsansatte) har taushetsplikt. De kan derfor ikke gi deg identifiserende opplysninger om andre, med mindre de får samtykke fra den det gjelder.

Dersom du forsker på egen arbeidsplass
Vi minner om at når du forsker på egen arbeidsplass må du være bevisst din dobbeltrolle som både forsker og ansatt. Ved rekruttering er det spesielt viktig at forespørsel rettes på en slik måte at frivilligheten ved deltakelse ivaretas.

Se våre nettsider eller ta kontakt med oss dersom du har spørsmål. Vi ønsker lykke til med prosjektet!

Figure C.3: NSD Approval 1 - Part 3

NSD

Guttorm Sindre
Sem Sælandsvei 7-9
7491 TRONDHEIM

Vår dato: 14.03.2018   Vår ref: 59331 / 3 / BGH   Deres dato: Deres ref:

Vurdering fra NSD Personvernombudet for forskning § 31

Personvernombudet for forskning viser til meldeskjema mottatt 19.02.2018 for prosjektet:

59331	Spillifisering av helhetslæring i et studieprogram
Behandlingsansvarlig	NTNU, ved institusjonens øverste leder
Daglig ansvarlig	Guttorm Sindre
Student	Daphne Leebeek

Vurdering
Etter gjennomgang av opplysningene i meldeskjemaet og øvrig dokumentasjon finner vi at prosjektet er meldepliktig og at personopplysningene som blir samlet inn i dette prosjektet er regulert av personopplysningsloven § 31. På den neste siden er vår vurdering av prosjektopplegget slik det er meldt til oss. Du kan nå gå i gang med å behandle personopplysninger.

Vilkår for vår anbefaling
Vår anbefaling forutsetter at du gjennomfører prosjektet i tråd med:
• opplysningene gitt i meldeskjemaet og øvrig dokumentasjon
• vår prosjektvurdering, se side 2
• eventuell korrespondanse med oss

Vi forutsetter at du ikke innhenter sensitive personopplysninger.

Meld fra hvis du gjør vesentlige endringer i prosjektet
Dersom prosjektet endrer seg, kan det være nødvendig å sende inn endringsmelding. På våre nettsider finner du svar på hvilke endringer du må melde, samt endringsskjema.

Opplysninger om prosjektet blir lagt ut på våre nettsider og i Meldingsarkivet
Vi har lagt ut opplysninger om prosjektet på nettsidene våre. Alle våre institusjoner har også tilgang til egne prosjekter i Meldingsarkivet.

Vi tar kontakt om status for behandling av personopplysninger ved prosjektslutt
Ved prosjektslutt 01.06.2018 vil vi ta kontakt for å avklare status for behandlingen av

Dokumentet er elektronisk produsert og godkjent ved NSDs rutiner for elektronisk godkjenning.

Figure C.4: NSD Approval 2 - Part 1

personopplysninger.

Se våre nettsider eller ta kontakt dersom du har spørsmål. Vi ønsker lykke til med prosjektet!

Marianne Høgetveit Myhren

Belinda Gloppen Helle

Kontaktperson: Belinda Gloppen Helle tlf: 55 58 28 74 / belinda.helle@nsd.no

Vedlegg: Prosjektvurdering
Kopi: Daphne Leebeek, daphnel@stud.ntnu.no

Figure C.5: NSD Approval 2 - Part 2

Personvernombudet for forskning

Prosjektvurdering - Kommentar

Prosjektnr: 59331

INFORMASJON OG SAMTYKKE
Du har opplyst i meldeskjema at utvalget vil motta skriftlig og muntlig informasjon om prosjektet, og samtykke skriftlig til å delta. Vår vurdering er at informasjonsskrivet til utvalget er godt utformet.

INFORMASJONSSIKKERHET
Personvernombudet forutsetter at du behandler alle data i tråd med NTNU sine retningslinjer for datahåndtering og informasjonssikkerhet. Vi legger til grunn at bruk av privat pc er i samsvar med institusjonens retningslinjer.

PROSJEKTSLUTT OG ANONYMISERING AV DATAMATERIALET
Prosjektslutt er oppgitt til 01.06.2018. Det fremgår av meldeskjema/informasjonsskriv at du vil anonymisere datamaterialet ved prosjektslutt.
Anonymisering innebærer vanligvis å:
- slette direkte identifiserbare opplysninger som navn, fødselsnummer, koblingsnøkkel
- slette eller omskrive/gruppere indirekte identifiserbare opplysninger som bosted/arbeidssted, alder, kjønn
- slette eller sladde bilde- og videoopptak

For en utdypende beskrivelse av anonymisering av personopplysninger, se Datatilsynets veileder:
https://www.datatilsynet.no/globalassets/global/regelverk-skjema/veiledere/anonymisering-veileder-041115.pdf

Figure C.6: NSD Approval 2 - Part 3

D | Usability Testing Question-naires

1. I think that I would like to use this system frequently

2. I found the system unnecessarily complex

3. I thought the system was easy to use

4. I think that I would need the support of a technical person to be able to use this system

5. I found the various functions in this system were well integrated

6. I thought there was too much inconsistency in this system

7. I would imagine that most people would learn to use this system very quickly

8. I found the system very cumbersome to use

9. I felt very confident using the system

10. I needed to learn a lot of things before I could get going with this system

Figure D.1: System Usability Scale Schema

Table D.1: Post Usability Testing Questionnaire

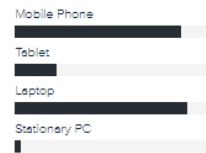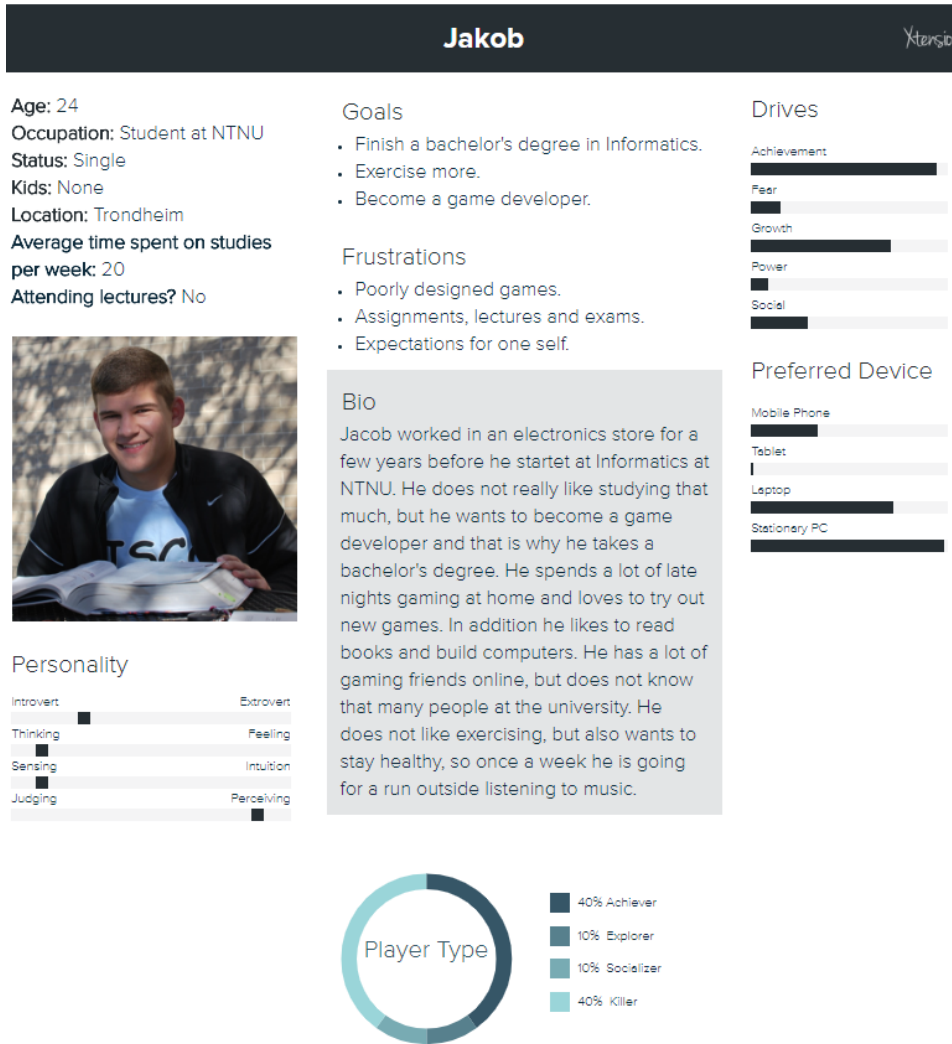| How strongly do you agree or disagree with the following statements: (1 = strongly disagree, 5 = strongly agree)	1	2	3	4	5
I think this system would motivate me in the long term					
I think this system would motivate me in the short term					
I think that I would want to use this system over a period of three years (Bachelor's degree)					
I think that I would use this system only for the rewards					
I like the rewards I can buy with Diamond Bits					
I like the rewards I can buy with NOK					
I like the overview of my personal goals					
I like the wheel of fortune					
I like to give and/or receive likes for resource contribution					
I think that I would use the timer to help track my time used on studying					
I think that I would use the flashcard to track if I know what I am supposed to know					
I think that I would use the community page to help and/or receive help from others					
I find this system useful					
I find this system fun					

E | Personas
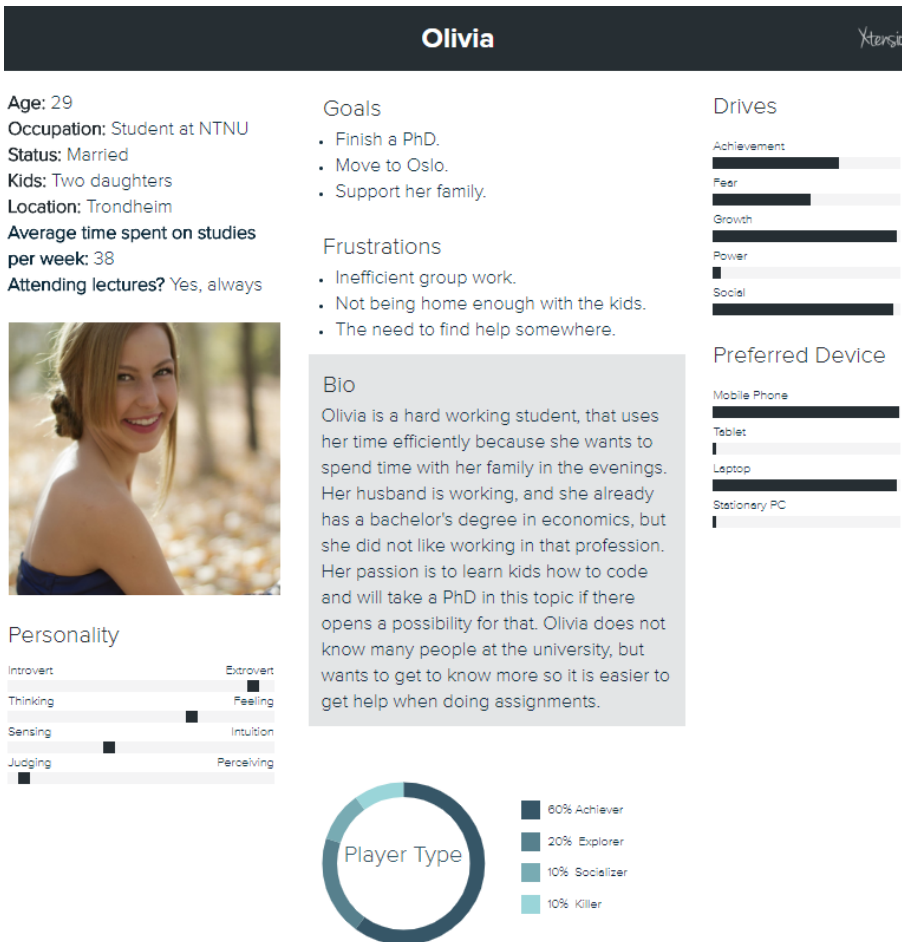
Figure E.1: Persona - Olivia
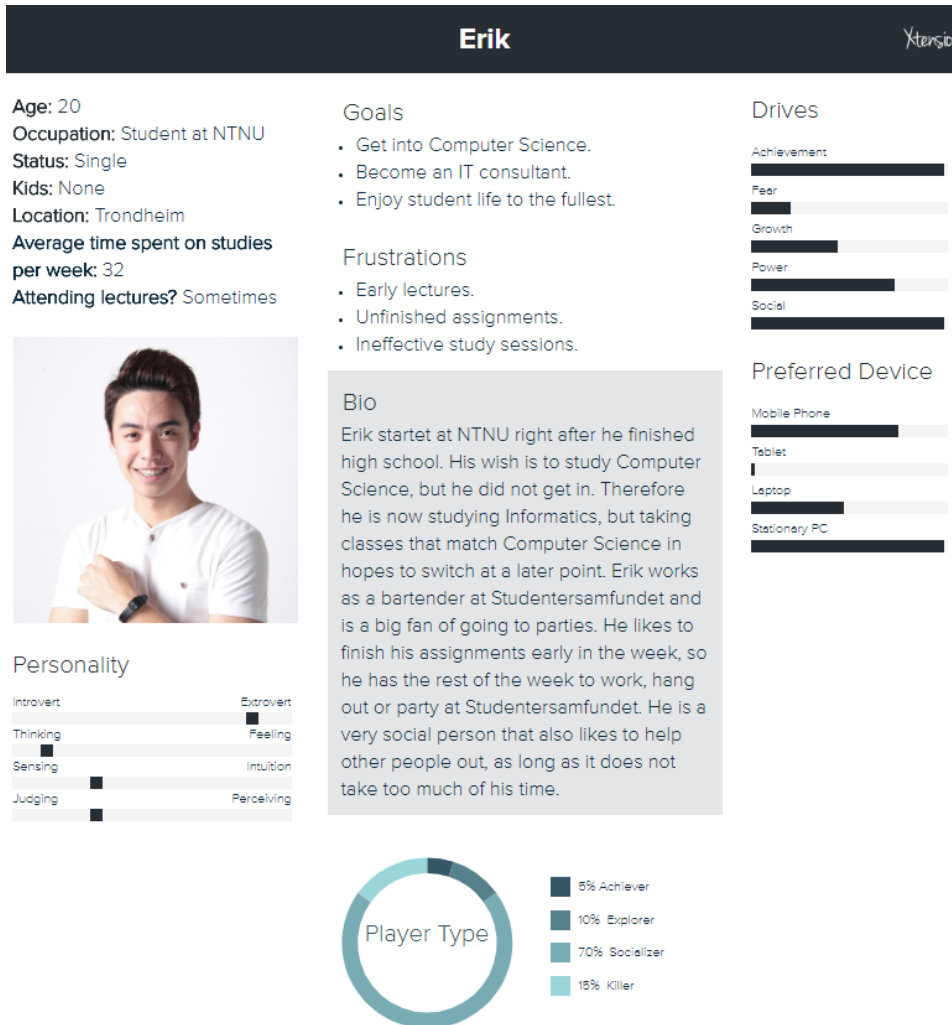
Figure E.2: Persona - Erik

Solveig

Xtensio

Age: 22
Occupation: Student at NTNU
Status: In a relationship
Kids: None
Location: Trondheim
Average time spent on studies per week: 40
Attending lectures? Sometimes

Personality

Introvert — Extrovert
Thinking — Feeling
Sensing — Intuition
Judging — Perceiving
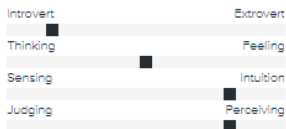
Goals

- Find a comfortable job.
- Get to know new friends.
- Explore the city of Trondheim.

Frustrations

- Hold presentations.
- Unforseen events.
- Loud people.

Bio

Solveig took two gap years after high school before she started at NTNU. She is not sure yet if Informatics is the right thing for her, but she likes technology and math classes. In her spare time she likes to go cross country skiing or go for walks in Bymarka, play board games with her friends and boyfriend and sing in a choir. She enjoys helping people and loves animals. If she ever quits Informatics she might want to be veterinarian. In high school she was used to being one of the best students in her class, but at NTNU she needs to work really hard to get average grades.

Drives

Achievement
Fear
Growth
Power
Social

Preferred Device

Mobile Phone
Tablet
Laptop
Stationary PC

Player Type
- 5% Achiever
- 60% Explorer
- 35% Socializer
- 0% Killer
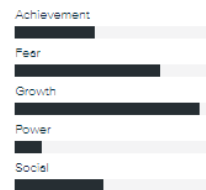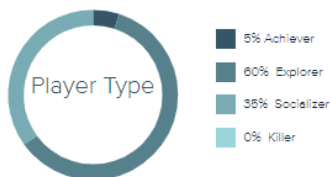
Figure E.3: Persona - Solveig

Jakob

Xtensio

Age: 24
Occupation: Student at NTNU
Status: Single
Kids: None
Location: Trondheim
Average time spent on studies per week: 20
Attending lectures? No

Goals
- Finish a bachelor's degree in Informatics.
- Exercise more.
- Become a game developer.

Frustrations
- Poorly designed games.
- Assignments, lectures and exams.
- Expectations for one self.

Bio
Jacob worked in an electronics store for a few years before he startet at Informatics at NTNU. He does not really like studying that much, but he wants to become a game developer and that is why he takes a bachelor's degree. He spends a lot of late nights gaming at home and loves to try out new games. In addition he likes to read books and build computers. He has a lot of gaming friends online, but does not know that many people at the university. He does not like exercising, but also wants to stay healthy, so once a week he is going for a run outside listening to music.

Drives
Achievement
Fear
Growth
Power
Social

Preferred Device
Mobile Phone
Tablet
Laptop
Stationary PC

Personality
Introvert — Extrovert
Thinking — Feeling
Sensing — Intuition
Judging — Perceiving

Player Type
- 40% Achiever
- 10% Explorer
- 10% Socializer
- 40% Killer

Figure E.4: Persona - Jakob

Trond

Age: 32
Occupation: Student at NTNU
Status: In a relationship
Kids: None
Location: Trondheim
Average time spent on studies per week: 40
Attending lectures? Yes, always

Personality

Introvert	Extrovert
Thinking	Feeling
Sensing	Intuition
Judging	Perceiving
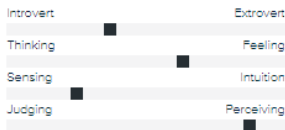
Goals

- Finish a master's degree in Informatics.
- Get a job in an IT company working with hardware.
- Develop a robot.

Frustrations

- Group work.
- Don't understanding the usefulness of classes.
- Failing exams.

Bio

Trond has been working in a gaming store for many years. In his spare time he loves building keyboards, robotics, movies, games and go mountain hiking with his girlfriend. After many years as a seller, he wanted a new challenge and started to study Informatics. He does not know many people at the university because he thinks that many of the people are too young for him. Since it is a long time ago that he went to school, he does not have good routines when working with assignments and has therefore failed some exams.

Drives

Achievement
Fear
Growth
Power
Social

Preferred Device

Mobile Phone
Tablet
Laptop
Stationary PC

Player Type

- 50% Achiever
- 15% Explorer
- 35% Socializer
- 0% Killer
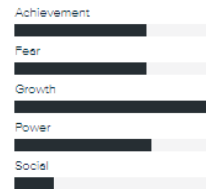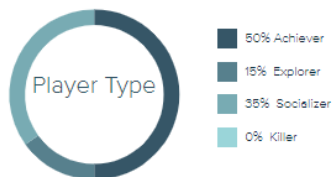
Figure E.5: Persona - Trond

F | Learning Outcomes

Kunnskaper

- Har grunnleggende kunnskap innen matematisk analyse, lineær algebra og diskret matematikk og kunne anvende kunnskapen til å løse konkrete problemer innen informatikk.

- Har grunnleggende forståelse av konstruksjon og virkemåte for moderne datamaskiner og beslektet datateknisk utstyr, kunnskap om konsepter og tilhørende teknikker som er nødvendige for styring av, samarbeid og kommunikasjon mellom datamaskiner.

- Har bred kunnskap om programmering og de teknikkene og verktøyene som brukes i utvikling og kvalitetssikring av programvare. Har kunnskap om etablerte algoritmer og datastrukturer og metodikken for å analysere og effektivisere løsninger.

- Har bred kunnskap om systemutviklingsprosessen og metodikken for utvikling, integrasjon og evaluering av større informasjonsteknologiske systemer. Er godt kjent med begrepsapparat, metoder og teknikker for design og evaluering av grafiske brukergrensesnitt. Har en god forståelse av samspillet mellom informasjonsteknologi og mennesker og organisasjoner.

- Har grunnleggende kunnskaper om datamodellering, databasekonstruksjon og databasehåndteringssystemer som grunnlag for å kunne velge teknologi og implementere løsninger for lagring og forvaltning av data og informasjon.

- Har kunnskap om relevant lovverk og etiske problemstillinger relatert til utvikling og bruk av informasjon og informasjonsteknologi.

Ferdigheter

- Kan identifisere, definere og analysere sammensatte datatekniske problemer og kunde- og brukerbehov og kunne spesifisere, designe, implementere og evaluere datatekniske løsninger.

- Kan jobbe effektivt med verktøy for modellering og konstruksjon av programvare og dokumentasjon.

- Kan finne frem til og ha faglige forutsetninger for å benytte seg av eksisterende programvare og rammeverk.

Generell kompetanse

- Kan kommunisere skriftlig og muntlig om eget fag og faglige problemstillinger og løsninger både ovenfor profesjonelle og ikke-spesialister/sluttbrukere.

- Kan fornye og omstille seg faglig, herunder kunne utvikle sin faglige kompetanse på eget initiativ.

- Kan forstå informasjonsteknologiens rolle og konsekvenser i et samfunnsperspektiv.

Figure F.1: Learning Outcomes, reproduced from (NTNU, 2018c)

G | Student Questionnaire Results

Table G.1: Students' Experience of Motivation and Study Effort, Raw Data

To what extent do you agree that:									
	(Response distribution)								
	1	**2**	**3**	**4**	**5**	**Don't know**	*Mdn*	*M*	*SD*
I am motivated for working on my studies	0	2	7	22	13	0	4	4,0	0.8
I think of myself as a hard-working student	0	1	24	9	10	0	3	3,6	0.9

Do you attend lectures?

5 %

43 %

52 %

Yes

Only a few times during the semester

No
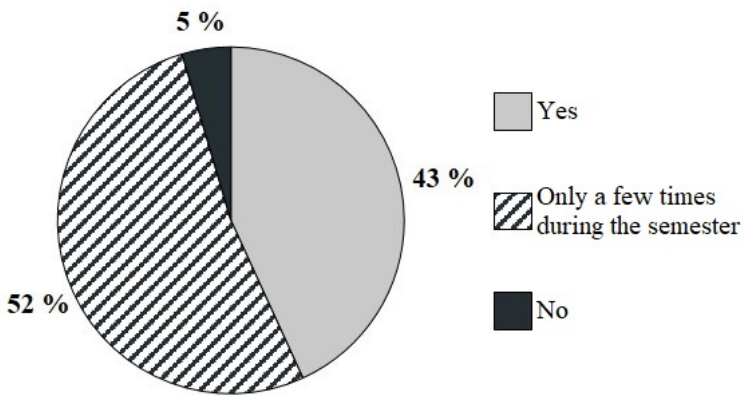
Figure G.1: Students' Awareness of Time Spent on Studies - Part 1

What would your thoughts be if you learned that students spend more time studying than you on an average?

11 %

14 %

2 %

41 %

32 %

I should work more

I don't care

I don't want to know

I don't know what I would be thinking

Other
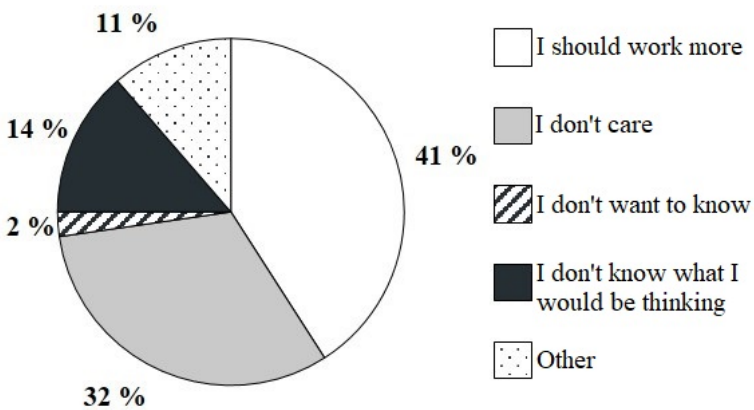
Figure G.2: Students' Awareness of Time Spent on Studies - Part 2

Table G.2: Students' Thoughts about Study Effort and Gamification - Part 1, Raw Data

Description: Imagine a system that allows you to set a goal with a number of hours you want to spend on your studies a week. The system lets you easily log the hours you spend on your studies during the week. The system gives you an overview of whether you have spent too little or enough time in relation to the goal. To what extent..

<div align="center">(Response distribution)</div>

	1	2	3	4	5	Don't know	*Mdn*	*M*	*SD*
..can such an overview give you better awareness of your own use of time?	2	1	9	15	17	0	4	4.0	1.1
..can such an overview motivate you to a greater study effort? (e.g. when you see that a goal has not been reached)	2	5	9	20	7	1	4	3.6	1.1
..is such a system useful to you?	5	4	13	11	9	2	3	3.4	1.3

Imagine that the system gives you badges or trophies awards when the goal is reached. To what extent..

<div align="center">(Response distribution)</div>

	1	2	3	4	5	Don't know	*Mdn*	*M*	*SD*
..can collecting awards motivate you to make an extra effort to reach your goals?	6	12	11	9	6	0	3	2.9	1.3

Table G.3: Students' Thoughts about Study Effort and Gamification - Part 2, Raw Data

Description: Imagine a system that can measure the effective use of time in your study effort. An example of this might be that the system checks whether you have actually learned something during the time you spent by using a quiz. That way the system can show you if your study effort have given you progress. To what extent..

| | (Response distribution) | | | | | | | | |
	1	2	3	4	5	Don't know	*Mdn*	*M*	*SD*
..can such a system give you better awareness of your own progress?	0	0	6	24	13	1	4	4.2	0.7
..can such an overview motivate you to a more effective study effort?	0	5	8	22	9	0	4	3.8	0.9
..is such a system useful to you?	0	3	10	22	9	0	4	3.8	0.8

Table G.4: Students' Thoughts about Study Effort and Gamification - Part 3, Raw Data

Description: Imagine a system that lets you compete with your fellow students to increase your study effort. You can set up the competition yourself and set a desired goal. For example, the goal might be to spend the most time studying for one week. Furthermore, you are able to invite study friends to participate. To what extent..

(Response distribution)

	1	2	3	4	5	Don't know	*Mdn*	*M*	*SD*
..can such a competition motivate you to spend more time on your studies?	8	10	15	7	4	0	3	2.8	1.2
..is such a system useful to you?	8	18	11	4	3	0	2	2.5	1.1

Imagine the same competition, but with all class students attending instead of voluntary choice of friends. To what extent..

(Response distribution)

	1	2	3	4	5	Don't know	*Mdn*	*M*	*SD*
..can such a competition motivate you to spend more time on your studies?	6	15	11	6	3	3	2	2.6	1.1
..is such a system useful to you?	10	20	6	3	2	3	2	2.2	1.1

Table G.5: Students' Thoughts about Helping Others and Gamification, Raw Data

To what extent..									
	(Response distribution)								
	1	**2**	**3**	**4**	**5**	**Don't know**	*Mdn*	*M*	*SD*
..is it easy to get help from fellow students when you are in need of it?	0	3	8	21	10	2	4	3.9	0.8
..is it fun to help fellow students with study related work? (i.e. show or explain, not to the job)	0	2	14	19	9	0	4	3.8	0.8

Description: Imagine a system where someone can contact you if they need help with a task. After the help has been given, they can give you some kind of award (badge, trophy etc.) if your help was good. To what extent..

	(Response distribution)								
	1	**2**	**3**	**4**	**5**	**Don't know**	*Mdn*	*M*	*SD*
..can such a system make it more attractive for you to help others?	2	10	17	10	5	0	3	3.1	1.0
..can such a system motivate you to try to give good help?	2	8	11	16	7	0	4	3.4	1.1
..is such a system useful to you?	8	10	18	5	3	0	3	2.7	1.1

Are you attending the degree program of Bachelor Informatics?
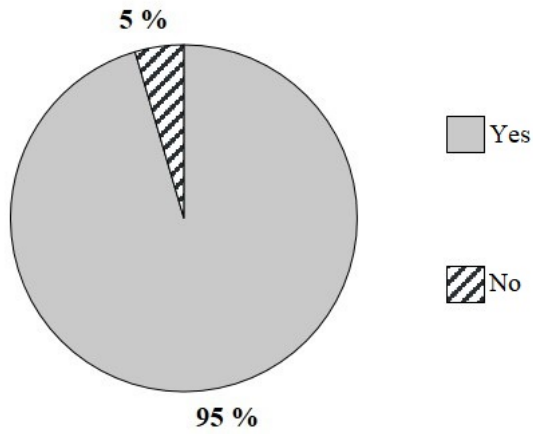
Figure G.3: General Information - Part 1

Which year are you in?
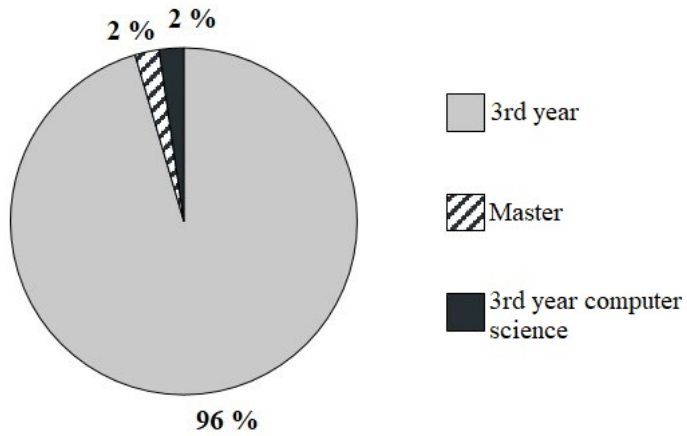
Figure G.4: General Information - Part 2

Gender
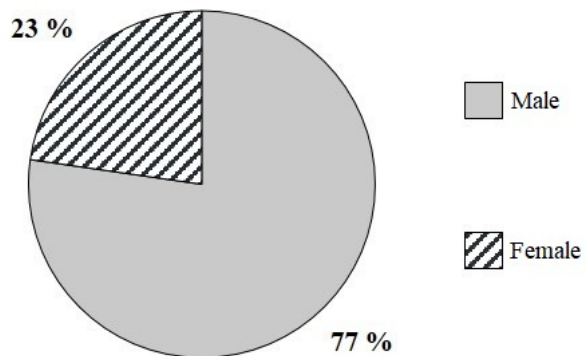
Figure G.5: General Information - Part 3

H | Prototype Iteration 2
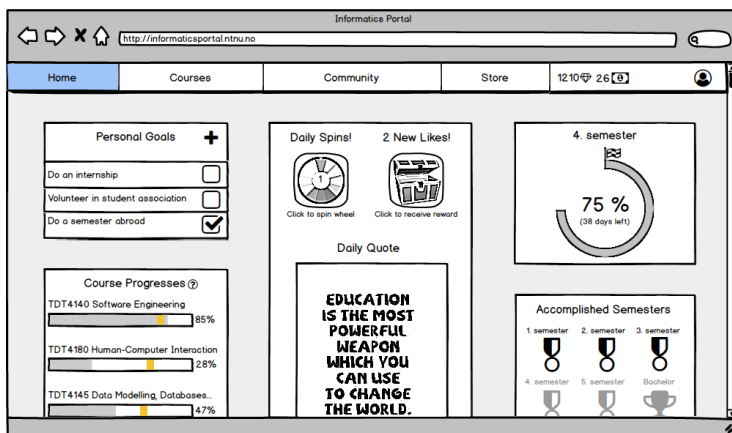
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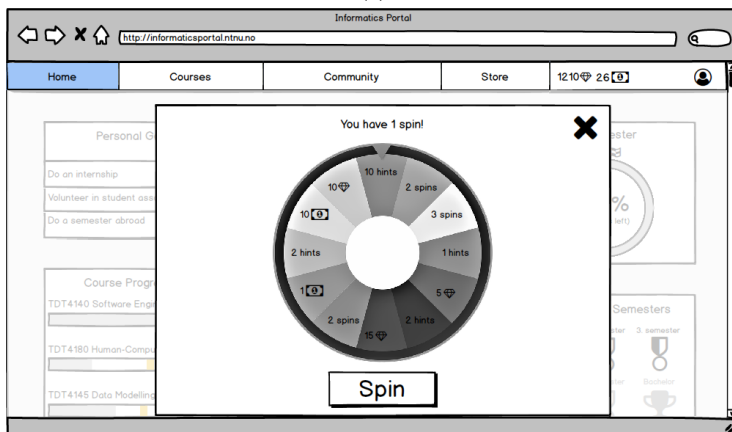
(b)

Figure H.1: Informatics Portal Iteration 2 - Part 1
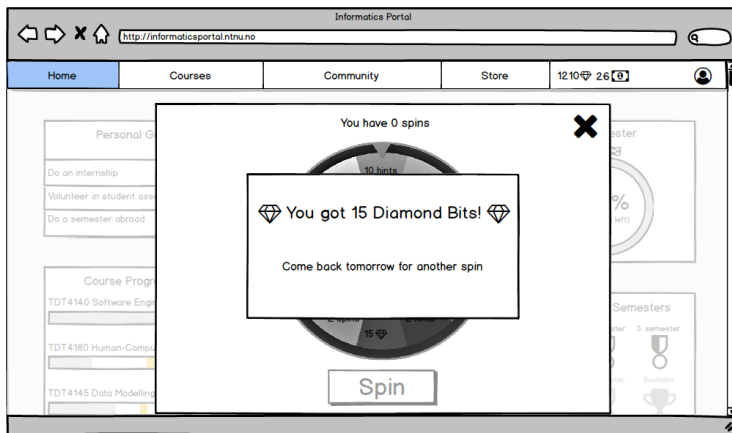
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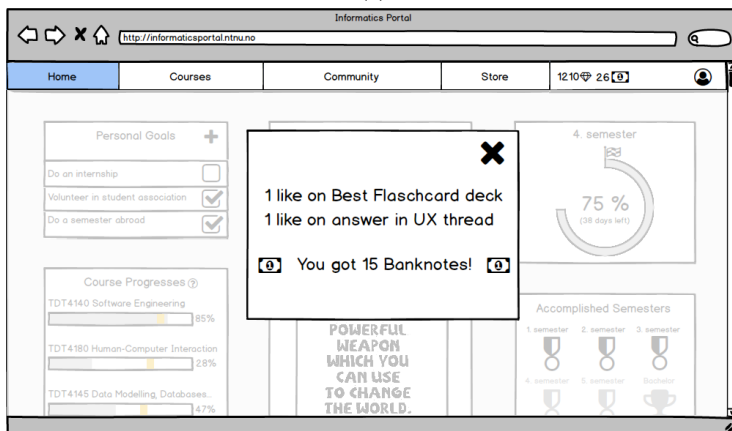
(b)
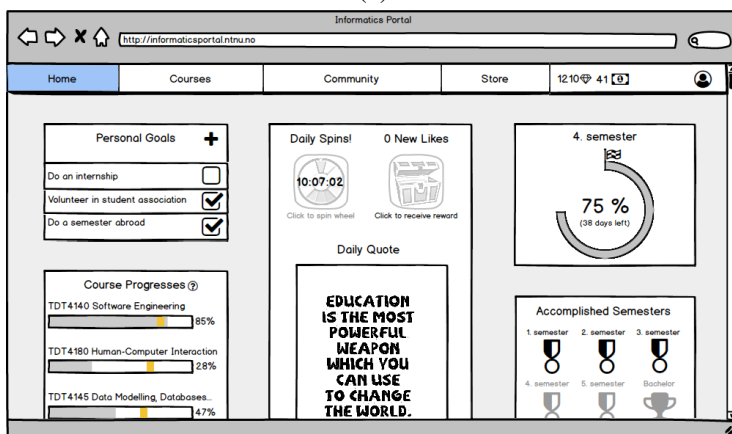
(c)

Figure H.2: Informatics Portal Iteration 2 - Part 2
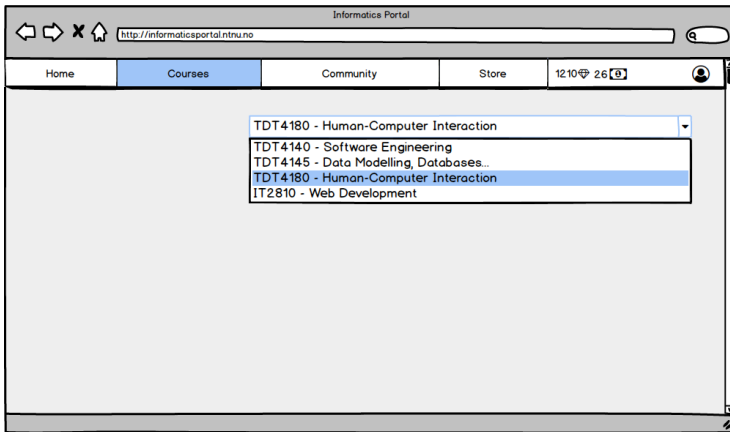
(a)
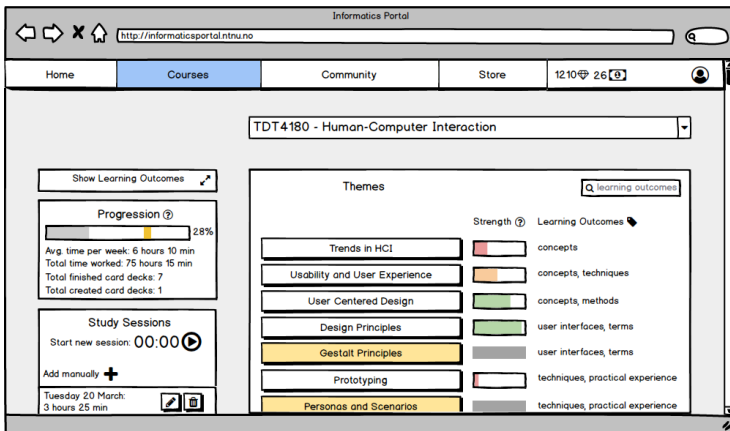
(b)
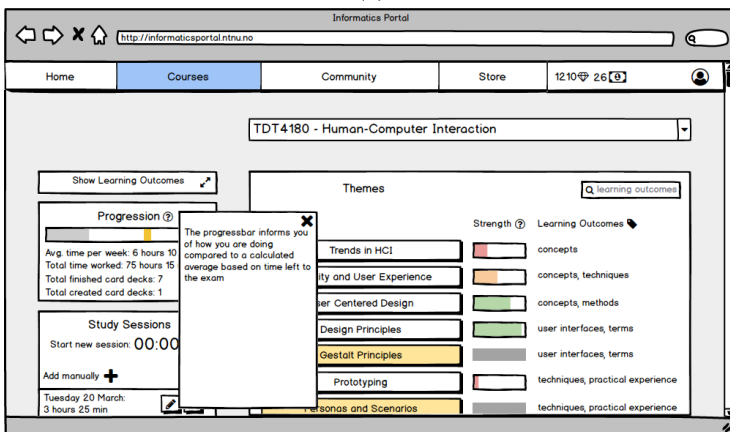
(c)

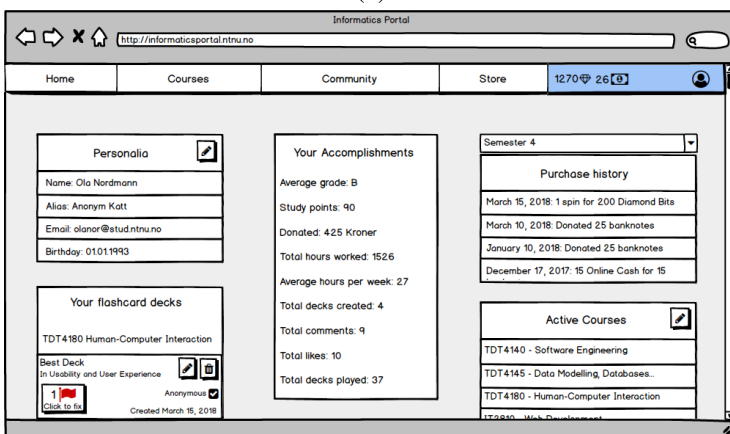**Figure H.3:** Informatics Portal Iteration 2 - Part 3
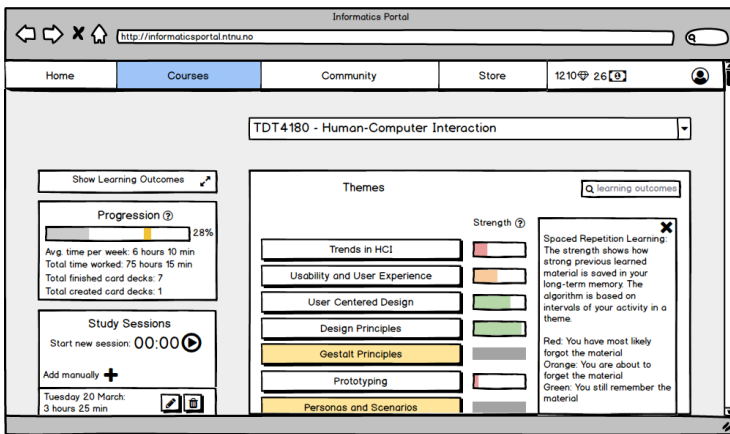
(a)
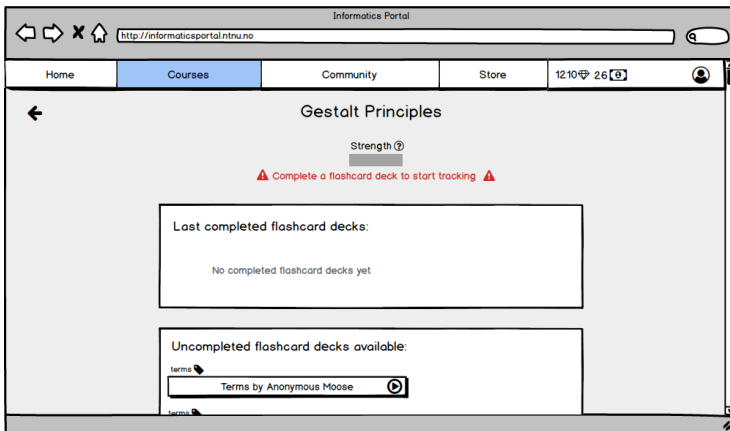
(b)
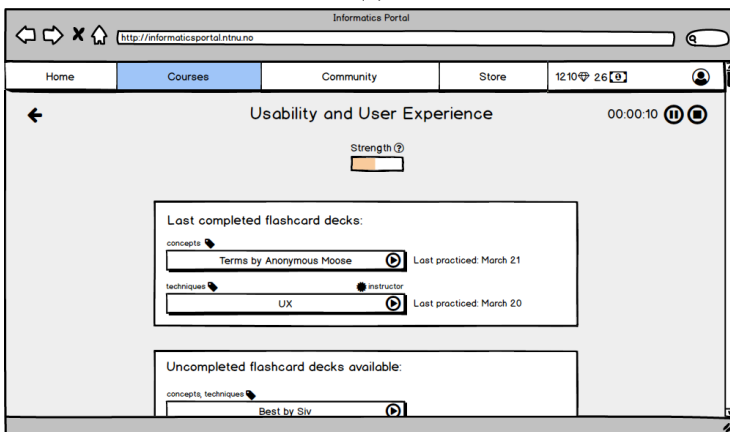
(c)

Figure H.4: Informatics Portal Iteration 2 - Part 4
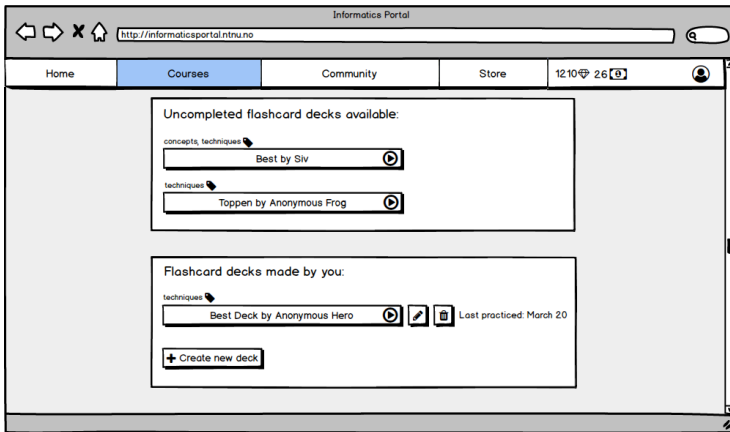
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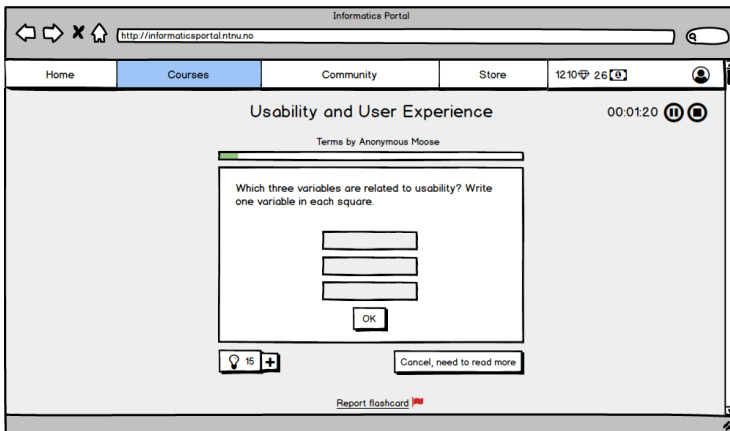
(b)
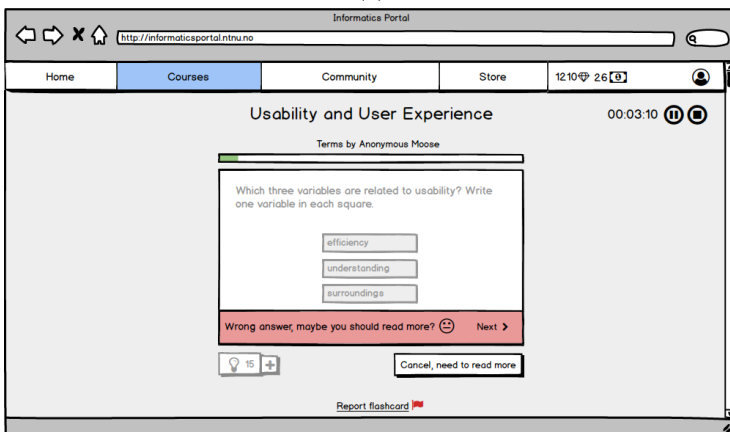
(c)

Figure H.5: Informatics Portal Iteration 2 - Part 5
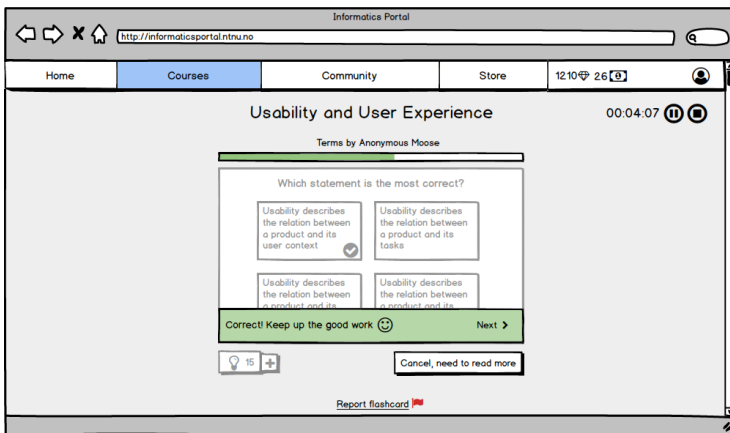
(a)
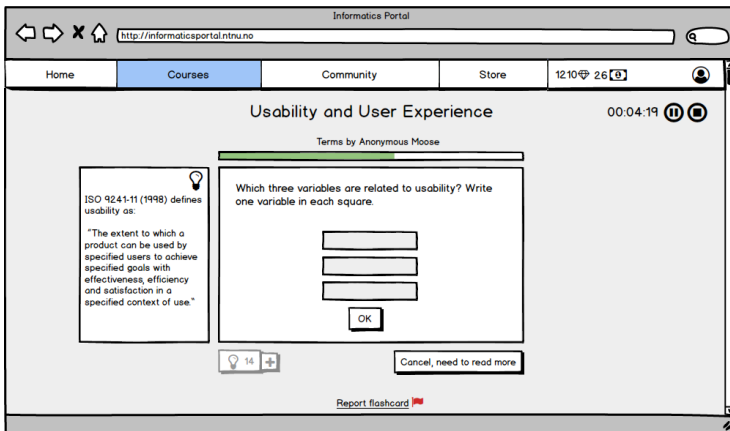
(b)
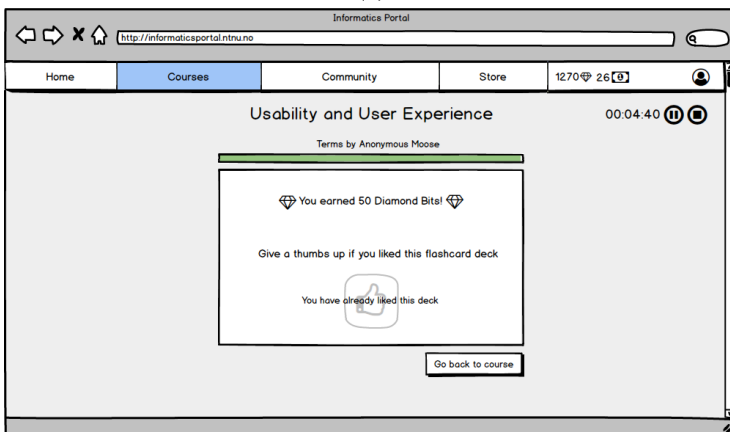
(c)

Figure H.6: Informatics Portal Iteration 2 - Part 6
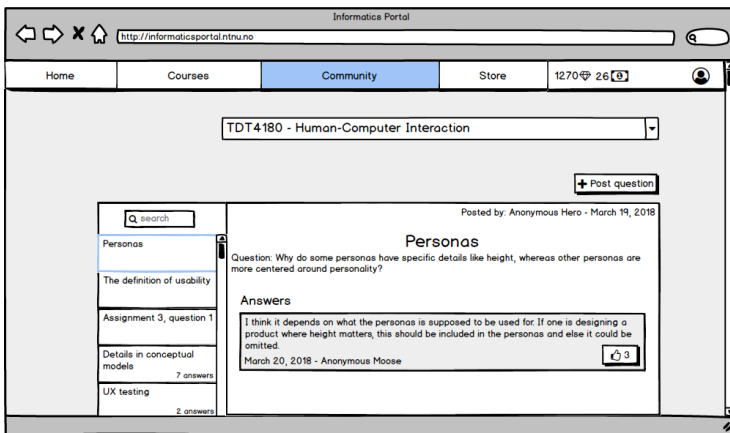
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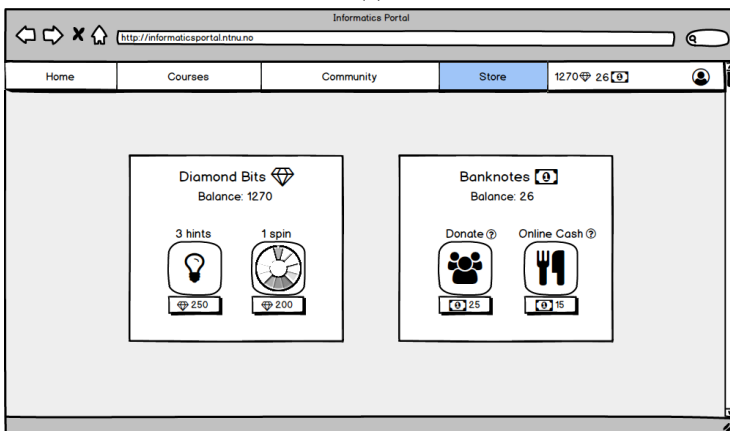
(b)

(c)

Figure H.7: Informatics Portal Iteration 2 - Part 7

I | Textual Use Cases

Table I.1: Use Case for U1 and U2

ID	U1, U2
Name	Overall overview
Description	U1: As a user I want to get an overall overview of study progress U2: As a user I want to have an overview of my accomplishments
Primary Actor	Student
Preconditions	The student must have opened the program.
Main Flow	1. Go to Home. 2. Look at progress bar of study progress and medals for accomplishments. 3. Go to Profile for additional statistical accomplishments.
Post Condition	Student got a quick overall overview.

Table I.2: Use Case for U3 - U6

ID	U3, U4, U5, U6
Name	Course overview
Description	U3: As a user I want to get an overview of course progress U4: As a user I want to know progress of specific themes in a course U5: As a user I want to know the learning outcomes for courses U6: As a user I want to know the relevance of learnings outcomes
Primary Actor	Student
Preconditions	The student must have opened the program. Instructor must have added the learning outcomes.
Main Flow	1. Go to Courses. 2. Look at the gray progress bar. 3. Look at progress bars next to each theme. These are color coded to indicate how well the student remembers the theme. 4. Scroll down to see learning outcomes. 5. Look at the tags next to the progress bars of the specific themes.
Alternative Flow	1. Go to Home. 2. Look at gray progress bar for a specific course.
Post Condition	Student got an overview of course progress, theme progress and learning outcomes.

Table I.3: Use Case for U10 - U13

ID	U10, U11, U12, U13
Name	Crowd sourced resources
Description	U10: As a user I want to contribute with resources U11: As a user I want to know if my resource contribution was good U12: As a user I want to make use of other students' resource contributions U13: As a user I want to let other students know if their contribution was good
Primary Actor	Student, fellow students
Preconditions	The student must have opened the program. Students or oneself must have added flashcards to practice.
Main Flow	1. Go to Courses. 2. Click on a theme. 3. Scroll down, click on Create new deck and create a deck with flashcards. 4. Receive likes if your flashcard deck was good. These are shown in Home. 5. Click on a flashcard deck made by others. 6. Use a hint to get the back of the flash card. 7. In the end, report or give the flashcard deck a thumbs up.
Post Condition	Student has created flashcard deck. Likes and reports are shown in Home and Profile. Student have learned through practicing flashcards.

Table I.4: Use Case for U14 - U18

ID	U14, U15, U16, U17, U18
Name	Helping each other
Description	U14: As a user I want to ask fellow students questions for help U15: As a user I want to know if my help was good U16: As a user I want to answer questions other students need help with U17: As a user I want to let others know if their help was good U18: As a user I want to explore questions other people have asked
Primary Actor	Student, fellow students
Preconditions	The student must have opened the program. Fellow students must have asked questions. Fellow students must have answered my questions.
Main Flow	1. Go to Community. 2. Click on Post question. 3. Give a thumbs up on good answers. 4. Click on a questions asked by some else in the left menu. 5. Leave an answer. 6. Receive likes, shown in both Community and Home. 7. In the end, report or give the flashcard deck a thumbs up.
Post Condition	Student got a question answered. Student answered some else's question.

Table I.5: Use Case for U19, U20 and U21

ID	U19, U20, U21
Name	Personal goals
Description	U19: As a user I want to add personal goals U20: As a user I want to check off personal goals U21: As a user I want to have an overview over personal goals
Primary Actor	Student
Preconditions	The student must have opened the program.
Main Flow	1. Go to Home. 2. See list with all goals under Personal Goals. 3. Click on the plus icon next to Personal Goals to add a goal. 4. When the goal is accomplished, click on the empty box next to the goal.
Post Condition	Student reached a goal.

Table I.6: Use Case for U22

ID	U22
Name	Inspiration
Description	U22: As a user I want to receive daily quotes for inspiration
Primary Actor	Student
Preconditions	The student must have opened the program.
Main Flow	1. Go to Home. 2. See Daily Quote.
Post Condition	Student got inspired.

Table I.7: Use Case for U23 - U26

ID	U23, U24, U25, U26
Name	Rewards
Description	U23: As a user I want to get real rewards, such as snacks from the Online store, for good help and resource contributions U24: As a user I want to get random rewards U25: As a user I want to get rewards for study effort U26: As a user I want to explore the types of existing rewards
Primary Actor	Student
Preconditions	The student must have opened the program. The student must have contributed with answers and flashcard decks.
Main Flow	1. Go to Home. 2. Spin the wheel of fortune and receive a random reward. 3. Collect rewards for received likes. 4. Complete a flashcard deck to receive more rewards. 5. Go to Store. 6. Trade Diamond Bits and Banknotes in to wanted rewards.
Post Condition	Student received rewards.

J | SUS Results Iteration 2
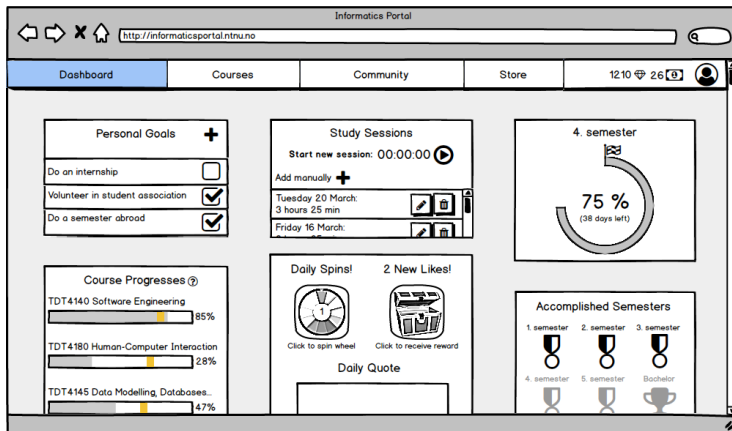
Table J.1: SUS Results Iteration 2

Statement	1	2	3	4	5
1				A B D E	C
2		C D E	B	A	
3			D	A B C E	
4	A B C D E				
5		A	D	C E	B
6	B C D	A E			
7				C D E	A B
8	A B C	D E			
9				B D E	A C
10	A E	B C D			

Table J.2: SUS Score Calculation Iteration 2

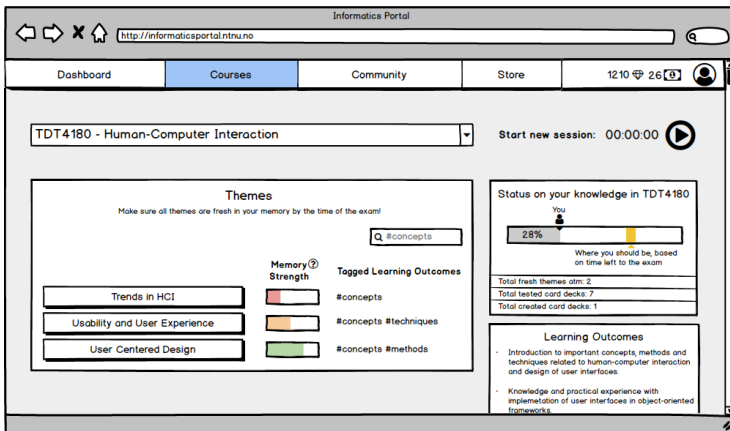| ID	Calculation	Score
A	((4-1)+(5-4)+(4-1)+(5-1)+(2-1)+(5-2)+(5-1)+(5-1)+(5-1)+(5-1))*2.5	77.5
B	((4-1)+(5-3)+(4-1)+(5-1)+(5-1)+(5-1)+(5-1)+(5-1)+(4-1)+(5-2))*2.5	85
C	((5-1)+(5-2)+(4-1)+(5-1)+(4-1)+(5-1)+(4-1)+(5-1)+(5-1)+(5-2))*2.5	87.5
D	((4-1)+(5-2)+(3-1)+(5-1)+(3-1)+(5-1)+(4-1)+(5-2)+(4-1)+(5-2))*2.5	75
E	((4-1)+(5-2)+(4-1)+(5-1)+(4-1)+(5-2)+(4-1)+(5-2)+(4-1)+(5-1))*2.5	82.5

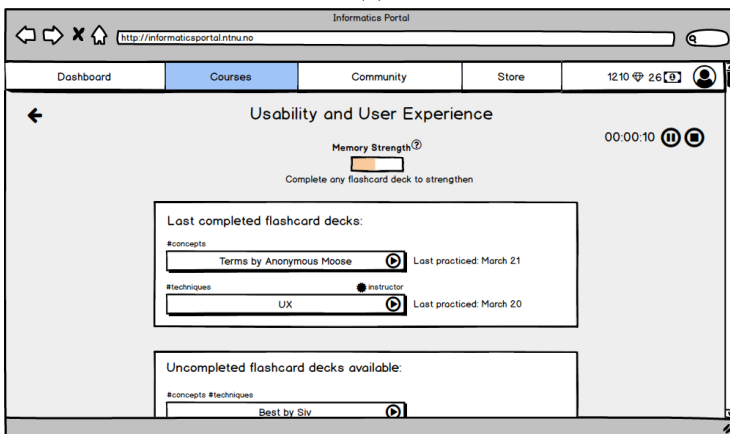# K | Prototype Iteration 3

(a)
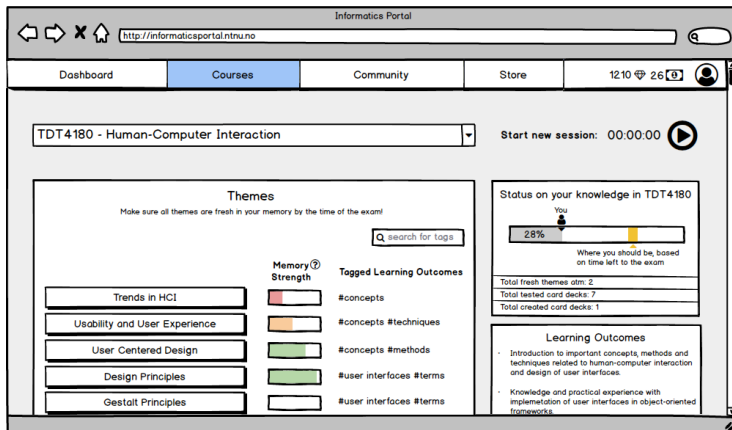
(b)

Figure K.1: Informatics Portal Iteration 3 - Part 1
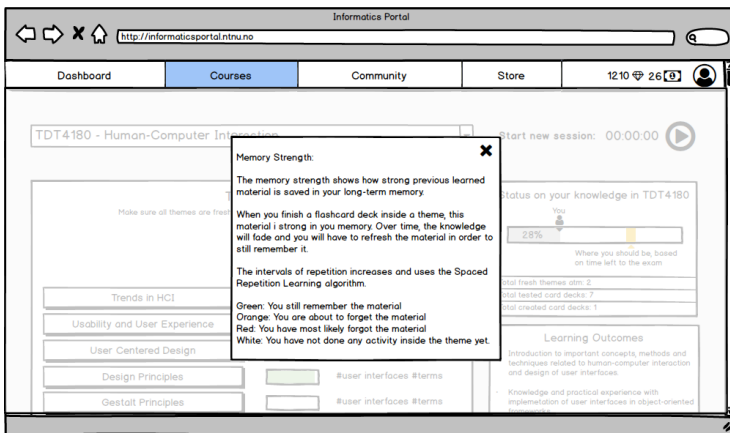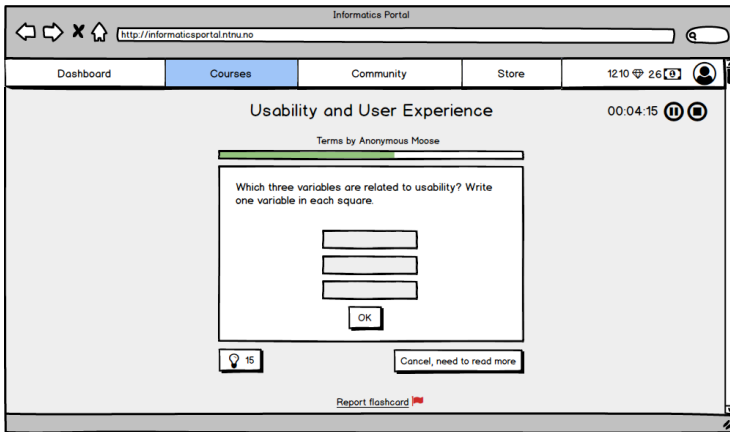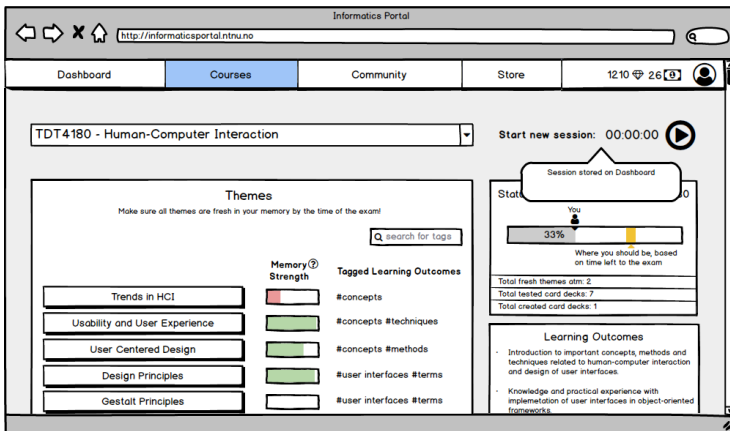
(a)

(b)

(c)

Figure K.2: Informatics Portal Iteration 3 - Part 2
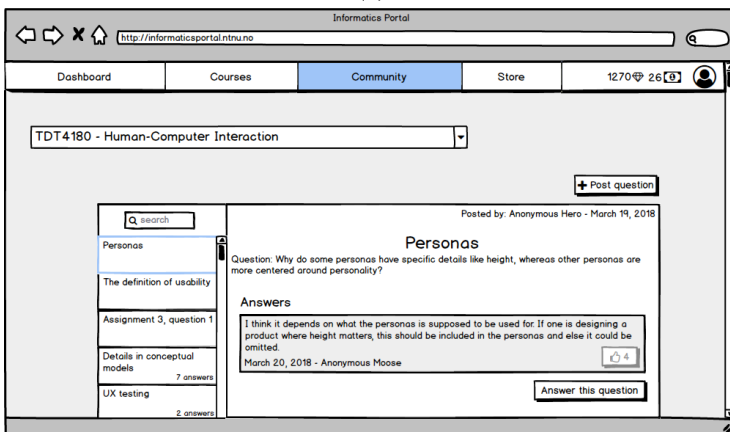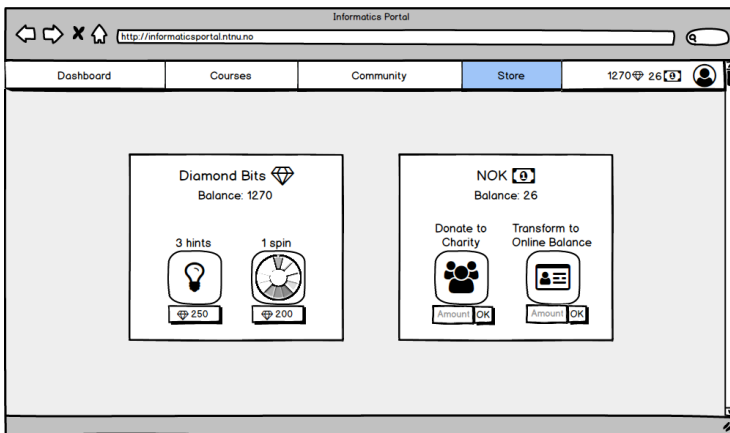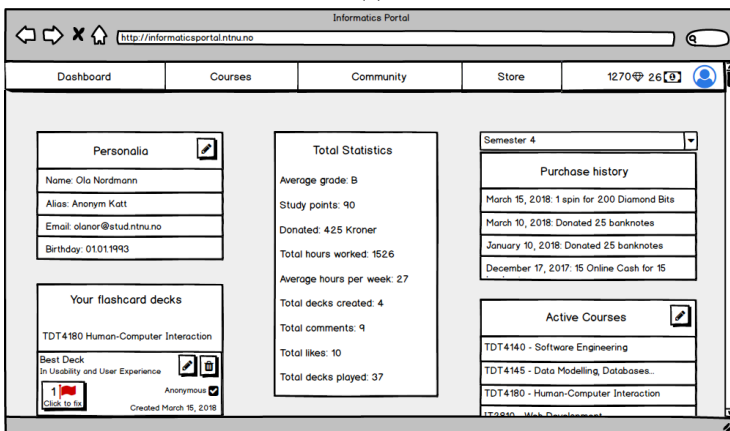
(a)

(b)

(c)

Figure K.3: Informatics Portal Iteration 3 - Part 3

(a)

(b)

Figure K.4: Informatics Portal Iteration 3 - Part 4

L | SUS Results Iteration 3

Table L.1: SUS Results Iteration 3

Statement	1	2	3	4	5
1				A B C D E	
2	A B E	D	C		
3			C	D	A B E
4	A B C D E				
5				A B C D E	
6	A B D E	C			
7					A B C D E
8	A B D E	C			
9			C	D	A B E
10	A B D E		C		

Table L.2: SUS Score Calculation Iteration 3

ID	Calculation	Score
A	((4-1)+(5-1)+(5-1)+(5-1)+(4-1)+(5-1)+(5-1)+(5-1)+(5-1)+(5-1))*2.5	95
B	((4-1)+(5-1)+(5-1)+(5-1)+(4-1)+(5-1)+(5-1)+(5-1)+(5-1)+(5-1))*2.5	95
C	((4-1)+(5-3)+(3-1)+(5-1)+(4-1)+(5-2)+(5-1)+(5-2)+(3-1)+(5-3))*2.5	70
D	((4-1)+(5-2)+(4-1)+(5-1)+(4-1)+(5-1)+(5-1)+(5-1)+(4-1)+(5-1))*2.5	87.5
E	((4-1)+(5-1)+(5-1)+(5-1)+(4-1)+(5-1)+(5-1)+(5-1)+(5-1)+(5-1))*2.5	95