Master's thesis

NTNU
Norwegian University of Science and Technology
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Department of Computer Science

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Adaptive and Gamified Learning Technologies to Support Motivation and Engagement

Master's thesis in Computer Science
Supervisor: Michail Giannakos
Co-supervisor: Zacharoula Papamitsiou
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Abstract

Gamification has become an increasingly popular concept over the last decade. Gamification involves the adaptation of mechanics and elements usually found in games, such as points, scoreboards and badges to have the user be more motivated and engaged in the non-game task at hand.

The goal of gamifying learning is to increase the motivation and engagement of the users continuous learning. Seeing as the dropout rate in higher education is quite high, actions to improve learners motivation and engagement is highly encouraged.

SmartU was created in the spring of 2020 with the goal of making the learner motivated through self-assessment of their own performance in subjects, making them self-aware of their learning outcome.

This thesis aims to investigate whether building upon SmartU with fun and engaging gamification elements will heighten the motivation and engagement of the learners engaging with SmartU. To address this issue, a collection of gamification elements were designed and developed to be deployed upon SmartU, an experimental study was conducted. The data collected during the study, was collected through questionnaires and follow-up interviews. The results from the data analysis gives an indication that the participants find the majority of the included gamification elements fun and engaging, but the quantifiable data does not show statistically significant improvement in motivation over SmartU without gamification.

Sammendrag

Spillifisering har blitt et stadig mer populært konsept det siste tiåret. Spillifisering innebærer tilpasning av mekanismer og elementer som vanligvis finnes i spill, for eksempel poeng, resultattavler og «badges» for å få brukeren til å være mer motivert og engasjert i oppgaver utenfor spill.

Målet med å spillifisere læring er å øke motivasjonen og engasjementet til brukernes kontinuerlige læring. Ettersom frafallet i høyere utdanning er ganske høyt, anbefales det tiltak for å forbedre studenternes motivasjon og engasjement.

SmartU ble opprettet våren 2020 med mål om å gjøre studenten motivert gjennom egenvurdering av sin egen prestasjon i fag, og gjøre dem selvbevisst over deres eget læringsutbyttet.

Denne oppgaven tar sikte på å undersøke om det å bygge videre på SmartU med morsomme og engasjerende spillelementer vil øke motivasjonen og engasjementet til de som tar i bruk SmartU. For å løse dette problemet ble en samling spillelementer designet og utviklet for å bli integrert i SmartU, en eksperimentell studie ble også utført. Dataene som ble samlet inn under studien, ble samlet inn gjennom spørreskjemaer og oppfølgingsintervjuer. Resultatene fra dataanalysen gir en indikasjon på at deltakerne synes flertallet av de inkluderte spillifiseringselementene er morsomme og engasjerende, men de kvantifiserbare dataene viser ikke statistisk signifikant forbedring i motivasjon over SmartU uten gamifisering.

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Acronyms

API Application Programming Interface. 10

DASH Evaluation of the dashboard as a whole. 22

GIN Game elements used inside assessment. 22, 29, 31

GOU Game elements used outside assessment. 22, 29, 31

LAD Learning Analytics Dashboard. 1, 2

OEUS Overall evaluation of the usability of SmartU. 22, 39

SmartU Self-assessment Measured with Analytics on Run-Time for YOU. 7

SUS System Usability Score. 22, 39

1 Introduction

Since Deterding's paper in 2011 (Deterding et al., 2011), the word gamification has become a trending topic on Google ('Google Søketrender', 2021). This is do to the increasing adoption of gamification in various domains, and we try in this thesis to gamify SmartU.

Learning and learning technologies have traditionally been quite the formal affair, where the learner will perform some task set forth by them by some teacher, and their performance will be assessed by the teacher after a review. SmartU is a Learning Analytics Dashboard (LAD) which gives the learner the ability to assess their own skill in a subject. The goal of this thesis is to find if the inclusion of gamification elements on top of SmartU could improve the experience of the learner.

The work of this thesis build upon the literature review performed in the researchers specialisation project (Erlingsen, 2020), and the previous work on SmartU (Westermoen & Lunde, 2020). An array of gamification elements were developed, with visual aesthetics inspired by the design of SmartU. In the following section the motivation for conducting this research will be outlined.

1.1 Motivation

Dropout rates in higher education in Norway keep being a problem (Tønnessen et al., 2016; Sæthre, 2019), with dropout rates as high as 40%. This is a problem that cannot be ignored and to attempt to keep the student motivated and engaged with their studies, any tool provided should be as straightforward to use and a engaging to use as possible.
As gamification has seen a lot interest this last decade and many studies that show good results, this could be an aiding factor in the attempt to lower the dropout rates.

SmartU in its previous iteration showed good results in terms of performance, but what about actual motivation and engagement this was not explored to its fullest. Adding gamification elements to SmartU could make the interaction with SmartU more fun and enjoyable, possibly increasing motivation and engagement with the platform. Keeping this in mind the following hypothesis is posed *"Does the intro-*

duction of gamification elements to SmartU, significantly change the motivation and engagement to keep using SmartU".

1.2 Research Question

With the hypothesis in mind these three research questions were identified:

- **Research question 1** *What is the effect of gamification elements on learners' motivation/engagement when applied to SmartU?*
- **Research question 2** *What is the learners' perceived usefulness of gamification elements in the SmartU interface?*
- **Research question 3** *Does the perception of SmartU's interface versions change if seeing the gamified version of SmartU first?*

1.3 Research strategies

This thesis follows two research strategies:

- Design and creation.
- Experiment: User-testing of the completed gamification elements.

Oates (2005) suggest that "Typically one research question has one research strategy". As some of the design process have been performed as a smaller project prior to the start of this thesis it can not be directly included as a contribution of this thesis. Still this thesis contributes with a mixed-methods study that combines quantitative and qualitative empirical data to evaluate whether adding gamification elements on top of an Adaptive Self Assessment LAD.

1.3.1 Design and creation

The design step was performed as a specialisation project this fall, and is included in its entirety as Paper I. There a literature review of the state-of-the-art in gamification elements in learning and self evaluation were performed, which concluded in suggested designs for the gamification elements.

The creation phase we will iteratively implement the suggested gamification designs

with alteration taking place in accordance to the ability of the system.

The evaluation of the gamification elements will conducted as a user-testing scenario with Within Subject Design Testing, where each participant will be subjected to each version of SmartU. To see if RQ3 can be answered, the gamification scenario will be presented as the first scenario at an alternated basis. This will be followed up by interviews of a subset of the participants, to complement the quantitative data received by questionnaires presented after each scenario.

This thesis will then conclude upon the results gathered during the research, as the gamification elements themselves only serve as artifacts for the study.

1.4 Thesis Structure

- Chapter 2 - Gives and overview of definitions, highlight of gamification elements suggested.
- Chapter 3 - Description of the systems design and implementation
- Chapter 4 - Gives an overview of the research methodology, design and user testing.
- Chapter 5 - Results from user testing.
- Chapter 6 - Discussion of the results.
- Chapter 7 - Conclusion.

2 Background

This chapter will point out some definitions of terminology used in the thesis, and bring to light the gamification elements that were evaluated for inclusion during previous work done during specialisation project this fall.

2.1 Definitions

2.1.1 Gamification

As seen in Figure 2.1, gamification have become a trending search term since early 2011. When (Deterding et al., 2011) coined the term Gamification and gave it the defenition: *"Gamification is the use of game design elements in a non-game context."*.

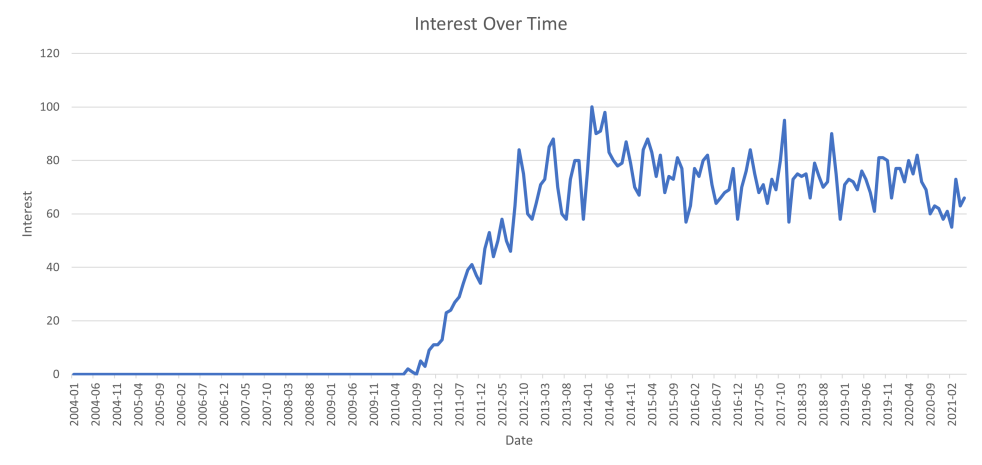

Figure 2.1: Gamification search term interest over time

2.2 SmartU

SmartU created by (Westermoen & Lunde, 2020) had the aim of creating a usable Adaptive Learning Analytics Dashboard with visualisations that would aid the usability of the dashboard. Although their study size being smaller than intended partly do to Covid-19, their system showed promise, with a high SUS score (Westermoen

& Lunde, 2020, p. 55) and mainly positive data from their study.

Through iterative research and design they came up with a sleek and modern UI, with an adaptive difficulty curve which showed promise in engaging the users in continuous learning.

2.3 Previous Work

This section will go into some detail about what was learned through reviewing literature covering gamified learning and self evaluation, and highlight the most prevalent gamification elements in use today.

2.3.1 Related Research

The literature review performed in (Erlingsen, 2020) had the aim of highlighting the prevalent gamification elements in use in modern times. This literature review covered 31 papers spanning the years 2015 to 2020, this culminated in a suggested list of gamification elements that may be used, and some visual implementations of them. See paper I

These gamification elements where covered in (Erlingsen, 2020):
Points showed great potential to provide immediate feedback; badges tended to give the participant a feeling of accomplishment; leader boards gave the participant an incentive to compete, giving them a slight motivation to become better; a narrative gave the participants an engaging story that could personally invest them in the system; adaptive elements that either change the difficulty of the learning experience based on the skill of the participants, or altered the experience in other ways based on the participants interaction with the system; Levels gave the participant a visual representation of their progress; Progress-bar the same as levels gave the participants a visual element of progression although a more animated one; Unlockable content gave the participants that experienced them a sense of accomplishment and exploration when gaining more content through interaction; Customizable profiles gave the participants a sense of ownership that motivated them to return and maintain their "property"; Avatars as well as customizable profiles give the participants a sense of ownership, but more in a way of how others on the platform they use should perceive them.; A forum or chat ability had high praise in the researched papers as it often

prompted the users to share their knowledge; And time constraints were prevalent in the papers as it is often seen as a quite basic game mechanic that give the participant a sense of emergency that may incentivize the participant to try harder.

Table 2.1 shows the gamification elements that were picked out the gamification elements covered as they could be feasible to implement on top of SmartU, and had high association with motivational gains.

Table 2.1: Chosen gamification elements with reasoning.

Gamification element	**Reasoning**
Points	Immediate feedback on performance
Badges	Rewards, collecting
Leaderboard	Motivate to climb the board
Unlockable/Time Constraint	Motivate participant to improve time
Customizable profile/Avatar	Give participant feeling of ownership
Limited atempts	Mediate the possibility of gaming the system
Adaptive difficulty *	Have difficulty scale with performance
*may be excluded dependent on platform architecture.	

Table 2.1 does not necessarily show the final list of gamification elements implemented, but rather a suggested list. As what was learner in (Erlingsen, 2020), all game mechanics does not suit all scenarios and these may be adjusted or cut based on how SmartU works. Chapter 3 will cover all gamification elements implemented, as well as an overlook of the SmartU system prior to implementation of gamification elements.

3 System Design and Implementation

This chapter will give an overview of the process of designing the gamified elements for SmartU and some technicalities around their implementation. This is done by presenting the base version of SmartU, and then presenting the gamification designs that was implemented on top of SmartU in Section 3.2. Followed by a technical description of the implementation and its limitations in Section 3.3.

The existing version of Smartu will from here on out be referred to as the legacy version, and the version made will be refered to as the Gamified version.

3.1 Tools and technologies

This section will cover the tools and technologies used for the visual design of the gamification elements and development of the gamification implementations.

3.1.1 Figma

'Figma: the collaborative interface design tool.' (2021) is a design and collaboration tool, enabling teams to work together simultaniously on the same files, designing and creating wireframes for projects. This tool was used to easily create design mockups of the gamification design ideas, making using the built in tools which make web page prototyping a breeze.

3.1.2 Google Drive

'Secure cloud storage for personal and business use – Google Drive' (2021) is a cloud storage solution that made it simple to share a spreadsheet which the study participant could sign up anonymously on. Making it easy to get a time that suited both the researcher and the participant.

3.1.3 Share Point

'SharePoint, Team Collaboration Software Tools' (2021), a part of the Microsoft Office 365 package, provided safe and secure cloud storage of sensitive data and test results of thestudy. The data agreement between Microsoft and NTNU ensured safe

accessible cloud storage, thus enabling greater efficiency, accessibility, collaboration and performance when processing the data.

3.1.4 GitHub

'GitHub: Where the world builds software' (2021), is a source control repository solution, which was used to house the source code and help keep track of the development process.

3.1.5 Docker

'Docker' (2021) is the de facto containerisation solution. Containers are in essence a cut down Linux machine which only run what is needed for the software stack to run. Utilising docker as both a development environment and production environment makes it so that if it works in development, then it will work in production. Docker was used to have a seamless development and production experience.

3.1.6 Open Badge Designer

Accredible (2021), was used to make all the badges featured in the Gamified version of SmartU. It provided a simple and intuitive way of making custom badges that would represent achievements done in SmartU.

3.1.7 PHP

'PHP: Hypertext Preprocessor' (2021), is an interpreted server-side programming language. Which make creation of a website business logic simple and straight forward, as SmartU had its server-side code already written in PHP it was retained, as the business logic language for SmartU.

3.1.8 Slim Framework

'Slim Framework' (2021), is a PHP framework that makes the creation of REST API's(Application Programming Interface) a easy and straightforward process with PHP, and this is the basis of SmartU's API.

3.1.9 MySQL

'MySQL' (2021), is a relational database solution which provides speed and flexibility as well as being a free and open source solution, which makes it easy to find guidance in online communities when facing issues.

3.1.10 React JS

'React – A JavaScript library for building user interfaces' (2021), was used to build SmartU's user interface and is also used to build the gamification elements that will be grafted onto SmartU. ReactJS is easy to learn framework to learn for building appealing and performent user interfaces.

3.2 Design

As the "design language" of SmartU have already been set in (Westermoen & Lunde, 2020), to be a system with lively colours and a modular looking interface with rounded edges. This made the initial system design phase somewhat mute as it is more of designing how the gamification elements should look in context with SmartU as to not feel out of place.

The design suggestions made in the specialisation project in the fall (Erlingsen, 2020), have been slightly altered to better fit the scenario, and some have not been implemented due to either not fitting a self evaluation scenario, or not being technically feasible.

The assessment progressbar seen in (Erlingsen, 2020, p. 18) was implemented, but due to that the final version of SmartU will have a dynamical number of questions the progressbar would either not be representable of the actual progress in the assessment, or be directly misleading.

Also seen in (Erlingsen, 2020, p. 18) is a representation of "strikes"(attempts before failing an assessment), these in conjunction with the product owners of SmartU was deemed not to be in the spirit of self assessment and were therefore left out.

On (Erlingsen, 2020, p. 19) there is shown an immediate result after answering an assessment task, these were tweaked to look like the figures 3.1.

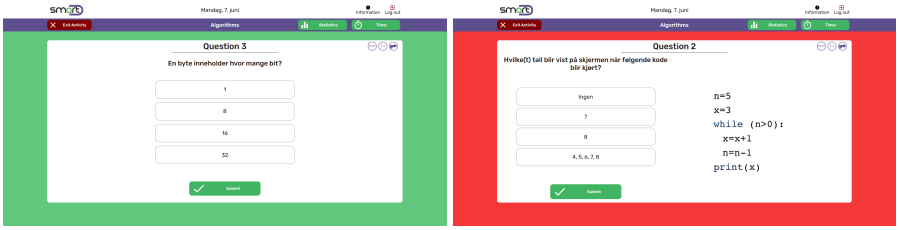

Figure 3.1: Implemented immediate feedback features

The screens shown in figure 3.1 deviate from the suggested design after considering that they would be to intrusive with an extra step that had to be conducted before being able to continue the assessment.

The main page design as seen in figure 3.2 ended up being quite similar to the initial suggested design with the exception of a leaderboard, which was left out to not entice competition in a system that should be all about the evaluation of one owns skill in a subject.

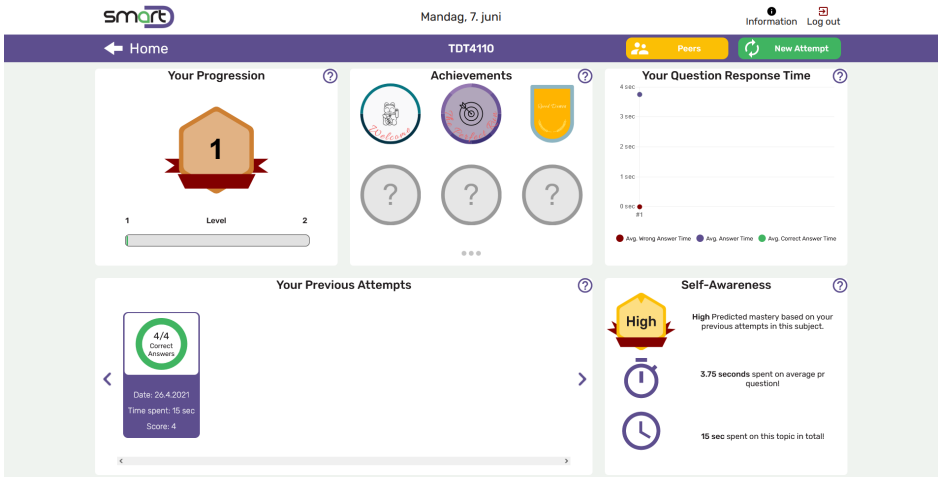

Figure 3.2: Main Activity page

The top left module in figure 3.2 shows the progression level module, that show the participant their current level inside a badge that will change as they progress through the level tiers of which there are three, accompanied by a progressbar that show how far away they are from the next level. The top middle module shows a preview of the achievement badges which will expand into a modal when clicked, providing a complete overview of the available badges as seen in figure 3.3, here the complete

available collection of badges will be shown, the ones that have yet to be unlocked can be hovered with the mouse to reveal a hint on how to unlock them.

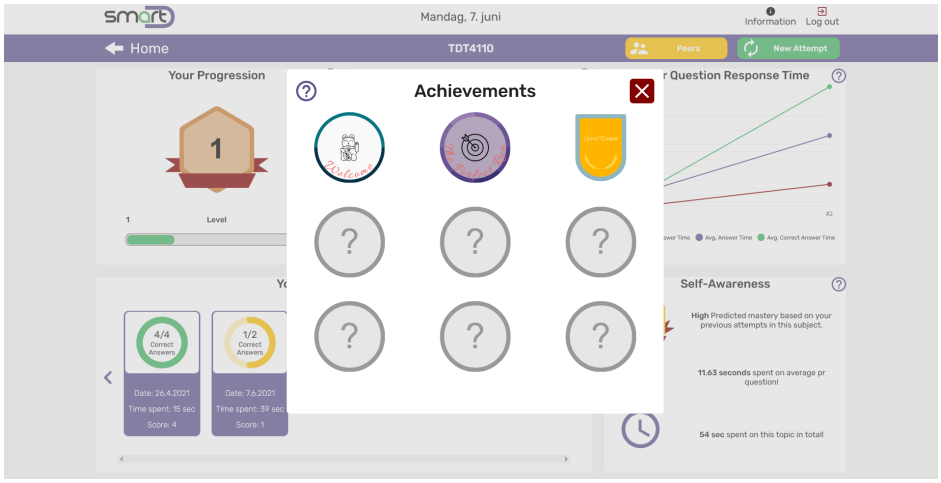

Figure 3.3: Badge overview modal

Now onto some of the elements that were designed and implemented that were not mentioned in (Erlingsen, 2020). The landing page of SmartU did not see any game elements exclusive to it, but did receive one that is prevalent throughout the gamified version of SmartU, which is help icons these show in the top right corner of each module seen in figure 3.4 and when hovered will show a helping hint of what this module contains.

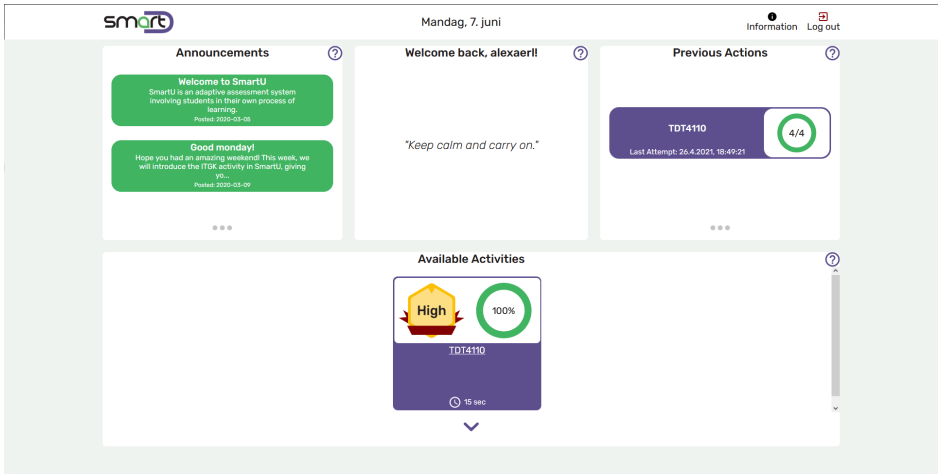

Figure 3.4: Landing page with help icons

Two new types of tasks were designed as seen in figure 3.6, the task on the left show a fill in the blanks of the text type of task, where the user will drag and drop the correct word in the correct spot in the sentence. On the right there is a reordering task, where the provided alternatives have to be dragged and dropped in the correct order.

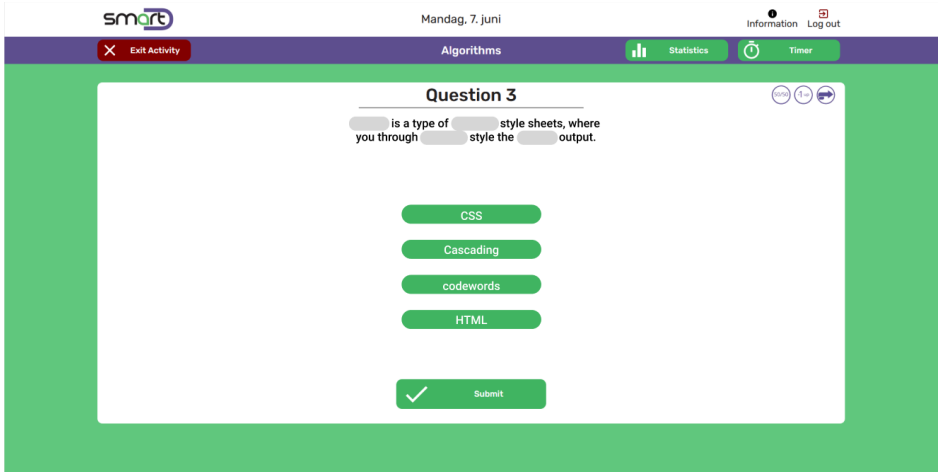

Figure 3.5: Fill in blanks

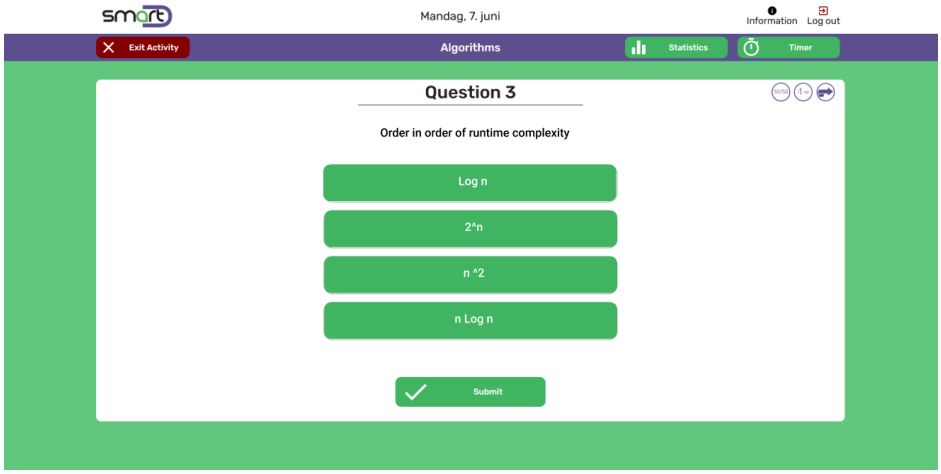

Figure 3.6: Reordering task

The icons seen in figure 3.7 represent help actions, or "power ups" that the user may interact with during assessment to make their time with the assessment easier on them. The icon with the image of 50/50 will remove half of the wrong answers available in the tasks, or in the case of fill in blanks put half of the word in the correct spot, or in the reordering task put the top half in the right place. The +1up gives the

user an extra attempt at the task if they were to answer incorrectly, and the arrow lets the user skip the question without being penalised.

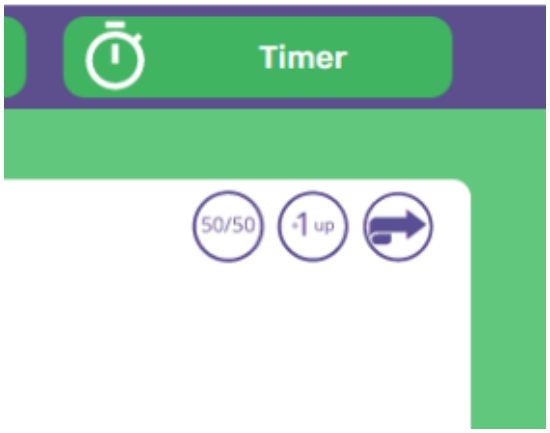

Figure 3.7: Help items

3.3 Implementation

This section will cover the technical aspect of implementing the designs on to SmartU, as well as highlighting some limitations with implementing the solutions.

The systems technology stack is as viewed in figure 3.8, where React JS makes up the user interface and MySQL in pair with the PHP Slim Framework makeup the server end.

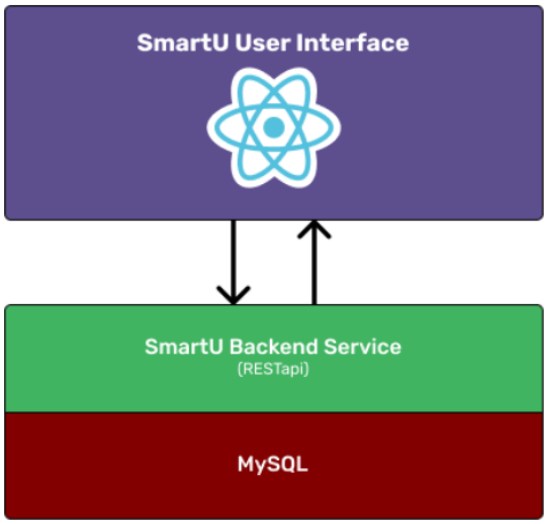

Figure 3.8: Technology stack

3.3.1 Limitations

A limiting factor on how the gamification elements might be developed was set early on, as the product owner wished the PHP code to be left untouched as much as possible, instructing the researcher to expect that everything needed for the gamification elements are already sent by the server. Making the development of the gamification elements more challenging as the data needed will have to be processed entirely in Java Script, and new data tables and API endpoints could not be made to serve the gamification elements specifically.

3.3.2 Badges

The implementation of badges turned out to be a challenge as the calculations of which badges the user had earned would have to be done at run-time with data fed from the server, checking if each badge condition had been met before showing them on screen.
The visual implementation of badges was done by creating a custom React component that would house each and every badge, which were SVG elements created with Open Badge Designer.

3.3.3 Progress Levels

The implementation of the progress level module was done by re-purposing the Mastery badge used in the legacy version of SmartU to house instead the level the user had achieved. The progress bar was made by creating a custom React components that used CSS to draw the progress bar with an easing in animation. The levels was calculated based on the amount of correct answers the user has given in relation to the total amount of tasks available.

3.3.4 Reordering Task and Fill in Blanks

Both reordering and fill in blanks were made with drag and drop functionality, where reordering would reorder a list upon dropping the option in a different position. While fill in blanks shared the technology used it posed more of a challenge as the fill in blanks should be based on the task text itself. This was implemented in such a way that e keyword in the task text would trigger the creation of droppable are component, which in turn would then be injected into the task text and take its place, making it possible to drop the green blocks into the grey fields.

3.3.5 Feedback mechanisms

To give the user some feedback to their answers, the background colour would change and sound would be played. As the React frontend does not know what is the correct answer to the task, this had to be done after the server responds with the answer. As the component that houses the task is sub a component of the component that receives the tasks, the control of the background colour and sound needed to be triggered when the React code received the answer. This was done by making a forward reference to a function that would trigger when tasks was answered, and would then in turn play the corresponding sound and change the background to an appropriate colour.

3.3.6 Help Items "Power Ups"

One of the power ups where made entirely with React, the 50/50 power due to the React code receiving the task with the answers in a predefined order it could relatively easily remove half of the answers that were not correct, this was done in such a way that the wrong answers that would be chosen to be removed were random. The +1up

power up would send a flag to the server, that would trigger so that if the answer was not correct the server would just send back the same task as before and not log this attempt. The skip function were made in a slightly similar manner as +1up where a flag was sent to the server, which would make the server send back a new task excluding the skipped task as an option.

4 Method

This chapter will cover how the study was conducted, described in the chosen research design and research methods detailed in Section 1.3. Section 4.1 cover how the user-testing was conducted, including a short description of the sample of participants. Section 4.2 will cover what data was collected and how it was analysed.

4.1 Study Design

In conjunction with research supervisors, within subject designed study was chosen as the study design. This is where each participant will be subjected to each scenario of the study. This entails that each participant would experience both the legacy and gamified versions of SmartU in varying order, to both see whether RQ is fulfilled and to see if the order of which the experience were presented posed any effect the attitude towards the gamified or legacy versions.

4.1.1 Participants

In total 12 participants completed the study. For recruiting participants an online bulletin board advertisement was posted, the recruitment ad can be seen in Appendix A.1. To further aid the the number of participant acquaintances of the researcher was asked if they could be interested to participate.

The resulting sample of 12 participants consisted of 7 (58.3%) females, 5 (41.7%) males, and included people in the age-range of 21 - 62 years-old (M=28.67; SD=10.99). Seven (58.3%) of the participants were students of NTNU, while the rest had other affiliations.

4.1.2 Test-setup

As Covid-19 has proven to stick around, the user testing could not be done in person at a fixed location with a well controlled environment. This made is so that SmartU had to be hosted online during testing, and the user-testing would be guided through online conference meeting (‘Zoom’, 2021), where the participants would use their own computer to test SmartU. SmartU was hosted on servers owned and run by

NTNU, making the data-integrity easy and safe to control in compliance with the data treatment agreement with NSD.

4.1.3 Process

As mentioned in Section 4.1 the study followed a within subject design. This made it so that all participant would see both versions of SmartU. None of the participants had any previous knowledge of SmartU. As there is only one researcher, a maximum of one participant could conduct the testing at a time. This was done so that the researcher could be available to the participant for any enquiries, and take notes during the user testing, of how it was going and note any stray comments the participant might have during the testing to try and capture some of the impressions made.

User-testing

Prior to testing, the participants were sent a Consent form Appendix A.2 which had to be signed before user testing could commence, to be in line with regulations set fourth by NSD.

The participant were asked to create a user-profile in the SmartU system and familiarise themselves with the system before continuing. After familiarising themselves with the system, the participants were asked to complete at least two full assessments of the available activity. Each attempt consisted of 12 questions, with with two to four possible answers, with only one correct answer in the legacy version, where as the gamified version would have the possibility of showing reordering tasks and fill in blanks as well.

While the participants were using SmartU, all the way from setting up a new user to finishing the last assessment and logging out of the system, the researcher was taking notes and providing aid as the participant felt the need.

After testing one version of SmartU the participant was directed on to filling out a survey of their current experience. With the survey coming after the gamified version containing questions directly related to the gamification aspects of SmartU. All who participated in the user testing were offered a Midtbyen giftcard (‘Midtbykortet - Gavekortet for Midtbyen’, 2021) or a giftcard at Komplett (‘Hele Norges nettbutikk - alltid gode tilbud’, 2021), valued ate 250,- NOK.

Interviews

The final part of the study consisted of a follow-up interview, conducted up to 7-days after the participants experience with SmartU. As all of the participants experienced both versions of SmartU all of them was given the opportunity to participate in a follow-up interview. Eight (8) participants completed the interview. The interviews were conducted with Zoom ('Zoom', 2021), which gave the opportunity of recording the audio of the interviews for transcription, the interviews were carried out in either Norwegian or English depending on what the participant were most comfortable with. More on the interviews in section 4.2.3.

4.2 Research Design

This section will cover the data collection methods used in this study, and describe the reasoning behind them. Followed by descriptions of the analysis performed on each of the types of data collected.

4.2.1 Data collection

As the performance of the participants is not relevant to this study no usage data of SmartU was collected, this part will describe which data was collected from the surveys, interviews and noted during user testing.

Surveys

The surveys used after each phase of the user testing were the source of quantitative data, and represented the participant views, opinions and attitude towards the two version of SmartU. In accordance with the approved NSD application they surveys where made using UiO Nettskjema.

The questionnaire compiled in (Westermoen & Lunde, 2020) was used as a basis for the questionnaires used in this study. Westermoen and Lunde (2020) reference [Oppenheim, 2000] as the reasoning for going with a 5-point liker scale, and dividing the survey into categories. As the reasoning for this is sound this trait was mimicked, to keep the comparison between the two version of SmartU relevant to the previous work.

Table 4.1: Overall categories in the questionnaire and their constructs

Category	Acronym	Constructs
System Usability Score	SUS	Usability score
Overall evaluation of the usability of SmartU	OEUS	General Usability
Evaluation of the dashboard as a whole	DASH	Usage Motivation Usefulness Positive and Negative emotions Intent for further use
Game elements used inside assessment	GIN	Usability of features Usage Usefulness Intuitiveness Motivation Positive and Negative emotions
Game elements used outstide assessment	GOU	–"–

The first two categories shown in Table 4.1, *System Usability Score* (SUS) and *Overall evaluation of the usability of SmartU* (OEUS) are the same as in (Westermoen & Lunde, 2020), to be able to compare the usability between the two versions of SmartU. (Westermoen & Lunde, 2020) had good scores in these two metrics, and keeping them the same will simplify the comparison in a way that if there is a statistically significant difference between the legacy version and the gamified, one could conclude that the implementation of gamified elements made an effect in one way or another.

Evaluation of the dashboard as a whole (DASH) is inspired by AGV, UGV and GVA from the questionnaire from (Westermoen & Lunde, 2020), where the questions were adapted to cover the entire experience as a whole to see if there could be measured any difference between the versions.

Game elements used inside assessment (GIN) and *Game elements used outside assessment* (GOU) takes inspiration from the same sources as DASH, but aims to find

how the participants perceive the gamification aspects.

Interviews

As stated in Section 4.1.3, after up to 7-days after the user testing, the participants that agreed to an interview where interviewed following a semi-structured approach, and the interview guide in Appendix A.3. This guide describes how the interviewer should act during the interview, with striking up an informal chat to lower the tension and a list of predefined open-ended questions that were meant to get the participant started talking about their experience with SmartU, sharing any feelings and thoughts they might have. Examples of predefined questions can be seen in the list below.

- Did you find the SmartU system interesting? If you did, how so?
- Do you think that the system would improve your motivation to study? If you do, why would it do that?
- What do you think of the game elements used in one of the user interface implementations?

During testing

Although the user testing sessions were not recorded the researcher would take notes of events during the testing session, as well as statements and comments made by the participants. This was done to get some data from the participants first impression of the system. This data was not enumerated into numerical values, but they gave insight that could be used in the discussion in Chapter 6.

4.2.2 Quantitative Analysis

The quantitative data analysis was done by aggregating data from the surveys. The quantitative data was further processed using Statistical Product and Service Solutions (SPSS) by IBM, to ease the extraction of descriptives of the data, and as mentioned in Section 1.3 perform Correlation analysis and Independent Samples T-tests on the survey data.

Correlations

To find meaningful relationships between the quantitative data, the Pearson product-moment correlation coefficient (Pearson's Correlation) was used. When Sig(2-tailed) was lower or equal to 0.05 one could state that there is a significant correlation between how the compared data behave.

Independent Samples T-tests

To compare variables Independent Samples T-test was used, with this approach one can easily compare whether there is any statistically significant difference between two groups in one within one variable. Significance as with correlation will be signified with Sig(2-tailed) being lower or equal to 0.05. As all participants experienced both scenarios the answers were grouped based on whether it was answered after the legacy version or the gamified version. This gives the groups equal size, giving the possibility of finding large effects even though sample size is small.

4.2.3 Qualitative Analysis

To analyse the interviews described in Section 4.2.1 the recordings of each interview was imported into Word Online in Share Point, and the interviews were automatically transcribed with errors. Then the transcriptions were manually fixed by ear.
The transcripts were then manually analysed for recurring subjects, and the attitude towards the different aspects were aggregated into positive, neutral or negative scores of the system aspect.

5 Results

This chapter will present result from the user testing and interviews performed, the user testing provided mostly quantitative data of which is presented in Section 5.1 and the interviews resulted in more qualitative data presented in Section 5.2.

5.1 Quantitative Results

In this section quantitative data collected in questionnaires and analysed with SPSS is presented, starting of with an analysis of the usability in Section 5.1.1, followed by a presentation of data from the overall evaluation of dashboard section from the questionnaire ending data focused on the Gamification elements.

5.1.1 SUS and OEUS

SUS is a good indication of the overall usability of some system without directly asking *"How usable do you find this?"*. This can lead to a more overall honest portrayal of usability. While OEUS measures how usable the participants perceive the system, these two metrics where included to measure whether the inclusion of Game-like elements would diminish the overall usability of SmartU as a whole as these two metrics were also tested in (Westermoen & Lunde, 2020).

Independent T-test on these two metrics where performed to find whether the usability of SmartU would remain consistent between the gamified and the non-gamified versions.

SUS

To get an indication whether the SUS score would have any statistical significant difference between the versions of SmartU, a independent T-test between the version was performed.

In Table 5.1 we see that the independent T-test does not show a statistical difference in usability of SmartU between the versions.

Table 5.1: Independent T-test SUS and OEUS

Equal variances assumed	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
SUS	,342	22	,736	,07500	,21960
OEUS	1,720	22	,099	,39815	,23148

Table 5.2 shows that between the two phases of user testing, there can not be said to be any significant difference between any of the topics covered in SUS. Topics were re-coded such that a higher number means a better score, this was done to make the visual control easier when looking over descriptives.

Table 5.2: T-test between each topic in SUS

Equal variance assumed	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Frequent Use	0,752	22	0,460	0,250	0,332
Unnecessarily complex	0,492	22	0,628	0,167	0,339
Easy to use	-0,557	22	0,583	-0,167	0,299
Would need support	0,000	22	1,000	0,000	0,266
Well integrated functions	2,183	22	0,040	0,750	0,344
Too much inconsistency	-0,233	22	0,818	-0,083	0,358
Learn it quickly	0,000	22	1,000	0,000	0,210
Slow or complicated	-0,484	22	0,633	-0,167	0,345
Felt confident	0,761	22	0,455	0,167	0,219
Required training	-0,447	22	0,659	-0,167	0,373

Table 5.3 shows the average score breakdown between the two phases, and shows a small lead to the gamified version.

Table 5.3: SUS score table

Question	Legacy phase (N=12)	Gamified phase (N=12)
Q1 - Frequent Use	3,92	4,17
Q2 - Unnecessarily complex	1,75	1,58
Q3 - Easy to use	4,58	4,42
Q4 - Would need support	1,33	1,33
Q5 - Well integrated functions	3,58	4,33
Q6 - Too much inconsistency	1,67	1,75
Q7 - Learn it quickly	4,58	4,58
Q8 - Slow or complicated	1,50	1,67
Q9 - Felt confident	4,67	4,83
Q10 - Required training	1,67	1,83
Average SUS-score for group	83,54	85,42

OEUS

OEUS was included as it measures usability more by directly asking the participants about how they perceive the usability of the system. As seen in Table 5.1 it can not be said to be a statistical significant difference in OEUS between the two versions.

One question in the variable that is meant to measure whether the system provides the users with joy/happiness, show statistically significant change in favour of the gamified version of SmartU, as seen in Table 5.4.

Table 5.4: Independent T-test between all questions in OEUS

Equal variances assumed	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Navigational ease	,355	22	,726	,167	,470
Autonomy	,986	22	,335	,417	,423
Ease of use for beginners	-,394	22	,698	-,083	,212
Navigational error unlikely	,596	22	,557	,167	,280
Easy to understand	-,447	22	,659	-,167	,373
Provides joy	2,449	22	,023	1,000	,408
Encourage engagement	2,057	22	,052	,833	,405
Encourage continued use	1,641	22	,115	,750	,457
Would continue use	1,732	22	,097	,500	,289

Table 5.5 show the descriptives of the two phases of user testing in regards to each topic in OEUS.

Table 5.5: OEUS descriptives

Topic		N	Mean	Std. Deviation
Navigational ease	Gamified	12	3,92	1,240
	Legacy	12	3,75	1,055
Autonomy	Gamified	12	4,08	1,165
	Legacy	12	3,67	0,888
Ease of use for beginners	Gamified	12	4,50	0,522
	Legacy	12	4,58	0,515
Navigational error unlikely	Gamified	12	3,83	0,835
	Legacy	12	3,67	0,492
Easy to understand	Gamified	12	4,17	0,937
	Legacy	12	4,33	0,888
Provides joy	Gamified	12	4,50	0,674
	Legacy	12	3,50	1,243
Encourage engagement	Gamified	12	4,50	0,905
	Legacy	12	3,67	1,073
Encourage continued use	Gamified	12	4,33	0,985
	Legacy	12	3,58	1,240
Would continue use	Gamified	12	4,50	0,674
	Legacy	12	4,00	0,739

5.1.2 Overall Dashboard Evaluation

Table 5.6 shows an independent T-test of the overall evaluation of the visual representation of the dashboard between the gamified version and the legacy version, it does not show any statistically significant difference in the versions evaluation of the dashboards visual representation.

Table 5.6: Overall evaluation of the Dashboard between the two phases

Equal Variance Aassumed	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
DASH	1,359	22	0,188	0,37121	0,27318

5.1.3 Game Elements Used

A independent T-test between whether the Gamified version was seen first or the legacy version was seen first was performed. As seen here in Table 5.7 there can not be said to be a statistically significant difference in how the gamified elements were rated.

Table 5.7: T-test between the orders the participants were exposed to the Gamified dashboard

Equal Variance Assumed	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
GOU	0,782	10	0,453	0,16667	0,21322
GIN	-0,617	10	0,551	-0,18333	0,29712

As Table 5.8 shows, there is in general high evaluation of the gamified elements shown to the participant given the answers they gave in the questionnaire.

Table 5.8: Descriptives of questions regarding game elements

Game Questions Descriptives					
	N	Minimum	Maximum	Mean	Std. Deviation
Clearness off leveling system	12	4	5	4,75	0,452
Badges conveying performance	12	3	5	4,58	0,669
Usefullness of Badges	12	3	5	4,67	0,651
Level progression usefullness	12	4	5	4,42	0,515
Usefullnes of badge hints	12	3	5	4,67	0,651
Badges giving motivation	12	4	5	4,83	0,389
Levels provided engagement	12	3	5	4,50	0,674
Feadback system was easy to understand	12	3	5	4,67	0,651
Assessment summary is understandable	12	4	5	4,75	0,452
The help mechanics are easy to find	12	2	5	4,17	1,030
The help items in assessment where usefull	12	3	5	4,42	0,793
Usefullness of feadback system	12	2	5	4,58	0,900
Usefullness of audio	12	1	5	3,00	1,348
Correct answer jingle providing motivation to continue	12	1	5	4,33	1,303
Help items made it motivating to continue	12	1	5	3,83	1,193
Game elements made assessment more fun and engaging	12	4	5	4,83	0,389
The help items made assessment less stressfull	12	2	5	4,33	0,888

5.1.4 Correlations

A Pearson correlation test was performed between the various variables collected gave this seen in Table 5.9. Here we can see that there is a positive correlation between most of the variables measured except for the measurement of Game Elements used inside assessment.

Table 5.9: Correlation between variables

Correlations				
		DASH	OEUS	GOU
OEUS	Pearson Correlation	,841**		
	Sig. (2-tailed)	0,001		
	N	12		
GOU	Pearson Correlation	,801**	,722**	
	Sig. (2-tailed)	0,002	0,008	
	N	12	12	
GIN	Pearson Correlation	0,298	0,451	0,340
	Sig. (2-tailed)	0,347	0,141	0,280
	N	12	12	12
**. Correlation is significant at the 0.01 level (2-tailed).				

5.2 Qualitative

This section presents the qualitative findings made during the qualitative analysis as described in Section 4.2.3. The results presented in this section have come from notes taken from statements made by participants during the live testing session, comments made by participants in the questionnaire and extracted from the 8 interviews that were conducted. As the findings in the interview part are statements made by the participants of the study, some of the original statements are in Norwegian and will be presented alongside an English translation where applicable. This is needed so that the intent of the expressions are not lost in translation.

5.2.1 Interviews

As stated in Section 4.2.3 the analysis of the interviews due to low volume were simplified to manually finding recurring themes that are relevant to the RQs defined in Section 1.2.

In Table 5.10 the recurring themes that came up during interviews, and the tone of their depiction in the interview with either positive, neutral or not mentioned and negative attitude towards the themes.

Table 5.10: Interview feature assessments

Feature \ Rating	Positive	Neutral/ Did not say	Negative
Ease of use	6	2	0
Visual Design	6	1	1
Badges	8	0	0
Immediate Feedback	6	2	0
Sound	2	4	2
Motivating	6	2	0
Power Ups During Assessment	4	4	0
Legacy Feature (Graphs, Statstics)	4	4	0

As can be seen in Table 5.10 almost all of the interviewees had a viewpoint in all the themes mentioned, and that there is variation in the data shows getting good coverage of the systems content.

When it came to ease of use there were almost a unanimous agreement that the system was easy to use, where one participant stated that:

Norwegian:

"Brukeropplevelsen var veldig god, den var klar og tydelig, og det er jo intuitivt hvordan du skal gå frem for å bruke teknologien. Du trenger ikke noe opplæring, så du kan ta det i bruk med en gang, og det er jo et stort pluss da."

English:

"The user experience was very good, it was clear and distinct, and it is intuitive how to proceed to use the technology. You do not need any training, so you can use it right away, and that is a large plus."

When it came to the visual design aspect, some participant had this to say:

Norwegian:

"Ja, det var ganske stilrent og oversiktlig. Det var fint med sånne store fargerike knapper som gjorde det lett å se."

English:

"Yes, it was quite stylish and clear. It was nice with such big colorful buttons that made it easy to see."

And another stating this:

English:

"Uhm, I think I like the layout. I like how everything was situated, uh, in kind of boxes and very organized. I also like the colors that were chosen."

Speaking of the badges, all of the interviewees talked positively about them and some even stating that:

Norwegian:

"Også likte jeg achievement delen. Det var litt gøy... Hadde jo grinda det sikkert, bare for å ha gjort det."

English:

"I also enjoyed the achievement part. It was fun ... Would have grinded it for sure, just to have it done."

Though universally liked one stated this:

English:

"And instead of showing the question mark like just hide all the badges, you can just show all the badges and just disable it like greyed out so that will make it more

attractive for me to win all the badges."

When it came to immediate feedback, some spoke quite positively about them:

English:

"The part I specially like is the the first system I got, when I answer a question and if I answer correctly it would give me a sound and the background would be green color. And if I answered wrong, it would give me another sound and the background turn red. For me personally, I like this immediately response that I know I'm right or wrong."

And another participant said this:

English:

"I think I like that part where I you know when you got the answer right and the screen light up in green, that was kind of rewarding."

And another saying this about the feedback:

English:

"Uhm, one system gives me the immediate response. So, when I use the second system and when I answer the question, I didn't get any response and so I feel a bit worse, but not that bad."

Sound were a more controversial topic, where not all the sound was received positively as one participant stated:

Norwegian:

"Lydeffektene skjønte jeg ikke først, det var fordi jeg startet med feil svar, jeg trodde det var feil med mikrofon."

English:

"I did not understand the sound effects at first, it was because I started with the wrong answer, I thought there was something wrong with the microphone."

And another stated that:

English:

"I really did not like the loud sound of when you made a mistake, I was a little bit startling. It's not that it shouldn't have any sound, because maybe that's a nice effect right there, but maybe something softer or something less sharp."

When it came to if they found the gamified system motivating, there were none that found any part demotivating or demoralising. Where one participant said this:

English:

"I prefer the first one, I would say because there is some feedback on whether you answer the questions correct or not. And also you get some help like there's some question marks that you can get more information and. And there are something like, you can eliminate some options if you want and you get more chances to answer the questions, I like this. "

The power ups that were available during assessment had someone saying this:

English:

"Take off 50% of the answers that are wrong and the other options which was, If you failed an answer, you could still go for the for another try that was, yeah that was nice. I think it made the learning experience better. "

Some of the legacy mechanics, like answer time graphs and statistics where mentioned in roughly half the interviews, and one stated this:

English:

"I like the diagram that study activity performance, something like that. I remember it's in a right corner."

And another:

Norwegian:

"Altså var det veldig god oversikt med de dere chartene og grafene og slikt litt gøy sånn statistikk."

English:

"So it was a very good overview with the charts and graphs and such a bit of fun statistics."

5.2.2 Session Notes

The session notes are presented as paraphrases taken from expressions made by the participants during the live user testing, as there was not made any recordings of the live sessions, and therefore a full transcript is not available. And is meant as a supplement to the qualitative data from the interviews.

Motivational differences between the versions were stated by one of the participants:

"I found it more motivating during assessment with immediate feedback."

Comments to the sounds used, were more plentiful:

"The failure noise was brutal."

"There should be an option to adjust the volume of the noises, and/or turn them of."

"I would like the ability to turn of the sound."

"I found the sounds to be delayed."

The way levels increased were commented with this:

"The progression should be point based and become progressively harder as you reach higher levels"

Comments to the first viewing of the gamified main page of activity:

"The first viewing of the activities main page should pull focus towards starting a new test."

5.2.3 Survey Comments

This section will present some comments made in the questionnaires that directly comment on some of the gamified aspects of SmartU.

Comments to the noise used in relation to wrong answers:

Norwegian:

"Litt heftig lyd og rødfarge når man gjør feil"

English:

"A little bit harsh noise and red colour, when answering wrong."

Norwegian:

"Det føltes som lyd effekter kom alt for lenge etter visuelle effekter."

English:

"It fealt like the sound effects were delayed in relation to the visual effects."

Engslish only:

"The response to correct or wrong (especially wrong) can be a little more subtle. The sound effects affect the focus."

Comments towards the levelling system in SmartU:

The levels in and of themselves seemed to lack a broader context, I don't really know what Lv5 means when compared to Lv7.

6 Discussion

As the previous chapter presented the results from the study, this chapter will discuss these results and try and make sense of whether the result can support the Research Questions.

6.1 Is the gamified version more motivating?

The main research question of this thesis is whether or not gamification can improve the motivation and engagement of the users of SmartU.
When looking directly at the quantitative data seen in Section 5.1 the usability of SmartU measured by SUS and OEUS does not show any statistical difference. This in light of how they performed in (Westermoen & Lunde, 2020) is good, as it shows that the inclusion of gamified elements did not adversely affect the usability of SmartU, but on the other hand it did not greatly improve it either.
Although the independent T-test between the phases on each topic of OEUS does show one topic that covers giving the user joy, or the system is enjoyable to use being significantly different then the legacy version and in favour of the gamified version.

If we look at the SUS score chart in Table 5.3 we can see that the gamified version takes a slight lead in total average score, and comparing this to the SUS score achieved in (Westermoen & Lunde, 2020), we can see that there is not much of a difference, the legacy version scores are comparable to the previous results, landing right in the middle. The gamified score on the other hand trumps both the other scores, but not by a large amount, and could be seen as variance in people.

The DASH results does not provide us with a significant difference between the versions of SmartU, but given the positive t values there is a slight bias towards the gamified version, which can be seen in the raw results in Appendix B.1.

The interviews gave some valuable insight, a majority participants interviewed although not outright asked if preferring the gamified version over the legacy, gave the impression that the immediate feedback system and the badges were fun additions they prefer to have, rather than not. As one stated: *"The part I specially like is the the*

first system I got, when I answer a question and if I answer correctly it would give me a sound and the background would be green color. And if I answered wrong, it would give me another sound and the background turn red. For me personally, I like this immediately response that I know I'm right or wrong.".

One detrimental factor brought up by several of the participants interviewed, which is also reflected in the questionnaire results is the sound, several stated they would like it to be possible to turn the sound of, or at least turn the volume of the sound down in SmartU itself.

6.2 Order of presentation

One smaller research question is whether the order the participants received the versions could skew the results. This was checked in Section 5.1.3, where the independent T-test performed did not show any statistical significant difference in between the two scenarios. Full results shown in Appendix B.1 tells a similar story of little to no difference between the scenarios.
Though one participant mentioned in their interview that experiencing the gamified version first made them miss the immediate feedback when absent in the legacy version.

6.3 Game elements reception

The reception of the gamification elements, given the results in Section 5.1.3 with a detailed breakdown of each topic in the questionnaire in Table 5.8, shows them to be in general quite well received with the majority of the topics showing positive results in regard to the topic in question. Although the topics regarding the sound available in the gamified version of SmartU were a controversial topic, which showed results in wither extreme of the results. This could have affected the participants overall impression of the gamified version of SmartU, and this with comments and interviews taken in mind may have been contributed by the sound made when answering a task wrong.

The data from interviews in Section 5.2.1 shows that the badges in particular was a element that was well received, and its inclusion was based on its previous positive

results as mentioned in Section 2.3.1, and in more detail in Paper I Erlingsen (2020). The badges were lauded for their representation of tangible milestones to achieve and rewarding the participant with neat little badges that gave them confirmation and motivation. Although well received, badges could be represented differently to be more attractive as stated by one participant, as seen in Section 5.2.1.

The ease of use and visual design aspects given the results of both interviews and quantitative results (SUS, OEUS) show to not be affected by the inclusion of gamified elements. As with audio the help items during assessment did not receive the highest results in the questionnaire, with even being less motivating then the correct audio jingle. The interviewees had little focus during the interview on these help items unless guided towards them during the interview, showing that they may not have made as much of an impact during the assessment.

The leveling system though given the quantitative data in Table 5.8 seem to be quite positively received, the interviews and comments during user testing, had some participant give of the impression that the levels felt disconnected that the levels could use some re-balancing, the level progression was to aggressive.

6.4 Limitations

The study did encounter some limitations, the researcher is not of to experienced with research studies and has mostly performed practical tasks throughout his studies. Due to Covid-19 the possibility to perform the study at a physical location at NTNU and possibly recruit participants in person, were made not allowed. This in conjunction with inexperience made the total amount of participants low leading the study to only being able to catch large effects from the user testing.
Limiting the researcher to assume that all that would be needed for the gamification elements were already provided by the existing server code, made it so the implementation of badges was quite cumbersome, instead of making the complete system be able to store which badge the user had achieved. The SmartU frontend code had to calculate at runtime which badges had been achieved and then show them, instead of showing the badges achieved based on a list provided by the server.
This limiting factor also made the usage of points not feasible as these as well would need to be stored, this in turn made the approach to how levels would be calculated,

needing to be revised and a good balance of how the levels would be calculated ended up not being achieved, as seen comments in questionnaire and one of the interviews B.2.
Although the idea of leaving the server side code alone making an attempt to have the gamification elements not tied to a specific version of the server code might seem like a good idea, the limitations this might impose to how something could be implemented is not good.

With the gift of hindsight, the researcher have found that going at a research task as this alone is not beneficial, even though the doing it alone makes disagreements non-existent. The inclusion of another researcher would make work balance better, and would make discussions about how, why and where possible.

Another possibly limiting factor towards the results, is that the newly made task types was not seen by any of the participants making it possible that the scores in favour of the gamified version could have been higher, as variation in the tasks was intended for the participants experience.

7 Conclusion

The study had the goal of investigating whether the inclusion of gamified elements on top the SmartU system made by (Westermoen & Lunde, 2020), would improve the motivation and engagement of the people using the system.

To answer this three RQ were devised, where RQ1 concerned the participants motivation and engagement towards SmartU, RQ2 questions whether the participants find the gamification elements useful and RQ3 if the order the participants would experience the SmartU version would affect their response to the gamified elements.

We can not say that RQ1 was fulfilled to the degree that the gamified version of SmartU showed statistically better motivation, as only a small factor in a larger variable of OEUS showed greatly improved results in favour of gamification. We may not conclude this as parts of SUS, OEUS and DASH all measure factors that would affect motivation and engagement, seeing as not all of these variables show significant gain in the factors that measure motivation and enjoyment.

RQ2 on the other hand do mainly show very positive results regarding the usefulness of the gamification elements employed. Only having some minor negative impacts from the choice of sound and the help items maybe being hard to see and understand at a glans. Unfortunately do the adaptive nature of SmartU any of the new task available did not trigger for any of the participants, which could have had an increased positive effect.

We can not say that RQ3 is fulfilled as the comparison of the results between the scenarios did not provide any statistically significant difference. Given the fact that trying to compare just 6 peoples result with 6 others would need their answers to be wildly different for the T-test to pick up any effects.

Future Work

As mentioned in Chapter 6 the amount of participants made it so that any effects found would need to be quite large for the T-test to be able to pick up. And the limitation of not being able to make significant changes to the server code and database made the implementation of some of the gamification elements harder then needed

to be, as well making some gamification elements not possible to implement. Below a list of suggested future work based on the researcher's experience these last five months.

- Prototyping of the gamification elements should be done in conjunction with volunteer feedback, to inject more opinions in the design phase so that the design of the gamification elements do not feel engineered, although they are.
- The gamification elements should be more tightly integrated with serverside code, with its own API's and functions allowing for more responsive and more variation in gamification elements.
- The user study is slightly limited, when the participants only get roughly half an hour with a system like this. As the time the participant has to make up a worthwhile impression of the system is quite short. Proposed is conducting an unsupervised user study over a longer period, with quite large control and experiment groups if possible making it an intervention in some classes. This will improve the possibility of catching smaller effects, but does require the system to be virtually bug free as breakage during the intervention could affect the data.
- Add more to the system, putting it under menu's will reward the user who likes to explore the system they use. This may be more statistics that may not have space or fit the idea of the main activity page.

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Abstract

Gamification is a hot topic, and leaning into this SmartU is to expanded with gamification features to foster motivation and engagement, to achieve this a review of relevant papers have been performed and has resulted in a set of proposed gamification elements: points, badges, leaderboard, unlockable content, time constraint, modifiable profile, avatar, limited attempts and adaptive difficulty.

Using findings from literature review and design ideas made, gamification elements will be developed and implemented onto SmartU in spring of 2021, for then to be user-tested for effectiveness, culminating in a master thesis.

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Abbreviations

LAD	=	Learning Analytics Dashboard
SmartU	=	Self-assessment Measured with Analytics on Run-Time for YOU

1

Introduction

The following report will cover the motivation behind its conception, gamification elements used in studies searching to explore gamification in a learning setting, and wireframes with gamification design ideas for implementation onto SmartU by (Westermoen and Lunde, 2020). Furthermore short remarks on what the masterthesis superseding this report will mainly cover. The structure will be as follows, first the motivation of this report will be brought into light, second a literary review to uncover the state of the art gamification elements, third design ideas for the implementation of gamification elements onto SmartU, and lastly conclusive remarks and tentative plans for future work.

1.1 Motivation

SmartU(Self-assessment Measured with Analytics on Run-Time for YOU) created as a masterthesis at NTNU(Westermoen and Lunde, 2020), showed promise as a LAD(Learning Analytics Dashboard)(Papamitsiou et al., 2020). Given the success of SmartU the possibility of adding gamification elements to increase motivation and engagement is requested.
To find the right gamification elements to add onto SmartU, a review of relevant literature was performed and the results are documented in chapter 2, taking the results found and making design wireframes of the proposed gamification elements illustrated and detailed in chapter 3. Then the last chapter address the conclusion of the report and work to be done in the next semester for the master thesis that will supersede this report.

2

Literature Review

2.1 Methodology

Before any choice of gamification elements to implement onto SmartU could be chosen, a review of the State-of-the-Art in respect to gamification elements used in research needed to be performed, to find what is in use and what is seen as the most viable gamification elements.

Finding papers to review was done by searching the scientific paper databases of Scopus and ScienceDirect, the search was limited to these two databases as they are highly reputable sources for scientific papers, and they have ample possibilities for filtering the output and sorting by relevance to the search query.

Search terms used: *Gamified AND adaptive AND learning / gamification AND "learning technologies" AND "mobile learning" / Gamification AND learning AND technologies / Gamification AND motivation / (gamified OR gamification OR gamify) AND learning AND (motivation OR adaptive or technologies)*

The search terms used were chosen in an attempt to cover a wide range of studies involving gamified e-learning as the main focus of their study. This search yielded many results, but one can not go through them all. To reduce the amount of papers needed to review the results were sorted by relevance, and the fifteen first from each query were then scanned for relevance and availability. Resulting in 71 papers.

These papers were then filtered down by this list of requirements in Table 2.1:

Table 2.1: Requirements

Requirement
Contain gamification elements feasible to implement on SmartU
Be a study seeking to measure the effectiveness of said gamification elements on the participants
Be either well cited, in a Journal with impact or in an International Conference/Workshop Proceedings

After a more thorough scan taking these requirements into account, the resulting amount of papers were 31. In the next sections the most prevalent gamification elements used in the papers will be presented with descriptions of different ways they were implemented in the studies reviewed. And a short discussion of their effectiveness and whether or not they can be implemented on SmartU. Followed by a conclusionary view on which gamification elements to add into the SmartU LAD.

2.2 Body of work

Table 2.2: Papers with goal of research

Goal of study	Papers
Effects on motivation	Papamitsiou et al. (2020); Treiblmaier and Putz (2020); Tsay et al. (2018); Park et al. (2019); Zainuddin et al. (2020); Kim (2020); Aguiar-Castillo et al. (2020); Daghestani et al. (2020); Buckley and Doyle (2016); Welbers et al. (2019); Su and Cheng (2015); Jagust et al. (2017); Groening and Binnewies (2019); Chapman and Rich (2018); Razali et al. (2020); Díaz-Ramírez (2020); Sun et al. (2017); van Roy and Zaman (2018); Barbosa and de Ávila Rodrigues (2020); Zainuddin (2018)

Effects on perfomance	Jagušt et al. (2018); Hubalovsky et al. (2019); Tsay et al. (2018); Sanchez et al. (2020); Zainuddin et al. (2020); Lopez and Tucker (2020); Daghestani et al. (2020); Fotaris et al. (2016); Buckley and Doyle (2016); Welbers et al. (2019); Attali and Arieli-Attali (2015); Naik and Kamat (2016); Groening and Binnewies (2019); Díaz-Ramírez (2020); Sun et al. (2017); Barbosa and de Ávila Rodrigues (2020); Zainuddin (2018); Legaki et al. (2020); Boticki et al. (2015)
Effects on engagement	Treiblmaier and Putz (2020); Tsay et al. (2018); Park et al. (2019); Zainuddin et al. (2020); Kim (2020); Daghestani et al. (2020); Fotaris et al. (2016); Welbers et al. (2019); Su and Cheng (2015); Naik and Kamat (2016); Chapman and Rich (2018); Sun et al. (2017); Barbosa and de Ávila Rodrigues (2020)

2.2.1 General topics

Motivational effects – The majority of the papers reviewed have explored the effects gamification elements have on the involved participants motivation. In particular (Jagušt et al., 2018; Zainuddin et al., 2020; Sun et al., 2017; Barbosa and de Ávila Rodrigues, 2020; Zainuddin, 2018) included a qualitative analysis of the effects on motivation, and were reported as quite positive.

Effects on engagement – In all the papers reviewed that take a view on engagement, there were always a positive result, with the participants having a positive increase in engagement with gamification elements present.

Effects on performance – On measure of performance the reviewed papers did not always have positive results, they were at times the same as without gamification elements(Sanchez et al., 2020), making them not achieve the result they were designed to do.

Novelty effect – (Tsay et al., 2018; Park et al., 2019; Sanchez et al., 2020; Fotaris et al., 2016; van Roy and Zaman, 2018) mentions the Novelty effect as a concerning factor in regards to

gamified learning interventions, where the interest for the gamified activity decrease as time goes on. (van Roy and Zaman, 2018) performed their study over a total of 15 weeks, which is longer than most studies performed in the papers covered. Their study did not show any signs of the "novelty effect". (Sanchez et al., 2020) showed on the other hand some presence of the "novelty effect" as they attempted to see if gamification would positively influence the testing effect of quizzes as a preparation to class tests, the results did not show any positive effects except for in the very beginning, making them conclude it was in relation to the "novelty effect".

Negative results – In all the reviewed papers there were not reported any directly negative results.

Negative reinforcement – The use of negative reinforcements in the studies reviewed, is not plentiful but two cases stood out. (Jagušt et al., 2018) gives negative points to the pupils if they give the wrong answer. Where as (Park et al., 2019) give the participants a limited number of wrong answers they can give, if the participant answer wrong three times, they fail the quiz.

Table 2.3: Most prevalent gamification elements

Gamification Elements	Papers which contain them
Points	Jagušt et al. (2018); Treiblmaier and Putz (2020); Park et al. (2019); Sanchez et al. (2020); Zainuddin et al. (2020); Kim (2020); Aguiar-Castillo et al. (2020); Lopez and Tucker (2020); Daghestani et al. (2020); Fotaris et al. (2016); Buckley and Doyle (2016); Welbers et al. (2019); Attali and Arieli-Attali (2015); Naik and Kamat (2016); Jagust et al. (2017); Chapman and Rich (2018); Razali et al. (2020); Díaz-Ramírez (2020); Barbosa and de Ávila Rodrigues (2020); Zainuddin (2018); Legaki et al. (2020); Boticki et al. (2015)

Badges	Papamitsiou et al. (2020); Treiblmaier and Putz (2020); Tsay et al. (2018); Park et al. (2019); Zainuddin et al. (2020); Kim (2020); Aguiar-Castillo et al. (2020); Daghestani et al. (2020); Fotaris et al. (2016); Welbers et al. (2019); Su and Cheng (2015); Naik and Kamat (2016); Groening and Binnewies (2019); Chapman and Rich (2018); Díaz-Ramírez (2020); Sun et al. (2017); van Roy and Zaman (2018); Zainuddin (2018); Boticki et al. (2015)
Leaderboard/Scoreboard	Jagušt et al. (2018); Papamitsiou et al. (2020); Treiblmaier and Putz (2020); Tsay et al. (2018); Zainuddin et al. (2020); Kim (2020); Daghestani et al. (2020); Fotaris et al. (2016); Su and Cheng (2015); Naik and Kamat (2016); Jagust et al. (2017); Chapman and Rich (2018); Barbosa and de Ávila Rodrigues (2020); Zainuddin (2018); Legaki et al. (2020)
Narrative	Jagušt et al. (2018); Treiblmaier and Putz (2020); Su and Cheng (2015); Sun et al. (2017)
Adaptive Elements	Jagušt et al. (2018); Hubalovsky et al. (2019); Papamitsiou et al. (2020); Treiblmaier and Putz (2020); Park et al. (2019); Kim (2020); Daghestani et al. (2020); Fotaris et al. (2016); Chapman and Rich (2018); Razali et al. (2020)
Unlockable Content	Tsay et al. (2018); Lopez and Tucker (2020); Chapman and Rich (2018)
Progress-bar/-meter/-metric	Sanchez et al. (2020); Zainuddin et al. (2020); Kim (2020); Chapman and Rich (2018); Díaz-Ramírez (2020)
Modifiable Profiles	Tsay et al. (2018)
Avatar	Park et al. (2019); Zainuddin et al. (2020); Lopez and Tucker (2020); Welbers et al. (2019); Razali et al. (2020)
Levels	Park et al. (2019); Kim (2020); Daghestani et al. (2020); Naik and Kamat (2016); Chapman and Rich (2018); Díaz-Ramírez (2020); Legaki et al. (2020)
Forum/Chat	Tsay et al. (2018); Daghestani et al. (2020); Díaz-Ramírez (2020)

Time Constraint	Jagušt et al. (2018); Treiblmaier and Putz (2020); Tsay et al. (2018)

2.2.2 Points

As shown in Table 2.3, points have been the most utilized gamification element in the papers reviewed. As stated in (Legaki et al., 2020; Barbosa and de Ávila Rodrigues, 2020; Zainuddin, 2018) among others, points are used as a feedback mechanism on performance/progression that aim to bolster feeling of competence and thereby intrinsic motivation. The implementation of points do not differ that much between the case studies done in the reviewed papers, the most used one is the presentation of an amount of points right after a single task is completed successfully as used in (Treiblmaier and Putz, 2020; Park et al., 2019).
(Attali and Arieli-Attali, 2015)used the method of presenting the points as an animated counter after completing a task of some sort.
(Fotaris et al., 2016) used among others Kahoot as a platform which also present the participants with a colored screen when presenting the participants with the points, giving a quick indication of correctness.

2.2.3 Badges

Badges are more often then not used as a visual representation of achievements made, these can be badges gained through progressing in levels (Naik and Kamat, 2016), or doing a specific task in a certain way (e.g. being the first, being the quickest and more)(Groening and Binnewies, 2019). The distribution of badges should not be taken lightly though, as (Groening and Binnewies, 2019) found that fewer more specialized badges were more favorable than many easy to collect badges. This gave the participants the feeling that the badges held little value(Groening and Binnewies, 2019).

2.2.4 Leader board

Leader-boards are a gamification element of contention, as (Jagušt et al., 2018; Kim, 2020; Daghestani et al., 2020) have found that in particular the underachieving students might find the leader-board demotivating. This is not a desirable outcome as it is especially the underachieving

students one wish to give incentives to with the inclusion of gamification elements.

On the other hand leader-boards have also shown they can foster motivation through friendly competition with peers (Zainuddin et al., 2020), where the users feel motivated to beat their peers on the leader-board. To combat the demotivating factor of leader-boards, (Jagušt et al., 2018; Fotaris et al., 2016) used leader-boards with only the top x ”players”, this so that to get on the leader-board the participants have to work hard, but failing to get on the board, does not mean one is at the bottom.

(Daghestani et al., 2020) Pursue this in a slightly different manner, as the leaderboard is only shown to a certain player type, whereas for the other types it does not show.

2.2.5 Narrative

The times that narrative was used the results were positive(Jagušt et al., 2018; Treiblmaier and Putz, 2020; Su and Cheng, 2015; Sun et al., 2017), specifically in (Jagušt et al., 2018; Sun et al., 2017) the subjects found the usage of a narrative to be highly motivating, and making the problem relatable and more engaging to partake in.

The manner of which both (Jagušt et al., 2018; Sun et al., 2017) use a narrative, is to tell a story to the participant that ties in to the task at hand, this in an attempt to make the participants feel more motivated to participate. (Treiblmaier and Putz, 2020) provide narrative addition with a practical example of the problem at hand told as a story for the students to solve.

2.2.6 Adaptive Elements

Adaptive difficulty is used in a hand full of the papers reviewed, this is implemented in a few different ways. (Jagušt et al., 2018) implemented the adaptability element as a mechanic that would decrease the time a participant had to complete a task as a function of the participants performance. If the participant did well, the time limit would decrease by some amount.
While (Hubalovsky et al., 2019) would allow the participants to skip subsets of the tasks, if capable of scoring over a certain percentage cap.
(Naik and Kamat, 2016) provide adaptivity through putting the participant in a trap state, where

the outcome is not certain, and woefully dependent on the action performed by the participant. Like giving the next question if the answer given is correct, or if incorrect send participant to a page giving information about the question, or some page visualizing the problem in some manner. (Naik and Kamat, 2016) also provide the possibility of adaptive feedback via their Adaptive Feedback Engine providing these kinds of feedback: *"informative feedback, technical feedback, intrinsic and extrinsic feedback, sub teaching feedback and intervention feedback"* Naik and Kamat (2016).

2.2.7 Levels

Levels are often used as an indication of progression (Park et al., 2019; Kim, 2020; Daghestani et al., 2020; Naik and Kamat, 2016), but they are also sometimes used as an indicator for the difficulty of the tasks one will receive (Park et al., 2019; Daghestani et al., 2020). Other aspects of levels are pairing it with badges that signify achieving higher levels(Naik and Kamat, 2016). In this respect one can use levels for a few things in context of a learning system. This can give the participants visible milestones to achieve, or help those who are creating the learning tasks segment the difficulty into progress levels(Park et al., 2019; Kim, 2020; Daghestani et al., 2020).

2.2.8 Progress-bar

(Sanchez et al., 2020; Naik and Kamat, 2016; Díaz-Ramírez, 2020) explicitly mention progress bars as visualization of progress in the learning systems in use, (Sanchez et al., 2020) use the progress-bar as visualization tool for the participants to see how far in the quiz they have come, and hinting at how far answering the next task correct would take them on the progressbar and then with a playful animation fill it in. (Naik and Kamat, 2016) shows a progress bar which inform the participants of their advancements through the levels.

2.2.9 Unlockable Content

(Tsay et al., 2018; Chapman and Rich, 2018) have parts of the system unlock as the participants complete given tasks, that would be for instance assignments might not be available unless a certain prerequisite is met. (Naik and Kamat, 2016) locks levels behind the completion of all

prerequisites, making levels unlockable.

2.2.10 Customizable Profiles

The ability to customize ones profile has not been well covered in the papers reviewed, but in the one that have implemented it(Tsay et al., 2018), the inclusion have not been documented to be a detriment to the study. The inclusion of customizable profiles in the aforementioned study was explicitly mentioned, but (Tsay et al., 2018) used Moodle as their platform of choice, and this platform were used by several others (Hubalovsky et al., 2019; Daghestani et al., 2020; Naik and Kamat, 2016). By this logic one can assume these possess the same capabilities in profile modification.

2.2.11 Avatar

The usage of avatars in the papers have not been heavily explored, but in those where it have been used they did not cause any harm. The avatar element used in (Park et al., 2019) is an evolving avatar, that change based on the progression level of the participant. In (Zainuddin et al., 2020; Razali et al., 2020; Welbers et al., 2019) the participants are presented with an option to choose an avatar to represent them as players when interacting with other players on the platform.

2.2.12 Forum/Chat

When taking into account social elements, the most frequently used elements would be discussion forums and chat as in (Tsay et al., 2018; Naik and Kamat, 2016; Daghestani et al., 2020), where the users have the ability to communicate with each other without resorting to other platforms. Some of the studies have tied other gamification elements such as rewards in the fashion of points or badges to the usage of the social aspects of the platform(Naik and Kamat, 2016; Tsay et al., 2018), in an effort to provide incentives to use the social aspects to foster social sharing(Tsay et al., 2018). Where the participants can share their opinions or post questions on forums for all other participants to see and respond to (Naik and Kamat, 2016; Tsay et al., 2018).

2.2.13 Time Constraint

Although time-constraint as a game element is not heavily mentioned in the reviewed literature, (Treiblmaier and Putz, 2020) put a lot of focus on their use of it as a gamification element, making many of the tasks the participant took part in timed. While (Jagušt et al., 2018; Tsay et al., 2018) made only some of the tasks in the gamified intervention have a constraint on completion time.

2.3 Discussion

As mentioned in section 2.2.5 a narrative is a very good motivational tool, but this do require the one who implements the gamification elements to have full control over the task content, to ensure there is a narrative that would fit the task at hand.

Although not all of the papers reviewed mentioned using adaptive techniques, there is more than likely some elements of adaptation in them all, as all learning is meant to have a learning curve. Meaning that tasks will gradually become harder as the participants progress. (Papamitsiou et al., 2020) Learning Analytics Dashboard SmartU of which the thesis that will ensue will build upon, already has some adaptive elements, although only visual.

As mentioned in section 2.2.11, the evolving avatar of GAMESIT showed promise of piquing the participants interest with "*how will it look next*". Although very intriguing and could provide engagement, there would need to be made quite a few different evolving avatars for each possible subject available in SmartU. Making it slightly unfeasible to implement, but giving the participant the opportunity to choose from a variety of different static avatar images could be possible.

As seen in Table 2.3 a large part of the reviewed papers have used badges in some way or form, the most common way is to use them as a reward like in (Groening and Binnewies, 2019). As well as indicating progress level(Papamitsiou et al., 2020). (Groening and Binnewies, 2019) focused their entire study on only achievement badges, where they found that a few harder to earn badges gave a higher feeling of achievement than plenty of easily achieved badges.

The possibility to customize ones profile is only mentioned directly in one paper as a gamification element (Tsay et al., 2018), but this does not mean the other studies did not give the participants the ability to do so. The possibility to personalize ones profile/character is inherently game-like, lending to the belief that the ability to customize ones profile is a gamification element.

Leaderboards are a ground staple of gaming, being present since the height of arcade gaming. This has lend it to be a very common gamification element, with its main purpose being to motivate the participants to get to the top. As mentioned in section 2.2.4, a leaderboard can cause already demotivated participants to become even more demotivated. As previously mentioned (Jagušt et al., 2018; Fotaris et al., 2016) have found that not showing all, but rather a top subset of the participants did not give the underachieving participants any detrimental effects, probably do to the participant not being able to see themselves at the bottom.

Levels give a simple way to segment content behind defined amount of progress, but how it is done are bit different between the papers. Where some have the levels being a simple number showing progress when a fixed amount of content is done, while some may have a more adaptive approach where how well a participant is doing can propel them faster through the levels, without doing everything (Hubalovsky et al., 2019).

Just like leaderboards, points has always been around. Almost all of the papers reviewed used points, this is do to that it is a simple mechanic to implement and gives the users a clear metric of performance. Points may not be suitable for every study though, as in (Sun et al., 2017) do to the brevity of the study they did not use points. Or maybe they are not directly points, like in (Buckley and Doyle, 2016) where there is virtual cash. How and if point should be used all depend on the system in use, if points can be represented as a viable metric of performance.

Progressbars may be use in different ways, and to represent different values. Using a progressbar in the activity like in (Sanchez et al., 2020), gives the participant a nice color-full way of determining how much of the activity is left. Using a progress bar to visualize the progress

through levels like in (Naik and Kamat, 2016), can give the participants incentive to reach for the next level.

The use of social aspects have been chat or discussion forums, these functionalities are in no doubt beneficial, encouraging social sharing of knowledge. But these functionalities may be difficult or consume excessive amounts of time to implement, if the underlying system does not have any such functionality already baked into the architecture. If the forums are not moderated, they may be used to game the system, and have the users not share the knowledge, but rather an answer key.

(Treiblmaier and Putz, 2020) emphasizes the use of time-constraint as a gamification element, but it is more like a challenge mechanic. Giving the participant more of a challenge do to the constraint of time, this is an external motivational force though, which could result in extrinsic motivation to perform better.

Unlockable content are a common sight in games (Contributors to Wikimedia projects, 2020), and implemented correctly as a gamification element could prove to be a good motivational factor. The most common unlockable used in gamified learning must be badges, although badges themselves are more mentioned than unlockables in table 2.3. Does not mean it is less common, it is just not specifically mentioned as a feature. But other parts that may be unlockable may be certain tasks, that may not be done until a certain prerequisite is reached (Tsay et al., 2018; Chapman and Rich, 2018).

Although not mentioned much, the use of negative reinforcement as a motivational tool like a limited number of strikes as in (Park et al., 2019), could give the feeling of consequence when giving the wrong answers. Although the only consequence being the quiz have to be attempted again, this could give the participants the incentive needed to study to find the answers required to achieve success on the first attempt.

2.4 Conclusive remarks and gamification choices

The existing system of SmartU already count time used on each task. Given this, one can aggregate points from the time used and present them to the participant after every correct answer given. This is an immediate feedback mechanism which could prove useful as the current system does not show how the participant is doing until after the quiz is completed.

As the system is now the participants may answer all questions in a quiz wrong and still complete it, as it is also possible to view the correct answer if wished. This enables the possibility of gaming the system, therefore a strike limit similar to the one used in (Park et al., 2019) is suggested to limit the possibility to game the system, by just viewing what in essence is an answer key.

Currently the SmartU system does not show progression through the quizzes when they are performed, this could be implemented with a progressbar. The gradient in the mastery levels in the current implementation could be more granular then low, medium and high, which is why the inclusion of levels as a gamification element could be seamlessly implemented into SmartU. Where there are several levels of each mastery tier. This could as well be visualized with a progressbar, with the inclusion a number inside the mastery badge rather then the text low, medium or high.

On the topic of badges, there could be included some more badges for completing certain feats of skill/knowledge(i.e. answering all questions in a topic set, doing all questions in a quiz under a certain time).

On the question of narrative, SmartU presents its tasks as Quizzes with pools of questions ready made. This makes it not feasible, at least at the present to add a narrative as a gamification element to SmartU. As the narrative have to tie into the tasks at hand.

Leaderboards have shown to provide strong motivation to the high achievers, it is only natural to implement a leaderboard in some shape or form. And limiting the leaderboard to show only the top x amount of participants, to reduce the chance of the underachievers getting the

feeling of being at the bottom, is seen as an effective way of motivating those that would find it motivating to try and reach the top of the board, while not deterring the ones that do not.

Time constraint could be implemented into SmartU quite seamlessly, by just making the counter on questions count down rather then up and tying this some time trial mode with accompanying achievement badges. This could be made as an unlockable feature that is available when the participant has completed all questions in a topic set, to incentives the participant to improve their score by doing timed challenges.

The possibility to customize one's user profile could give the participants a feeling of ownership of their user account and might motivate them to participate more actively on the system. This ties in with the usage of profile avatars as an option to the participants, they may choose an avatar to represent them visually on the platform.

On the topic of social gamification elements like chat and discussion forums, they are deemed not suitable for SmartU. This due to that it may be abused, with the forum making it possible for the participants to post answers to the questions directly on the same platform, which could make the participants not put in an effort. Chat on the other hand maybe more benign, but it may as well be used to share the answers without both parties actually possessing the knowledge. This is a little against social sharing, but the point of a self assessment platform is to be able to assess one's own knowledge, without making it easy to game the system and making the results not representative.

With adaptive elements, SmartU already contain some semblance of adaptation. This in the form of having the interface change based on how the participant performs. This will not change, but how the visuals look may change some, or just move. Adaptive difficulty may be implemented as an additional adaptive element, but how may depend on the underlying architecture.

With this in mind table 2.4 is a tentative list over the chosen gamification elements to be implemented onto SmartU.

Table 2.4: Chosen gamification elements with reasoning.

Gamification element	**Reasoning**
Points	Immediate feedback on performance
Badges	Rewards, collecting
Leaderboard	Motivate to climb the board
Unlockable/Time Constraint	Motivate participant to improve time
Customizable profile/Avatar	Give participant feeling of ownership
Limited atempts	Mediate the possibility of gaming the system
Adaptive difficulty *	Have difficulty scale with performance

*may be excluded dependent on platform architecture.

3

Design

In this chapter wireframes of the proposed gamification elements will be presented with a description of how they may be implemented.

The existing design aesthetic of SmartU will be closely mimicked, as to make the gamification elements not adversely stand out. According to (Westermoen and Lunde, 2020) the core design aesthetic of SmartU were carefully chosen through user testing.

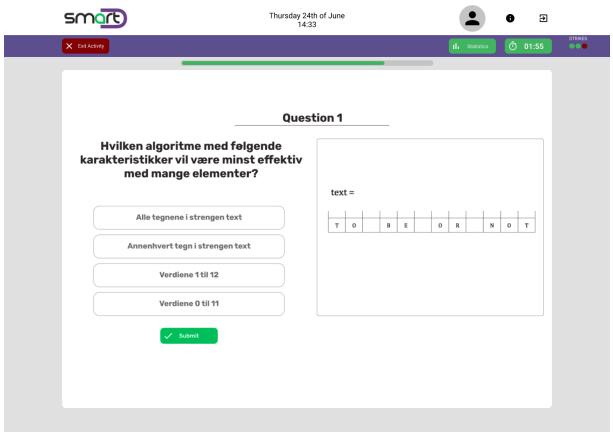

Figure 3.1: Task view

In figure 3.1 we will see the screen presented when a task is being undertaken, it does not differ much from the one already found in SmartU, and that is by design. But some key differences are in place, as a progressbar just above the question window, and the strikes indicator to the right of the timer.

The progressbar will animate when progressing through the quiz, and the strikes indicator shows how many mistakes the participants can make before failing the quiz and have to start over. The strikes available in the quizzes may be dynamic based on the amount of questions available in the current quiz, to balance the difficulty to complete a quiz. This may be a fixed amount in certain steps, or a fraction of the available questions rounded to closest whole number.

Figure 3.2: Question result modal

Figure 3.2 show concepts for when a question is answered, where a correct answer will present the participant with a green congratulatory screen with the amount of points achieved and maybe some animated confetti for flare. Whilst a wrong answer will present the participant with a red screen with the count of zero points and a randomly chosen motivational quote on not giving up. The same screen for wrong answer may be used for failing a quiz, but with a slight change to the text and maybe giving the participant a tip on where to acquire the knowledge necessary to complete the quiz may be found.
The tips may be the associated curriculum provided by the makers of the questions, if the curriculum is not available, motivational quotes will be presented in its stead.

In the left image of figure 3.3 we see the topic overview page, this is quite different from the current implementation in SmartU, which show detailed statistics on the participants progress to mastery of the topic. Whereas the presented view show progress in a more game like fashion, with level progression and badges achieved. Clicking on the badges would give the participant an overview of all available badges in the given topic as a simple modal with a grid of the badges.

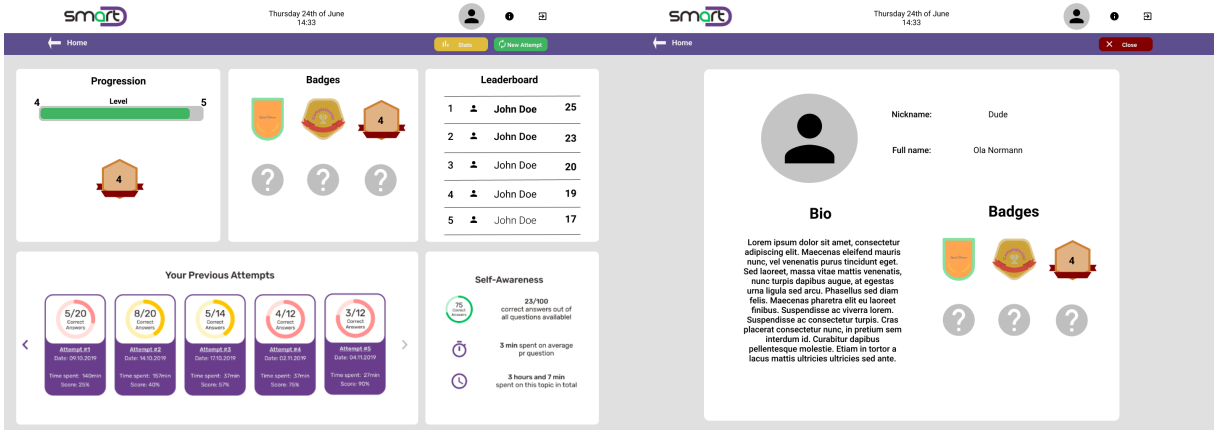

Figure 3.3: Topic view and Peer profile view

As well visible on this page is the top five participants in the topic, showing their ranking and mastery level. Clicking on a participant will present the user with a profile page showing of the user information of the clicked on participant, including a short bio, nickname/username, name and badges. All of which the participants may choose to not have visible.

The lower part of the overview screen will remain the same, as this is not seen as deterring. Clicking the yellow stats button, will present the user with a statistics screen illustrated in figure 3.4, giving the participants still full access to all previous statistics. Clicking on the peer comparison will present the user with a dialog window asking if they are sure they want to see their own performance in comparison to the peer average. This in an attempt to have those who do not wish to see those statistics not be able to accidentally view them.

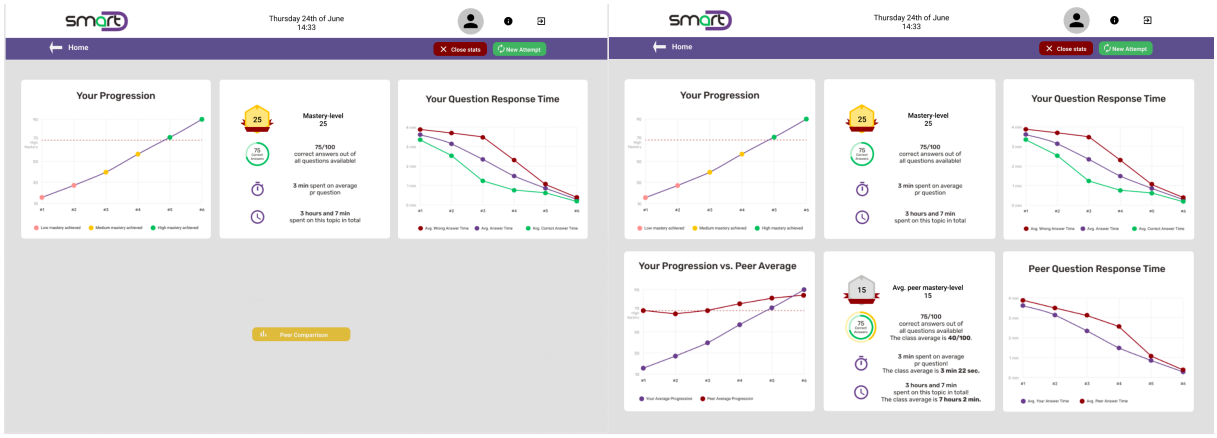

Figure 3.4: Statistics modal

Clicking on the profile button on the top navigation bar visible in most illustrations will take the user to a profile page illustrated in figure 3.5, here the user may choose what should be

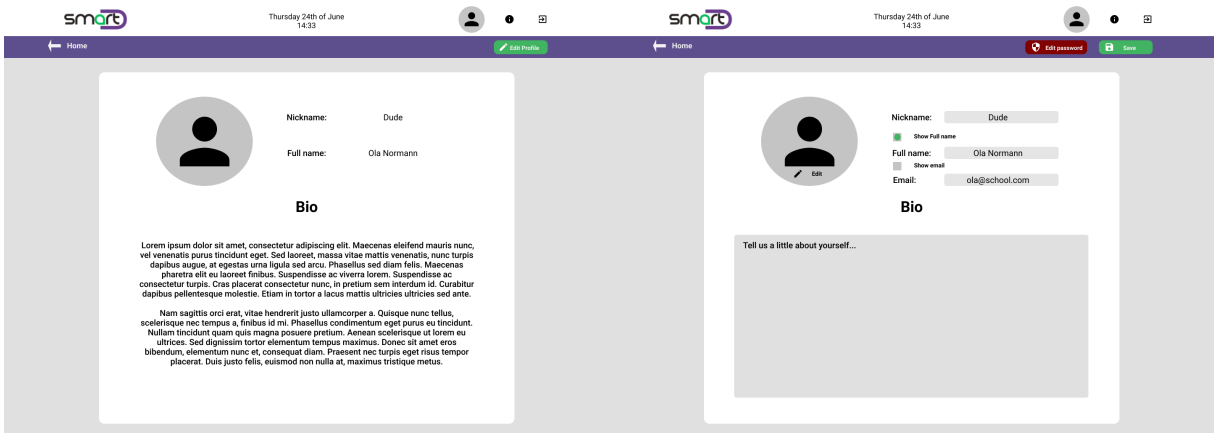

Figure 3.5: Profile page

visible to other users viewing their profile. The only limitation being that username/nickname and avatar may not be hidden from others viewing their profile as they need to be visible on the leaderboard. Editing the profile image will present the user with a page similar to figure 3.6, as the avatars used in the image are for illustration purposes the final produkt may differ slightly. Depending on privacy concerns and implementation difficulty it may be possible for the user to upload a self chosen profile image to use as an avatar.

Figure 3.6: Avatar selection modal

As for unlockable time-trial mode as mentioned in section 2.4, this may be implemented as a new button that will appear next to the new attempt button visible in figure 3.3 when all the available questions have been answered. This will present the user with a very similar task screen, but instead of the timer counting up it will count down limiting the time available on each question, this may be adaptive based on the participants own answer time average. Some

achievement badges may be tied in to this mode as well.

4

Conclusive remarks and future

To conclude, presented in this report is a review of relevant literature in an attempt to identify the cutting edge in gamification elements, to support the decision of gamification elements to implement onto the SmartU LAD. Although the papers reviewed were not vast in scope, the gamification elements in use seem to repeat time and time again.

Furthermore some design ideas for the implementation of gamification elements onto SmartU are presented in chapter 3, with focus on maintaining the aesthetic of SmartU, but seamlessly integrate some gamification elements.

This is meant as a start on a master thesis, and for future work the gamification elements will be developed and integrated onto SmartU, user tests of the new gamified SmartU will be designed with both qualitative and quantitative data being of importance.

The user testing scenario will preferably be done with two groups, where one group will start with testing the gamified version of SmartU and the other will test the legacy version. After they have done so for some time they will switch, and they will answer some questionnaires with a random selection being interviewed.

The data will be collected and analyzed with this all culminating into a thesis which will attempt to answer whether gamification of SmartU will positively affect motivation and engagement in regards to using SmartU for self assessment.

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A Study

A.1 Recruitment Ad

Do you want to test out a Gamified interface that will be used at NTNU in the future?

By participating in this two-phases study, you will test out a new dashboard interface for self-monitoring your progress, with and without fun gamification elements added on top of a simple self-assessment quiz and help us to design a future service for NTNU students. The whole study will not last more than 30-45 minutes, and upon completion of each phase, you will answer a short questionnaire about your attitude towards the interface in different aspects. Some participants will be selected for a short interview that will take place on a later time after the completion of the interface testing, where you will be asked questions about your experience with the system.

The study will take place 26-30 April (approx.) and the testing of the interface and the interviews will be conducted online. All you need is a PC or a tablet with a large screen (i.e. 10 inches or larger) with a browser and access to the internet. Previous knowledge on web-programming (i.e., HTML, Javascript, CSS) is advisable but optional, and anyone can participate.

Participants will be awarded a gift card with a value of 250NOK - for most of the shops and restaurants of Trondheim centrum. All participants are welcome.

If you want to participate, please send me an email: alexaerl@stud.ntnu.no until April 23rd, and I will contact you back for participation arrangements.

Thank you.
Master's student IDI
Alexander Erlingsen

alexaerl@stud.ntnu.no

A.2 Consent form

Are you interested in taking part in the research project

"Adaptive and Gamified Learning Technologies to Support Motivation and Engagement"?

Background and Purpose

Adaptive and Gamified Learning Technologies to Support Motivation and Engagement is a research project that aims to investigate whether the addition of gamified elements on top of an Adaptive Learning Analytics Dashboard (LAD) named SmartU, heightens the engagement and motivation to use SmartU as a self-assessment tool. The user-test will consist of hands-on testing of the LAD either from participants own computer/smart-device or if conditions allow this, at NTNU Campus Gløshaugen in Trondheim, Norway. The participants will get familiar with the dashboard and test themselves in the available self-assessment activities in the system.

The participants of our project will be students and employees at NTNU Campus Gløshaugen in Trondheim, Norway, and other interested parties volunteering to participate in the user-testing.

The supervisor of the project will be an Associate Professor at the department of Computer and Information Science (IDI) at NTNU, Trondheim, Norway. (see general information section).

What does participation in the project imply?
For the purpose of the research project, data will be collected using observations, web-based questionnaires. Questions that will be used for the questionnaire, will concern participants' attitudes (e.g. sensemaking, satisfaction, easiness, difficult/easy/challenging parts of the activity) toward the use of visual elements in the LAD. Data regarding participants' name, email, gender, age, year of study, line of study will be collected using a questionnaire on mobile phones/tablet or computer belonging to the participant.

The duration of the user-testing will be approximately 30 minutes, consisting of the mentioned hands-on user-testing of the system and a follow-up questionnaire.

Participants can request to see the questionnaire and ask for any additional information regarding any other data collection instrument before giving consent.

What will happen to the information about you?
All personal data will be treated confidentially. Only the project group (see general information section below) will have access to the personal data. The list of names of the participants will be stored in NTNU Sharepoint according to the data processing agreement between NTNU and Microsoft. Only the researchers and data controller will have access to this site.

Video conference will be performed via Zoom video conferencing, and questionnaires will be hosted by UiO Nettskjema.

We state that the participants will not be recognizable in the publication. The project is scheduled for completion by June 2021, then all data will be anonymized.

Voluntary participation
It is voluntary to participate in the project, and you can at any time choose to withdraw your consent without stating any reason. If you decide to withdraw, all your personal data will be made anonymous.

Participants' rights
Participants have the right to request access to/deletion/correction/limitation of personal data, the right to data portability, and the right to send a complaint to the Data Protection Officer at NTNU or The Norwegian Data Protection Authority about the processing of personal data.

General information-project group:
The supervisor of the project is Michail Giannakos, Associate Professor at Department of Computer and Information Science at NTNU, e-mail: michailg@ntnu.no, address: Sem Sælands vei 9, IT-bygget * 103, phone number: +47 73590731.

Co supervisor of the project is Zacharoula Papamitsiou, Postdoctoral Fellow at Faculty of Information Technology and Electrical Engineering at NTNU, e-mail: zacharoula.papamitsiou@ntnu.no, address: : Sem Sælands vei 9, IT-bygget * 142.

If you would like to participate or have any questions concerning the project, please contact:

Alexander Erlingsen, e-mail: alexaerl@stud.ntnu.no, mobile number: +47 95009679
Master student at the Department of Computer Science (IDI) at NTNU

Data Protection Officer (Personvernombud) at NTNU (Thomas Helgesen, thomas.helgesen@ntnu.no)

The study has been notified to the 'NSD – The Norwegian Centre for Research Data AS (personverntjenester@nsd.no, 55 58 21 17) has assessed that the processing of personal data in this project is in accordance with data protection legislation.

Consent for participation in the study

I have received and understood information about the project *Adaptive and Gamified Learning Technologies to Support Motivation and Engagement* and have been given the opportunity to ask questions. I give consent for my participation and personal data to be processed until the end date of the project, approx. 14th of June 2021.

(Signed by participant, date)

A.3 Interview Guide

Semi structured Interview Guide

Capturing answers: Recording of answers will be done through taking notes and audio recording. This procedure allows the interviewer to highlight key points to probe further on relevant topics, while making sure no information is lost due to the transcripts of the recordings.

Develop a rapport with the respondent: Obtaining meaningful information from respondents will be easier if they are comfortable opening to the interviewer. This can be done by asking non probing questions related to their hobbies, their spare time and so on.

Ask questions that lead detailed answers: It is important that you phrase questions in a way that gets respondents to provide detailed answers, rather than simple "Yes" or "No" answers.

Examples of questions:

- Did you find the SmartU system interesting? If you did, how so?
- How did you feel about the main activity page and presented visualizations?
- Do you think that the system would improve your motivation of studying? If you do, why would it do that?
- Could you mention some features that you found useful in the system?
- Could you mention some features which were easy or hard to understand?
- Would you use the system again? If so, what encourages you to do so?
- What do you think of the game elements used in one of the user interface implementations?

It is good to have a set of questions on hand, but the interviewer must also be prepared to expand on, or probe, the predetermined questions as the need arises. This is the essence of qualitative interviews.

End the interview: Deciding when to end an interview may depend on several factors. E.g. interviewers may feel that they have exhausted their questions, and that they are no longer getting new information or if the respondent seems tired or has other commitments to attend to. It is good practice for interviewers to summarize the key points that they feel the respondent has provided, because this gives the respondent a final chance to expand or clarify any points. Finally, it is important to thank the respondent for their time and to provide them with the interviewer's contact details. Depending on circumstances, it may also be worth letting respondents know how they can obtain the project reports because this provides them with a sense of ownership of the material that they have shared.

A.4 Questionnaire

Gamified SmartU

Side 1

Personalia

Your name? *

What is your e-mail address? *

What is your age? *

Gender *

- Female
- Male
- Other/Prefer not to say

Sideskift

Side 2

Usability of SmartU

System Usability Scale

1: Strongly disagree ... 3:Neutral ... 5: Strongly agree

	1	2	3	4	5
I think I would like to use SmartU frequently. *					
I found SmartU unnecessarily complex. *					
I thought SmartU was easy to use. *					
I think that I would need the support of a technical person to be able to use SmartU. *					

I found the Gamified elements in SmartU well integrated. *	○	○	○	○	○
I thought there was too much inconsistency in SmartU. *	○	○	○	○	○
I would imagine that most people would learn to use SmartU quickly. *	○	○	○	○	○
I find the use of SmartU sluggish. *	○	○	○	○	○
I felt very confident using SmartU. *	○	○	○	○	○
I needed to learn a lot of things before I could get going with SmartU. *	○	○	○	○	○

Overall evaluation of the usability of SmartU

1: Strongly disagree ... 3:Neutral ... 5: Strongly agree

	1	2	3	4	5
I think that the navigation in SmartU was nearly effortless. *	○	○	○	○	○
I think that when I needed help to learn how to use SmartU, the system provided me with sufficient information. *	○	○	○	○	○
I think that a user who has never seen SmartU before can learn how to accomplish basic tasks fast. *	○	○	○	○	○
I think that it is not frequent that users make navigational errors while using SmartU. *	○	○	○	○	○
I think that the interaction with SmartU is clear and understandable. *	○	○	○	○	○
Using SmartU makes me happy to accomplish my self-assessment tasks. *	○	○	○	○	○
Using SmartU gives me enjoyment for my continuous learning. *	○	○	○	○	○
Using SmartU leads me to explore my continuous self-assessment. *	○	○	○	○	○

I would like to continue to use SmartU to increase my skills. *	○	○	○	○	○

Sideskift

Side 3

Dashboards visual representation (outside of assessment)

1: Strongly disagree ... 3:Neutral ... 5: Strongly agree

	1	2	3	4	5
It was easy to understand what part of the user interface represented my skill-level. *	○	○	○	○	○
I was able to make sense of the user interface and extract information regarding my skills. *	○	○	○	○	○

Usefulness of the available dashboard's visual representation (outside of assessment):

1: Strongly disagree ... 3:Neutral ... 5: Strongly agree

	1	2	3	4	5
I think the visual elements used helped my understanding of my current knowledge level (i.e., Progress level, mastery badge or achievement badges.) *	○	○	○	○	○
I believe that the visual representation of my skill in SmartU as a whole was easy to understand. *	○	○	○	○	○
I think that the dashboard provided me with the information I needed to assess my knowledge in the subject. *	○	○	○	○	○

Attitude towards dashboards visual representation (outside assessment):

1: Strongly disagree ... 3:Neutral ... 5: Strongly agree

	1	2	3	4	5
I believe that the visual elements that represent my progress was easy to understand. *	○	○	○	○	○

I was motivated to further use the system to see my progression unfold in the visual elements representing progress. *	○	○	○	○	○
I was motivated to further use the system to achieve the highest mastery-level. *	○	○	○	○	○
By utilizing the visual elements continuously, I gain better understanding of my own progress. *	○	○	○	○	○
The design and colors in the visual elements made me feel joy. *	○	○	○	○	○
The design and colors in the visual elements made me feel confident and comfortable while using SmartU. *	○	○	○	○	○

Other comments regarding the overall visual representation of the dashboard outside assessment:

Sideskift

Side 4

Usage of game elements (outside assessment):

1: Strongly disagree ... 3:Neutral ... 5: Strongly agree

	1	2	3	4	5
It was clear how I progress in the activity from the “Your progression” widget. *	○	○	○	○	○
The badges made it clear that I am doing well. *	○	○	○	○	○

Usefulness of the game elements outside assessment:

1: Strongly disagree ... 3:Neutral ... 5: Strongly agree

	1	2	3	4	5
I found it useful to have badges visualizing my achievements in the activity. *	○	○	○	○	○

The visualization of progression through the activity as levels was intuitive and helped me know how far I have come in the activity. *	○	○	○	○	○
I found it useful to be able to see what is required to receive the badges. *	○	○	○	○	○

Attitude when interacting with game elements outside assessment:

1: Strongly disagree ... 3:Neutral ... 5: Strongly agree

	1	2	3	4	5
I felt motivated by being able to earn achievement badges. *	○	○	○	○	○
The progression represented as levels made it engaging to use SmartU. *	○	○	○	○	○

Other comments to the use of game elements outside of assessment:

Sideskift

Side 5

Usage of game elements (inside assessment):

1: Strongly disagree ... 3:Neutral ... 5: Strongly agree

	1	2	3	4	5
It was easy to understand if I was doing well during the assessment. *	○	○	○	○	○
In the summary of the assessment, it was clear whether I had a lot of correct answers or not. *	○	○	○	○	○
There were clear indications to where I could get help. *	○	○	○	○	○

Usefulness of the game elements in the assessment:

1: Strongly disagree ... 3:Neutral ... 5: Strongly agree

	1	2	3	4	5
I found it useful to have aid mechanics available during assessment. *	○	○	○	○	○
I found it useful to see immediate feedback on my previously answered question. *	○	○	○	○	○
I found the audio effects useful. *	○	○	○	○	○

Attitude when interacting with game elements in assessment:

1: Strongly disagree ... 3:Neutral ... 5: Strongly agree

	1	2	3	4	5
I felt motivated when I heard the correct jingle. *	○	○	○	○	○
I felt motivated to answer questions when I knew I could receive some help. *	○	○	○	○	○
I felt the game elements made the self-assessment more fun and engaging. *	○	○	○	○	○
Having the opportunity to use aid mechanics made the assessment more comfortable. *	○	○	○	○	○

Other comments to the use of game elements during assessment:

Are you available to be contacted for a short interview (10-15 mins) about your experience with SmartU. *

- ○ Yes
- ○ No

Se nylige endringer i Nettskje

B Results

B.1 Questionnaire

B.1.1 SUS scores

Table B.1: Results from the SUS-test, based on standard SUS-schema

		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total Score
Gamified	P1	5,00	1,00	5,00	1,00	5,00	1,00	5,00	1,00	5,00	1,00	100,00
	P2	5,00	1,00	5,00	1,00	5,00	1,00	4,00	1,00	5,00	1,00	97,50
	P3	5,00	3,00	4,00	1,00	4,00	4,00	5,00	2,00	5,00	2,00	77,50
	P4	4,00	1,00	5,00	1,00	5,00	1,00	5,00	1,00	5,00	1,00	97,50
	P5	4,00	1,00	5,00	1,00	4,00	1,00	4,00	2,00	5,00	2,00	87,50
	P6	5,00	1,00	5,00	1,00	4,00	1,00	5,00	1,00	5,00	2,00	95,00
	P7	4,00	1,00	4,00	1,00	4,00	2,00	5,00	1,00	5,00	2,00	87,50
	P8	3,00	4,00	2,00	3,00	3,00	3,00	4,00	4,00	4,00	4,00	45,00
	P9	4,00	2,00	4,00	2,00	4,00	2,00	4,00	2,00	4,00	2,00	75,00
	P10	4,00	2,00	4,00	1,00	5,00	2,00	4,00	3,00	5,00	3,00	77,50
	P11	4,00	1,00	5,00	2,00	4,00	2,00	5,00	1,00	5,00	1,00	90,00
	P12	3,00	1,00	5,00	1,00	5,00	1,00	5,00	1,00	5,00	1,00	95,00
Legacy	P1	5,00	2,00	5,00	1,00	4,00	2,00	5,00	2,00	4,00	2,00	85,00
	P2	4,00	2,00	4,00	2,00	4,00	1,00	5,00	2,00	5,00	1,00	85,00
	P3	5,00	2,00	5,00	1,00	4,00	3,00	5,00	1,00	5,00	2,00	87,50
	P4	3,00	1,00	5,00	1,00	4,00	1,00	5,00	1,00	5,00	1,00	92,50
	P5	4,00	1,00	5,00	1,00	4,00	1,00	4,00	1,00	5,00	1,00	92,50
	P6	4,00	3,00	4,00	1,00	4,00	1,00	5,00	1,00	5,00	2,00	85,00
	P7	5,00	1,00	5,00	1,00	5,00	1,00	5,00	2,00	5,00	1,00	97,50
	P8	3,00	2,00	4,00	1,00	2,00	3,00	4,00	3,00	5,00	4,00	62,50
	P9	3,00	2,00	4,00	2,00	4,00	2,00	4,00	2,00	3,00	2,00	70,00
	P10	3,00	2,00	5,00	1,00	2,00	1,00	4,00	1,00	5,00	1,00	82,50
	P11	5,00	1,00	5,00	1,00	4,00	2,00	5,00	1,00	5,00	1,00	95,00
	P12	3,00	2,00	4,00	3,00	2,00	2,00	4,00	1,00	4,00	2,00	67,50
											Average	84,48

B.1.2 OEUS

Table B.2: Questionnaire Descriptives OEUS

Overall evaluation of the usability of SmartU (OEUS)

Mean is based on Likert Scale from (Strongly Disagree) 1 to 5 (Strongly Agree)

	Gamified			Legacy		
	N	Mean	Std. Deviation	N	Mean	Std. Deviation
"I think that the navigation in SmartU was nearly effortless."	12	3,92	1,240	12	3,75	1,055
"I think that when I needed help to learn how to use SmartU, the system provided me with sufficient information."	12	4,08	1,165	12	3,67	0,888
"I think that a user who has never seen SmartU before can learn how to accomplish basic tasks fast."	12	4,50	0,522	12	4,58	0,515
"I think that it is not frequent that users make navigational errors while using SmartU."	12	3,83	0,835	12	3,67	0,492
"I think that the interaction with SmartU is clear and understandable."	12	4,17	0,937	12	4,33	0,888
"Using SmartU makes me happy to accomplish my selfassessment tasks."	12	4,50	0,674	12	3,50	1,243
"Using SmartU gives me enjoyment for my continuous learning."	12	4,50	0,905	12	3,67	1,073
"Using SmartU leads me to explore my continuous selfassessment."	12	4,33	0,985	12	3,58	1,240
"I would like to continue to use SmartU to increase my skills."	12	4,50	0,674	12	4,00	0,739

B.1.3 DASH

Table B.3: Questionnaire Descriptives OEUS

Overall Dashboard Evaluation (DASH)

Mean is based on Likert Scale from (Strongly Disagree) 1 to 5 (Strongly Agree)

	Gamified			Legacy		
	N	Mean	Std. Deviation	N	Mean	Std. Deviation
"It was easy to understand what part of the user interface represented my skill level."	12	4,50	0,905	12	3,92	1,165
"I was able to make sense of the user interface and extract information regarding my skills"	12	4,25	0,965	12	4,00	1,128
"I think the visual elements used helped my understanding of my current knowledge level (i.e., Progress level, mastery badge or achievementbadges.)"	12	4,75	0,452	12	4,25	0,965
"I believe that the visual representation of my skill in SmartU as a whole was easy to understand."	12	4,42	0,669	12	4,08	0,996
"I think that the dashboard provided me with the information I needed to assess my knowledge in the subject."	12	4,08	1,084	12	3,75	0,965
"I believe that the visual elements that represent my progress was easy to understand."	12	4,58	0,900	12	4,33	0,778
"I was motivated to further use the system to see my progression unfold in the visual elements representing progress."	12	4,75	0,452	12	4,17	0,937

"I was motivated to further use the system to achieve the highest masterylevel."	12	4,50	0,522	12	4,00	1,128
"By utilizing the visual elements continuously, I gain better understanding of my own progress."	12	4,58	0,515	12	4,33	0,778
"The design and colors in the visual elements made me feel joy."	12	3,58	0,996	12	3,08	1,084
"The design and colors in the visual elements made me feel confident and comfortable while using SmartU"	12	3,58	0,996	12	3,58	1,311

B.1.4 GIN

Table B.4: Questionnaire Descriptives OEUS

Game Elements Inside Evaluation (GIN)

Mean is based on Likert Scale from (Strongly Disagree) 1 to 5 (Strongly Agree)

	Gamified		
	N	Mean	Std. Deviation
"It was easy to understand if I was doing well during the assessment."	12	4,67	0,651
"In the summary of the assessment, it was clear whether I had a lot of correct answers or not. "	12	4,75	0,452
"There were clear indications to where I could get help."	12	4,17	1,030
"I found it useful to have aid mechanics available during assessment.."	12	4,42	0,793
"I found it useful to see immediate feedback on my previously answered question. "	12	4,58	0,900
"I found the audio effects useful. "	12	3,00	1,348
"I felt motivated when I heard the correct jingle."	12	4,33	1,303
"I felt motivated to answer questions when I knew I could receive some help."	12	3,83	1,193
"I felt the game elements made the self-assessment more fun and engaging."	12	4,83	0,389
"Having the opportunity to use aid mechanics made the assessment more comfortable. "	12	4,33	0,888

B.1.5 GOU

Table B.5: Questionnaire Descriptives OEUS

Game Elements Inside Evaluation (GIN)

Mean is based on Likert Scale from (Strongly Disagree) 1 to 5 (Strongly Agree)

	Gamified		
	N	Mean	Std. Deviation
"It was clear how I progress in the activity from the "Your progression" widget. "	12	4,75	0,452
"The badges made it clear that I am doing well."	12	4,58	0,669
"I found it useful to have badges visualizing my achievements in the activity. "	12	4,67	0,651
"The visualization of progression through the activity as levels was intuitive and helped me know how far I have come in the activity."	12	4,42	0,515
"I found it useful to be able to see what is required to receive the badges. "	12	4,67	0,651
"I felt motivated by being able to earn achievement badges."	12	4,83	0,389
"The progression represented as levels made it engaging to useSmartU."	12	4,50	0,674

B.2 Interviews

B.2.1 Participant 1

```
Interviewer
What parts did you like about the gamified system you saw?
Participant 1
Is it for both these scenarios or am I free to answer for
   either scenario?
Interviewer
Yes, either scenario. But I would prefer most answers about the
    gamified scenario.
Participant 1
So I like the part where the progress was defined as these
   steps.
Participant 1
Then you can come back and see how far you reached.
Participant 1
I like the reward system and the like.
Participant 1
The badges and milestones are quite nice, and they're
   motivating.
Participant 1
So that was pretty nice.
Participant 1
I also like the feedback system in the second scenario for
   every question, but I.
Participant 1
I mean it can be made a little better.
Participant 1
I mean, I like the fact that there is a feedback, but it's a
   bit abrupt right now, so I think that contribute.
Interviewer
What are some parts that you particularly disliked?
Participant 1
My only comment is about the feedback system that I felt it was
    very important.
Participant 1
Feedback is very abrupt, like after every question, especially
   if you have like a negative answer then.
Participant 1
Really, it could be more subtle right now.
Participant 1
It's very kind of sharp, so it like jars your focus.
Participant 1
That would be one thing I had better focus on.
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Participant 1
I would also like if there can be timed sessions and like
    individual items that can be looked for because right now.
Participant 1
Like the graph on the right hand side top on the main page only
     shows you progress through all the tests.
Participant 1
But if it can be more selectable for specific tests, then that
    also helps.
Interviewer
Is there anything you would like such a system to offer you?
Participant 1
I'm I mean I don't know to what extent you're developing this
    system.
Participant 1
I don't know.
Participant 1
But the nearest system that I could think of which has a
    similar interface is the Duolingo language app if.
Participant 1
You've seen that.
Participant 1
So that also offers a like variety of short competitions and
    variety of questions.
Participant 1
So maybe something like that that I mean the type of tests can
    be.
Participant 1
More interesting, maybe it's also possibility to pair up with
    someone and do a test at similar time and compare your
    answers.
Participant 1
Something like that would also make it interesting platform to
    collaborate, like if you work in a group or a team or in.
Participant 1
Pairs, then their are options.
Interviewer
Do you think the system would improve your motivation to study
    and if so, why would it do so?
Participant 1
Oh yes, it definitely does, because it's easy to keep track of
    it purpose.
Participant 1
And there are milestones all through the problems, which is
    very interesting, at least to me because.
Participant 1
```

```
Because it gives you motivation to do.
Participant 1
It's not just about the test.
Participant 1
Going through the levels of the test.
Participant 1
I like that problem so that gives me a reason to come back and
    try something again and again.
Interviewer
Would you use the system again, and if So what would encourage
    you to do so?
Participant 1
It's easy to access and it has a personal Dashboard, it is not
    just a test, but you get to see your progress.
Participant 1
You get to compare performance overtime.
Interviewer
What do you think of the game elements used in the second
    scenario?
Interviewer
And their implementations.
Participant 1
I really like it.
Participant 1
I think it adds another.
Participant 1
The reason for using this platform again and again so it adds
    added motivation.
Participant 1
And it's it's a bit more interesting, so that's quite nice.
Participant 1
There are a lot of things that can be added as well.
Participant 1
A lot of things that should be added as well.
Participant 1
That's part of the process, but the fact that this system is
    interactive is quite interesting in itself.
Participant 1
That it does respond to you, so it seems much more personal
    when we automatically test then just going through a set of
     questions.
Interviewer
Could you mention some features that were easy or hard to
    understand?
Participant 1
```

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I think overall the interface was quite intuitive, so there's
   nothing which was hard to understand.
Participant 1
So right now it's it's quite simple and accessible and I didn't
    personally have any particular issues with any part.
Participant 1
But I would like to add that at this point I did not know what
   to expect from there, so in that way if I see it, I don't
   have a benchmark to compare it with, so maybe some things
   might be missing, but I didn't quite notice it because for
   what I collected with, it seemed quite easy and intuitive
   and can be used without any particular guidance.
```

B.2.2 Participant 5

```
Interviewer
Hvar det noe du likte, å i så fall hva var det du likte?
Participant 5
Æ likt fargan.
Participant 5
Fordi de viste om det er rett eller feil.
Participant 5
Og altså jeg likte dere.
Participant 5
Lydene også, jeg ble veldig lett. Jeg nå hørte jeg jo på lydene
   , men til vanlig så har jeg vel lydløst uansett.
Participant 5
Ofte påvirke av sånn effekt da er lett lett påvirkelig. Sånn
   fall greit, tror jeg.
Participant 5
Hæ er altså jeg likte de der hjelpemidlene.
Participant 5
 Jeg liker dem på generell basis, men jeg vet ikke om jeg liker
     dem liksom i skolesammenheng. Det er jo målet å kunne
    mest, så set det litt som juks.
Interviewer
Det her er ment som selvevaluerings plattform.
Interviewer
Det er for å vurderer hvordan du gjør det selv.
Participant 5
Ja.
Participant 5
Er knyttet det sikkert litt opp mot skolen, og da?
Participant 5
Tenker jeg må.
```

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Participant 5
Men, men jeg liker at det er en mulig for det. Det hjelper meg
    jo på vei å få rett svar.
Participant 5
Og det er jo bra.
Participant 5
Jeg husker mer informasjon på den slutt siden.
Interviewer
Ja.
Participant 5
Sånn badge og sånn?
Participant 5
Og det er jo praktisk, men det.
Participant 5
Men fikk litt lite erfaring med det, på de gjennomgangene.
Participant 5
Men men jevnt over, så liker jeg jo å fullføre på sånn andre
    spill som har det.
Participant 5
Det er sånn man kan få.
Participant 5
Vet ikke jeg mine premier for å få riktig.
Interviewer
Ja.
Interviewer
Hva er noen deler som du mislikte da?
Participant 5
Nei.
Participant 5
Er litt usikkert. Det prøver å komme på, hvordan det var.
Participant 5
Jo, jeg kunne tenkt meg at det var forklaring på de dere
    hjelpemidlene.
Interviewer
Beklager det var utelatt ved et uhell.
Participant 5
Så da jeg trykte jo den pil knappen og den byttet ut spørsmålet
    .
Participant 5
Uten å vite hva den egentli betydd,  og det var vel mer at jeg
    ville hatt mer en sånn info.
Participant 5
Jeg likte lydene, men jeg tror ikke det kommer til å hatt på
    lyd når jeg har spilt.
Participant 5
```

Så det er en sånn litt likegylidg for meg, men det fungerte jo når man først brukte det.
Interviewer
Hva kunne du tenkt deg at sånn her type system skulle kunne tilby deg?
Participant 5
Nei, det er vel å vise fremgang i ting jeg holder på med.
Participant 5
Nå har ikke jeg helt skjønt det med selvevaluering er det ikke for ulike fag eller er det?
Interviewer
Jo det er for ulike fag, det kan bli lagt inn flere forskjellige typer fag med slike spørsmål som du kanskje kunne se hvordan du gjør det i fagene.
Participant 5
Ja, og det er jo veldig praktisk.
Participant 5
Det spesielt i fag der det finnes rett og galt svar.
Interviewer
Det er bare noe i systemet som jeg synes du savner egentlig som kunne kanskje vært der. Som ville gjort ting litt bedre?
Participant 5
Det var ei informasjon så knapper og sånn hvertfall i starten, kanskje en sånn.
Participant 5
Første runde, der du kan få valg med å få informasjonen og kan leser mere.
Participant 5
Men det er jo bare en runde, og så vet man jo alt like vell.
Participant 5
Kanskje, eller man ser kanskje hvordan andre gjør da i faget.
Interviewer
Ja det var en mulighet får å se gjennomsnittet til de andre som tok faget.
Participant 5
Det ja litt greit å vite om.
Participant 5
Tar meg en sånn toppscore?
Interviewer
Nei, det var ikke noen slik score liste.
Interviewer
Er det noe du vil finne greit å hatt med egentlig?
Participant 5
Kanskje en anonym variant, for når man gjøre det dårlig så vises det ikke for resten av klassen, men er veldig.
Participant 5

Kan jo sånn, det er jo motiverende å vite at man gjør det bedre eller kan
Gjør det flere ganger, altså?
Participant 5
Kan ligge på toppen av liste.
Participant 5
Men som sagt bilder, så er jeg jo jeg veldig lett påvirkelig av slike spill greier.
Interviewer
Kunne du nevnt noe del altså kanskje var lett eller vanskelig å forstå i det systemet?
Participant 5
Ja farger var veldig lett å forstå sånn.
Participant 5
Og oversikten der man fikk se sin egen tidsbruk og slikt.
Participant 5
Lydeffektene skjønte jeg ikke først, det var fordi jeg startet med feil svar, jeg trodde det var feil med mikrofon.
Participant 5
Men jevnt over så var det og ganske sånn selv forklarende det. Det er oversikten og sånn.
Interviewer
Ja.
Interviewer
Var det noe som var litt vanskelig å forstå.
Participant 5
Hei, det var nå bare det da med hjelpemidler man ikke skjønt i starten helt men.
Participant 5
Utover det så var det vel ikke så veldig vanskelig. Det var mer min usikkerhet for å si at det ikke er helt ferdig, og jeg har lov til å trykke på alt egentlig.
Participant 5
Hadde jeg fått tiligang til systemet i en annen setting, så hadde jeg jo bare trykket litt friere sikkert.
Interviewer
Ja.
Interviewer
Kunne du tenkt deg å bruke et slikt system som dette, om du skulle studere videre i fremtiden?
Participant 5
Ja.
Participant 5
Spesielt litt sånn en sånn fag som var ja.
Participant 5
Litt kjekt som.

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Participant 5
Mattefag og sånne ting som er veldig praktisk å vite om.
Participant 5
Da får man jo teste seg litt, og spesielt å ha noe som man kan
    ta seg jevnt over og ikke bare helt på slutten av året.
Participant 5
Jeg syns kanskje sånn her system fungerer bedre enn Kahoot på
    slutten av én time, for da er det jo målet egentlig å være
    så var rask som mulig.
Participant 5
Mot andre.
Participant 5
Får nokk like god effekt som når du, konkurere mot deg selv.
```

B.2.3 Participant 6

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Interviewer
Var det noen del av dashboardet du likte, og i så fall hvilke
    deler?
Participant 6
Ja, det var ganske clean og oversiktlig. Det var fint sånn
    store fargerike knapper som gjorde det lett å se.
Participant 6
Altså var det veldig god oversikt med de dere chartene og
    grafene og slikt.
Participant 6
Litt gøy sånn statistikk.
Interviewer
Hva med spill elementene noe spesifikt rundt dem.
Participant 6
Det det var det var lett å forstå.
Participant 6
På den andre enden, så den andre typen så merket jeg ikke de
    hjelpemiddlene i starten.
Participant 6
Vet ikke om de kunne ha blitt utpekt mer når du begynner.
Participant 6
Også likte jeg achievement delen. Det var litt gøy.
Participant 6
Også likte at det var mulig å se hvor mange av spørsmålene du
    har vært igjennom totalt sett.
Participant 6
Og ja igjen sånn mye statistikk da ganske gøy å se.
Interviewer
Var det noen deler som du mislikte?
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```
Participant 6
Og på den andre, så var det en sånn lyd når du svart feil eller
    noe sånt.
Participant 6
Og det var litt høyt, synes jeg.
Participant 6
Æ hadde på ganske høy lyd da, men sånn uansett sånn det burde v
   ært mulig å skru av den lyden, eller det blir lettere å få
   vite at det du kan få lyd og sånt.
Participant 6
Også noen av spørsmålene, det er jo sånn som det er, men når
   det er sån flervalgs spørsmål og de ble plukket ut fra en s
   ånn database da at det blir mer at du pugger svaret på spå
   rsmålet.
Participant 6
Hvert fall. Jeg er ender opp med sånne type spørsmål med å
   liksom bare se hva er svaret på spørsmålet her. Og så har
   jeg pugga svare uten at jeg egentlig helt forstår det.
Interviewer
Ja, men ideen bak siden er ikke å øve på materialet, men heller
    se eller evaluere selv hvordan du gjør det i emnet.
Interviewer
I et sånn her type system, er det noe du synes det burde kunne
   tilby?
Participant 6
Dark mode.
Participant 6
Jeg vet ikke, jeg kanskje?
Participant 6
Sånn? Ja, det var jo sånn sammenligning med andre.
Participant 6
Med andre, det er jo litt sånn gøy. Jeg vet ikke om det er litt
    sånn. Alle som har tatt det, eller om det er sånn. Du kan
   ha det med en sånn liten gruppe med folk du kjenner for
   eksempel.
Participant 6
Så du ser, hvem så ligger ann best.
Interviewer
La oss si at du fortsatt var student, ville du kunne brukt det
   her videre, eller noe system sånn som det her.
Participant 6
Ja.
Participant 6
Ja det jeg kunne jo kanskje ha brukt det, men.
Participant 6
Hvis det er sånn jeg føler.
```

```
Participant 6
Jeg hadde ikke brukt for at jeg hadde brukt mer til å øve på sp
    ørsmål og sånn eller å øve på ting.
Participant 6
Det blir mer liksom sånn at du.
Participant 6
Du vil bare ha rett svar, så da pugger du bare svaret i stedet
    for å prøve å forstå det.
Participant 6
Føler jeg fort kan skje
Interviewer
Ok.
Interviewer
Hva synes du om spillelementer i den ene versjonen du så? Var
    det noe som stakk ut?
Participant 6
Nei, det var jo.
Participant 6
Det var de hjelpemiddlene, føler ikke de gjor så mye for mæ. Fø
    ler ikke at det er noe æ ville brukt.
Interviewer
Hva med de badges, levels og lignende?
Participant 6
Ja det er det er jo.
Participant 6
Hadde jo grinda det sikkert.
Participant 6
Bare for å ha gjort det, men sånn ja.
Participant 6
Jeg vet ikke om hvis at du liksom du kan ta samme testen over
    og over igjen, så vet ikke om det sier så mye om forstå
    elsen din.
Interviewer
Nei, du kan ikke ta samme testen om igjen.
Participant 6
Når du har gjort ferdig en test, så kan ikke du ta opp noe
    lignende igjen.
Interviewer
Hva syntes du om hovedaktivitets siden?
Participant 6
Ja det det henger sammen med liksom hele siden, så det var jo
    fint.
Participant 6
Det det her all den statistikken og sånn var. Det var jo litt
    artig å se hvordan du hadde gjort i forhold til andre.
Participant 6
```

```
Det var enkelt å navigere, man rotet seg ikke bort.
Interviewer
Var det noe på siden du synes var lett eller vanskelig å forstå
    .
Participant 6
Nei egentlig ikke. Alt var lett å forstå.
Participant 6
Det var ikke noe som var ikke lett forstå.
Interviewer
Synes du systemet kunne være en motiverende faktor i ditt
    studie?
Participant 6
Ja nei, altså, følte ikke det hadde kanskje vært en sånn.
Participant 6
Hvis du kunne ha liksom sjekket hvordan det lå an i forhold til
     andre eller i forhold til klassen da på en måte.
Participant 6
Hvordan du ligger ann i nivå og slikt, og eventuelt kunne få
    hint om hva du burde se mer på på egen hånd.
Participant 6
Hadde vært mer slik så hadde det kanskje hjulpet en del.
Participant 6
Og da liksom hvis det går an å liksom trekke fram områder. Hele
     klassen er svake i da så kan.
Participant 6
Så vet man at det man bør fokusere på som en helhet.
```

B.2.4 Participant 7

```
Interviewer
Did you like any parts of the SmartU you gamified version, and
    if so, which parts did you like?
Participant 7
OK, ah, I think I like the system because it's very.
Participant 7
Uh, it's really. It's very easy to understand and like when you
     first use this system, and you know where to go and and
    how to do it.
Participant 7
The special part I like is the the first system I got, and when
     I answer a question if I answer correctly it would. It
    would give me a sound and the background would be green
    color.
Participant 7
```

```
And if I answered wrong, it would give me another sound and the
    background turn red. For me personally, I like this
   immediately response that I know I'm right or wrong.
Participant 7
When I finish my answer.
Interviewer
Are there any parts in the in the main activity page you
   noticed?
Participant 7
Uh, you have the you have a badge part.
Participant 7
Like I am in a primary level or in medium level, it will show
   the badge and it's fun and also you have a diagram like
   show the.
Participant 7
Uh, like like you use the numbers to show my study activity
   performance, something like that. I remember it's in a
   right corner.
Interviewer
OK, are there some parts that you particularly dislike?
Participant 7
Uh, for me I think no, but because I used the first system that
   , uh?
Participant 7
Uhm, one system gives me the immediate response. So, when I use
    the second system and when I answer the question, I didn't
    get any response and so I feel a bit worse, but not that
   bad.
Interviewer
What would you like such a system to offer you?
Participant 7
If I have a such system, firstly, I hope it's like.
Participant 7
It's easy to use. I don't have learn how to use this system.
Participant 7
The first time, uhm, I hope it's directly and it's simple and.
Participant 7
Umm, it can like it, it just show what it is. It's not so
   complicated.
Participant 7
And secondly, I hope it can help me record my study activities
   and study performance.
Participant 7
And show my and show my study results.
Participant 7
```

Yeah, I, I think that's all I knew you already done. I think most of those.
Interviewer
If possible, would you use such a system again, if so what would encourage you to do so?
Participant 7
Ah yes, I would like to use it.
Participant 7
Because I think the.
Participant 7
When I answered the question, it gave me the immediately response and.
Participant 7
And when I finished the.
Participant 7
Uh, questions I also gave. I also was giving some badge so it would encourage me to learn more. I think I like this kind of study activity.
Interviewer
Were there some parts that you found hard or easy to use?
Participant 7
I think, uh, I think it's easy like it in each module, you just write your name and it is easy to understand.
Participant 7
Uhm?
Participant 7
Yeah, I think so.
Participant 7
Notice there are some differences between the two systems, like the layout.
Participant 7
Or some content, but I think that's fine like.
Participant 7
It won't influence me using this system.
Interviewer
Do you think the system would improve your motivation to study?
Participant 7
I think the first system improves.
Participant 7
Because it gives me the results directly and if it works, if if the study result is bad and I would, I would try again.
Participant 7
Yeah, and the 2nd is also good, but compared to the first one I would prefer the first one.
Interviewer
OK.

```
Participant 7
Maybe it could be possible to switch modes on and off, like
    some people might not like the imediate feedback part.
Interviewer
It's nice to hear.
```

B.2.5 Participant 8

```
Interviewer
Was there any parts of the gamified system you liked, and if so
    , which ones?
Participant 8
Uhm, I think I like the layout. I like how everything was
    situated, uh, in the in kind of boxes and very organized. I
     also like the colors that were chosen.
Participant 8
And, uh, I like the badges and the the graphs of how you
    progressed every time you did a test?
Interviewer
OK.
Interviewer
OK, was there any part during a quiz that you liked?
Participant 8
I think I like that part where I you know when you got the
    answer right and the screen light up in green. That was
    kind of rewarding and I also like the little detail of you
    know those.
Participant 8
Take off 50% of the answers are wrong and the other option
    which was, If you failed an answer, you could still go for
    the for another try that was, yeah that was nice.
I think it made the learning experience better.
Interviewer
That's nice.
Interviewer
So were there some parts that you did not like?
Participant 8
I really did not like the loud sound of when you made a mistake
    , I was a little bit startling. It's not that it shouldn't
    have any sound, because maybe that's a nice effect right
    there, but maybe something softer or something less sharp.
Participant 8
Yeah, I guess not as loud.
Interviewer
```

OK, any part of the, uh, like the main activity page that you did not like?
Participant 8
Of what I can remember, uh, I think everything was quite alright, uh.
Participant 8
Yeah, I like where everything was situated.
Participant 8
Uh, yeah, I think I think I could find everything pretty much easily and I I I wouldn't change anything. I think it was quite alright. Yeah, OK, yeah.
Interviewer
What would you like such a system like smartU to offer?
Participant 8
I, I think that these kind of systems are important not only to test yourself, but they also allow you to learn so.
Participant 8
I think that, uhm.
Participant 8
Part of what was offered already was really nice, as I as I already said what you added with the 50%, uh, you know, take the wrong answers and give it another try. I think that's that that improves the learning experience.
Participant 8
Maybe other types of tests, something maybe more dynamic and not only multiple choice, but maybe that's, uh, that's not part of the interface as it is.
Interviewer
There, there there were some, but they didn't show up during the testing.
Participant 8
I think it's good to have different types because it it kind of makes the brain a little bit.
Participant 8
You know, training different ways, so it's not only kind of a 1 sided training for a learning experience, but yeah, that's that's good that there are different types of tests.
Participant 8
Not only multiple choice.
Interviewer
Were there some parts that you found hard to understand?
Participant 8
Maybe at the very beginning. I didn't know how to navigate the page, where to go to start the test.
Participant 8

```
But other than that, I think everything else is quite intuitive
    because on the main page you have every like every
   possible information you you'd want to to know the graphs,
   the badges and the medals or the level I. I think. I think
   it's.
Participant 8
You see in that sense, but yeah, I think probably at the
   beginning is, you know, the as in any other interface, it's
    just takes a bit of time to familiarize yourself. But
   other than that, nothing else.
```

B.2.6 Participant 10

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Interviewer
Hva var det noe du likte og hva det var?
Participant 10
Ja, jeg likte jo veldig godt hele konseptet med gamification,
   og jeg tenker at det er spesielt interessant for kall det
   mengdetrening da å utvikle ferdigheter som gjør at du kan
   repetere pensum og.
Participant  10
Og få litt mer sånn automatikk inn i den kunnskapen du har.
   Slik at tankene blir automatisert da på en bedre måte, slik
    at du kan bruke korttidsminnet til å tenke på de veldig
   kompliserte ting.
Participant 10
Ja, det er jo en fin måte å å styrke kompetansen sin på, tenker
    jeg.
Participant 10
Og det er en slags egen egen vurdering, da du får
   tilbakemelding på hvordan du står også.
Participant 10
Og i forhold til hva du trenger å lese videre med på.
Participant 10
Hva du, hva du kan, hva du er usikker på.
Participant 10
Så det er en slags tilbakemelding til deg selv, som i form av
   en egen vurdering, da.
Participant 10
Andre ting jeg likte var jo.
Participant 10
Elementer med gamification at du får tilbakemelding på fremgang
    og både tid og antall oppgaver du har gjort og hvor aktiv
   du har vært. Det er jo en motiverende faktor.
Participant 10
```

Og så tenker jeg jo at kvaliteten er jo avhengig av hvilke oppgaver som ligger der og hvordan de multiple choice alternativene er utformet da.
Participant 10
Det er jo et viktig element for å for å bygge opp plattformen og få den til å bli med mer og mer bedre og bedre og mer og mer funksjonell.
Participant 10
For forbrukere.
Participant 10
Og ellers så synes jeg jo utforminga var veldig positiv. Var lett å ta i bruk trenger noe instruksjon for å komme i gang .
Participant 10
Ja på design og sånne ting, så kunne det kanskje vært litt bedre, men litt mer sånn delikat da. Men men bortsett fra det så var jeg veldig fornøyd med med hele applikasjonen. Synes den var var bra.
Participant 10
Godt inntrykk av en for å si det sånn.
Interviewer
Var det noen noe spesifikt med noen spill elementer i den versjonen?
Participant 10
Nei, det er jo inkludering av badges og lyder og oversikter som som er hovedingrediensene i den type tilbakemelding du får da, og det er jo veldig mye basert på hva studentgruppa kanskje er vant til å finne i andre sammenhenger.
Participant 10
Som er noe vi tydeligvis liker.
Interviewer
Var det noen deler du var litt misfornøyd med, eller mislikte?
Participant 10
Nei, jeg fra mitt ståsted da siden jeg ikke hadde peiling på faget i det hele tatt, så kan jeg jo ikke si noe mer om så nn faglige innholdet.
Participant 10
Nei så sånn innholdsmessig, så kan ikke jeg si noen ting om kvaliteten da.
Participant 10
Ja men ellers så så synes jeg det er et veldig bra initiativ, og jeg ser jo at det her har potensial til å kunne bli brukt i en hel rekke fag.
Participant 10
Den teknologien da. Det er jo positivt.
Participant 10

```
Jeg vet ikke hva du om det er noen spesielle ting du vil at jeg
    skal kommentere på.
Interviewer
Tenker litt på om hva du synes om de spill elementene og
   usteende?
Participant 10
Jeg synes jo sånn generelt sett så synes jeg jo at den type
   masteroppgaven som bidrar til studentenes læring veldig
   konkret. Det er utrolig positivt da.
Participant 10
Så det trenger vi mer av.
Participant 10
Men sånn spesielt for programmet, så har jeg egentlig ikke så
   mange andre kommentarer, altså enn at jeg likte jeg så syns
    det var bra.
Interviewer
La oss nå si at du er i støvelen til en student.
Interviewer
Ville du sett før deg å kunne bruke dette systemet videre?
Participant 10
Ja helt klart.
Participant 10
Jeg bruker jo noe tilsvarende i språkundervisning.
Participant 10
Og har veldig gode erfaringer med det. Så ja, helt klart at det
    her er noen ting som kan være et sånt supplerende tilbud
   til studenter som har lyst til å jobbe med med faget på på
   flere måter da.
Participant 10
For å variere på arbeidsmåtene sine litt.
Participant 10
Da ser jeg ikke at det kan erstatte en del av det arbeidet som
   allerede foregår i fag, men det er et veldig nyttig
   supplement da som skaper variasjon og motivasjon.
Participant 10
I undervisningen.
Participant 10
Man tenker, individuelt arbeid, gruppearbeid og den type arbeid
    som som er her. Alt må jo tas i bruk for å for å styrke
   kompetansen.
Participant 10
For å lære det man skal.
Interviewer
Var det noe elementer ved en nettside du fant vanskelig å forst
   å eller vanskelige å bruke eller lett å forstå. Lett å bruk
   ?
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Participant 10
Brukeropplevelsen var veldig god.
Participant 10
Den var klar og tydelig, og den den er jo intuitivt hvordan du
    skal gå frem for å for å bruke teknologien.
Participant 10
Du trenger ikke noe opplæring, så du kan ta det i bruk med en
    gang, og det er jo et stort pluss da.
Participant 10
Så det er jo egentlig bare å informere om tilbudet, og så er
    folk i gang.
Participant 10
Det er ikke noe mer arbeid som skal til. Det er ikke noe
    terskel for å for å ta i bruk teknologien som det er på en
    del andre teknologier.
Participant 10
Sånn som blackboard?
Interviewer
Hva med spill elementene under selve spørringen? Hvordan synes
    du den var?
Participant 10
Ut fra det jeg husker på da, så var det jo du fikk jo en
    oppgave, og så fikk du valgmuligheter.
Participant 10
Mm, så fikk du, så fikk du da tilbakemelding i form av lyd når
    du gjorde bra slik applaus og så fikk du sånn ut ein ulyd n
    år du når du gjorde feil.
Participant 10
Men nå husker jeg ikke helt om du fikk du prøve på nytt igjen
    med en gang, eller fikk du svaret med en gang? Det gjorde
    vel egentlig.
Participant 10
Du fikk svaret med en gang etter at du har gjort feil, gjorde
    ikke det.
Interviewer
Du fikk en oppsumering til slutt på hvordan du har svart.
Interviewer
Ja ja, men så var det også noen sånn hjelpemidler, kan du synes
     om det?
Participant 10
Ja, vi har hatt i hjelpemidlene. Ja, det var hvor du kunne få
    redusert antall valgmuligheter.
Participant 10
Det, det virker jo positivt inn.
Participant 10
Så kan du jo, da kan du jo variere.
```

```
Participant 10
Vanskelighetsgraden på oppgavene selv da da har du den
    muligheten selv.
Participant 10
Det var positivt, og så var det tre slike dere ene reduserte
    svaralternativan, og så var det andre var. Var det noe med
    tid?
Interviewer
Nei, vi fikk et ekstra forsøk.
Participant 10
Ekstra forsøk, ja stemmer, og så det tredje var.
Participant 10
Hopp over ja riktig.
Participant 10
Ja riktig ja det. Det er jo elementer som ja, i og med at jeg
    ikke ikke kan fag og sånn så så.
Participant 10
Men jeg så jeg så jo, at det var elementer som ville bidra til
    det motivasjon da i og med at du du fikk etter hvert kun
    kun prøv deg på vanskeligere ting, og at det i begynnelsen
    så var det mer tilpasset. Hvis du var svak akkurat i den
    delen der.
```

B.2.7 Participant 11

```
Interviewer
So were there some parts of the gamified version of the
    dashboard that you liked?
Participant 11
I prefer the first one, I would say because there is some
    feedback on whether you answer the questions correct or not
    .
Participant 11
And and also you get some helps like there's some question
    marks that you can get more informations and.
Participant 11
And there are some like you can, uh, you can eliminate some
    options out if you want and you get more chances to answer
    the questions. So yeah, I think that makes it easier.
Participant 11
And for the gamification part, uh.
Participant 11
Uh, I'm not totally sure because it's not.
Participant 11
```

It doesn’t looks totally like a game for me, but there are some elements like the badges and.
Participant 11
And you can see your, uh, your performance compared to your peers, so uhm.
Participant 11
Yeah, I think the main gamification element is just badges.
Participant 11
I can’t recal other elements.
Participant 11
Yeah yeah, but I think that I think the badges is fine.
Participant 11
But maybe a bit more relevant to the courses.
Participant 11
Yeah yeah. And instead of showing the question mark like just hide all the badges, you can just show all the badges and just disable it like grayed greyed out so that will make it more attractive for me to win all the badges.
Interviewer
Only some parts that you particularly did not like?
Participant 11
Maybe the activities the activities looks the same as attempt summaries, I find this confusing. And that it is called activity, I find this confusing because this is more like testing or quizzing.
Participant 11
So I don’t know like maybe you should have different testing for each.
Participant 11
Each course or each chapter right so?
Participant 11
Then you can see the progression like.
Participant 11
Uh, some test for some chapters and you still need more. They need to finish more test and.
Participant 11
And other things is like the question response time.
Participant 11
Yeah, I would say the the data that you use would be confusing.
Participant 11
Average correct answer time I I don’t know if I really need to know my average wrong answer time because.
Participant 11
I mean, what? What can I do based on this data? Because I care more about how many answers are answer correct and how many answer I answer, correct, wrong and.

Participant 11
And what kind of wrong answers that what kind of answers that I give from now? What kind of questions that I give wrong answers and it tells me that I need to, uh, read more about which chapter or
Participant 11
Uh, what kind of knowledge that I need to learn more about that is more meaningfull to me then answer time?
Interviewer
OK, let's try and focus on something else, maybe a little bit.
Interviewer
In such a system that you're supposed to evaluate your own.
Interviewer
Skill in the subject.
Interviewer
What would you like such a system to offer you?
Participant 11
Like to to evaluate my performance right?
Interviewer
Yeah, the this this system is for your self evaluation, so it's for you to evaluate your self how you are doing.
Participant 11
I think I would like to note that I my correct rate.
Participant 11
How many answers that are correct and like the percentage of correct?
Participant 11
This and also how much time I spent and.
Participant 11
I finished the the test and I compared to the peers. Do I spend more time and it's my correctness rate higher than others higher than the average? Maybe the ranking as well?
Participant 11
And also what kind of questions that I answer wrong? And, uh, what does it indicate? Like which part of the knowledge that I am missing and I which maybe which chapter that I need to refer back to?
Participant 11
Yeah, maybe we can provide some.
Participant 11
I don't know, maybe it can like tell you that maybe you should watch.
Participant 11
The week three lessons again, or some reading materials that the teacher provides. So if you can refer back to the knowledge that you're missing, so that would be very

valuable.
Interviewer
Like, that the system would give you some study tips?
Participant 11
Yeah.
Participant 11
And yeah, and also I can go back and to see the questions that I answer wrong.
Participant 11
I think you can. I think you can already do that in this. Uh, in this, yeah.
Interviewer
Yes.
Participant 11
Uh, I have used another tool like learning coding before, so at each question you can actually link to a forum so you can't see other peoples answers. Or you can post a question there if you don't.
Participant 11
If you don't understand the questions or options.
Participant 11
Yeah, I think it. That might be helpful as well.
Participant 11
Yeah, so there's more explanation like why you why the correct answer is that.
Interviewer
Would you think this system would be motivate you to keep studying, and if so what would do that?
Participant 11
Yeah, I think it might motivate a bit.
Participant 11
Some of the the elements are like totally taken from the taken from the game and it's not well integrated because learning is not totally like a game.
Participant 11
Yeah, but I I think it do. Kind of.
Participant 11
It at some point it can motivate like you seeing your achievements and.
Participant 11
Uh, just seeing your progression.
Participant 11
But maybe there should be more rewards. I don't know. Maybe at some point? Like a point system.
Interviewer
Well, thank you for your time.

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Participant 11
You're welcome, I hope my answers is helpful to you.
Interviewer
Yeah, I think so. Thank you.
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B.2.8 Participant 12

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Interviewer
Ja, så var det noe du likte med den gamifiserte versjonen, og i
    så fall hva da?
Participant 12
Jeg likte en jeg likte en litt sånn hyggelig feedback at du får
    et et hyggelig pling når du svarer rett.
Participant 12
Og at du også får en sånn umiddelbar feedback for at det det du
    synes er veldig viktig hvis du prøver å.
Participant 12
Jeg lærer noe om om du svarer feil. Dette er feil når du få
   umiddelbar feedback, så klarer du å vite om du har svart
   rett på det spørsmålet.
Participant 12
Men om du bare får se statistikken etterpå, så vet vi kun at
   det var 3 av 12 spørsmål som har feil på.
Participant 12
Også.
Participant 12
Likt jeg også.
Participant 12
Level og sånt som skal vise presentasjonen nivået ditt.
Participant 12
Det eneste jeg kan tenke meg. Det er jo at hvis du.
Participant 12
Hvis level og nivå sånn at ikke ikke har noen forbindelse med
   hverandre eller noe.
Participant 12
Sånn nok av reelt at det ikke bare er et tall som tikker
   oppover, uten at det egentlig forteller noe om
   prestasjonsnivået ditt.
Interviewer
Ja, det er vell kanskje andre ting? Ja, så hva syntes du badges
    og litt andre ting?
Participant 12
Ja, det er jo alltids artig det.
Participant 12
Jeg husker ikke i farta hva slags badges jeg fikk, men å kunne.
```

Participant 12
Men å kunne sikte på som prestasjon da ikke sant, så så mange rette svar på rad og sånt så høy prosent, ikke sant? Og at du skal svare så kjapt og sånt litt sånn forskjellige forskjellige ting som ikke.
Participant 12
Nødvendigvis. Det er ikke nødvendigvis klare å se.
Participant 12
Av statistikken alene veldig enkelt. Det er jo artig.
Participant 12
Selvfølgelig så har jeg klart å kurere meg selv for en sånn trang til å samle alle merkene.
Interviewer
Ja altså jeg når jeg spør om noe spesifikt du mislikte.
Participant 12
Nei, det var jo det her om det er grufulle lyden som kommer når du hadde feil.
Participant 12
Nei, men det var vel stort sett det eneste.
Participant 12
Er mistenke at at det var ett sånt et vindu med en sånn graf som ikke var med på den gamifiserte versjonen. Jeg vet ikke om det bare var tomt der.
Interviewer
Nei, der sto ditt nivå med nivå badge og progressbar.
Participant 12
Og så er det et nattmodus. Det er et must uansett et nattmodus.
Interviewer
Og så her sånn her type selvevaluering, plattform eller hva du synes den burde tilby.
Interviewer
Det du testet var en selvevalueringsplattform som skal hjelpe brukeren å se hvordan de ligger ann i et emne.
Participant 12
Jeg tror at det kan være veldig nyttig å oppmuntre til sånt, for vi har jo faktisk tilfeldigvis våres.
Participant 12
Prosjekt i der han økonomifaget. De har jo tenkt oss sånn applikasjonen med quiz og sånt for å kunne repetere fagstoff for å kunne jeg husker bedre fordi vi.
Participant 12
Vi bruker jo å glemme ting.
Participant 12
I spesielt de som har litt teoretisk tunge fag rett etter eksamen. Ikke sant? Så liksom holde kunnskapen livet. Jeg tror at det kan være veldig nyttig å å oppmuntre til å

repetere og.
Participant 12
Liksom beholde ferdigheter man har tilegnet seg med plattformer som denne. Det tror jeg.
Participant 12
For det var vel?
Participant 12
En studie av Frank Klug som visste at.
Participant 12
At, det er sånne data assistert læring og repetisjon ved hjelp av data assistert læring det.
Participant 12
Det lot deg beholde teoretiske ferdigheter. Mye bedre. Det ga veldig gode utfall for.
Participant 12
Folk av meg alle er alle nivåer som lære evne.
Interviewer
Hvis det her var et system du vil bruke i studiet, det ville det vært motiverende for studiet i så fall hvordan grad?
Participant 12
Jeg tenker, kan jeg sånn spesielt dette er gjort noe med, kan du slenge inn og enkle moduler i sant for barneskolen og ungdomsskolen, sånt vi kommer til å hive seg rett over der, ikke sant? Spesielt hvis de kan konkurrere med vennene sine for å få.
Participant 12
Ja for å få merka og nivå og sånt. Men jeg tenker fort at det kan være et nyttig verktøy også for universitet og sånt vist bare.
Participant 12
Kommer helt an på innholdet da så hva du putter i de testene.
Interviewer
Ja du mener man skal kunne putte ikke hva som helst nesten det.
Interviewer
Men jeg tenkte mer sånn ville du synes det øker motivasjon til å studere i så fall hvis du hadde hatt et sånn system tilgjengelig.
Participant 12
Det kan det fort hende, men det er jo.
Participant 12
Egentlig noe som jeg ikke helt vet hvem man har gjort det rett sånn lengre studier på det, men selvfølgelig lengre studier . Veldig vanskelig å fortelle.
Interviewer
Var det noe du fant
Interviewer

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Vanskelig å forstå i systemet?
Participant 12
Nei, det var ikke noe som så ut som vanskelig.
Participant 12
Ikke noe jeg ikke forstår meg på der?
Interviewer
Så det er bare sånn høvelig intuitivt og lett å forstå?
Participant 12
Ja
Interviewer
Ok det er bra.
Interviewer
La oss si du hadde muligheten til å fortsette å bruke systemet,
    er det noe du ville fortsatt å brukt?
Participant 12
Altså hvis jeg hadde hatt.
Participant 12
Det er sånn jevnlig vest har fått jevnlig oppfriskning i en
   mange av dere der mattefagene de har spesielt.
Participant 12
Så hadde jeg absolutt brukt det før. Det er jo noe jeg har
   tenkt til å gjøre i sommer uansett. Det er jo å repetere
   mye av den matematikken vi har hatt.
Participant 12
Og spesielt litt sånn litt teoretisk matematikk og sånt.
Interviewer
Hva du synes om de hjelpemidlene i som var tilgjengelig i
   spillversjonen, var noe altså interessant å kunne være
   tilgjengelig.
Participant 12
Sånn jeg følte jo litt at jeg hadde hjelpemidlene sånn at hvis
   jeg hadde vært, vil du bli millionær? Da hadde vært veldig
   grei, men når det på en måte er for å teste deg selv, så er
    kanskje de hjelpemidlene litt mindre relevant.
Participant 12
Det var jo fifty fifty.
Participant 12
Og så var det vel at du kunne prøve 2 ganger og at du kunne
   hoppe over spørsmålet.
Interviewer
Ja.
Participant 12
Man trenger jo ikke å bruke de hjelpemidlene, ikke sant? Jeg
   trengte ikke å bruke de hjelpemidlene følte jeg, og da
   brukte den ikke så det.
Participant 12
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Det tok jo liksom ikke nok av det tok ikke noe fra meg at de
    hjelpemidlene der var en mulighet, men.
Participant 12
Hvis noen liker noe, men andre finner det nøytralt så skader
    det ikke å ha det med.
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