Master's thesis

Tam Duc Ha Vo

Gamification to Promote Student Learning Activity

Master's thesis in Computer Science
Supervisor: Trond Aalberg
July 2020

NTNU
Kunnskap for en bedre verden

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Faculty of Information Technology and Electrical Engineering
Department of Computer Science

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Abstract

The research aim for this thesis was two-fold. Firstly, we wanted to understand what gamification was in the context of learning, the relationship between game elements and learning theories, the motivational affordance of game elements and how gamification can be used to motivate. Secondly, we will create our own solution in hopes of sparking motivation and engagement in students. Before we started designing our solution we wanted to have a basic understanding of gamification. To get sufficient information about gamification and to present the term in a structural way, we devised four research questions:

- **RQ1**: What are the typical game elements used in motivational-based applications?

- **RQ2**: What theories exists for the relationship between game elements and motivation?

- **RQ3**: How can game elements be used to promote student activity?

- **RQ4**: How can gamification affect student motivation?

The four research questions are meant to answer the statement below:

> How is gamification used and can be used to increase student motivation and engagement?

Gamification can briefly be described as a non-game related application created to promote human behaviour through the usage of game-design elements and principles. The relevant sources shows that gamification can be a powerful tool, because it engages students into thinking more critically and sets them into a more problem solving mindset. It is seen to have a positive effect on the learning outcome when used properly with the right elements.

The thematic and theoretical background of the thesis is based upon literature found through a literature study. On top of the found information a solution will be developed and tested up against the theory. The focus is on different game elements and

how they contribute to engage and motivate students. We also take a look at the effect game elements have on extrinsic and intrinsic motivation. We will explain our design choices, go through the functionality and the implementation of our design. The evaluation for the concept of our solution will be carried out in a focus group and will focus on our choice of game elements. Lastly, we conclude the thesis by discussing if our solution is of interest and further work.

Sammendrag

Hensikten med masteroppgaven er å forstå hva gamification er i sammenheng med læring, forholdet mellom spillelementer og læringsteori og se på hvordan gamification kan bli tatt i bruk av studenter slik at vi kan lage vår egen løsning. Vår løsning skal være et forsøk på å øke motivasjon og engasjement i dagens studenter. Før vi startet med å designe løsningen vår ville vi ha grunnleggende bakgrunnsinformasjon om gamification. For å få dette til på en mest mulig strukturert måte satte vi opp fire forskningsspørsmål:

- **FS1**: Hva er de typiske spillelementene som er brukt i motivasjonsbaserte applikasjoner?

- **FS2**: Hvilke teorier eksisterer for forholdet mellom spillelementer og motivasjon?

- **FS3**: Hvordan kan spillelementer bidra til økt aktivitet hos studenter?

- **FS4**: Hvordan kan gamification påvirke motivasjon?

De fire forskningsspørsmålene er ment for å kunne svare på problemstillingen vår:

> Hvordan er gamification brukt og kan bli brukt for å øke motivasjon og engasjement hos studenter?

Gamification kan kort beskrives som et ikke-spillrelatert program for å fremme menneskelig atferd ved bruk av elementer og prinsipper innenfor spilldesign. De relevante kildene vi fant viser at gamification kan være et kraftig verktøy, da det engasjerer studentene til å tenke mer kritisk, samt forbedrer dine ferdigheter til å løse problemer. Flere empiriske studier om gamification har vist at bruken av det kan ha en positiv effekt på læringsutbyttet når det brukes med de riktige elementene.

Den tematiske og teoretiske bakgrunnen for oppgaven er basert på kjent litteratur funnet gjennom et litteraturstudie. Etter at grunnlaget har blitt satt går vi videre med å utvikle en løsning for å teste teorien som har blitt funnet. Vi fokuserer på spillelementene og velger dem med omhu. Vi ser videre på hvordan de påvirker

engasjement og motivasjon. En beskrivelse av spilldesignet vårt, funksjonaliteten og implementasjonen vil bli presentert. Evalueringen for vårt designkonsept vil bli utført ved bruk av en fokusgruppe og kommer til å fokuserer på våre utvalgte spillelementer. Avslutningsvis konkluderes oppgaven ved å diskuterer om hvorvidt løsningen vår er av interesse og forslag til videre arbeid.

Nøkkelord Gamification, psykologi, høyere utdanning, Kahoot, menneskelig atferd, spilldesign, spillprinsipper, spillelementer, spillmekanikk, geolokasjon.
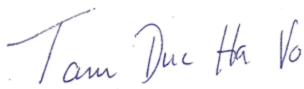
Preface

This master thesis was written at the Department of Computer Science at the Norwegian University of Science and Technology, NTNU, and marks the end of a 5-year master's program. The thesis was written during the spring of 2020 and is the continuation and the final product of the project thesis written the previous semester in the fall of 2019.

The purpose of the thesis is to discover and map what effect gamification and the usage of game mechanics can have on student activity and motivation. We will utilize the found theory to create a motivational-based application. The topic of gamification has been exciting to work with, and it has given me new and useful knowledge. I hope this knowledge that has been presented here can be of use.

I would like to thank my supervisor Trond Aalberg for giving me important guidance and constructive criticism on what to focus on to succeed with the thesis.

Lastly, I would like to thank family and friends for their support during my five years of study.

Trondheim, 1. July, 2020

Tam Duc Ha Vo

Tam Duc Ha Vo

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Chapter 1: Introduction

The following chapter will briefly describe the thesis background, purpose, statement, research questions and the structure of the paper.

1.1 Background

In this day and age it is difficult for some students to stay focused, stay motivated and encouraged in doing school work seeing as they are surrounded by social media and have access to all other forms of digital entertainment in their own pockets. It is understandable that lecturer's may find it hard to have the attention of students and keeping them motivated and encouraged (Dicehva et al., 2018).

Our education system has changed much over the years, in terms of the quality of teaching and the quality of education (Roser et al., 2019). Why is it necessary to change anything if education never has been better? Education has indeed changed, but it has changed superficially. The change should instead be at the core, seeing as how education is the most stagnant process that is still accepted in this day and age (Papert, 2001). The problem is that our current education system is not training our brain the right way, seeing as the learning process is lacking elements to motivate and to encourage students (Dislen, 2013). In recent years industries have taken notice of the evolvement of digital games and their effect on users and tried to recreate the appeal that games have to achieve these missing elements (Mekler et al., 2013a). This is a practice that takes place in the field of the technical area of digital game-based learning - in other words, gamification (Urh et al., 2015).

Games have been around for centuries in human culture and have been a source of fun and enjoyment for millions of people across the globe. In recent years, the buzzword gamification has become more popular since its first introduction in the early 2000s, but did not get traction until the second half of 2010 (Groh, 2012). Examples of gamification are Codecademy, Duolingo and many more. The idea of gamification is to use game design elements in a context that is non-game related to see how the elements can affect certain human behaviours (Deterding, 2012). It is

therefore desirable to explore how gamification can work in harmony with our brain and how it can improve productivity and to create healthy habits. We will also look at theory about behavioural changes caused by gamification and put the theory to test by designing a solution.

1.2 Purpose and thesis statement

The purpose of this thesis is to get an overview of the background of gamification, how gamification is used in the context of teaching, the impact gamification can have on motivation, and the effect it can have on student behaviour. We will then use the found information and theory to design a solution by putting the theory to test. Several related literature from trustworthy sources will be used to answer the statement below. The statement was devised as a way to pin point what kind of literature we were looking for, and it goes as follows:

> How is gamification used and can be used to increase student motivation and engagement?

1.3 Research questions

Four research questions have been devised to answer the statement in a systematic way. These are as follows:

- **RQ1**: What are the typical game elements used in motivational-based applications?

- **RQ2**: What theories exists for the relationship between game elements and motivation?

- **RQ3**: How can game elements be used to promote student activity?

- **RQ4**: How can gamification affect student motivation?

The research questions will be explored by gathering theory through the use of literature study. We will look for sources that contain information about gamification, different learning theories, how these learning theories has been put to use in gami-

fication, and how game elements can promote student activity. We will then look at the typical used game elements in motivational-based applications to see how these elements have succeeded in boosting both extrinsic and intrinsic motivation and encouragement in students. Lastly, we will use the theory to design a prototype and evaluate our concept by conducting a focus group consisting of tertiary students.

1.4   Course information and limitations

This master thesis was written during the spring of 2020 and builds on the project thesis that was written in the fall of 2019. The majority of the information found in the project thesis has been reused. Newfound information and slight changes to the project thesis has been added a long the way. The data collection for this thesis consists of theoretical and empirical samplings. The theoretical part has been collected from a literature study that has stretched from the start of fall 2019 to spring 2020. The empirical samplings has been carried out by evaluating our concept against a focus group.

The task at hand is to look at the impact gamification can have on motivation and engagement in students. The term gamification has gotten rather broad these past years, and so there is much to look into. That is why this thesis has decided to briefly review gamification in the context of learning, game design frameworks, different aspects of psychology in gamification, with focus on theories of learning such as behaviourism and cognitive psychology, and also look at the negative aspects of gamification. The found information will then be used to implement a solution.

Limitations for this thesis has been in the form of time and place constraints, so everything will be described just enough so the reader will get a general understanding.

1.5   Overview of the thesis

This thesis consists of 6 chapters and ends with a list of references. A brief introduction of each chapter is described in table 1.1.

Chapter	Chapter content
1. Introduction	This chapter introduces the purpose and thesis statement and the research questions to better understand gamification, course information and limitations regarding the thesis. Lastly, an overview of the thesis will be presented.
2. Background	This chapter introduces the chosen literature survey method and the different search engines used. The information found will be presented in relation to the research questions.
3. Method	In chapter 3 we will discuss our design approach, explain our solution and list out our chosen game mechanics and why. Lastly, we will explain the functionality.
4. Implementation	This chapter will go through our implementation. We describe the APIs used, the database used and the accuracy of one of our features. Lastly, the interface will be explained.
5. Evaluation	Chapter 5 describes a focus group case study where the application will be tested out by 5 students.
6. Conclusion	The last chapter will present our conclusion and suggestions towards further work.
References	A list of all the references that has been used.

Table 1.1: Structure of the thesis

Chapter 2: Background

In the following chapter the method used for retrieving information will be described. The found literature will also be described.

2.1 Literature Study

The theoretical foundation for this thesis will be achieved by collecting information from literature. The following and the next section will describe how we acquire specific literature. Table 2.1 describes the following methods used to answer the research questions.

2.1.1 Information retrieval: Search engines

Before finding relevant literature we needed to identify which search engines to use. We identified four different search engines: Google Scholar, NTNU Open, Oria and ResearchGate. The first task was to figure out how these search engines worked and which engine had the most relevant literature. We decided to drop Oria and ResearchGate, because articles posted on these search engines could also be found using NTNU Open and Google Scholar. That way we saved time by only going through two search engines. Google Scholar was more frequently used than NTNU Open. These were the search engines that was used during our project thesis. We relied heavily on Google Scholar for our master's. The information we found for our project thesis was mainly to help us map basic literature surrounding gamification. The way we found relevant literature was to systematically list all important keywords we could extract from the research questions. Table 2.2 shows the number of results found for the project thesis. The literature study for our master's was more specific towards certain keywords or full sentences as we can see in table 2.3.

Research question	Method	Comments
What are the typical game elements used in motivational applications?	Literature study	To answer RQ1, we focused on literature study to find out about what gamification is to find the most common game elements. The important thing to take from this research question is why a particular set of game elements are more favourable than others.
What theories exists for the relationship between game elements and motivation?	Literature study	We used literature study to find out about learning theories that has been mentioned in empirical studies about gamification.
How can game elements be used to promote student activity?	Literature study Focus Group	We used literature study here as well. The interesting part about this research question is that it is a follow up to RQ1. So, to actually test out if the most used game elements can be used to promote student activity we used qualitative research in the form of a focus group.
How can gamification affect student motivation?	Literature study Focus Group	As with every other research question, literature study was used. There were surprisingly few empirical studies that showed results of long-term effects. However, the studies showed that gamification had positive effects in some way or another. A focus group will also help us to answer this question.

Table 2.1: Research method to answer the research questions

Keyword	Google Scholar	NTNU Open
Gamification	57 700	173
and psychology	25 400	8869
and higher education	31 300	30 638
and negative aspects	23 300	30 224
and first introduced	22 400	30 999
Learning theory	3 510 000	27 478
and gamification	33 200	27 501
and behaviourism	118 000	30 458
and cognitive	3 500 000	28 297
and constructivism	203 000	27 481
and socio-constructivism	58 700	27 982
and situated learning	851 000	30 686

Table 2.2: The number of results for our project thesis with the keyword *gamification* and *learning* in combination with other keywords

Keyword	Google Scholar
Point system gamification	36 800
Reward system education	1 420 000
Game mechanics app	39 400
Gamification motivation	38 800
Game mechanics education	346 000
Motivational apps	38 000
Types of gamification	38 600
Serious games	2 600 000
Usage of game mechanics	139 000
Empirical study gamification in education	24 600
Empirical study gamification	28 200
Game mechanics incentive	78 000
Game mechanics task motivation	189 000
Points motivation	3 940 000
Gamification framework	39 600
Gamification design framework	36 800
Importance of progress bar	2 910 000
Self-efficacy expectancy	142 000

Table 2.3: The number of results for our master's with different keywords

2.1.2   Literature evaluation

As we can tell from figure 2.2 and figure 2.3, there exist a great amount of literature, and it would take ages to go through them all. We focused mainly on articles written in English. To evaluate the quality of the literature we found we focused on titles closely related to what we searched for, when the literature was published, the number of references they had to pin point the credibility of the literature, and the content of the summary. A clear strength when using literature study as a method is the wide range of knowledge available. That way we can compare different

literature against each other to find the accuracy of their content and whether or not the content is outdated. The literature found is a mixture of master's theses, articles in the form of conferences and journals, and books.

We started out with 17 relevant sources while working on our project thesis. Further work forced us to conduct a more abductive approach when it came to changing our research questions and statement continuously to fit the found literature and ended up with around 25 relevant sources. As for our master thesis, we now had the option to be more specific. Meaning we needed to find multiple articles to check if the information in an article could be verified by another source to be as accurate as possible with what we presented. This has resulted in the thesis being written with the help of 73 sources.

2.2 Literature Results

This section presents the results from the literature study.

2.2.1 Game

Before we dive into the term gamification, we want to differentiate between *games* and *play*. The distinction between games and play can be explained by looking at Caillois' concept of *paidia* and *ludus* (Deterding et al., 2011). The concept paidia (play) denotes the way of playing without rules and limits. It is unproductive and a waste of both energy and ingenuity when carrying out paidia. Whereas the concept ludus (games) is about a play that is more restricted by rules and more structured in hopes of achieving goals (Caillois, 2001). Game-based learning applications are therefore more focused to use design elements for goal-oriented and rule-bound ludus rather than for paidia (Deterding et al., 2011).

2.2.2 Defining gamification

Gamification can be seen as a set of relevant activities and processes to engage users in a way that changes their behaviours (Kim et al., 2018). The term first surfaced when Nick Pelling coined it in 2002. Pelling created the word to explain

how game-design could be used to make electronic transactions enjoyable and fast, but Deterding's explanation is more favorable (Burke, 2014). Deterding explains the definition of *gamification* as: *a way to use elements of game-design in non-game contexts, products, and services to motivate desired behaviours* (Deterding, 2012). To get a better understanding of the term, we can look at another definition and break it down to clear any confusion: *the use of game mechanics and experience design to digitally engage and motivate people to achieve their goals* (Burke, 2014). The broken down definition is explained in table 2.4.

Term	Description
Game mechanics	Game mechanics are mechanics that typically occur in games, such as points, challenges, levels, and leaderboards.
Experience design	The term describes the experience players get when playing the game.
Digitally engage	In other words, any kind of interaction that happens through digital devices.
Motivate people	The most important term in gamification. The goal is to try to change peoples behaviour by motivating them through gamification.
Achieve their goals	To let players solve problems related to learning and education.

Table 2.4: Explanation of gamification in greater detail

As we see from figure 2.1, the term did not appear on Google Trends before the second half of 2010. The sudden rise of gamification in businesses can be explained by advancements in sensors that allow tracking of everyday activity, a shift in Web analytics and the current cultural momentum of video games (Deterding, 2012). It was also seen as a tool that could be used to increase customer engagement. In 2014 it was estimated that 50% of innovation process organizations would gamify different aspects of their businesses. At the same time, there was an increase in startups that had focus on adding a layer of gamification to their core activity, such as Codecademy (Hamari et al., 2014).
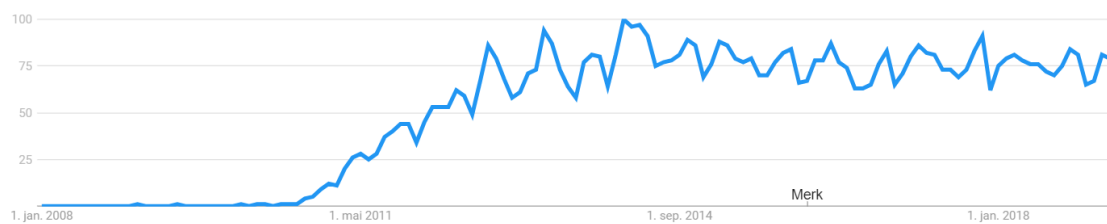
Figure 2.1: The trending of gamification in the whole world since 2008 (Trends, 2019)

Gamification has sparked interest in the academic domain as well, and the term has drawn the attention of academics and educators in recent years. As of when we write this thesis, the increase in number of articles can be seen in figure 2.2. An analysis of literature from different domains show that the majority of empirical research has been done in the domain of education and learning (Koivisto and Hamari, 2019).
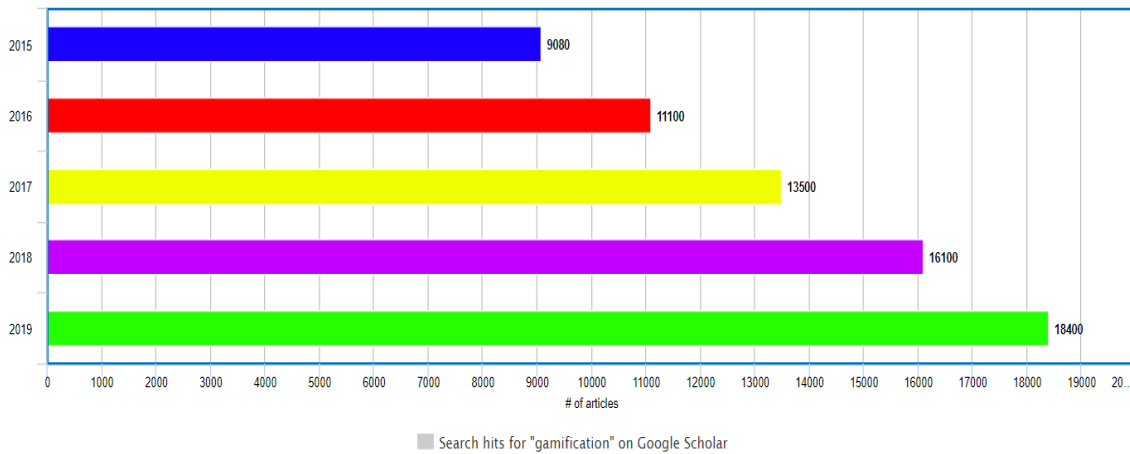
Figure 2.2: Number of articles about gamification from 2015-2019 at Google Scholar

Even though the number of papers published about gamification is increasing every year, its academic worth is still questioned. The reason may be in the fault of insufficient empirical study towards trying to validate gamification as a meaningful concept (Seaborn and Fels, 2014; Hamari et al., 2014). It is therefore its academic worth is questioned, seeing as they are skeptical to gamification being used as a tool to motivate and engage students in non-game contexts (Cozar-Gutierrez and Saez-Lopez, 2016). (Koivisto and Hamari, 2019) reviewed 819 studies and found out that the majority of the papers lacks consistency in research models, in the measured quantities of data, and in theoretical foundations. (Koivisto and Hamari, 2019) discovered that the results shown in those papers were mixed, but they all were leaning towards that gamification can have a positive effect on users. Other studies published by Wang et al. (2016); Papp (2017) also leaned towards positive findings by collection data over a period of time from the usage of gamified applications.

2.2.3   Gamification in higher education

Many university students world wide sit and listen everyday in a lecture hall taking notes while the educator talks. This form of teaching is the traditional way of teaching, and it is highly instructor centered. Before we go any further as to why gamification is useful in higher education, we begin by separating university students into two groups: The extrinsically motivated and the intrinsically motivated. The former attends lectures to either pass the class, to get a good grade or for other external factors. The latter attends lectures because they find enjoyment in learning and doing tasks (Buckley and Doyle, 2014). The former can be associated with the theory of behaviourism, while the latter can be associated with the theory of cognitivism. These learning theories are described in a later section. For extrinsically motivated students to be engaged as much as the intrinsically motivated, it is a necessity to make lectures more student centered. Gamification can be used to achieve exactly this and to increase student self-efficacy (Banfield and Wilkerson, 2014).

Gamification has in recent years been presented as a disruptive force in education trying to break free from the traditional ways of teaching. The reason for that is that digital game-based learning applications have caught the attention of educators as a technology used to motivate and engage students more in the learning process (Deterding, 2012). The thing about gamification is that it relies on the premise that traditional learning is boring and uninteresting, while the use of games in otherwise boring activities could make learning more attractive (Attali and Arieli-Attali, 2014). It enables students to do tasks and experience different scenarios which may have otherwise been impossible, a waste or time, or even expensive (Liarokapis et al., 2010). Limitations for gamification in an educational context depends only on the educator's creativity (Banfield and Wilkerson, 2014).

Not only can the use of gamification increase motivation and student engagement, but it can also increase learning performance, give instant feedback about a students progress, promote collaboration skills, and activate behavioural changes (Kim et al., 2018). We are looking at the broad definition of gamification when writing about

the positive aspects, and not for a specific application, as every game-based learning systems may give different positive aspects. The core positive aspects are mentioned above.

2.2.4   The dark side of gamification

Gamification has, as with everything else in the world, its pros and cons. We discovered that recent studies only focused on the bright sides of gamification, so this section will explore the negative effects of gamification. It was rather difficult to find articles that focused entirely on the negative aspects of gamification.

Gamification is used to purposely improve motivation, performance, and increase engagement in users, but there are also dark sides. As an example, gamification techniques was used in an application to motivate users in Berlin, Germany to vandalize or steal CCTV cameras, where they would get points with bonus scores for the most creative way to vandalize the cameras (Stallwood, 2013).

To fully understand the negative aspects of gamification we will categorize the cons into two groups: The first group addresses the limitations of gamification. The second group addresses side effects of gamification (Hyrynsalmi et al., 2017).

2.2.4.1   Limiting issues

Everything has a limit, and gamification is not an exception. Some may argue that it is possible to use gamification techniques on any activity. But, is it really necessary?

The real issue about gamification is not knowing when to stop. As mentioned before, gamification is used to focus on the inherent values in an activity. If the users do not not find any inherent value from using it, it would not matter whether or not your application is great. Gamification would not add any extra motivation by using the application if there was already enough motivation without it. Gamification may even go as far as demotivating users because of its way of representing tasks in a childish way and the simplicity of the design (Hyrynsalmi et al., 2017).

Another great example on limitations within gamification is the fact that users may be playing the game just for the fun of it and ignores the task at hand. One could

also say that gamification may create competition, which would hinder teamwork and the teams performance (Hyrynsalmi et al., 2017).

2.2.4.2   Side effects

Examples of side effects could be loss of productivity from being distracted from the main task, over engagement, or addiction as some would call it, and only doing things because there is a reward at the end of the stick (Hyrynsalmi et al., 2017). An example of loss of productivity would be a gamification system that allows for customization of the game. The customization of the game may not be directly related to the learning, so the users would spend more time on this feature rather than focusing on learning. One might ask themselves how addiction can happen from a gamified solution in a learning context. For example, a student exposed to only game-based learning systems may find it difficult to learn and acquire knowledge from lectures that do not use game elements and some extrinsic reward system (Andrade et al., 2016).

Now that we have gotten a brief introduction about gamification, the next section will briefly explain the main difference between gamification and games, as well as looking at some existing applications and their features. The main difference between gamification and games is how we would treat a given content. The way we treat the content can be divided into two separate definitions, mainly *structural gamification* and *serious games* (Kapp, 2014).

2.2.5   Structural gamification

Structural gamification is commonly used in domains such as education and health. The goal of structural gamification is to gamify a given content, but not altering the actual content of the activity. In other words, the content of the activity is not designed to be game-like, only the structure surrounding the content. The integration of game dynamics should be applied with carefulness and consideration on how the design can evoke certain psychological behaviours in the users which will be describing in a later section. They have to be able to understand the learning goals quickly and on how to earn rewards. The rewards are there to keep them engaged and motivated and to show that the application creates incentive value. The key is also to create an enjoyable application.

The possibility of having meaningless dynamics in the design may happen and may have the opposite effect of what we want. There are therefore three questions we need to ask ourselves before the design process:

- Q1: Why is this particular game dynamic considered?

- Q2: What is the purpose of the game dynamic

- Q3: How will the game dynamic function

As we can tell, gamification design is not an easy task to carry out and is seen as reasonably complex (Hallifax et al., 2018). The implication of each of these questions can be seen in table 2.5.

Questions	Explanation
Why is this particular game dynamic considered	The question is concerned about how the game dynamic will contribute to trigger a certain behaviour from the users, and will help the designers to think rationally about their choices.
What is the purpose and focus of the game dynamic	The question is concerned about whether or not the game dynamic is there to address the main goal of the activity or sub-goals of an action surrouding that activity.
How will the game dynamic function	There are different layers to consider for this question. The question addresses how often the game dynamic will be shown to the users, how it is presented and the functionality. Will the presentation just be a progress bar or something related to the activity. For example an app that tracks your water intake where the progress bar is a water bottle.

Table 2.5: Three questions to consider during the design process

Since the term gamification was first coined, there has been created multiple successful gamification applications. We are going to take a look at two of them, as well as answering the questions in regards to the applications to see how they became successful and why it worked for them. Seeing as we mentioned that domains such as education and health commonly used gamification, we want to take a look at one motivational-based application and one health-based application.

RunKeeper

RunKeeper is an application with over 50 million users created to help people to get out more and start being more active. The users have the ability to view their activity in real time, set goals, follow a plan, join challenges, and being able to look at in-depth details on your progress. RunKeeper utilizes many different game elements, such as a reward system, progress bars, virtual races, challenges, and being able to share your achievements with friends.

Since we do not know how the designers thought when creating this application, we have to speculate when answering the questions. RunKeeper succeeds in triggering various behavioural changes in the users. These changes have been triggered by using, for example, a reward system. The reward system can contribute to encourage users to be more active through peer pressure, seeing as how the users are able to share their achievements with friends. Sharing your progress with friends and family can be seen as a motivational factor. That particular motivator however can be seen as a double-edged sword, as it may demotivate when users feel like they are falling behind compared to others. As for the second question, RunKeeper is designed to address both the main goal and the sub-goals. The main goal is to get healthier and fitter, while the sub-goals are any other action leading up to the main goal. Statistics and being able to create your own long-term plan address the main goal by being able to take a look at in-depth details of your overall progress, while the game dynamics addressing sub-goals are achievements you get from completing a run. Lastly, the different game mechanics are presented through progress bars, achievements and statistics. The progress bars when running are only available during a run, while the achievements and statistics can be seen whenever.

Forest: Stay focused

Forest restricts the usage of your smartphone so you can focus on more important things. The concept is simple and easy to understand. The application will give you the option to start a timer whenever you want to focus. As time goes a growing tree is displayed for the users to see. Each session gives you n amount of coins. If the application is exited, the tree dies. Various motivational slogans are displayed as well as time passes.

We take a look a the different game dynamics to tackle the first question. The dynamics are rewards, statistics and achievements. The most prominent changes are motivational and psychological changes. Forest motivates the users by letting them accumulate coins and sharing your progress with friends and family. These coins can be used to unlock different trees. The best part about Forest is that the users can plant real trees when they have gained 2500 coins. The psychological aspect of the application is that it creates habits. As we know, the main goal of this application is to help you to stay focused, to grow a forest, and to maintain a habit. The sub-goals are the sessions. The game dynamic that address the main goal is the growing tree and the overall statistics. The game dynamic that address the sub-goals are the coins you earn for each session and the progress bar. As with RunKeeper, these game dynamics are also presented through a progress bar, achievements and statistics. The progress bar can be seen whenever the timer is activated, while the achievements and statistics can be seen whenever.

2.2.5.1   Other applications

Here are other applications that are worth mentioning without going into much detail as above. These applications are specifically motivational-based with focus on tracking activities, and location-based applications with focus on attendance management of students. To find the most relevant applications for us, we used keywords such as *motivational*, *gamification*, *students*, *location*, *tracking*, and *attendance*.

Motivational-based applications for tracking activities

In the section below we have briefly described four motivational-based applications with features that are of interest to us.

Coach.me

This application tracks your habits. You can set up your own tasks or choose between predefined ones. After choosing a task, you are able to see a list of people that have chosen the same task. You can leave a little note on each task. From there, you can communicate with each other and like each other's notes. The main screen of the application will show how many likes you have gotten and how many tasks you have completed.

Beeminder

This application is a useful tool for when you want to motivate yourself in doings things you want to do. Meaning, you are able to set your own activities or use predefined ones. The way this application imprints habits into you is that when you do not do a certain activity often enough the application will charge you money.

Habit Bull - Habit Tracker

This is another habit tracker. The purpose of the application is to help you manage your time on a daily basis to create healthy habits. You get streaks whenever you complete the same activities consecutively. You are able to track any kind of habits, even the bad ones. Motivational quotes are offered in the application to help you combat the bad habits. Statistics over each activity are presented in the application as well.

Habitica

Habitica makes use of role-playing games to build new habits. You earn rewards such as points after completing a habit. From there, you are able to level up and unlock different features. Failing to complete a habit will affect your character negatively, such as loss of health, death of your character, and loss of progress.

Figure 2.3 checks out the most important game mechanics that are present or not in each application from above.

	Points	Levels	Challenges	Virtual goods	Leaderboards	Gifting and charity
Forest	✔	✔	✔	✔	✔	✔
Coach.me	✘	✘	✔	✘	✘	✔
Beeminder	✘	✘	✔	✘	✘	✔
Habit Bull	✔	✘	✔	✘	✔	✘
Habitica	✔	✔	✔	✔	✔	✘

Figure 2.3: Game mechanics used in the motivational-based applications

Location-based applications for attendance management

The following applications have been chosen for the reason that they use GPS and time tracking features.

Time Doctor

Time Doctor's mobile application enables tracking of users location through GPS, as well as tracking how much time have been used on created projects to effectively manage time.

Calamari

As with Time Doctor, Calamari also uses GPS location to clock in. The difference is that Calamari uses iBeacon technology to track attendance. The mobile app also has the option to receive notifications.

Hubstaff

Hubstaff has features like time tracking, GPS tracking, productivity monitoring and geofencing to set perimeters for a location.

Figure 2.4 list features that are used in the applications above.

	Geolocation	Time tracking	Geo check-in	Geofencing
Time Doctor	✔	✔	✘	✘
Calamari	✔	✔	✔	✘
Hubstaff	✔	✔	✘	✔

Figure 2.4: Some features that have been used in the location-based applications

2.2.6   Serious games

The popularity of games, the boundless use of the world wide web and the demand and need to create more alluring ways of presenting educational practices have made serious games a more favourable form for education and training (Alvarez et al., 2011). The term dates as far back as to the Renaissance, but the current wave of serious games started back in 2002 (Alvarez et al., 2011). The idea behind serious games is to turn content into a game (Kapp, 2014). Meaning, they are suppose to be full games and should not only contain certain game mechanics. They utilize game mechanics such as storytelling, challenges and the freedom to make mistakes and learn from them. A vast majority of serious games are created for the purpose of targeting education, learning, training, military applications and many more, and should be used for a serious purpose rather than only for entertainment purposes (Breuer and Bente, 2010). Serious games are often used in a novel way for players to interact with games in hopes of learning new skills and knowledge. The potential to transfer less abstract knowledge easier through serious games are immense if we are able to combine the games with conventional training and educational approaches (Ma et al., 2011). Although structural gamification and serious games serve to motivate and engage players, there is still a big difference between them, and we wanted to make that as clear as possible.

2.2.6.1   Examples of serious games in education

This section contains an overview of two popular educational games specifically used in higher education.

Hubro Business Simulation

Hubro Business Simulation is an online web-based tool used for learning tertiary learners and high school students about business economics- and entrepreneurship. The goal of the simulation is to work in teams against others to become the top selling production company. 99 % of students that have use the simulation recommends it. 93 % found it both motivating and engaging, and 93 % agreed that this way of teaching was way more exciting than doing traditional exercises (Education, 2019). Figure 2.5 shows the graphical user interface (GUI) of the simulation.
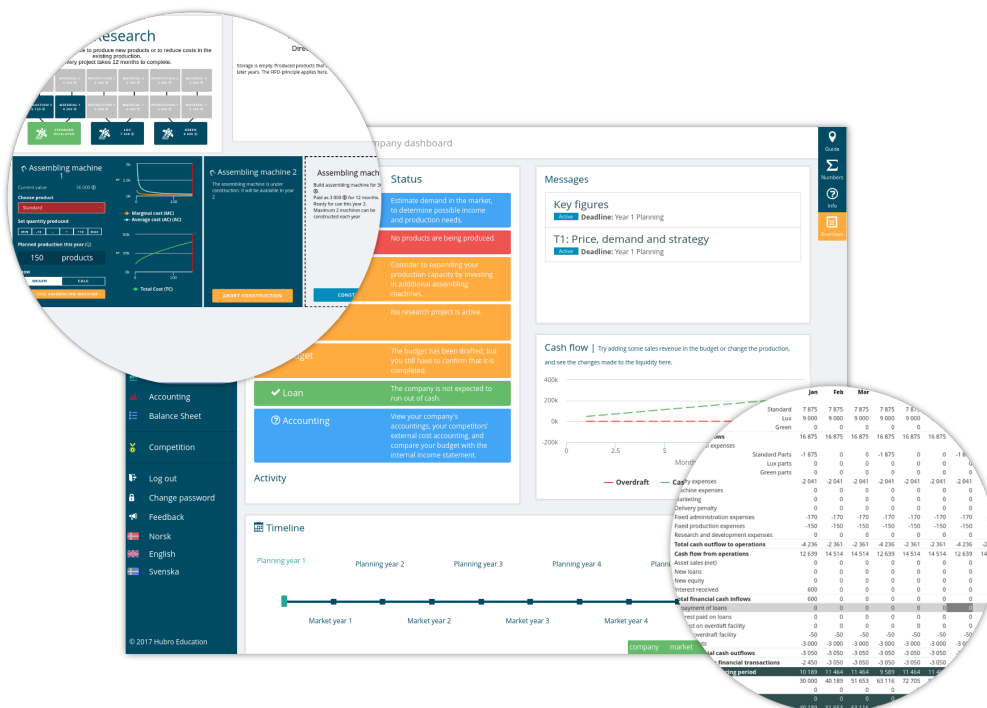
Figure 2.5: GUI of Hubro Business Simulation (Education, 2019)

abdceSIM

abcdeSIM is an online simulation that teaches medical students about the ABCDE-
method. The ABCDE-method is used for patients in need of emergency care
(Barisic, 2017). The simulation will learn students to accurately diagnose patients
and creates a real-life experience where students can see the direct effect of their
chosen medical methods and decisions. abcdeSIM is used by over 10.000 medical
professionals and used in over 40 % of dutch hospitals (Medschool, 2019). Figure
2.6 shows the GUI of the simulation.

Figure 2.6: GUI of abcdeSIM (Medschool, 2019)

Even though structural gamification and serious games are different, they both share
similar learning theories to trigger certain behaviours. These learning theories will
be described in the next section.

2.2.7 Learning theories

Learning theories can be described as a set of views in respect to how an individual acquires knowledge and connects the information encountered in the world (Buchheister, 2018). These theories can help to get a better understanding on how to use information and communication technology to improve learning (Tollefsrud, 2006). Down below are five different learning theories.

2.2.7.1 Behaviourism

Behaviourism, also known as conditional learning, is a learning achieved through trial and error and can be measured by looking at the observable relationship between a stimuli and a response. Familiar concepts such as consciousness and introspectiveness, i.e the internal, unobservable mental actions such as thoughts and feelings, is not of importance when talking about the actions or behaviours of an individual, seeing as behaviourism believe that knowledge is independent of these concepts (Boghossian, 2006). To unlock the motivational factors in behaviourism, we look towards using external forces. These forces can be in the form of rewards when users give the correct response upon stimuli (Buchheister, 2018; Skara, 2015).

2.2.7.2 Cognitivism

The theory of cognitive learning, which is the opposite of behaviourism, explains the mental processes that are influenced by both internal and external forces during learning. A key word in cognitive learning is repetition. Repetition is important to build schemas in the brain, where schemas can be described as a set of patterns that organizes and connects all the information and the relationship between the information in an individuals mind (Tollefsrud, 2006).

A subtheory of cognitivism is the theory of expectancy, also known as outcome expectancy theory. The theory of outcome expectancy proposes that a person will perform a given behaviour depending on the outcome from doing so (Maddux and Sherer, 1982; Williams et al., 2005). For instance, an employee working harder by doing longer hours to get that promotion he/she has been promised. The behaviour is not only dependent on the outcome, but also if the outcome will present a reward

that is of value. Giving a reward not worthy in the eyes of the person will result in demotivation.

2.2.7.3   Constructivism

Constructivism is the theory that explains how learning and thinking occurs in stages. Meaning, individuals will construct their own knowledge and meaning from their previous experiences (Boghossian, 2006). The use of constructivism can make learning more meaningful by letting users engage and interact with a given problem or a concept, which will make them more active in a learning process (Buchheister, 2018). Constructivism differ from behaviourism from the fact that constructivism focus more on understanding and making sense out of new information, rather than focusing on getting a reward out of the learning process.

2.2.7.4   Socio-constructivism

Socio-constructivism is similar to the theory of constructivism. This one focus more on how humans develop during social situations, while the one above focus more on the cognitive aspect. The idea of socio-constructivism is to acquire knowledge through social interactions (Tollefsrud, 2006).

2.2.7.5   Situated learning

The aspects of situated learning is to help users feel inclined to learn through active participation in the learning process. Most learning activities do not use situated learning, seeing as the knowledge is mostly abstract and out of context. To achieve contextual knowledge, the learning process should focus on carrying out authentic tasks and create contextual situations (Tollefsrud, 2006).

2.2.8   Learning theories and gamification

This section will explore how learning theories is used in digital game-based learning applications.

2.2.8.1   Behaviourism in gamification

The most important action of behaviourism in gamification is the interaction between the game and the player - the game has given the player a task and the player will complete that task. In other words, the focal point is on players learning to give the correct responses when given a set of stimuli. Give enough correct responses and the player will be rewarded. Having reward systems or any kind of incentive in a game is a perfect example of extrinsic motivation. Extrinsic motivation can be described as our reward driven behaviour (Egenfeldt-Nielsen, 2006).

Games that give learning through trial and error falls commonly under genres like adventures, puzzle, and strategic and many more. An example of an application in one of these genres is the language-learning platform DuoLingo. DuoLingo uses levels as its game mechanic: the users are not able to go to the next level until they have finished the previous one. DuoLingo makes them repeat tasks until they gives the correct response. Giving the wrong response will only force them to learn from their mistakes, which will change their behaviour and give them a sense of achievement (Tollefsrud, 2006; Naik, 1998; Skara, 2015).

2.2.8.2   Cognitivism in gamification

Behaviourism in gamification relies more on extrinsic motivation, whereas for cognitivism, the intrinsic motivation is of importance. To create a game with a cognitive approach, the focus would have to be on integrating learning and game experience. That way the game can challenge a player's **schemas**. In other words, games with a cognitive approach will try to engage players into discovering different materials that is presented in different ways through a strong game experience. These game experiences would be equal to the limitations and potentials of the human mind. Examples of games that would fit into the cognitive approach would be mathematics and science games (Egenfeldt-Nielsen, 2006).

2.2.8.3 Constructivism, socio-constructivism and situated learning in gamification

Microworlds is a familiar concept in these approaches. A microworld can be seen as an open-ended universe where a topic can be presented through different interactable artefacts present in the game. These worlds will try to force the player to think critically and to use prior knowledge to help them make sense and connections, and create their own meaning out of the artefacts. The focus is on aligning and creating authentic and relevant experiences for the players (Egenfeldt-Nielsen, 2006).

The social-constructivism approach and situated learning would be to let students work in groups to discuss and collaborate on tasks in the game. What all these approaches have in common is that they force the player to learn, simply because the game demands it, which will increase their intrinsic motivation. Typical genres for the approaches would be strategy or puzzles (Tollefsrud, 2006). A great example of a game that uses these approaches would be the *Civilization* franchise, the strategic game where players have to build a civilization from the ground up with the help of science, trading and war.

With gamification it is important to know the correlation between certain game elements and learning theories. It is equally important to know how to apply these theories to design a successful gamification system. The next section will list a few known gamification frameworks. To start of the section, we describe the difference between game design and gamification design.

Game design and gamification design are two different design methods with two different purposes. Game design has the purpose of creating pure entertainment and enjoyment, whereas gamification design has the purpose of gamifying certain contexts to enhance engagement (Mora et al., 2015). To understand the basics of gamification design, we need to understand the principles of game design theory and games in its wholeness. A formal approach to understanding games was then created in San Jose from 2001-2004 by (Hunicke, 2004) called the MDA framework

2.2.9 The MDA framework

The MDA framework was created with the determination to connect game design, development, game criticism, and technical game research together. As stated by MDA, games can be deconstructed down to three elements: mechanics, dynamics, aesthetics (Mora et al., 2015). Game mechanics and game dynamics are often interchangeably used. In order for us to create an effective gamification application, it is important to know how these two compliment each other and their differences.

Game mechanics

Game mechanics are the basic actions, control mechanisms and behaviours in an application that contributes to gamify a given activity (Pothineni et al., 2014). The task of the mechanisms are to encourage certain behaviours. Creating purpose for the mechanics and aligning these to the goals you want your users to achieve is not easy to accomplish alone. Adding some kind of point system and challenges may bring about a short-term behaviour change, but the interest lies on manifesting long-term behaviour changes. For game mechanics to have a long-term effect on users and keeping them engaged, we need to add game dynamics into the equation (Digitally, 2019).

Game dynamics

Game dynamics defines how the users evolve and experience the application over time (Pothineni et al., 2014). In other words, it is the implicit aftereffect from explicit game mechanics. Seeing as every user is different, we may hypothesize that a set of learners that prefer learning through social collaboration would not necessarily be driven to learn by elements that utilize competition and so forth. The purpose of game dynamics is then to customize specific game mechanics to hit different human desires in the users (Digitally, 2019).

In this study the following game elements have been listed in table 2.6. The relationship between those can be seen in figure 2.7.

Game mechanics	Game dynamics
Points	Rewards
Levels	Status
Challenges	Achievement
Virtual goods	Self-expression
Leaderboards	Competition
Gifts and charity	Altruism

Table 2.6: Elements in game mechanics and game dynamics (Bunchball, 2010)

Aesthetics

Aesthetics of an application can be defined as the underlying psychological and emotional responses that comes from using it. The most common used aesthetic in gamification is the feeling of competition (Hunicke, 2004).

The green dots depicted in figure 2.7 are the primary human desires the game mechanic satisfies, while the white dots are the desires that are influenced by the game mechanics, but not significant enough to be primary motivators.

Human desire: Reward

Reward is an essential part in any gamification application. Users love to earn and achieve points to redeem rewards, tangible or intangible, it does not matter. According to studies done by IBM Research and University of Chicago earning points can have a dramatic effect on human behaviour, even though the points do not have real value. Points are highly motivational, seeing as users respond positively when earning points after giving the correct response upon stimuli. There are five different

Figure 2.7: Game mechanics and their respectable human desires (Bunchball, 2010)

points systems identified by (Zichermann and Cunningham, 2011). These are:

- Experience points (XP)

- Redeemable points

- Skill points

- Karma points

- Reputation points

The intention of rewards is to cause certain behaviours to happen multiple times (Bunchball, 2010). Rewards may improve user behaviour in the short term, but there is little evidence of rewards having long-term effects (Lewis et al., 2016). According to a study done by (El-Khuffash), on which he studied 79 systems from domains such as education and health, approximately 84 % used the game mechanic points. Followed by badges, leaderboards, competition, challenges and cooperation. 51 % of the systems had goals to motivate their users. The three most typical game elements in gamification are points, badges, and leaderboard. These elements are called the PBL triad (Werbach and Hunter, 2012; Mekler et al., 2013a; Dicehva et al., 2018).

The feeling of competence, autonomy and relatedness users get from certain game elements are important for them to keep using an application. These definitions are the three basic needs of a theory called self-determination theory, which will be described in **section 2.4.10.1**. A study done by (Buckley et al., 2018) discovered that out of all their reviewed papers, 14 articles referenced badges, 12 articles referenced points, and 10 articles referenced leaderboards. Rewards and achievements followed right behind. As explained in our study, points and badges have a direct connection with the game dynamic rewards. The competence of points were at 85 %, but none at autonomy and relatedness. Badges had a competence of 64 %, while leaderboards had a competence of 64 % and relatedness of 71 % (Buckley et al., 2018). (Hamari and Lehdonvirta, 2010) explained that points had an immediate and clear effect on people's behaviour. (Hamari and Lehdonvirta, 2010) has the same reasoning when it comes to badges as with points. The reason was that having a certain amount of points made the test subjects feel like they got put in a more advantageous position with certainty and linearity. They discovered that the test subjects put in more effort than usual when given this medium. What points fail to achieve is to secure the meaningfulness of the application (Lamprinou and Paraskeva, 2015). Points had no substantial effect on psychological need satisfaction, but more of an effect on performance quantity (Sailer et al., 2016). An example of this effect can be seen from an experiment done by (Mekler et al., 2013b) with 172 participants. The task was to provide tags to describe the mood of 15 paintings. The participants were split into groups where each group had different experimental conditions. The first group had no points displayed and the second had the opposite. They discovered that the group with points displayed generated significantly more tags than with no points displayed, which shows that points had an effect on performance. Although research has shown that badges and points can demotivate their users (Thiel, 2016), this study still found out that points increased their participants intrinsic motivation to a certain degree, whereas without points lowered their level of intrinsic motivation.

Human desire: Status

The behaviour concerning status can be achieved by the usage of levels or rank. Levels can be seen as you being in a different league than anyone else, indicating you have gotten to a certain point and should be given more status. Us humans seek or need any type of recognition, attention or fame. Recognition, fame and social status can however be undesirable for some and may conflict with their need for autonomy (Dicehva et al., 2018). As we can see from figure 2.7, all six game mechanic elements affect status, but the drive to achieve a higher level is the primary motivator (Bunchball, 2010).

Human desire: Achievement

Creating challenges will give users the feeling of workings towards goals that have value. All accomplished challenges will reward users for having changed their behaviour with achievements in the form of either badges, trophies or points (Lewis et al., 2016). Achievements can be seen as long-term objectives, seeing as users have to perform certain actions or have progressed further to reach a milestone. To make achievements as effective as possible it is important to display every achievement so the users can see. Bringing in social collaboration and competition will strengthen the effect even more (Bunchball, 2010).

Human desire: Self expression

Virtual goods, which are intangible and therefore have no intrinsic value, are often used for users to express themselves. Self expression is the human desire to show how unique you are or how alike you are with other groups in our society. They can express themselves by creating their own identity from buying different virtual goods through earned points or gifts from other users. The option to buy virtual goods with points give users the reason to earn more points. Snapchat, for example, lets their users create their own avatar. These avatars can be seen as a rich focal point for expression (Bunchball, 2010).

Human desire: Competition

Competition can be seen as a double-edged sword as mentioned before. Some people are able to be motivated through competition, and the use of competition has evidence of being successful (Thiel, 2016). The reason behind that is the satisfaction we get from comparing our results with others and being rewarded for being the best at performing an action. While some people may find it discouraging to compete against others if they see they are doing worse than others. We can again see that all six game mechanic elements affect competition, but having a leaderboard is seen as the primary motivator (Bunchball, 2010).

Human desire: Altruism

From figure 2.3 we can see that 3 out of 5 have the option of gift-giving or the option to give to charity. This game mechanic is a strong motivator for applications that seek to create a community. Upon receiving a gift, you feel the need to reciprocate that action, which creates a loop of giving. The game element can be seen as a powerful retention mechanic, seeing as how it "forces" the users to use the application to try to achieve virtual goods to give away (Bunchball, 2010).

2.2.10   Generic frameworks

Models alone, like MDA is seen as only a fraction of the whole game design process (Gamez et al., 2010). Further we take a look at some frameworks from a study done by (Mora et al., 2015).

2.2.10.1   Self-Determination Theory framework

In 2000, (Ryan and Deci, 2000) published a book about self-determination theory. SDT has shown to be a useful to understand the relationship between games, gamification, and motivation. (Ryan and Deci, 2000) argue that the use of game mechanics as a way to motivate, may only target users extrinsic motivation, rather than their intrinsic motivation (Buckley et al., 2018). As a counterargument, (Deterding, 2011) believed that to know how to use extrinsic motivation without interfering with users intrinsic motivation, we must have a good understanding of SDT. SDT has been well-studied and is the most used theoretical framework for studying the motivational effects of gamification (van Roy and Zaman, 2018). This theory was used by Dustin DiTommaso in 2011 to define a framework for gamification. (Ryan and Deci, 2000; DiTommaso, 2011) mention three basic needs in order to trigger motivation in people and in order for natural growth and integration (Skara, 2015):

- 1: **Autonomy** - Choices, control, and personal preferences should be determined by the users to give the feeling of having meaningful choices. This need relates to constructivism which we explained in **section 2.4.7.3 Constructivism**

- 2: **Competence** - You feel the actions you do have meaningful growth in the long-term

- 3: **Relatedness** - To have social interactions. This need relates to socio-constructivism explained in **section 2.4.7.4 Socio-constructivism** (Lamprinou and Paraskeva, 2015)

Later he proposed steps to create a framework for success:

- Step 1: **Why gamify?** - Find out your main reason for gamifying your service

- Step 2: **Player profile** - Find your target group, find out their goals and needs, find out what drives their motivation

- Step 3: **Goals and objectives** - Create ways to make long-term and short-term goals exciting

- Step 4: **Skills and actions** - List out skills and actions that are relevant to succeed with what your users can achieve when they use your application, i.e mental skills

- Step 5: **A look through lenses of interest** - What type of application are you creating? Will it involve competition, puzzles, teamwork and so forth

- Step 6: **Desired outcomes** - What will the users achieve from giving the correct response upon stimuli multiple times? These can be in the form of tangible or intangible rewards. How they achieve them can either be randomized, time framed or completing actions a reasonable amount of times

- Step 7: **Play-test and polish** - The final step is to test your application out. Find out the game mechanics that do and do not work. An important question to be asked is if this will keep the users interested for a long period of time. What have you not considered? Are you hitting the three basic needs? (DiTommaso, 2011)

2.2.10.2   The Six Steps to Gamification framework

The Six Steps to Gamification is, according to (Mora et al., 2015), the best-known design framework. Also known as 6D and was constructed by (Werbach and Hunter, 2012). These steps are as followed:

- Step 1: **What are your business objectives?** - Define them and your goals. Is it to create an application to make players more efficient or to create a better sense of enjoyment while studying? Do not only create an application that the players will like, but create something that will give them value in the long run

- Step 2: **Get to know your target behaviour** - What goals do you want your players to achieve, and how are they going to achieve them?

- Step 3: **Get to know your target group** - Do not just think of them as users, as they are players taking their time to use your application. What will keep them engaged and motivated to proceed using the application. Are they driven by competition or teamwork?

- Step 4: **Activity loops** - This step describes the structure of how the system functions. The system can be split into two levels. The first level describes what the activity is. How does the system give feedback to the players? The second level describes the evolution of the player. How are they evolving from being a beginner to being a master?

- Step 5: **Fun** - The fifth step is to remember to create a fun application. Designers get so caught up in game mechanics and dynamics that they forget to create something that is fun to use.

- Step 6: **Deployment** - Pick the right game mechanics, the right game dynamics and the right platform and software to use (Werbach and Hunter, 2012)

2.2.10.3   GAME framework

An easier framework than the two already mentioned was created by (Marczewski, 2013) in 2013 and is called the GAME framework. Every letter in the word GAME describes the different steps:

- Step 1: **G**ather - Collect relevant information about your target group, about which domain you are targeting, why you want to gamify and what activity you are trying to gamify and how.

- Step 2: **A**ct - You should now have enough information to design a solution that fits your goals and your target groups' needs. This is also the testing phase

- Step 3: **M**easure - How well is your application doing? It is important to get feedback from the users, as well as measuring their activity and their progress

- Step 4: **E**nrich - Make changes to your application as your users are changing to keep them engaged and to satisfy their needs (Marczewski, 2013)

(Marczewski, 2013) makes use of a second framework called the RAMP framework, with focus on triggering intrinsic motivation. As with GAME, every letter has a description.

1. **R**elatedness - One of the three basic needs in SDT

2. **A**utonomy - One of the three basic needs in SDT

3. **M**astery - The process of becoming skilled at something

4. **P**urpose - One of the three basic needs in SDT (competence) (Marczewski, 2013)

Chapter 3: Method

This chapter will address research question RQ3 and RQ4 by designing an application that tries out the concept of using gamification to motivate. We will try out game elements that are typical for motivational-based applications. The application will be evaluated by reviewing it in a focus group to discuss with them about our choices. The experiment will then be used to see if the results from the research corresponds with the theory found.

3.1 Design framework

In (Mora et al., 2015), they mention technological-based, goal-based, and human-based design. Seeing as we want to create an application where we want the users to achieve goals and to become more motivated, we picked out frameworks that leaned more towards goal-based and human-based. The three frameworks from the previous chapter are quite similar in terms of their design steps, but the GAME framework considered the three basic needs of STD in the design process. That is why we have decided to use the GAME framework to come up with a design, such as figuring out why we need and want to gamify an activity, knowing who our target group is and what results we want from our implemented prototype. The design steps are described below.

1. **G**ather - Our target group are tertiary students. We want to gamify certain activities to learn more about what motivates people. This will done by exploring features of our prototype and to explore the situated motivational affordance the chosen game mechanics and game dynamics have. We have gathered information through the use of literature study to find out about gamification.

2. **A**ct - This is the developing and testing phase. The testing will be done through conducting a focus group. Our hypothesis is our reward-based systems with its chosen game elements will affect motivation. Also that our application can be of use to help create good habits.

3. **M**easure - This phase is going to tell us how well our application is doing. The feedback from the focus group will tell us what needs to be changed. The results are presented in **Chapter 5**.

4. **E**nrich - The last phase is to actually apply the changes and the features that the users wanted. The information presented on this phase and the Measure phase can be of use for further work.

3.2   Our design

This section will go through our reasoning for choosing a certain game mechanic over the other. We also explaining which learning theories that we take into account while designing. We have created a prototype with a simplistic design and have implemented features we are interested to see can be of help to promote student activity.

3.2.1   The idea

The important question to answer is what activities are we able to gamify to boost motivation? To answer that question we need to know our target group and what activities they partake in and list out activities that are of interest and discard useless activities. Our target group are tertiary learners. They have activities such as staying at campus, doing school work and creating and completing learning tasks.

The purpose of our reward-based application is to try to motivate students to go to school, attend lectures, and making organizing schoolwork more structured. We focus more on the theory of behaviourism from **section 2.4.8.1 Behaviourism** and less on constructivism and cognitivism from **section 2.4.7.2 Cognitivism** or **section 2.4.7.3 Constructivism**. The way we plan to target constructivism is to create the habit of going to school and completing tasks throughout the day. Socio-constructivism and situated learning from **section 2.4.7.4 Socio-constructivism** or **section 2.4.7.5 Situated learning** is not applicable for our application, seeing as they both rely on acquiring knowledge through social interactions or carrying out hands-on activities. They are more commonly used for serious games.

There is somewhat of an automation going on in our application, seeing as the student will have to start the application and click the Locate-tab to start tracking their location. However, the student will only have to "check-in" and not "check-out", because the application will figure out if the student has left the campus area or not. After the student has checked in, the application will register the location of the student as well as simultaneously starting a timer. The users will be able to create ToDo's and track the time they use on different projects to manage time more efficiently. The achievements will be displayed in their own tab for the users to see. For the application to work the way we want it to work, we need to find a good balance between how many game elements we should include so they will not thwart the student's intrinsic motivation. We want it to be a helping tool for students to keep things organised and easily accessible, but also fun enough for the students to keep using it. Our application is not a full-blown out gamified application such as **Habitica**, so we do not worry too much about the game elements working against their purpose.

The applications we looked at in **section 2.4.5.1 Other applications** all made their users do things manually, such as adding their own activities, registering completion of an activity and so forth. We do not differ much from these applications, seeing as we want the users to do things manually, except for tracking location and time. The location-based examples had many features that we wanted to try out. What they all had in common, as with our application, is that we all operate under the rule of the honor system. We cannot possibly control whether or not they actually do work related to school or that they are completing tasks. What we can control is whether or not they are at campus. If the users choose to "fake" an activity completion, there is nothing much we can do about it, but we firmly believe that the majority of humans do not break the rule.

3.2.2   Choosing the right game mechanics and game dynamics

We need to ask ourselves what game mechanics are realistic to implement for our set of activities. To be successful in creating and applying gamification to a service, we need to understand the value of game mechanics. It is equally important to

understand how game mechanics motivates you. As mentioned in **section 2.4.8** there is a great amount of psychology behind gamification. Seeing as few game designers are psychologists, it may be difficult to choose the right game mechanic. Luckily, there are published numerous papers that list the key game mechanics to spark certain human behaviours that is of importance to us, which we wrote about in the previous section.

3.2.2.1   Points and badges

(Deterding et al., 2011) believed that listing all possible game elements would be useful when designing your application, but it would be hard to delineate. The study suggest to use those elements that are most frequently used, which is self-explanatory. Our desired game dynamics are rewards, status, and achievement. However, we will mot be implementing leaderboards, as the application will not be supporting social interactions. Other elements not related to the PBL triad are progress bars.

We want our users to be acknowledged for certain behaviours to show that they are doing something right, and that they should keep doing it. That is the purpose of our application. Our strategy is to use points and badges to give users a sense of achievement which hopefully will boost their motivation. Points are also used as a progress indicator. As mentioned in the previous section, there are five different points systems. We plan to use experience points. Experience points are points achieved through doing desirable actions. The points will then be of value to the users. Points can be achieved by staying at campus for a fixed amount of time and when users complete ToDo's or projects.

As for badges, badges are the main rewards for our application. The users will work towards achieving all the available badges. Seeing as how easy it is, but not too easy, to achieve points and badges will give the users a feeling of mastery and hopefully encourage them into using the application more frequently. The badges will not be available for the users to see before they actually achieve them, the badges will be blurred out before that to make achieving them more exciting. The users would have to accumulate more points than the predecessor badge to obtain the next one.

That means it is required of them to put in more effort in achieving the rest.

The application will not be supporting leaderboards, as mentioned before, but there can still be a competitive nature to the application. This competitive nature can be in the form of social status which is one of the human desires from **Section 2.4.9**. Showing to other users how many achievements you have acquired will exhibit your dedication in going to school and completing tasks. It is also interesting for them to compare number of achievements to see if they are better than their fellow students.

We have decided to go for the PBL triad, which consists of points, badges, and leaderboards, as these three are the most typical game mechanics in motivational-based applications. Our decision to use the PBL triad has been supported by empirical studies we looked at in the previous section under **section 2.4.9**. The fact that points give immediate feedback that the users have responded correctly to a stimuli might motivate users. Badges are for visual representation of the rewards achieved by the users, which shows the importance of a particular action. That will motivate users to do the given actions frequently to achieve more badges. Throughout this whole study we have talked about the consequences of applications relying too much on extrinsic motivation. PBL rely mostly on extrinsic motivation, but have shown to raise intrinsic motivation as well. Meaning, the PBL triad targets behaviourism explained in **section 2.4.7.1 Behaviourism**. It is therefore important to know how to give extrinsic rewards correctly in order to not demotivate the users, which links up to the theory of outcome expectancy described in **section 2.4.7.2 Cognitivism**.

3.2.2.2   Progress bar

A progress bar can help combat demotivation by using it as a way to give positive feedback. The use of progress bars will help users keep track of how far off they are from being rewarded, seeing as the element measures progress from the start (El-Khuffash). As with points and badges, progress bars can be used so that the users can control their activity process, to give them a feeling of their overall performance and retain them as users. A system without some kind of assessment structure is not considered a good practice when designing a gamified system (Werbach and Hunter,

2012). (Salen and Zimmerman, 2004) backs this up by saying without an indication of progress, meaningful play would not be possible. The users will want to see that their decisions have meaning. Even back in 1985 (Myers, 1985) saw the importance of progress indicators and instant feedback, and believed that the usage of progress bars would enhance the attractiveness and effectiveness of applications that utilized the element. They are an effective way to engage, because we as human beings like to have and set goals and to see them finished.

To give feedback on how may points the students have accumulated before earning a reward was an important part for our solution. We introduce the progress bar at a page containing all possible badges. We also have a counter to show have far off they are from a badge at a page where the users are able to see details about their progression, such as number of tasks done and points earned. That way they can have an overview of their own efforts to help combat discouragement in using the application, and to show that the choices they make have meaning. These choices can be linked up with **section 2.4.7.1 Behaviourism**.

3.2.2.3   Randomness

The amount of points achieved when completing a task will be randomized, while the points achieved by staying at campus is fixed. It will be randomized whether or not the users gets zero points or some points when completing a task to keep them on their toes. This functionality can be called an alternating encouragement functionality. The theory behind the functionality states that being unpredictable in giving encouragement will lead to a more persistent and longer lasting favourable behaviour than if they were to be given encouragement every time (Skara, 2015). The way to achieve badges can be done by accumulating enough points. They will be notified about how many points they earn from completing tasks. The fixed countdown timer will also show how many points they have earned from being at campus.

3.3   Functionality

Our main goal for this application is to test out our chosen game mechanics up against the theory found to answer RQ3 and RQ4. We decided to go with the PBL triad, because those mechanics were the most common variant used to test motivational affordances (Hamari et al., 2014). Motivation and promoting student activity is what we wish to increase in our users. This section will describe the functionality, the requirements, the three basic needs of SDT for our application and a mock up sketch that will show how to interact with the application.

3.3.1   The three basic needs in SDT

Down below are the three basic needs achieved in our application:

Autonomy

- ✓ Control your own choices
- ✓ Immediate feedback

The users gets to do whatever they want to do with what is presented in the application. The application will not force them to create tasks or force them to go to school in any way. Immediate feedback will be presented in the form of a progress bar and progress information.

Competence

- ✓ Creates good habits
- ✓ Makes activities fun

Hopefully the users will feel like the application give meaning by trying to create habits to help them manifest certain goals. Not only is the purpose to create habits, but they will have fun doing it.

Relatedness

- ✓ Badges for social status

We do not plan on having a social interaction feature in our application, but the users can make it social through showing each other how many badges they have achieved. Users are then able to compete with each other to get a higher social

status among themselves.

3.3.2   Requirements

We found it important that our application had to be easy to use, reliable, and somewhat autonomous. This section will describe how we managed to achieve those goals.

3.3.2.1   Ease of use

The application has to be straightforward to use, and the users should know how to navigate through the application rather quickly and without much difficulty. There is no need for registration to use the application.

3.3.2.2   Reliability

The application should be reliable when getting the location of the users, so they are able to start earning points, as well as registering points correctly. They should get rewarded upon giving the right behaviour. If that core functionality is not working, the purpose of the application is gone.

3.3.2.3   Autonomous

The application should detect when users are in the designated area and outside of the designated area. There is not much automation other than that functionality. We want the users to interact with our application. The application is almost like a digital backpack stored with tasks and projects.

3.4   Interface interaction

The application presents 5 tabs: A Home-tab, a ToDo, a Locate-tab, a Projects-tab, and a Badges-tab. These are the features we want to try out. The way to interact with the application and the relationship between the tabs can be seen in a mock up sketch in figure 3.1. The interface will be explained in greater detail in **Chapter 4**.
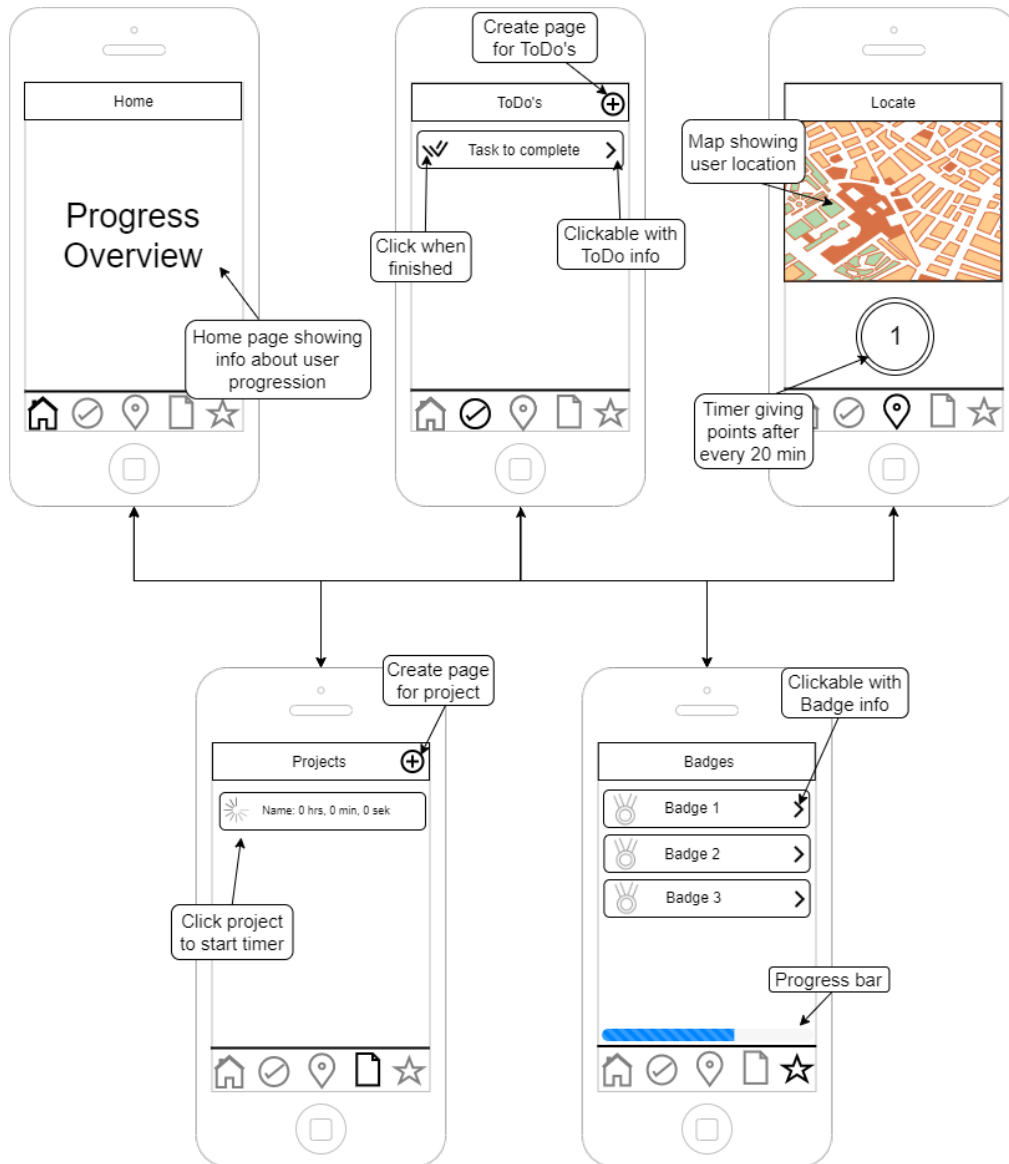
Figure 3.1: A mock up sketch to show how to interact with the application

Chapter 4: Implementation

This section describes the backend portion of the application by describing the APIs and platforms used to fetch and store data from the application. We will also describe the interface.

4.1 Location data

As mentioned before, the concept for this application was to make the activity of attending campus more interesting by using game mechanics. To achieve the results we wanted, we used Capacitor with Ionic, an open-source SDK, and Google Maps API to fetch location data to pin point when the users are on campus.

4.1.1 Capacitor

We used Capacitor, a cross-platform app runtime, as a native bridge for our Ionic project. The cross-platform app provides with a set of APIs, among the APIs is the Geolocation API.

4.1.1.1 Geolocation and location accuracy

The Geolocation API that makes use of the device's GSP provides with 4 methods for fetching and tracking of a position. We made use of watchPosition() and clearWatch(), as those methods go hand in hand. The former method will trigger every time there is a change in location. Using this method in an application has its negative sides, seeing as it is forcing the app to constantly run geolocation in the background, thus draining battery life. This is where the latter method comes in. We used this method to stop tracking whenever the users are outside of the designated area, an only track when the they are inside the designated area. This implementation may still kill battery life, but not that much.

The accuracy of the API may vary. There are options to get higher accuracy by feeding watchPosition() different options to achieve a somewhat high accuracy. The accuracy is also dependent on which location provider the device is using. The three

location providers are: passive, network and GPS. GPS location providers are the most accurate ones, as the GPS usually triangulates from satellites (Rich, 2018). By fetching the accuracy of the user location, we can find the accuracy and get a clue on which location provider that has been used. High to moderate accuracy lies between 3 to 16 metres, but also below 30 meters, wheres a low accuracy will be above 30 metres. We let watchPosition() run for a while and found out that the accuracy shifted between 21, 27, 40, and 42 metres, which is low accuracy. This can easily be fixed by discarding locations with accuracy below 16, or at least below 30. Having low accuracy may prevent users from using the application again, because the application is not giving points when it should, seeing as they are in the designated.

The Geolocation API has been used with Google Maps API to display the location on a map for the users to see, as well as feeding the Google Maps API with a polygon array consisting of coordinates around NTNU to create a geofence.

4.2   Database

We decided to make use of a cloud-hosted NoSQL database called Cloud Firestore provided by Firebase.

4.2.1   Cloud Firestore

The data model of Cloud Firestore is rather simple. We store data in storages called documents, seeing as how Cloud Fistore is document-oriented. Documents contain fields and their respective values. A document must be stored within a collection, where the collection works as a container for the document (Firebase, 2020). As an example on how the hierarchy in Cloud Firestore looks, we will provide our structure for ToDo's and badges as we see in figure 4.1. Neither positional location or any personal data was stored, as we did not find it necessary to do so.

As an example, the collection name is badges, whereas the document is a randomly generated id by Cloud Firestore. The fields are flag and points1 mapped with their respective values.

Figure 4.1: The data model for ToDo's and badges

4.3   Interface

The application make use of a tabbed interface with 5 different tabs. This section will explain each of them and their functionality.

4.3.0.1   Home-tab

The Home-tab presents the users with an overview of their progress. The page
will show progress such as how many tasks and projects they have completed, the
amount of points they have gained, days they have attended school, and how far off
they are from receiving a reward. We can see the interface in figure 4.2.
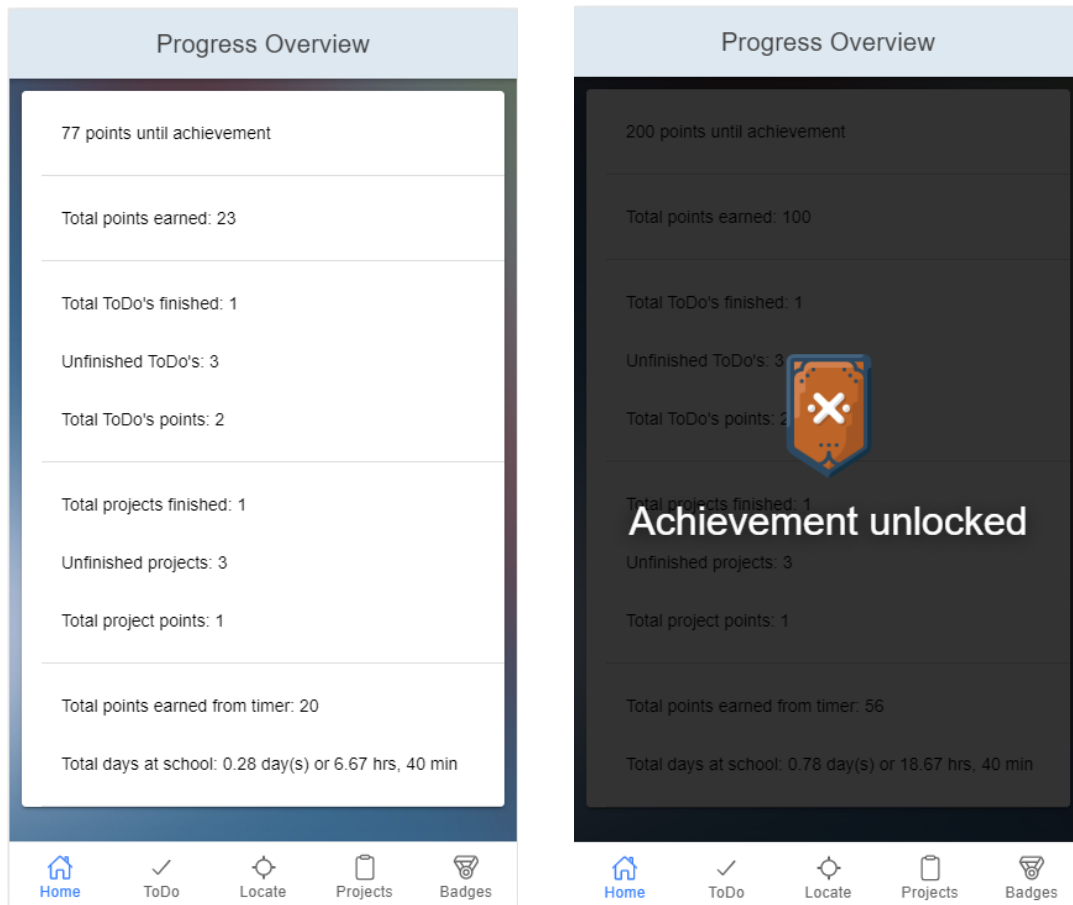
(a) Progress overview   (b) Achievement unlocked

Figure 4.2: The two states of the Home-tab

The page operates asynchronously and will update whenever the application is run-
ning. The users will then get immediate feedback, thus achieving the basic need
of autonomy. Whenever the users have earned enough points to achieve a badge, a
popup will appear indicating the achievement, as we see in figure 4.2b, and will dis-
appear after 3 seconds. The badge depicted is the reward corresponding to earning
enough points for that particular badge, so every popup will show a different badge.

4.3.0.2   ToDo-tab

From figure 4.3a we see all created tasks displayed neatly. These tasks are clickable, and every task has its own detailed page shown in figure 4.3c. Clicking the check mark can will prompt the users with an alert asking them if they are finished. Points received from finishing a task are between 0 and 2. Clicking the add button will direct the users to a create page shown in 4.3b.
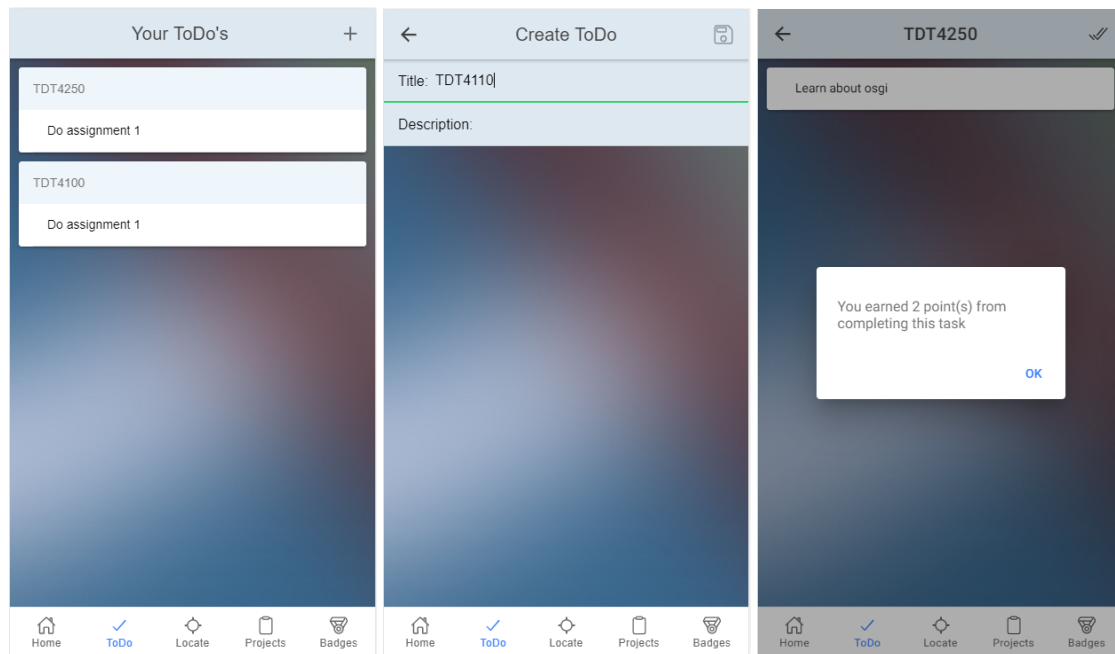
(a) Displaying ToDo's   (b) Create ToDo   (c) Complete ToDo

Figure 4.3: The different pages for the ToDo-tab

We have three different pages for each operation, mainly create, read and delete. We wanted to check if users preferred three different pages rather than having to complete every operation on one page. We will get back to this in **Chapter 5**.

4.3.0.3   Locate-tab

The Locate-tab is the most important interface for our application. The screen dumps of the two states of the locate tab can be seen in figure 4.4.
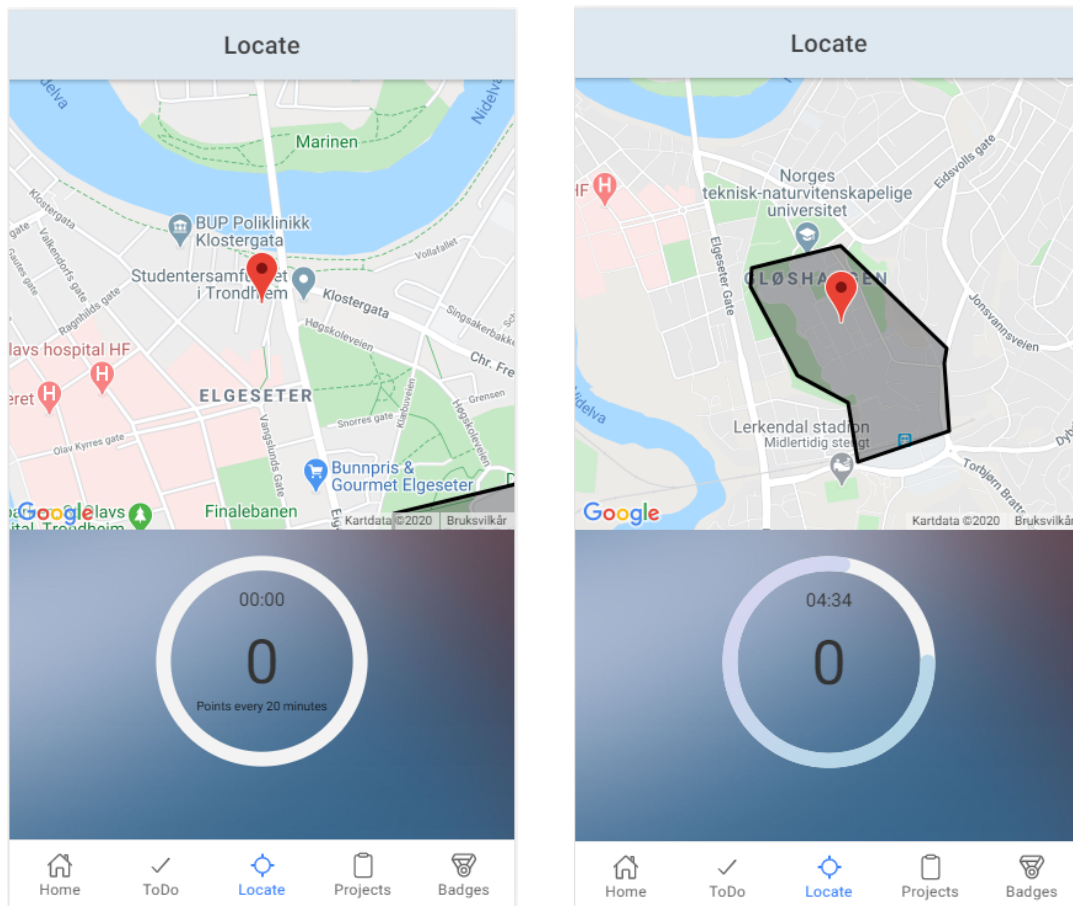
(a) User is outside of geofence   (b) User is inside of geofence

Figure 4.4: The two states of the Locate-tab

As soon as the users clicks the Locate-tab the application will track their location. The timer will not start counting points until the users are inside the geofence depicted in figure 4.4b. The timer will stop whenever the users are outside of the designated area and display a small message telling the users that points are earned after every 20 minutes as we can see from figure 4.4a. The small message, the map showing where the marker is, and the progress bar not updating will work as an indicating for the users to see that they are not within the designated area. The map is also interactive so the users can see their own position and how far they are from the designated area.

4.3.0.4   Projects-tab

At the Project-tab the users have the option to time track their projects to help manage their time better. Poor time management has been researched as one of the factors causing poor performance at school (Hamzah et al., 2014). Being able to see how much time you use on a certain project may promote better techniques to tackle project work.

(a) Active project   (b) Completed project
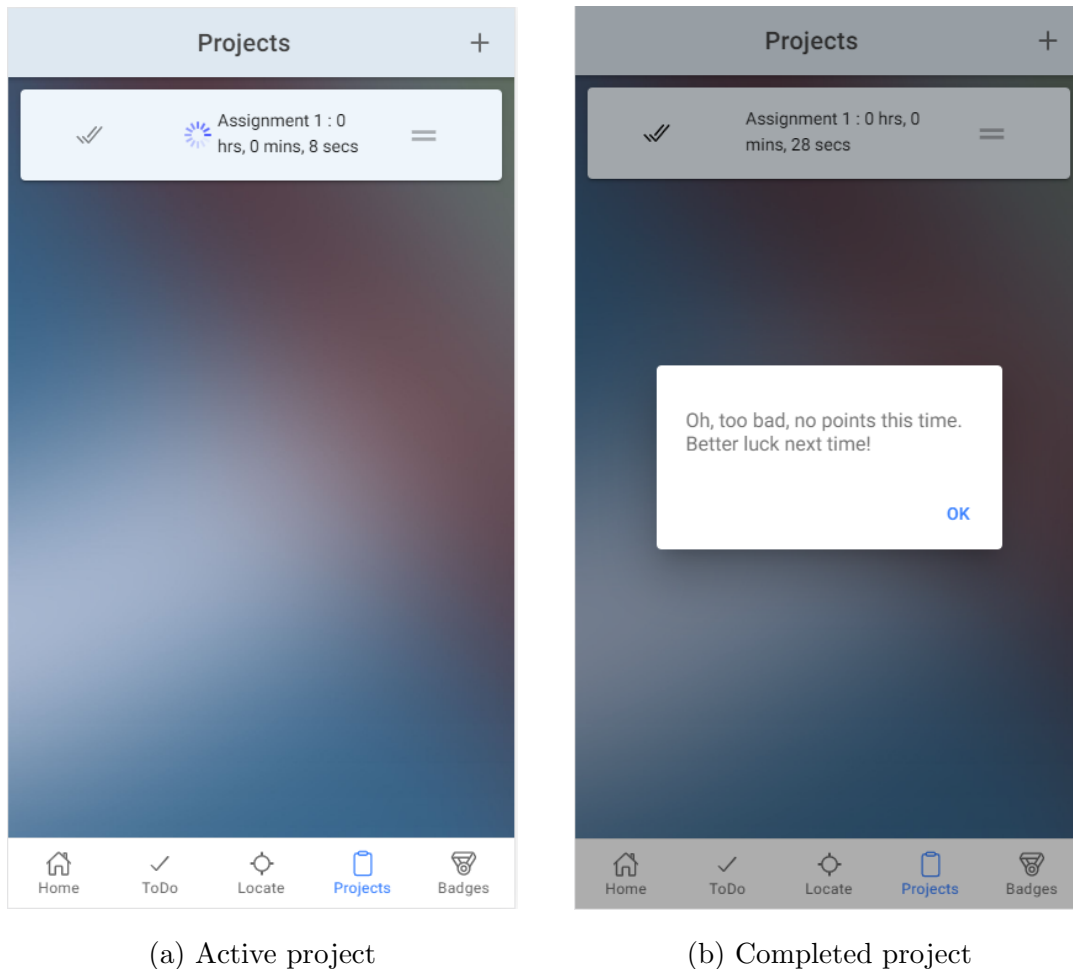
Figure 4.5: Showing a project in active state and a project being completed

A project is created by clicking the add button at the top right corner. The users can create how many they want. Whenever a project is clicked, a timer will start and the project will be set to active. Only one project can be active at a time. An active project can be paused by clicking it again. They also have the option to reorder their projects to have the most important project at the top of the page. The Project-tab also make use of create, read and delete. What this tab differs from

the ToDo-tab is that every operation is done on one page. We wanted to see which design method was most preferred, which we will get back to in **Chapter 5**.

4.3.0.5 Badges-tab

This tab displays all the badges that the users have achieved. The badges can be seen as a rank/level system, where the points are experience points. As mentioned, we wanted to hide the badges until the users gained enough points. This was to make things more mysterious. The only thing that can be seen is the title of the badge as seen in figure 4.6a. Clicking on the badge while being disabled will redirect the users back to the Home-tab. When the users have earned enough points, the same prompt window will appear as we saw in figure 4.2b. These prompt windows are however only optional in the Home-tab and the Badges-tab. The badges have their own detailed page when they are enabled as seen in figure 4.6c.
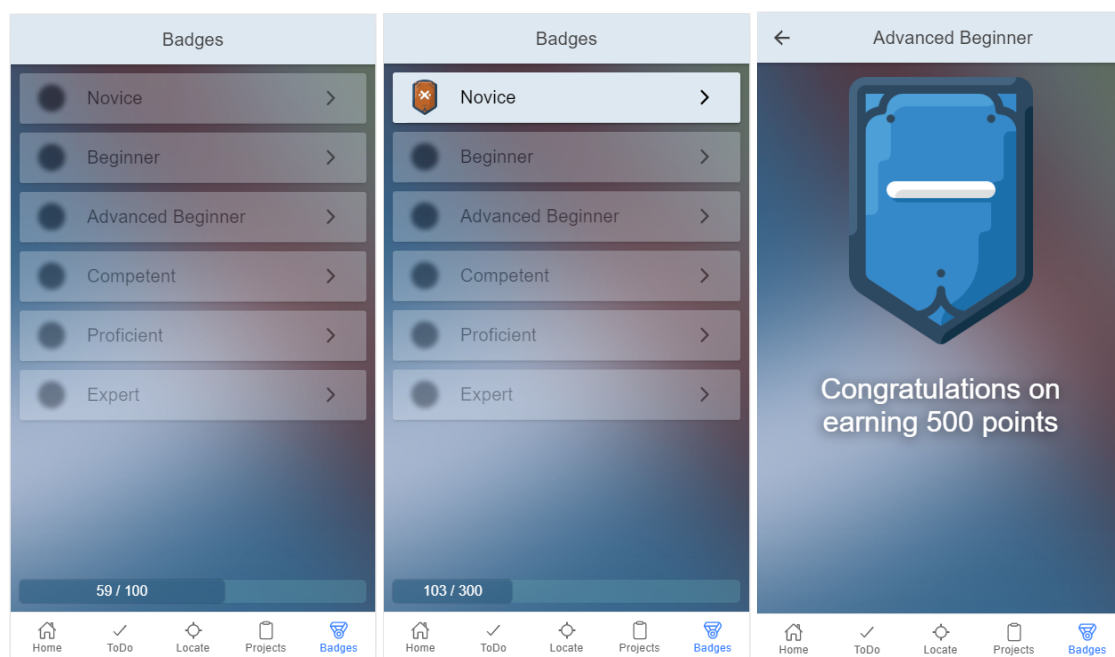
(a) Displaying hidden badges   (b) Achieved badge   (c) Page for a badge

Figure 4.6: The different pages for the Badges-tab

At the bottom of the page there is a dynamic progress bar. This progress bar will listen to all the other pages when they receive points and update accordingly. The amount of points to achieve a badge will change in the progress bar each time a new

badge has been achieved. To further explain we can see from figure 4.6a that the goal is at 100 points. After achieving the first badge the goal is now 300 points as we see in figure 4.6b.

Chapter 5: Evaluation

This chapter will describe the method used to evaluate the concept of our application, the process of the evaluation and the results.

5.1 Research methods

Research methods can be understood as ways to gather a collection of data or evidence by utilizing techniques, strategies or processes to either discover new information or to get a better understanding of a topic. It is common to differentiate between two methods: qualitative and quantitative research method (of Newcastle, 2019; Jacobsen, 2000).

5.1.1 Qualitative research

The qualitative research method is used when the purpose is to get a better understanding of a case, a theory or an idea. This method have its emphasis on relevance. The techniques or tools used are interviews, focus groups, observations, document analysis, and oral history or life stories (of Newcastle, 2019; Jacobsen, 2000).

5.1.2 Quantitative research

Usage of the quantitative research method is better suited when the research relies on measuring variables and analyzing the measurements through either statistical models or tables. The method collects data through surveys or questionnaires, observation, document screening or experiments (of Newcastle, 2019; Jacobsen, 2000).

5.2 Method of choice

We will be using qualitative research in the form of focus groups to test out our solution. We are interested in finding out what students find interesting about the concept of using gamification as a motivational and encouraging tool. Before conducting a focus group it is important to ask ourselves what we expect the outcome to be from this research. (Breen, 2006) mentions the importance of knowing the

answer to this question, so it becomes easier to see if focus group methodology is the right way for us to test out the prototype. We see focus groups as a great way to generate ideas and recommendations for improvement and future changes for further work on the prototype.

5.3 Case study

Participants in this case study were students at NTNU who were asked to review our prototype to inform us about the motivational affordance of our chosen game elements.

What we expect to get from this focus group research is:

1. An insight into how students experience the use of game elements to promote student activity

2. An insight into what features to include in an application to boost motivation and encouragement in students long-term

3. An insight into if the chosen game elements work the way we want them to work

5.3.1 Participants

According to a study done by (Tang and Davis, 1995; Krueger and Casey, 2014), the ideal size of a focus is 5 or 8 participants. We had 5 participants, all students with different majors and in different years of study. The participants and their majors are listed below:

- A third grade student studying Petroleum Geoscience and Engineering

- A bachelor's student studying Digital Business Development

- A fourth grade student studying Geotechnology

- A master's student studying Civil and Environmental Engineering

- A master's student studying Entrepreneurship and Innovation

Due to the circumstances with covid-19, we did not attempt to gather all the participants together, nor did we try to gather a bigger group. The experiment was therefore conducted online and was carried out by running the application on our computer and sharing the screen. We went through the application step by step. After a brief tutorial, we let the participants "navigate" through the application one at a time. The navigation was done by them telling us what to do in the application.

5.3.2 Protocol

Before we began testing our prototype we wanted to explain the context and idea of the application so they had the idea in mind when answering the total of 10 questions. We defined goals on how we wanted the application to be perceived by the focus group and what we expected the results to be for this research. The goals, along with the questions and the concept, were sent in a word document to each participant beforehand. The goals can be seen in the list below:

- G1: They find the application fun to use

- G2: They find the application interesting to use

- G3: They can see themselves using the application

- G4: They can establish good habits from using the application

- G5: They will feel motivated to attend school and stay there for a longer period of time

- G6: They find the application relatable

- G7: They find the application easy to use

- G8: They find the game mechanics to have incentive value

- G9: They find the application stress free to use

- G10: They think the application have good immediate feedback

- G11: They find going to school more fun and exciting

The participants had questions and suggestions along the way about the application,

which was written down, so the data collected from the focus group was in oral and written form. The word document that was sent beforehand got sent back to us with the questions filled out. The data we collected did not contain any personal data about the participants, and did not require any application to the Norwegian Centre for Research Data.

5.4   Questions

These are the answers the participants gave us.

Question 1: What is your first impression of the application?

The focus group perceived the application to be user-friendly, good, straightforward and easy to use, thus achieving goals G7 and G9. They found the ranking system to be likeable, and agreed that the feature to keep track of ToDo's and projects was a nice touch. A favourable feature among the participants was being able to see their points and follow their progress through the dynamic progress bar, thus perceived the application to have immediate feedback, thus achieving goal G10. The entire application is well structured and simple, albeit some perceived the application to be colorless. One of the participants found the application to be a fun way to keep track of how long the participant stayed at school, thus achieving goals G1 and G11. Said participant had this to say:

> "It is nice to know how long you have stayed at school this year so you can show your parents."

Question 2:What is problematic with the interface - what does not work - what is missing?

The majority of the participants found the progress page to be too simplistic. They were missing some colors, graphs and icons along side the text, and to separate the information better. Even though they liked the simplistic design, they still wanted the application to look more modern and fun with more colors and animations.

One of the participants had this to say:

> "The layout can contain more colors and be a little more clear so that you
> can easily see what you are looking for."

They all mentioned that the application would be better with an information page
telling you about the different functionalities and how to get started. What the
participants were missing was the option to add ToDo's and projects to a calendar
to add deadlines and to color coordinate ToDo's and projects with different priorities.
They would also like to see a social page with leaderboards, seeing as they would
feel more motivated and inspired to work harder when having the option to show off
their hard work and being able to compare and compete with other students across
the country. They also missed having the progress bar on all the pages.

The way points were distributed could be discouraging as well. The fact that users
could use hours upon hours on a project or a ToDo and still get 0 points did not
sit well with them. They suggested that amount of points you receive should be
dependent on the hours used on a project or the importance of the ToDo.

As we mentioned we designed the ToDo-tab and the Project-tab differently, but
they both had the same operations, which was create, read and delete. We wanted
to test out which design was more favourable among the participants. They found
it more tedious and clustered the way the ToDo-tab was design, and found it easier
and more user-friendly to have it they way the Project-tab was designed.

Question 3: What in the interface does work for you?
The ranking system, the location functionality and the simplistic design on certain
pages were favourites among the majority. They found the application to be easy to
navigate, easy to follow your progress, easy to create new ToDo's and projects and
being able to prioritize your projects. The following quote was said by the fourth
grade student:

> "Easy to keep track of the number of points and when you reach your goals.
> Adding projects and keeping track of what needs to be done is quick and easy.
> Nice to have an overview of all the things on a page, but this page can be more

catchy."

Question 4: Do the incentives work? Explain your answer

The incentives have their pros and cons. The incentives works by forcing them to stay long at school to achieve a badge and feel more motivated to do actual work related to school. The incentives are a neat way to keep them motivated and to create good habits by seeing that you earn points from planning and structuring your days more organized. The fact that the badges are hidden until you get them makes the application more interesting and exciting to use. The previous sentence was said by one of the participants and has been included word by word below:

> "I think that the incentives work to some extent. For me, badges and point can be a cool way to keep myself motivated for some time. I like the way that the badges are hidden until you get them, which makes me curious and makes me want to get that badge."

They all mentioned that the incentives would only work for a short term, seeing as they felt things might get a little repetitive after a while. The answers from the participants shows that we met our goals G2, G4, G5, and G8.

Question 5: Any incentives that you feel are missing?

To have them more invested, they would want us to add a way to exchange your points and badges with virtual goods, something like a virtual shop. Meaning they would like to have both experience points and redeemable points. A functionality to show how many consecutive days you have attended school would be interesting to see as well, in other words, a streak functionality. A participant suggested that after reaching a certain streak, a streak multiplier would be added to the point system to receive more points. Weekly goals and monthly goals would also be interesting to see. For example when you reach a certain amount of points within a week, you should get a special reward. The suggestion from the participant can be seen below:

> "If you reach a certain amount of points within a week you get a special reward. Maybe add a streak multiplier so that if you are consistent with going to school you get more rewards."

They find intangible rewards to be good, but would be using the application longer if they were to win tangible rewards as well in the form of coupons, a free dinner at the school cafeteria or discounts in the school kiosk. They all felt that a prize must be included to make the application more attractive for students to use.

Question 6: Does having a progress page make you more motivated?

The majority perceived the progress page to be a good feature, because it will keep you motivated as you are able to see how you are doing with all your ToDo's and projects, as well as how far you are from achieving a badge. A progress page can have negative impact as well. One participant proposed a solution for that: Make the progress page and progress bar an optional feature which only pops up once in a while when you reach half way. Showing progress may also show that you are working more effective, thus wanting to keep doing what you are doing to stay on the effective path.

Question 7: How do you feel about being tracked?

The participants did not have any problems with being tracked, seeing as we do not store their location nor any personal information about them. Although, having an option to turn off geolocation would be favourable.

Question 8: Does this application feel relatable for you to achieve motivation and habits - does it give you value?

Four out of five participants found the application to be relatable, thus meeting goal G6, but would want more intangible and tangible rewards, and sub goals that are new every week to receive special rewards. They felt the application would make it easier to stay motivated by being able to structure your school work easier. It works like a checklist you can have on your device which forces you to make habits and to get better at planning and remember things. The one participant that did not find it relatable, whom we will call participant 1, explained that participant 1 would not be using the application that often without any form of tangible rewards upon reaching a new rank/level. Another participant had this to say about the relatability of the application:

> "It is like a checklist you have on your phone, but more advanced and you get points from completing things. The application is "forcing" you to make habits to get better at planning and remember stuff."

Question 9: What is missing in the application for you to feel more motivated to go to school?

As we have already mentioned, what they were all missing was statistics of your progress in the form of graphs and charts, leaderboards so that you can compete with other students, virtual goods you can exchange with gained points and challenges and competitions to spark more motivation and encouragement to go to school more often to win a particular challenge or competition. They were also missing a social interaction feature as a way to receive praise for your work by fellow students. A participant had this to say about the functionality of challenges and leaderboards:

> "I miss a leaderboard where I can compete and compare with friends and other students across the city/country. For me competition is a great motivation and inspiration to work harder."

Another great suggestion worth mentioning was the option to post pictures and meet up with other students to work with them. The bachelor student had this to say:

> "I would like to have the option for people to post pictures of them at school and being able to post questions, then maybe people could study together. If you are studying with another student you could get more points to motivate for social use of the app."

Question 10: Can you see yourself using an application with such a concept? Explain your answer

They could all see themselves using an application with this concept. Some would try to use it long-term, whereas others would use it a lot at the start and stop after receiving all the possible rewards.

5.4.1   Feedback on the application

The overall feedback was similar between the participants. They perceived the application to be good, user-friendly, simple and motivating. The simplistic design may become boring over time. It has potential, but could have been better with some added features to keep using the application and to focus more on motivational factors to keep them motivated long-term.

Chapter 6: Conclusion

This thesis has through the use of qualitative research and literature study reviewed a great amount of articles to find out more about the motivational affordance of game elements and how these can be used to promote student activity. As a result, we found out that gamification can be successful when the developer has basic knowledge about how game elements can affect human behaviour, the motivational affordance of game elements and the importance of knowing how to apply those game elements correctly.

After getting sufficient background information we designed an application. Gamification can be used to motivate and encourage, but it is challenging to implement a successful application. Listing your goals, your target group and activities that your target group participates in that are realistic to gamify is the first way to go when trying to create a system. Our goal was to create an application that students can interactive with on a daily basis to create good habits of going to school, good habits of managing time and managing everyday tasks. To help users achieve these behaviours we made use of two of the most typical game elements as motivational factors. The two most typical game elements are points and badges. After going through the answers from the focus group we can say that our incentives gave value, but only for a short term. It is also important to mention that the incentives may have worked more on extrinsic motivation as one of the participants mention that the participant would stop using the application as soon as there were no more rewards to achieve. The core features of the application would be the reward system, position tracking, and the habit making. The reward system went as planned, and was a favourite among the participants. However, they wished to achieve rewards for more specific goals, which will be explained in a later section. The geolocation had troubles with the accuracy of the tracking, but seemed to be working most of the time. The idea was to use MazeMap, but the API had difficulties with our chosen technology, so we had to make use of Google Maps API instead, which forced us to rethink our design approach. Even though we had challenges here and there, the focus group seemed to like the idea of such an application. As of now, the application

is just a prototype and needs further development before it can be considered done.

Seeing as we only had five participants it may be too drastic to conclude that our application only worked on extrinsic motivation. It may be a fault in that we only conducted one focus group, but then again we were not interested about what the average opinion of the application was, but rather interested in the feedback about the concept and on what worked and what did not work. The results from the focus group helped us understand what went well and what we should have done differently. In other words, the experiment went as expected. The goals we jotted down were met and the statements we wrote down on what to expect from the research gave us a better understanding on the topic of gamification.

6.1   Further work

This section will describe the things we could have been done differently. One obvious suggestion is to include more motivational elements. These game elements were mentioned consistently in the results from the focus group: Leaderboards, virtual goods, statistics, competition, challenges, tangible rewards and status. Competition and status can be great motivational factors to make someone work harder to reach the top of the leaderboard. Those two elements can however be a doubled-edged sword, as users can become demotivated from seeing that their friends are doing better than them. A suggestive feature that would prevent this from happening is the option to choose who to share your points with. That feature could be able to motivate different types of users. The option to use your points to buy virtual goods will trigger the human desire self expression, and having the option to express yourself through buying virtual goods with points will only affect users to want to earn more points as well. Another great idea suggested by the participants would be a weekly lottery raffle feature where all users can register their earned points after a week and win rewards.

As we mentioned, points had 0 % effect on autonomy and relatedness. Relatedness can be achieved by adding social interactions to an application. Adding features like leaderboards and challenges may give points more relatedness in the eyes of the users,

as they are able to show off how many points they have earned and compare with other users. An occurring incentive mentioned was that of tangible rewards, rather than only intangible, as the use of only intangible rewards will make the application boring after a while. It is quite understandable that our target group would rather receive tangible rewards when the target group are students. Leaderboards was the only element we did not implement from the PBL-triad. Now we understand that the PBL-triad has to be implemented together and will not work equally as good with one of them not present. Another highly suggested feature was the option to have sub-goals. They wanted the application to create weekly and monthly goals and challenges for them, such as staying at school for 5 days straight or finishing 20 ToDo's before the end of the week would give you a specific reward based on those achievements.

The next suggestions to mention are not motivational factors, but features that can remind users of upcoming deadlines and being able to color coordinate their tasks and projects. The option to set a deadline on your ToDo's or projects would greatly increase the value of the application and make it easier to structure and plan a student's work.

To summarize, the application was intended to promote student activity at school and to use the application on a daily basis. The experiment told us that students are interested in a social application that promotes good habit making and good time management skills. They are also interested in an application that can show their progress through the use of graphs and charts to visualize their progress over a longer period of time. Adding social features would promote students to attend school more frequently to either recruit other students or to socialize with other students to show of their points and achievements. Almost all the suggested features targets extrinsic motivation, but seeing as two of our core features are to make going to school more fun and to create good habits, we do not find it bad that our application targets extrinsic motivation more than it does intrinsic motivation. That can be explained by saying that our application do not actually make users learn anything related to their studies, but rather more about how they can better structure their school lives

to eventually get more motivated and encouraged from seeing that they are sticking to goals they have set themselves. Lastly, we found out that the game elements we used and the features we had were good choices in the eyes of the participants, but could be tweaked to give the application a more modern look. If this application get further traction, or the concept of said application get further traction, it will be easier to gather new information about what the needs of students are to keep them coming back for more. It will also be easier to add new features that will meet their needs, which is the last step in the design framework we used.

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