Master's thesis

NTNU
Norwegian University of Science and Technology
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Department of Computer Science

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Prototyping and Evaluation of Hover - a Socially Beneficial Alternative Game

Master's thesis in Computer Science
Supervisor: Alf Inge Wang
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Abstract

In this project, an alternative game concept has been invented, developed, and evaluated. An alternative game is defined as a game that *"deviates from regular games in one or more of the game characteristics categories, input, output, target group, game variant, domain, interaction, or model."* The project builds on a pre-study where existing alternative games and fundamental game design theory were examined.

Our concept, *Hover*, is a pervasive game where location is used as the primary input source. Players get points for being at certain locations in the real world that could improve their well-being. Examples include training centers, schools, and museums. Social elements and other typical game design elements were used to develop an enjoyable game.

Hover was tested on two groups of people to evaluate how the game affected the players' engagement, motivation, enjoyment, and habits. Differences between the groups were also assessed. The participants used the application for two weeks and were asked to complete a questionnaire at the end. The answers from this questionnaire, in addition to in-game observation, interviews, and analytics data, were used to conclude the project.

The testing revealed that the game's social elements impacted the players' engagement, motivation, and enjoyment. Other game elements, such as points and leaderboards, also influenced the players' perception of the game. In contrast, the players' habits were not affected. The experiment also illustrated that the social bond between participants within a group affected the use of the application.

Even though the ongoing Covid-19 pandemic highly impacted the testing of Hover, the results show promising potential. Thus, further development and testing of the concept are recommended to draw a complete conclusion.

Keywords – NTNU, Computer Science, Software Engineering, Game Development, Master's Project, Alternative Games, Pervasive Games, Gamification, Socially Beneficial, Location-based

Sammendrag

I dette prosjektet har vi funnet opp, utviklet og evaluert et nytt alternativt spillkonsept. Et alternativt spill defineres som *"et spill hvor en eller flere av karakteristikkene til spillet avviker fra et vanlig spill."* Prosjektet bygger på en forstudie der eksisterende alternative spill og grunnleggende teori om spilldesign ble studert.

Konseptet *Hover* er et gjennomgripende spill, på engelsk *pervasive game*, hvor lokasjonen brukes som primær input. Spillere får poeng for å være på bestemte steder i den virkelige verden som kan forbedre deres livskvalitet. Eksempler på steder inkluderer treningssentre, skoler og museer. Sosiale elementer og andre typiske spilldesignelementer er blitt brukt for å utvikle et engasjerende spill.

Hover ble testet på to grupper for å evaluere hvordan spillet påvirket spillernes engasjement, motivasjon, glede og vaner. Forskjeller i resultatene til gruppene ble evaluert. Deltakerne brukte applikasjonen i to uker før de ble bedt om å fylle ut et spørreskjema. Svarene fra dette spørreskjemaet, i tillegg til observasjoner av deltakerne underveis i testingen, intervjuer og analysedata, ble brukt for å konkludere studien.

Testingen avslørte at spillets sosiale elementer påvirket spillernes engasjement, motivasjon og glede. Andre spillelementer, som poeng og toppliste, påvirket også spillernes inntrykk av spillet. Derimot ble ikke spillernes vaner påvirket i nevneverdig grad. Eksperimentet illustrerte også at det sosiale båndet mellom deltakerne i en gruppe påvirket bruken av applikasjonen.

Selv om den pågående Covid-19-pandemien hadde stor innvirkning på testingen av Hover, viser resultatene lovende potensial for videre konseptutvikling. Dermed anbefales videreutvikling og testing av konseptet for å kunne trekke en fullstendig konklusjon.

Nøkkelord – NTNU, Datateknologi, Programvareutvikling, Spillutvikling, Masterprosjekt, Alternative spill, Gjennomgripende spill, Gamification, Samfunnsnyttig, Lokasjonsbasert

Contents

Appendices **193**

List of Figures

List of Tables

Part I

Introduction

This part introduces the topic of the project and its primary purpose. First, we present our motivation for choosing this project. Then, we define the high-level research goal, research questions, and how to answer those questions. Lastly, we present an outline of the report's content to give the reader a brief overview of what the report includes.

Chapter 1

Our Motivation

In this project, we are faced with the task of inventing and developing an alternative game concept. Our primary motivation for selecting this task was the possibility of creating something that can be socially beneficial. The resulting alternative game should, to some degree, help an individual or society as a whole. A To-Do list that enables you to keep track of things, or an application that increases your training motivation, are examples of applications that we define as socially beneficial. Our motivation can also be seen in conjunction with the ongoing Covid-19 pandemic, where we hope the resulting game could be a positive detail in an otherwise boring everyday life.

An essential aspect of this work, that is largely correlated with our motivation, is the solution's availability. The game needs to be available to as many users as possible. If not, the purpose diminishes to some degree. When comparing and choosing concepts and technologies, this will be kept in mind.

A game variant often associated with socially beneficial applications is gamification. Examples include applications that gamify education and exercise. The goal of gamification is to support value creation for the user through game design elements to get a sense of motivation, achievement, and mastery (Hamari & Koivisto, 2013). A gamification concept may therefore be an appropriate solution to this. Furthermore, access to smartphones and wearable technology has boosted the development of pervasive games and gamified applications in the past few years. An example is the gamified location-aware application Strava. Strava uses game design elements (e.g., medals, progress tracking, rankings, challenges, and competition) to encourage and motivate exercise. Players are also rewarded with positive reinforcement from the social network through likes and comments. Strava is just one of many gamification concepts that reap the psychological benefits of utilizing game design elements (Sailer, Hense, Mayr, & Mandl, 2017).

The motivation presented above will be an essential consideration that will largely influence our decisions in this project, including defining the research goal and choosing an alternative game concept to develop.

Chapter 2

Project and Context

This master's project is the continuation of our specialization project (Mykland & Tyldum, 2020). The written assignment for both projects was as follows:

> **[Game technology] Alternative games**
> *In this project, the goal is to prototype an innovative game and test this game on users. The innovation can be in the type of gameplay the game provides, how it combines various game genres, what technology is used to control or play the game, how the social interaction between players is supported, the purpose of the game, etc.*

Due to this assignment's large scope, the project was separated into four phases. Two of which were conducted during the specialization project and two in this master's thesis.

The *first phase*, conducted in the specialization project, included a study of game design theory, alternative games, and relevant technologies. This study helped us develop a model for creating new alternative game concepts. In the *second phase*, we explored and developed new game concepts that could generate a socially beneficial value. This phase utilized the model developed in phase one and led to the invention of our game concept. In this report, the relevant content from our specialization project is described in Part II.

In this master's thesis, we proceed with the last two phases of the project. The *third phase* is to implement a prototype of the game concept, while the *fourth phase* is to study and evaluate the benefits of said concept through user testing. The game design and rough implementation plan created in the specialization project will enable us to quickly start the phase of game development in Part III.

The planning of phase four will be conducted in parallel with phase three. It involves defining which game metrics to test, how and when they should be tested, who to test it on, how to measure and collect data, and planning the game's distribution. The research scheme will be created in line with guidelines provided by NTNU and the Norwegian Centre for Research Data (NSD).

The work presented in this master's thesis is our contribution to the field of alternative games.

Chapter 3

Research Goal and Questions

In this project, the Goal, Question, Metrics (GQM) approach (Basili, 1992) is used to define the high-level research goal, research questions, and how to answer those questions. This methodology introduces a conceptual, operational, and quantitative level. At the conceptual level, a goal for what the project should achieve is defined. The operational level includes a set of research questions associated with the goal, indicating whether or not the goal is accomplished. The quantitative level defines a set of metrics that will help answer the research questions.

3.1 Research Goal

The research goal of this project is:

> *The goal of this project is to invent an alternative game concept with a socially beneficial effect that can be developed, explored, and tested.*

To complete the goal, research questions focusing on the different aspects are defined. By answering them, the research goal is considered fulfilled.

3.2 Research Questions

To evaluate the potential of our game concept, we have defined five research questions (RQs) decomposing the research goal:

RQ1: *Which background knowledge is needed for developing an alternative game concept?*

RQ2: *How do game design elements and social interaction in our game concept affect the players' engagement?*

RQ3: *How do game design elements and social interaction in our game concept affect the players' motivation?*

RQ4: *How do game design elements and social interaction in our game concept affect the players' enjoyment?*

RQ5: *How does the use of our game concept affect the players' habits?*

The first research question (RQ1) is answered in the prestudy, Part II, of this thesis. The content is based on work done in the pre-project, which consisted of exploring literature, defining an alternative game, researching existing alternative games, and inventing new ones.

Research questions RQ2, RQ3, and RQ4 will investigate how game design elements and social interaction in our game concept will affect the players' engagement, motivation, and enjoyment. All game elements used in the application (e.g., points, leaderboard, challenges, and achievements) will be explored. Different types of social interaction will be evaluated and compared against each other. Concrete usage data from the application and direct feedback from players will be used to analyze and answer questions RQ2, RQ3, and RQ4.

The last research question (RQ5) will examine how the players' habits evolve as a result of testing our game. The study will compare the players' habits within the game's socially beneficial focus areas before and after the test period. Due to the limited time of this master project, measuring actual user habits is not possible. Hence, answers to RQ5 will primarily be based on responses from the questionnaire answered by all test participants.

3.3 Summary

This chapter presented our research goal and research questions together with a short description. In the next chapter, we will focus on giving an overview of the research methods used to create answers to these questions.

Chapter 4

Research Methods

In this chapter, a general explanation of the research process will be given. The chapter is based on "Researching Information Systems and Computing" by Briony J Oates, a book dedicated to presenting information systems' research process. The learnings from this chapter will help us answer the research questions and goals later in this project.

Oates presents an overview model of the research process illustrating its content, including defining the research, strategies, data generation methods, and data analysis. Figure 4.1 shows Oates' model where the components we have used in our research are shaded blue.

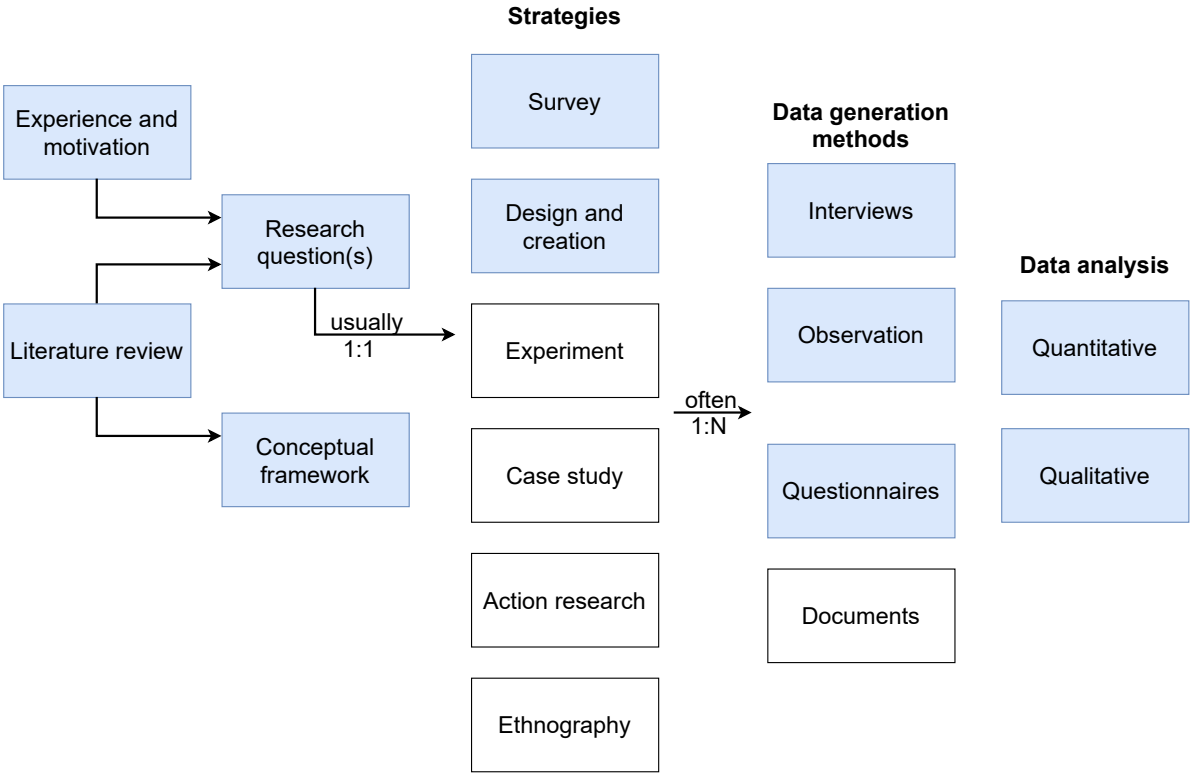


Figure 4.1: Model of the research process (Oates, 2006).

In the first phase of a research process, it is crucial to decide what you want to study and how you want to define your project. Our decision to create an alternative game was based on prior *experience and motivation*. We did a *literature review*, established *research questions*, and developed a *conceptual framework* to define our task.

4.1 Experience and Motivation

As explained in Chapter 1, our motivation for doing this research was the opportunity to create a socially beneficial solution. Prior software development experience, game development insight, and general research theory knowledge helped us reliably complete the research.

4.2 Literature Review

To get the insight needed to design and develop an alternative game, we reviewed relevant literature. The main source for the literature was refereed research papers, most of whom were provided by our supervisor. We adopted an ad-hoc approach, searching and reading some papers on the topics we wanted to review (Farshchian & Parmiggiani, 2020b). The CRAP-test (Currency, Reliability, Authority, and Purpose), evaluating the reliability and validity of the sources, was used before incorporating them in the review (Farshchian, 2020). The study included game development and game flow literature, research of existing alternative games, and available game technology. The purpose of our review was to combine approaches from several articles to give the reader and writer a clear academic understanding of relevant theories and an introduction to the research field of alternative games. The knowledge is also helpful to conduct further research in this area of study. Part II summarizes this literature review.

4.3 Research Questions

The research questions provide a description of what we want to accomplish; what do we want to investigate? Our focus was to create rigorous questions that were focused and drove the research design. For quality assurance of the questions, we used the "so what"-test. This method evaluates the questions by asking "so what?" on every one of them to assess their significance (Farshchian & Parmiggiani, 2020a). As presented in the previous chapter, we chose to target our research by looking at the players' engagement, enjoyment, motivation, and how the game may change their habits.

4.4 Conceptual Framework

A conceptual framework is a way to make explicit how you structure your thinking about the research topic and the process undertaken (Oates, 2006). At the beginning of our specialization project, we realized the need for defining what an alternative game is. A clear definition of this game type was hard to find, so we developed a conceptual framework (described in Chapter 9). The model helped us agree on which games could be categorized as alternative games and helped invent new ones.

4.5 Research Strategies

In research projects, it is vital to select strategies to answer the research questions. Strategies are overall research approaches, and Oates mentions six types in her work. Two of them, *design and creation* and *experiment*, are relevant for our research.

Design and creation

In the "design and creation" strategy, the goal is to develop one or multiple new IT products. Oates mentions four types of products (March & Smith, 1995):

- *Constructs:* A concept used to describe problems in a domain. May include specialized language or shared knowledge.
- *Models:* A description or a representation of a situation. It could be a data flow diagram, functional requirement, or some other specific IT product description.
- *Methods:* A collection of steps used to perform a task. Algorithms or data structures in IT solutions are typical examples of methods.
- *Instantiations:* A concrete IT product demonstrating how constructs, models or methods can be implemented.

Since the project's goal is to create an alternative game, the design and creation strategy will be used. Specifically, models describing what the user can do and instantiation of these requirements in the application will be conducted. This strategy is necessary to test the application on users and also demonstrate that the idea can be implemented in a computer-based system.

Experiment

"An experiment is a strategy that investigates cause and effect relationships" (Oates, 2006). Researchers try to prove or disprove a theory they have between a factor and an observed outcome. An idea is established about a specific topic which the researchers empirically test to check whether it holds or not. The strategy will be used in this project to answer the research questions defined in Chapter 3, by letting people try the game and investigate the effect it has on them.

4.6 Data Generation Methods

There are multiple ways of generating data. As illustrated in Figure 4.1, we will, in this project, rely on *interviews*, *observations*, and a *questionnaire* as data generation methods from Oates' model. Triangulation of data, combining multiple methods or data sources in qualitative research, will be used to corroborate findings and enhance the validity of the research (Oates, 2006). Specifically, *method triangulation*, utilizing two or more data generation methods, will be used. This approach increases the reliability of the result because the data can be cross-validated. More specifically, how the techniques are used to collect data will be described later in Part IV.

Interview

An interview is defined as "a particular kind of conversation between people, with a set of assumptions where one person usually has a purpose" (Oates, 2006). Interviews are useful for getting in-depth perspectives of participants involved in the research. The researchers can get longer and more detailed answers on matters they want to investigate. Additionally, it is often quicker and simpler for the person being interviewed to provide detailed feedback than in other data generation methods. Interviews can be divided into three different types, depending on how they are performed (Oates, 2006); these are listed below. In this project we will use semi-structured interviews to generate data.

- *Structured interviews:* Questions are pre-determined and standardized, almost like a regular questionnaire.
- *Semi-structured interviews:* The interview is based on a list of themes and questions to be covered but is more like a standard conversion.

- *Unstructured interviews:* The person being interviewed talks freely about the chosen topic without the interviewer trying to interrupt, only listen.

Observation

In observations, the goal is to find out if people actually do what they say they do. An observation can be *overt* or *covert*. Overt means that the participants know that they are observed and covert that they do not know. There are two distinct observation methods (Oates, 2006); both listed below. In this project we will use participant observations to generate data.

- *Systematic observation:* The observer decides in advance the particular type of events to observe. This type of observation usually involves counting or timing.
- *Participant observation:* The observer takes part in the situation and experience of the participants. Participant observation creates deeper insight into what occurs during the testing.

Questionnaire

A questionnaire is a set of predefined questions that are asked to the participants in a survey. The method is an efficient method to get structured data that can be categorized and analyzed. There are multiple ways of asking questions depending on the type of information the research is supposed to investigate. However, the questions must be asked so that all participants get the same understanding. Additionally, each question should have a clear link to the research goals. A questionnaire can be conducted using a self-administered or research administered method (Oates, 2006).

4.7 Data Analysis

After data generation, analysis is necessary to conclude the research. The data are usually categorized into one of two categories, *quantitative* or *qualitative*, before being analyzed.

Quantitative

Quantitative data is data based on numbers, and it is the primary type of data generated from surveys. Answers from questionnaires are typically defined as quantitative. Analyzing quantitative data can be done using simple techniques such as tables, charts, and graph

presentation. More complex statistical methods can also be used to analyze the data further if required.

Qualitative

Qualitative data, on the other hand, is all non-numerical data. Data from interviews and observations are usually categorized as qualitative. Analyzing and seeing patterns in qualitative data is often more challenging than in quantitative data. The work depends on abstracting important findings, a procedure that depends on the researcher's skill.

4.8 Summary

In this chapter, the research process and methods relevant to our project have been presented. These methodologies constitute the foundation for carrying out this project. In Chapter 21 we will further explain the data we collected in this project, including which questions were asked during the interviews and in the questionnaire.

Chapter 5

Reader's Guide

This report consists of six parts. Below is a short description of each of them, together with some reader guidelines.

Part I - Introduction

Part I introduces the project, describes the task, and our motivation for choosing it, together with some context around the topic of alternative games. To present our contribution in a structured and understanding way, the research goal and questions that should be answered were defined.

The introduction part is recommended reading for everyone interested in getting an overview of this report's content and the purpose of this research.

Part II - Prestudy

Part II presents the relevant prestudy content. This part is based on the specialization project and includes a literature review of how to design enjoyable games. It also defines what an alternative game is, describes some already existing concepts, and presents a technology review of what is possible with today's technology in this field. Lastly, the part presents some ideas for new alternative game concepts.

This part is particularly useful for all readers that do not have any prior knowledge of the alternative games field. Although the part may be relevant for all, readers familiar with game design principles and alternative games may find it less relevant

Part III - Hover

Part III presents Hover in detail and how the concept was selected. Additionally, technical choices and requirements will also be introduced. The part will also mention how game design elements have been used to create a more enjoyable game experience.

Part III is recommended for readers interested in a more detailed concept description or how the application was implemented.

Part IV - The Experiment

In Part IV, the study of Hover will be detailed. An explanation of practical details on how the research was executed and a description of which data was collected will be given. The part also touches on some reliability and validity concerns that could influence the results.

Part IV is recommended reading for getting a description of how the research was conducted and is the foundation for Part V where the results of the study will be presented.

Part V - Results

Part V presents the results from testing Hover on a selection of users. The results are categorized by our research questions' topics along with a presentation of the test population.

Part V is recommended for readers that are interested in the abundant data collected in the experiment. The content is also used as a foundation for Part VI where the results will be discussed and evaluated.

Part VI - Discussion & Conclusion

Part VI discusses the results found in part V and concludes the project by answering the research questions. The part also evaluates the different phases of the project and presents suggestions for further work.

Part VI is recommended for readers that are interested in the findings and the future of this research.

Part II

Prestudy

This part of the thesis is based on the work done in our specialization project. The project is the foundation for inventing and developing our chosen concept Hover. First, an introduction to general game development concepts is given. Specifically, how to design an enjoyable game, player types, and game reward systems. After that, a definition and model for categorizing alternative games and a description of existing alternative games are presented. Further on, a technology review exploring the possibilities in alternative games' field and relevant technologies is conducted. At last, all the potential concepts we invented during the specialization project conclude the part.

Chapter 6

Designing an Enjoyable Game

How to create an enjoyable game is an important part of every game development process. This chapter presents a literature study of the subject based on work conducted by Malone in 1980, and Sweetser and Wyeth's "GameFlow: a model for evaluating player enjoyment in games" article. Malone's research outlines challenge, fantasy, and curiosity as the three main elements to increase motivation in games. The GameFlow article presents a model for evaluating enjoyment in games based on eight elements. Even though different authors wrote these articles, they present a lot of the same mindset in what characterizes an enjoyable game.

6.1 What Makes Things Fun to Learn?

Malone presented in his study from 1980 a framework for creating enjoyable games. As mentioned above, he organized the essential properties of what makes a good game into the three categories: challenge, fantasy, and curiosity. Malone wrote multiple articles on the topic. His main findings were summarized in "What Makes Things Fun to Learn? Heuristics for Designing Instructional Computer Games". Even though this research was conducted in 1980 and the examples he presents are somewhat old, the main concepts are still highly relevant today.

6.1.1 Challenge

The first property presented by Malone is *challenge*:

> "*In order for a computer game to be challenging, it must provide a goal whose attainment is uncertain.*" (Malone, 1980b).

From this principle, three essential characteristics of why challenge is necessary to create good computer games follow:

Goal

Based on studies done by Malone, users tend to prefer games that have clearly defined goals. However, it is necessary to note that all goals are not equally valuable. Consequently, four different properties on how to create appropriate goals are mentioned:

1. Simple games should include obvious goals.
2. A complex environment should provide a structure so that players can easily generate appropriately difficult goals.
3. Practical and fantasy goals are often the best ones.
4. Players need to know when they are getting closer to the goal.

Uncertain outcome

The next characteristic is *uncertain outcome*, and the article describes four different ways it can make computer games more challenging:

1. **Variable difficulty levels**

   Good computer games should include variable difficulty levels that can match the user's skill level. The difficulty level can be determined in three ways: Automatically, chosen by the player, or determined by the opponent's skills.

2. **Multiple level goals**

   Finding a goal for various player types is easier when creating multiple-level goals. Generally, two levels of goals are defined: Basic goals and meta goals. One typical example of this could be to have a basic goal of completing platform game levels. Collecting all the coins could then be the meta-goal.

3. **Hidden information**

   Hiding information can be an appropriate way of creating challenging games. Guessing games use this technique regularly.

4. **Randomness**

   One last way of creating challenging games is to include randomness. When a random element is included, the player cannot predict the next step, making the game more challenging. Gambling games primarily succeed based on using randomness.

Self-esteem

In addition to goals and uncertain outcomes, self-esteem is mentioned in the article. Self-esteem can be seen as the reason why goals and challenges are essential in good games. Completing goals and challenges can increase a person's self-esteem and thus create a captivating game.

6.1.2 Fantasy

The next property is fantasy, which is often used in games to make them more appealing. In games, fantasies often appear as models of physical objects and social settings that are not truly present (Malone, 1980a).

One typical example where fantasy is used to increase enjoyment is in learning games, where one can increase the level of fun by overlaying the curriculum with elements of fantasy. The fantasy can visualize the progression of the player towards the goal based on right or wrong answers. An example could be getting to the finish line in a marathon or avoiding a catastrophe, like in Hangman. In these games, the fantasy depends on how the skill is used, but not necessarily vice versa. Fantasies that only have the one-way logical dependency, where skill affects the fantasy, are called extrinsic fantasies. Extrinsic fantasies are good for arithmetic problems, where answers are either wrong or right, and the skill does not depend on the fantasy (Malone, 1980b).

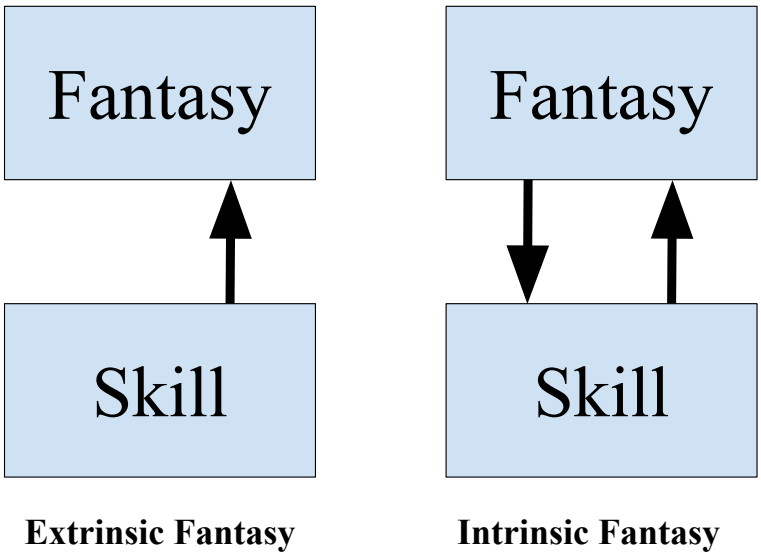


Figure 6.1: Logical dependencies in extrinsic and intrinsic fantasies. (Malone, 1980b).

Fantasies that have a two-way logical dependency are named intrinsic fantasies; the fantasy depends on the skill, and the skill depends on the fantasy. Figure 6.1 illustrates the two types of fantasy side-by-side. In the spelling game Hangman, the player's spelling skills affect the fantasy, and the feedback of right or wrong guesses from the fantasy influences the player's skill as it becomes easier to guess new letters each time.

The emotional aspect of fantasy

Fantasies in games can appeal to players differently based on what emotions they need to satisfy (Malone, 1980b). It may be challenging to design a computer game that meets the emotional needs of the person playing. Malone states that "...fantasies can be very important in creating intrinsically motivating environments but that, unless the fantasies are carefully chosen to appeal to the target audience, they may actually make the environment less interesting rather than more." (Malone, 1982). This statement suggests that different people find different fantasies appealing and that the fantasy must be appropriate for the target audience. Furthermore, if games had different fantasies to choose between, players are more likely to find it enjoyable, motivating, and engaging because it has a broader appeal.

6.1.3 Curiosity

The last property, curiosity, is about a player's motivation to learn within a game environment. The learning is, however, independent from goal-seeking or fantasy-fulfillment. Games can trigger a player's curiosity by creating optimal information complexity environments based on their existing knowledge. Finding such balance for the information complexity will evoke the player's curiosity to explore the environment further. An optimal environment has a complexity level where the player uses its knowledge to create an expectation of how the environment should behave. Still, these expectations should sometimes be unmet to be novel and introduce an element of surprise. Malone states curiosity should be distinguished into two categories: sensory and cognitive.

Sensory curiosity

Sensory curiosity is about the use of sensory-stimulating technology that attracts the user's attention. In games, sensory curiosity appears as both audio or visual effects. Malone

suggests that the effects can be used in four main ways (Malone, 1980b):

1. **As decoration**

   The use of audio and visual effects that are present regardless of user interactions. In games like Just Dance Now, this can be found as background music in the menu.

2. **For enhancing fantasy**

   Sensory curiosity is used to improve fantasy in a game like "decorative" effects. However, the special effects are distinguishable because of their captivating nature and association with fantasy. In Wii Fit, this appears as audio effects that mimic an audience.

3. **As a reward**

   The use of audio and graphical effects to reward good performance. It can increase the motivation for reaching the goal. Pokémon Go uses flashing lights and stars, together with victory sound, when users perform well, for instance, when they catch a new Pokémon.

4. **As a representation system**

   Is the use of audio and visuals to convey information without using text. This usage is widely used in games to share information with the user efficiently. If a player in Pokémon Go unsuccessfully throws a Pokéball at a Pokémon, then the Pokéball will bounce away to indicate that a player missed the Pokémon.

Cognitive curiosity

Cognitive curiosity is about the desire to improve one's knowledge structures. Malone claims that people prefer their cognitive structures to be complete, consistent, and parsimonious. According to his theory, to stimulate a player's cognitive curiosity, they must be given just enough information to make their existing knowledge appear incomplete, inconsistent, or miserly. Cognitive curiosity will engage the user because people are willing to learn more to improve their knowledge-structures. A typical example occurs when people are watching a movie with only some minutes left. The probability of them watching the rest of the video is high because they want to figure out how it will end and bring completeness to their knowledge structure.

6.2 The GameFlow Framework

Another essential framework for creating good games is Sweetser and Wyeth's "GameFlow: A Model for Evaluating Player Enjoyment in Games" from 2005. The authors define a model for designing, evaluating, and understanding enjoyment in games based on work previously done by Csikszentmihalyi in 1990. Csikszentmihalyi conducted extensive research and surveys to find out what makes experiences enjoyable. Sweetser and Wyeth modified these principles to be representative of enjoyment in games. The GameFlow model consists of eight elements: *concentration*, *challenge*, *skills*, *control*, *clear goals*, *feedback*, *immersion*, and *social interaction*. Each of these includes a goal and a set of criteria that can be used when developing games (Sweetser & Wyeth, 2005).

6.2.1 Concentration

Concentration is the first of the eight elements presented in the article. Enhancing how much concentration a task requires increases its immersion. Games should grab the player's attention immediately and keep holding it for as long as possible. The player's workload should be maintained at an appropriate level, and unimportant tasks should not be presented during the game to achieve this. Also, nongame-related interactions (e.g., settings menu) should be minimized, and the game should strive to use as much screen real estate as possible for the gameplay.

In Guitar Hero, players have to stay highly concentrated throughout the game. The gameplay is set in an environment with few distractions so that the player can become more immersed. The game also forces the player to stay concentrated throughout the song to avoid ending up in the game-over state. Figure 6.2 illustrates a screenshot from the gameplay in Guitar Hero.

Figure 6.2: Screenshot of gameplay in Guitar Hero.

6.2.2 Challenge

Challenge is often considered the essential aspect of good game design, and appropriate challenges should be presented to the player. The players' skill levels should match the challenges given. Additionally, the challenge level should increase as the player moves through the game at an appropriate pace. In the language learning game Duolingo, players take a placement test to start at a proper level of challenge, as seen in Figure 6.3. This test makes sure that any previous language experience is considered to match the player's skill to the level of difficulty.

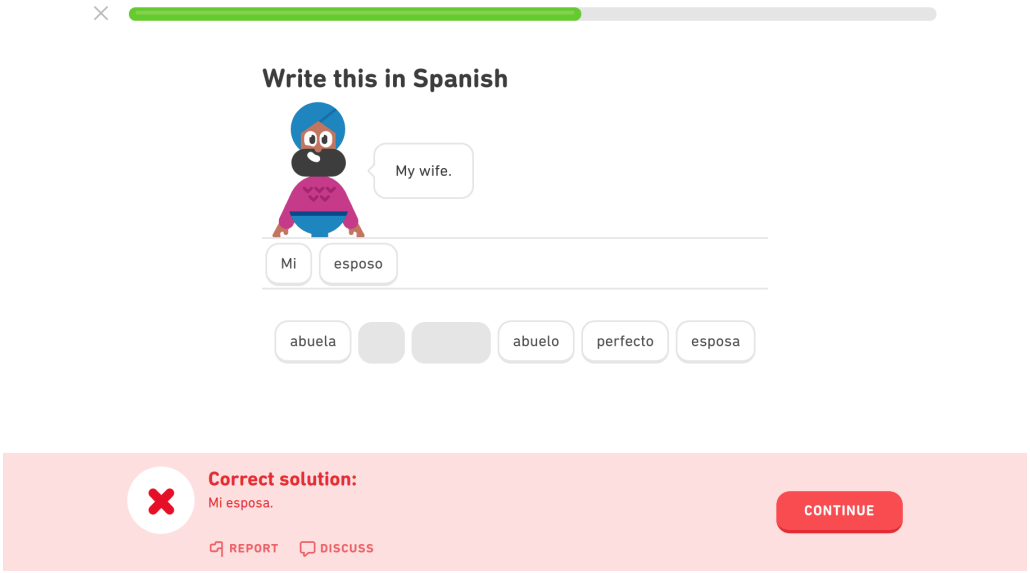


Figure 6.3: Spanish placement test in Duolingo.

6.2.3 Player Skills

As mentioned, the player's skill level needs to match the difficulty level of the game. The player's skills also need to increase during the game, at the same rate as the difficulty of challenges. If not, the game could quickly get too challenging or too easy. Rewarding players appropriately when completing specific tasks, with points or similar, is an essential part of this process.

Again, in Duolingo, players are matched with the appropriate skill level, and as the game progresses, both the player's skills and the level of difficulty grows. The placement test, see Figure 6.3, makes sure that players are met with an appropriate level of difficulty. Also, players have to put their knowledge to the test before they are allowed to ascend to the next level. This additional test mechanism makes sure that users are qualified for new levels and prevents players from being demotivated from challenges that are too demanding.

6.2.4 Control

Another central element of good game design is control. The players should feel a sense of control over their actions in the game and transfer their intentions to in-game behavior. Essential aspects of the game to achieve this are intuitive interfaces and easy-to-use input devices. Controlling the game should be intuitive and straightforward. In addition to this, players should not make errors that are disturbing to the gameplay. If they do, recovering from their mistakes should be supported.

Racing games are, in general, examples of games that are intuitive to maneuver. Custom racing wheel controllers mimic the action of actually driving a car, as seen in Figure 6.4. Recovering from errors that are disturbing for the gameplay, such as flipping the car or driving off a cliff, is also usually supported with a "reset" button.

Figure 6.4: Wii Steering wheel used to play a racing game.

6.2.5 Clear Goals

Clear goals should be provided to the user at appropriate times. A primary goal should initially be presented to the user. Some introductory cinematic history that tells the story's background is often used to describe this goal to the user. Intermediary goals should be provided when the user progress. Games often use "briefings" or "missions" for this.

In Super Mario Bros, players are introduced to a mission of saving Princess Peach from the villain Bowser. This background establishes a clear goal for the entire game. The game also has intermediate objects of completing each level towards the final goal.

6.2.6 Immersion

Immersion describes a deep and effortless involvement in games. Players should feel engaged by the game to experience an altered sense of time, less awareness of surroundings, less self-awareness, and fewer worries. Immersion also indicates emotional attachment to the game. Examples of game elements that can increase immersion are audio and narratives. Sounds and music in games improve the players' attraction to the game and keep them immersed for a more extended period. A history that gives the player some background information or a storyline also creates the same effect.

The role-playing game the Witcher 3 has become known for being a highly immersive open-world game. The game has a strong storyline, realistic graphics and audio, and many intermediate goals that draw the player deeper into the game, as seen in Figure 6.5. For Witcher 3, immersion can cause players to feel an emotional attachment to the game and reduce concern for self and sense of time.

Figure 6.5: Screenshot of gameplay in Witcher 3.

6.2.7 Feedback

Players should get the feedback they need during the game. They should always know their status or score and progress towards the goal. Additionally, appropriate feedback based on their actions should be provided.

Pokémon Go uses direct and immediate feedback. Visual, textual, and audio feedback is used frequently. The game also uses points, levels, streaks, and medals to award good performance and engagement. Figure 6.6 shows the visual feedback a player receives when leveling up in Pokémon Go.

Figure 6.6: Feedback in Pokémon Go when leveling up.

6.2.8 Social Interaction

The last element in the GameFlow model is not an element of flow. Social interaction may often interrupt the immersion in games. However, it is an essential element in the GameFlow model because social interactions improve enjoyment in games. Games should support and create opportunities for player-to-player communication and social competitions. Online games are a typical example of how important social interaction can be. In this type of game, social interaction is often the main reason people are attracted to them. World of Warcraft is a classic example of such a game.

Another example is social motives like affiliation and recognition in online fitness communities (OFC). A 2018 study on running motivations concluded OFC users are significantly more oriented towards achieving running goals and entering competitions than non-OFC users (Stragier, Vanden Abeele, & De Marez, 2018). The results suggest that social gamification features such as recognition or leaderboards in these communities affect player motivation and enjoyment.

6.3 Summary

In this chapter, two frameworks describing how to create an enjoyable game have been presented. The frameworks include a description of central elements in game-design associated with producing good games. Even though all framework characteristics are essential aspects, a game should not necessarily incorporate all of them. As a game designer, the most valuable knowledge is understanding the theory and utilizing the appropriate parts.

The concept and elements proposed by Malone and Sweetser and Wyeth will help invent new alternative games and develop our chosen concept later in this thesis. As described in the motivation (Chapter 1), our focus is to create a socially beneficial alternative game. Consequently, the social element in the GameFlow model will be the essential consideration that should influence our game design. However, the other elements will also serve as guidelines and inspiration for us when developing the game. To what extent and which parts are used to create our game will be described later.

Chapter 7

Reward Systems

Reward systems play an essential role in every game. Players are motivated by rewards and reward systems to increase social meaning (H. Wang & Sun, 2011). Rewards are crucial for gamification applications where the concept often is built around introducing reward systems to enhance the users' enjoyment.

H. Wang and Sun presents an article describing how reward systems are used in games and which design considerations a game developer should take into account. The paper proposes classifications for rewards, reward characteristics, and how players utilize them. In this chapter, the article's key points will be presented, including the aspects just mentioned. After that, we present a summary of A. I. Wang and Lieberoth (2016), showing the effect of game reward systems (points and audio) in Kahoot.

7.1 Forms of Rewards

Based on multiple studies done by other researchers, H. Wang and Sun proposed eight forms of rewards used in games to create positive experiences for the players:

7.1.1 Score Systems

Score systems are a type of reward that uses numbers to keep track of the player's performance. Scores are considered crucial to the design of a fun game by many researchers and generally serve as a tool for self-assessment and comparison. The reward system is typically classified as a "glory" reward, i.e., it does not directly impact gameplay. World of Warcraft is an example of a game where the score system reward is used. The ladder system uses scores to determine player ratings. Figure 7.1 illustrates the game view showing the PvP rating in World of Warcraft: Battle for Azeroth.

Figure 7.1: PvP player rating in World of Warcraft: Battle for Azeroth.

7.1.2 Experience Point Reward Systems

Experience Points (XP) are utilized in the majority of games where players control developable avatars. XP are typically used to measure the players' progress in the game, leveling up when a certain number of points is reached. The reward is classified as a "facility" type of reward, meaning a reward that increases the avatar skills at certain levels. XP are similar to score systems but differ in at least three ways:

- XP are bound to specific avatars rather than the player itself.
- XP are rarely used for a ranking purpose.
- XP directly affects gameplay.

7.1.3 Item Granting System Rewards

This type of reward consists of in-game items that players or avatars can use. Item granting systems are often adopted in RPGs and MMORPGs to encourage exploration of the game world. Their primary purpose is to maintain players' interest in-between intense battles, missions, or other exciting moments. Figure 7.1 illustrates a typical avatar in World of Warcraft wearing rewarded items.

7.1.4 Resources

Resources are in-game valuables collected and used in a way that affects the gameplay. The reward system is similar to an item granting system. Still, there is a significant difference between the two: Resources are mostly for practical game use, while items have a collecting and social value only. An example of resources is virtual wood and stone in Age of Empires Online. Figure 7.2 illustrates the tribute part of the game where players can donate resources to other players.

Figure 7.2: Player tribute screen in Age of Empires Online.

7.1.5 Achievement Systems

Achievement systems consist of titles bound to a user or avatar collected by completing clearly stated requirements. This type of reward encourages players to complete certain tasks, which may be more challenging than what they otherwise would have considered doing. Achievements can also be a way of improving the players' urge to explore the game world. As an example, there are over a thousand different titles in World of Warcraft. Collecting these is publicly acknowledged by the community, consequently encouraging players to complete these tasks. Figure 7.3 illustrates the achievement screen in World of Warcraft: Legion.

Figure 7.3: Achievement screen in World of Warcraft: Legion.

7.1.6 Feedback Messages

Feedback messages provide instant feedback, an important element of flow (Sweetser & Wyeth, 2005), to the player. The reward is not collectible, and thus, cannot be used as a player comparison or directly affect the gameplay. In Dance Dance Revolution, a message with the word "Perfect" appears every time you perform the correct dance move with precise timing, as seen in Figure 7.4. This game element is a perfect example of a feedback message reward. The feedback can also be pictures, sound effects, or video clips.

Figure 7.4: Screenshot from Dance Dance Revolution.

7.1.7 Plot Animations and Pictures

Plot animations or pictures are used in games following notable events, such as completing a level or a mission. The purpose of this reward is to motivate players to continue advancing in the game. A famous plot animation is found in Super Mario Bros after completing a level. Figure 7.5 illustrates this scene in New Super Mario Bros. U Deluxe.

Figure 7.5: "Level completed" scene in New Super Mario Bros. U Deluxe.

7.1.8 Unlocking Mechanisms

The last reward type is unlocking mechanisms, which give players access to new game content when certain conditions, such as a new level or a special environment, are met. Unlocking mechanisms are hiding elements and awarding them to players as they progress in the game. The reward is substantial in regards to maintaining player curiosity. An example is found in World of Warcraft, where avatars must achieve certain levels before accessing higher-level environments.

7.2 Design Consideration

The article proposes seven reward system design considerations, which are directly relevant for us when we are going to develop our alternative game concept:

Life Constraint

Rewards must be available in a manner that fits the intended target group of the game. Hardcore gamers tend to spend more time playing; thus, the rewards should take longer

to obtain. However, if the game is designed for casual gamers, the rewards should be accessible during shorter sessions.

Create Autotelic Experiences

The rewards should create intrinsically rewarding experiences. One way of doing this is to develop multi-level goals which will keep their engagement in the game. Players will then also learn and experience the pleasure of learning.

Balance

An essential part of designing reward systems is to balance the time spent with the value of the reward. It is frustrating for players to feel like the rewards are never valuable enough. On the other hand, if the rewards are too valuable, the player might appreciate them less.

Uncertainty and Secrecy

Uncertainty in rewards can create additional fun in games, but appropriate handling is essential. Not all reward types are suited for secrecy. For example, ammunition and life counts are typical rewards that are preferred to be exposed to the player. Other kinds of rewards such as treasures and quests may be hidden to introduce more fun. Hiding these elements encourages players to dive deeper into the game and spend more time exploring it.

Accumulated vs. Instant Feedback

Accumulated rewards are important attributes for marking progress and comparing status between players. Accumulated feedback is appropriate for creating long term and social sense of achievement. Contrary, instant feedback provides responsiveness and an element of flow to the game.

Social Purposes

Game rewards enable social status that can be shared with others. Hard to get rewards, such as special items, distinguish advanced and casual players. These types of rewards also serve as a symbol to increase unity between skilled players.

Physical World Activities

Reward systems that support physical world activities impact the playing willingness. By being physically active, the guiltiness often associated with playing diminishes. An example is the physical world activities in Nintendo Wii, which changed the image of game playing.

7.3 The Effect of Points and Audio in Kahoot!

To conclude the topic of rewards systems in games, a concrete example of its importance will be briefly described. A. I. Wang and Lieberoth conducted a study in 2016 looking at the effects of points and audio in the game-based learning system Kahoot!. Points as a reward system correspond to the "score systems" category, while audio classifies as "feedback messages," according to the forms of rewards presented earlier in this chapter.

The paper describes an experiment where Kahoot! was used as a learning method for teaching a lecture on software engineering. The students were divided into four groups using four different combinations of reward systems. The first group used Kahoot! as usual, with sound and audio. The second group played the game with audio but without points. The third group played Kahoot! without audio but with points, and the last group without audio and points. A questionnaire with statements related to concentration, engagement, enjoyment, learning, and motivation was filled out by the students after completing the lectures.

The results from the study revealed notable differences in how the game was experienced in different groups. The effects of points and audio demonstrated a significant change in concentration, enjoyment, motivation, and engagement. The audio had a noticeable impact on classroom dynamics, but points also contributed to a more limited extent. An interesting observation was done in the group using Kahoot! where audio was removed, but points still present. The classroom was completely silent during the lecture, and students reported afterward that it felt more like a formal test than a game (A. I. Wang & Lieberoth, 2016).

The study illustrates the importance of reward systems. Without points and audio in Kahoot! several of the students answered that they were less motivated and engaged.

7.4 Summary

In this chapter, a study of reward systems, including the eight different forms and seven design guidelines, has been introduced. In addition to this, a concrete example of the effects of reward systems in Kahoot! was presented.

The content is highly relevant for our project and goal of developing an alternative game concept that has a socially beneficial effect. Especially in gamification concepts, reward systems are an essential tool for creating enjoyable games. In Part III, where our concept is presented, a concrete description of how reward systems are used will be given.

Chapter 8

Player Types

Understanding player types and motivations are essential for designing games. This is because changes in game business practices have elevated the need for distinguishing player types and player styles, similar to how segmentation is used in marketing. Players can have very different interests in playing, which are important to consider when designing games. This chapter takes a look at Hamari and Tuunanen's player types (2014). The article presents different approaches and understandings of player topologies found in previous literature.

The use of segmentation has always been a central part of marketing practices. This practice implies that products are designed with specific end-users in mind as opposed to mass-marketing. The goal of segmentation is to identify homogeneous customers, to offer products that better match their needs. There are four categories of segmentation established in marketing theory; geographic, demographic, psychographic, and behavioral segmentation. *Geographic* segmentation divides people into groups based on their geographical region. *Demographic* segmentation divides people into groups based on descriptive features such as age, gender, occupation, and education. *Psychographic* segmentation divides people based on personal traits, such as attitude, interests, lifestyle, and values. And, *Behavioral* segmentation categorizes people into groups based on behavioral patterns observed in people.

Out of the four categories, geographic and demographic segmentation have not been of primary interest due to their irrelevance to game design. Hamari and Tuunanen (2014) explicitly states that their review attempts to conceptualize motivations, behavior, and traits that categorize within the psychographic and behavioral segments. The two segmentation categories are often challenging to distinguish, and Hamari and Tuunanen (2014) states that the literature interprets these differently. The game genres covered in Hamari and Tuunanen (2014) vary; however, Massive Multiplayer Online (MMO) games are more recurring than others.

8.1 Bartle's Four Archetypes

Though Hamari and Tuunanen (2014) review several papers on player topologies, many of them seem to stem from the core principles of Bartle's four player types (1996). The player types, also known as Bartle's taxonomy, are the result of observations Bartle made in player behavior in Multi-User Dungeons (MUDs). Through his observations, he created a two-dimensional model where each quadrant represents a player type, see Figure 8.1. The model's two dimensions to playing are action vs. interaction, and player-orientation vs. world-orientation. Based on players' position on the axes, one can distinguish players into the four player types; *Achievers*, *Explorers*, *Killers*, and *Socializers*. An Achiever is a player that prefers world-oriented actions to achieve measurable rewards like points. An Explorer is a player that prefers interaction in the game world, like discovering new areas. A Killer is a player that prefers action towards other players and thrives on competition. And a Socializer is a player that prefers interaction with other players over the game itself.

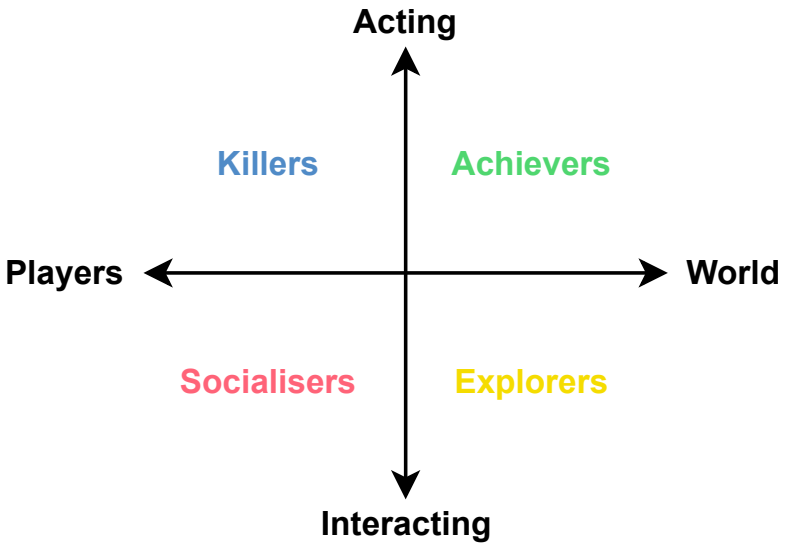


Figure 8.1: Bartle's player types model (Bartle, 1996).

Although Bartle's model on player types is insightful, it has received criticism for being too generalizing. Besides, it does not consider that players can have multiple motivations or that their motivations for playing may change over time, making it difficult to pinpoint a player type. Hamari and Tuunanen (2014) emphasizes that the criticism stems from how the topologies have been used and suggests that the dimensions can be used as scales rather than nominal categories.

Hamari and Tuunanen also review the work of Yee (2007), where he observed player motivations in MMORPGs. Yee (2007) builds on Bartle (1996), however, Yee suggests that there are only three main motivational factors of motivation, with additional sub-factors. The main factors are Achievement, Social, and Immersion. Yee's underlying facets of Achievement and Social have a resemblance to Bartle's heuristics found in Achievers, Explorers, and Socializers; however, they are not perfectly comparable. Moreover, Bartle did not consider Immersion explicitly, while Yee found that immersion was a major motivational factor for players.

8.2 Hamari and Tuunanen's Proposed Dimensions

The review on player topologies is extensive; however, it is surprisingly uniform. Hamari and Tuunanen suggest that the results can be summarized as seven dimensions, based on recurring ideas from the reviewed papers.

Achievement

Related keywords: Achiever, Single-oriented player, Guardian/Achiever, Aggressive gamer, Achievement, Progress & provocation, Power & domination, Runner, Hard fun, Casual, Avatar level, (Semi-)professional.

The achievement dimension focuses on single world-oriented players that thrive on rewards, progress, provocation, and power.

Exploration

Related keywords: Explorer, Solver, Rational/Explorer, Aggressive gamer, Social gamer, Immersion, Exploration & fantasy, Story & escapism, Curiosity.

The Exploration dimension is about exploring the game world. The players are driven by curiosity, fantasy, and storyline to escape the real world.

Sociability

Related keywords: Socialiser, Social mentalities, Community-oriented player, Idealist/Socialiser, Social, Helping & support, the people factor, Friends & collaboration, (Semi-)professional, Amateur.

The Sociability dimension is about community-oriented players who enjoy and are motivated by other players' support and presence.

Domination

Related keywords: Killer, Artisan/Killer, Aggressive gamer, Off-real world-oriented player, Progress & provocation, Power & domination, Casual.

The domination dimension is about the player's need for aggressive gameplay. This could be players trying to accumulate as much gear as possible or damage others, leading to the underlying desire of feeling powerful.

Immersion

Related keywords: Immersion, Committed mentalities, Exploration & fantasy, Story & escapism, Off-real world-oriented player, Altered states, Hardcore.

The Immersion dimension is about the degree to which players are committed and immersed in the game. Players may be driven by exploration, story, and fantasy.

Gaming intensity and skill

Related keywords: Hardcore, Committed mentalities, Aggressive gamer, Veteran, Casual, Casual mentalities, Inactive gamer, Pacifist, Avatar level, Amateur.

The Gaming Intensity and skill dimension are about the player's commitment, experience, and attitude towards the game. Players are often said to be casual or hardcore players. Hardcore players are usually experienced and highly skilled, whereas casual players might be less experienced and less committed. Players are placed by their willingness to participate, make an effort, and play.

In-game demographics

Related keywords: Avatar class and profession, non-clan member, Amateur, Professional, Group centrality, Size of the guild, Type of server, Faction.

The In-game demographics dimension is about the player's progress vs. their role. Examples of this can be different avatar classes, in-game professions, and positions in the hierarchy. For instance, players can pursue to level up their avatar from warrior to king as they progress in the game.

Though the papers are not directly comparable, because of their different scope, Hamari and Tuunanen go on to suggest that these seven recurring dimensions can instead be considered

as five key dimensions and two supporting dimensions of player motivations. Achievement, Sociability, Exploration, Domination, and Immersion are the five key dimensions, and Game intensity and In-game demographics are the supporting dimensions. The reasoning behind this seems to be about the motivation of play. Achievement and Sociability seem to be the most recurring concepts in the literature; Immersion and Domination appear in some papers, whereas In-game demographics were only found in a few papers.

8.3 Player Types and Reward Characteristics

In the light of Hamari and Tuunanen's player types, it is logical to see this in context with H. Wang and Sun (2011) work on reward systems, previously discussed in Chapter 7. H. Wang and Sun (2011) review also presents four reward characteristics that can be used to analyze the influence of reward systems on different kinds of players.

The first one, social value, can be used for comparison of players or social interaction. This type of reward characteristic is particularly attractive for Socializers and Achievers. Rewards in games make it easier for players to compare themselves against others. An example is a high score list. The player can compare their points to others to see how they rank. Another good example is how hard-to-get items often draw attention.

The next characteristic looks at "how rewards affect gameplay". For this particular characteristic, it is interesting to see how rewards can help the player advance in the game, motivate them to produce new content, and participate in the game. Using the player types from Bartle's taxonomy, H. Wang and Sun (2011) summarizes the effect reward has on different player types as:

- **Achievers and Killer:** Most interested in accumulating rewards that are evidence of their advanced skills and do not care about the visual aspect.
- **Socializers:** Greater interest in rewards that can draw attention to them, e.g., hard to get items.
- **Explorers:** Like Achievers and Killers, the motivation behind is gaining sufficient strength to explore game world details.

The third attribute is "suitability for collection and review" (H. Wang & Sun, 2011). The logic behind this is that building a sense of accomplishment improves the ability

to preserve game memories. Collecting rewards is also a tool for players to recognize other players with similar interests. An important design consideration for this attribute is to showcase the rewards, so they are easy to present and review in the game. For instance, medals or badges that indicate game status or ranking can be showcased on the player's profile. The rewards could then strengthen the sense of collection and produce a feeling of completion and perfection among the players. The last characteristic is "the time required to earn and/or receive a reward" (H. Wang & Sun, 2011). In contrast to real-world rewards, e.g., job promotion, a game reward can be instantaneous or rewarded after a couple of hours of gaming. A player may, for example, get a new level as a reward after a couple of hours of play. The time and intensity required to earn a reward are crucial aspects of game design that must be carefully planned to create a positive player experience.

Though most of the player topologies have been built on observations of MUDs, MMORPGs, and other online games, the topologies seem to be relevant for various game types. The results can, for instance, be applied in the context of gamification, where game mechanics related to sociability and achievements are frequently used. Some of these mechanics can be social rewards such as likes and comments or achieving good results, and breaking records for other players to see.

8.4 Summary

This chapter has introduced different interpretations of player types. We looked at the recurring ideas present in literature and have concretized them into seven primary dimensions. Depending on the game concept and genre, game designers may use Hamari and Tuunanen's dimensions to create organic game environments that offer rewarding gameplay for different player types. The dimensions and understandings from this chapter will be useful later for developing new game concepts and for the design, development, and analysis of the final game.

Chapter 9

What is an Alternative Game?

To develop a concept for an alternative game, a clear understanding of which games can be categorized as alternative games are crucial. Let us first take a look at what the word "alternative" means in this context with some definitions from three well-known dictionaries:

> *"Different from the usual or traditional way in which something is done"*
> **Oxford learner's dictionary**
>
> *"Different from the usual or conventional"*
> **Merriam-Webster's Collegiate Dictionary**
>
> *"Alternative things are considered to be unusual and often have a small but enthusiastic group of people who support them"*
> **Cambridge dictionary**

While all of these dictionaries define the word differently, we can see that there are some commonalities. All three describe alternative as something "unusual" or "different from the usual." The key takeaway from the definitions is that an alternative game is a game where the creators have done something to differentiate the game from ordinary ones.

To increase the ability to recognize alternative game concepts more efficiently, we will examine existing alternative games (see Chapter 10) and analyze their commonalities. The research result is a list of six game characteristics categories where alternative games often differ from regular games. The characteristics can be illustrated in a model which helps recognize and invent alternative games.

9.1 Alternative Game Characteristics

Our proposal of what alternative games are is then the following:

> *If a game deviates from regular games in one or more of the game characteristics categories,* ***input***, ***output***, ***target group***, ***game variant***, ***domain***, ***interaction***, *or* ***model***, *it can be considered an alternative game.*

Below are explanations of all categories with relevant alternative games presented. The six categories are based on recurring observations found in different game concepts, covering all alternative games we have studied during this phase of the project. However, it is important to note that there might exist other categories that are not yet developed, or that we are not aware of. As technology moves forward, it is reasonable to assume that new branches of alternative games will emerge. In addition to this, the categories could possibly be expanded with more characteristics than what we mention in this chapter. The model is meant to be a tool for categorizing alternative games and can be developed further in the future.

9.1.1 Input

A common way of creating an alternative game is to use an unusual input source (such as GPS, microphone, special controllers, or accelerometer) for controlling the game. Using input sources such as GPS has become more regular in recent years, although it is still not mainstream. Three examples of games using alternative input sources are Knowledge War (A. I. Wang, Forberg, & Øye, 2016), CityZombie (Zhu, Wang, & Rolland, 2010) and Exermon (A. I. Wang, Hagen, Høivik, & Olsen, 2017). Both Knowledge War and CityZombie use the user's position as a central part of playing the game. Moving around in the real world translates to the gameplay. Exermon is an example of utilizing the accelerometer on the player's phone. The game is a strength-based exercise game that tries to motivate people to do more strength exercises. An alternative input source, the accelerometer, is used to register the number of repetitions the user completes in one workout.

9.1.2 Output

The output from the game is another category of characteristics commonly explored in the development of alternative games. Some known examples are sound, haptics, and augmented reality, but there are many more. Two examples of games using alternative outputs are "Unexceptional.net" and "The Amazing City Game." Unexceptional.net is a story-driven, pervasive game where "the story evolves through multiple media channels interacting with the player" (A. I. Wang & Nideffer, 2009). The game includes different untraditional outputs, such as SMS and phone calls, to provide feedback to the player.

The Amazing City Game is also a pervasive game where the players can play a knowledge competition tour. The game utilizes location and augmented reality to show different vital landmarks at a user's location (A. I. Wang & Wu, 2011). The number of location-dependent games and augmented reality games has, in recent years, increased. However, the technologies have yet to become common.

9.1.3 Target Group

The target group is an essential category of characteristics in a game, and it decides what type of users the game should appeal to. Some games include adjustments to target specific groups of people, and some of these can make the game fall into the alternative game definition. More special target groups, like people with physical disabilities, often require more adjustments to play games at all. For example, people who cannot maneuver a game using traditional handheld controllers need other ways to interact. A Brain-Computer Interface (BCI) could be a way of bringing games to this group of people. One concrete example is the use of brain waves (via a NeuroSky brain set) to control the movement in a Snake game (A. I. Wang & Larsen, 2012).

9.1.4 Game Variant

Computer games are usually categorized within a game genre. Historically, computer games have been limited to one game genre. However, games today are often categorized by multiple ones or by their type. For that reason, we look beyond the scope of game genres in this category and name it *game variant*. Prensky (2001) suggest that games can be classified within one of eight game genres:

1. Action Games
2. Adventure Games
3. Fighting Games
4. Puzzle Games
5. Role-Playing Games (RPG)
6. Simulation Games
7. Sports Games
8. Strategy Games

Furthermore, since we consider the classification of games to be game variants instead of game genres, we can include other application types. Alternative games usually consist of unique concepts and uncommon gameplay that often fall into different variants than those listed. An example of such a variant is gamification, defined as applying "game design principles in non-gaming contexts" (Robson, Plangger, Kietzmann, McCarthy, & Pitt, 2015). An example of a game not fitting directly into the ordinary game genres is the "Kinect Recycling Game." This game is a gamification concept of recycling trash, where the goal is to teach recycling in an engaging and realistic manner. As the name implies, the game uses Kinect to recognize players' hand gestures to place the trash into the correct bins (A. I. Wang & Ibánez, 2015).

9.1.5 Domain

Computer games can be applied to different domains. The domain of a game depends on what area of use it serves. Some examples of game domains are entertainment, education, industry, government, and health. Alternative games may sometimes define their area of use, where the new domain may be a combination of other domains or a subset of an existing domain. For instance, edutainment games are a crossing between education and entertainment. Another example of an alternative domain is Attensi's system for gamified work training, mixing industry, and learning (Attensi, 2020). The company offers tailored 3D job simulators to large organizations to achieve tangible and measurable changes in employees' behavior and skills.

9.1.6 Interaction

There exist many forms of interaction in games. Examples are cooperation, competition, player vs. player (PVP), and more. Interaction can also contain an alternative twist, i.e., interaction forms that are not used in ordinary games. One such concept is the multimodal "Multiplayer On One Screen Entertainment System (MOOSES)" approach. Here, many players use their smartphones as controllers for gaming on a shared screen (A. I. Wang & Føllesdal, 2010). AirConsole is a concrete example of where this concept is utilized. The console includes multiple MOOSES based games where the players use their smartphones as controllers. Games can also be pervasive, meaning the game experience is extended beyond the fictional world. The player interacts with both the virtual and real worlds.

9.2 Alternative Games Model

Based on these six categories of characteristics, we have created a model (see Appendix A) to help us compare alternative game concepts. The model categorizes a game's properties using the six categories to compare and justify why concepts can be described as alternative games. Thus, the model will help describe existing alternative games in Chapter 10 and new ideas in Chapter 13.

Additionally, the model is useful for inventing new alternative game concepts by exploring the categories separately. Modifying properties in each category one by one can create ideas that would otherwise not have come up. It will also improve the structure of an idea brainstorming session. Consequently, we will use the model in the brainstorming part of inventing new alternative games in Chapter 13.

9.3 Summary

This chapter presented our definition of alternative games together with the six coherent categories of game characteristics. A short description of each of them with relevant examples from the literature was given. The chapter provides a more concrete understanding of an alternative game and a model to distinguish different concepts. This knowledge will help us later when we are going to invent and develop our alternative concept. In the next chapter, existing popular and known alternative games will be described. How they fit into the proposed categories in this chapter will also be outlined.

Chapter 10

Existing Alternative Games

In this chapter, seven different alternative games will be presented. The games are picked based on popularity, relevance today, and how they compare to each other. Different types of games are carefully chosen to illustrate the diversity of alternative games that exist. A brief explanation of the game concept and why it is an alternative game will be given for each game.

10.1 Hold

Hold is an application that rewards players for not using their phones (Hold, 2020). The game was initially launched in 2016 for iOS and Android, focusing on Norwegian university students (Ringheim, 2018). Since then, the application's target group has expanded beyond this focus.

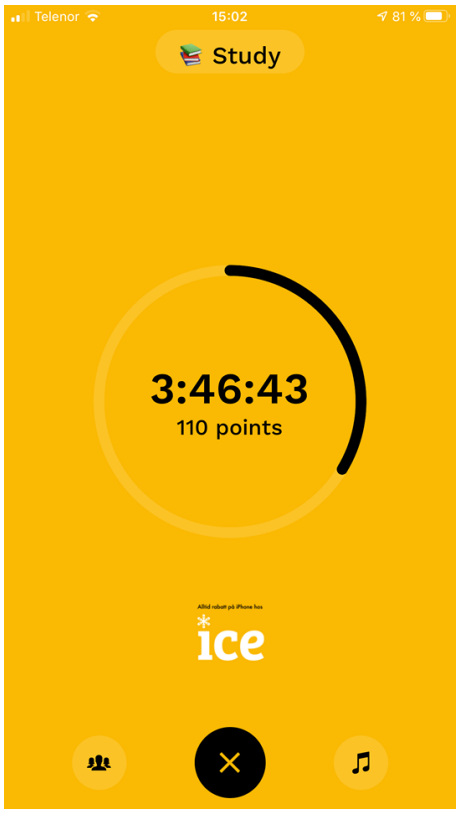


Figure 10.1: Main timer screen in Hold.

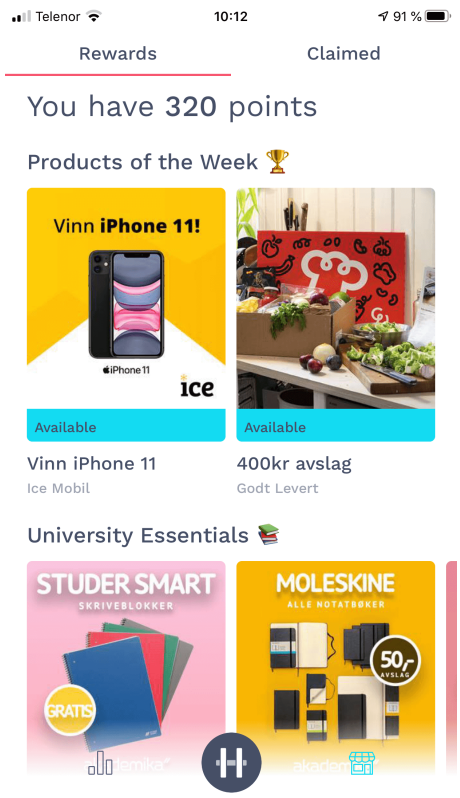


Figure 10.2: Choices of rewards in Hold.

The application helps players limit distractions through gamification. When a player activates the application, a timer starts running (see Figure 10.1). The player is rewarded ten points for each twentieth minute they are not using their phone. The points can later be exchanged into real-life items such as coffee, food, or discounts, as seen in Figure 10.2. The rewards are the primary motivating factor for using the application.

Unlike other games, Hold's concept is to encourage people not to use their mobile phones. The player can choose to play alone against the environment (PvE) or connect with friends to compare scores, making it more competitive (PvP). The application also lets players connect with nearby friends through Bluetooth, enabling them to focus (collaborate) while boosting their points collectively (Wakefield, 2018).

Hold is a perfect example of an alternative game with a different concept, where the developers have explored multiple of the game characteristics categories. The game classifies as alternative primarily for two reasons: It explores alternative game genres by using gamification, rewarding the player points for not using their phone. Furthermore, it uses an alternative input source, Bluetooth, for connecting with nearby friends.

10.2 Mario Kart Live: Home Circuit

Figure 10.3: Mario Kart Live poster illustrating gameplay.

Mario Kart Live is a newly developed augmented reality (AR) concept from Nintendo (released 16th October 2020) for its Switch game console. The game is based on the classic Mario Kart game, but with a unique twist: the inclusion of a specially designed racing

kart that follows the player's maneuvers in-game. A live video feed from the racing kart is relayed to the player's Switch, mapping the virtual track to the player's home (Velazco, 2020). The game can be played individually (against AIs) or as a multiplayer game with more than one kart (Hashimoto, 2020).

The game is a typical example of how alternative sources for input and output can bring something new to an already familiar game concept. For this Mario Kart game, the alternative twist is to use a camera to produce AR output. Figure 10.3 shows a poster from the game where you can see the karts racing a player's home and how the game is presented to the player.

10.3 Pokémon Go

Pokémon Go is another good alternative game example, published and developed by Niantic for iOS and Android. The game was launched in 2016 and quickly became one of the most popular mobile games of all time (Grubb, 2016). The concept is an extension of the classic Pokémon game found on multiple of Nintendo's handheld devices.

Figure 10.4: Screenshot of an ongoing battle in Pokémon Go.

Figure 10.5: Screenshot of gameplay in Pokémon Go.

The concept is similar to the previous Pokémon games but utilizes AR and location determination (GPS) to find and catch Pokémons. The player needs to move around in the real world to play the game. Battles between Pokémons (to increase combat points and get prices) can happen at specific places known as Pokémon Gyms. These spots correspond to real-world points of interest (POI) such as parks and tourist attractions (Bastow, 2016). There are also additional important POI in the game, such as PokéStops and Nests. Figure 10.4 is an in-game screenshot where you can see a typical Pokémon battle, while Figure 10.5 shows a screenshot of gameplay while catching a Pokémon.

The game is an alternative game as it explores uncommon input and output sources such as camera, GPS, and AR. The game is also classified as a pervasive game because the player experience is extended to the real world. A literature review on the health effects of Pokémon Go reveals that the pervasive game has a noticeable effect on the player's physical, mental and social health (A. I. Wang, 2021). Pokémon Go is an excellent example of how alternative games can become very successful.

10.4 Just Dance Now

Just Dance Now is an alternative game produced by Ubisoft, launched in 2014 (Fandom, 2020). The game is an addition to the Just Dance franchise, where the concept is to pick a song from the catalog and follow the moves of the on-screen character, see Figure 10.6.

Figure 10.6: Just Dance Now screenshot from a computer display.

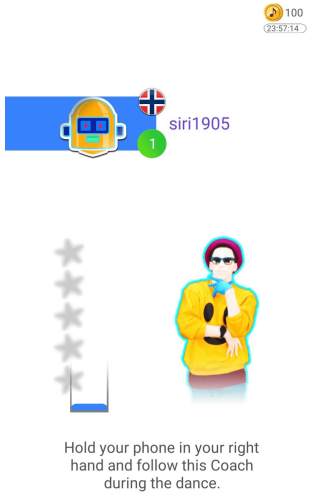


Figure 10.7: Just Dance Now screenshot from a smartphone.

Just Dance Now distinguishes itself from the other games of this type by being more available because it does not require a dedicated gaming console. It can be played using an iOS or Android-based smartphone as the controller and a large screen connected to the internet, such as AppleTV, Chromecast, or a computer (Ubisoft, 2020). The player's smartphone is used as a movement tracker, and the large screen displays the dance moves they should perform. Multiple players can join the same game and dance together, competing to get the highest score.

This game can be viewed as an alternative game because of the use of the player's mobile phone as a movement tracking device, as seen in Figure 10.7. Based on the sensors' measurements in the player's phone, the game determines whether or not the player is doing the dance moves well.

The interaction form is another reason why this game is an alternative game. The game is an example of a multi-modal exergame, where all players in one game use the same large screen to see the moves they need to perform in order to earn points. A recent study on the use of exergames in physical education in primary schools revealed that Just Dance Now had positive effects on students' performance, engagement, and motivation for physical activity (Quintas, Bustamante, Pradas, & Castellar, 2020). This concept can also be described as a "Multiplayer On One Screen Entertainment System" (MOOSES), presented in Chapter 9.

10.5 Guitar Hero

Guitar Hero is a series of games initially developed for PlayStation 2 in 2005. The game series later expanded to multiple other game platforms, including Xbox 360 and Nintendo Wii. The game concept is based on simulation and gamification of playing guitar, using a custom-developed guitar controller (see Figure 10.8). The player tries to match the in-game "notes" with buttons on the guitar controller, resulting in a score coherent with the number of notes hit. Songs available to choose from vary between different games, but generally, they belong to the genre of rock (Metacritic, 2020). Figure 10.9 shows a screenshot example from playing the game in single-player mode.

One of the categories of alternative game characteristics is input. As per the definition (in Chapter 9), a game using alternative input sources can be classified as an alternative game.

Guitar Hero is a typical example of such a game because it depends on a custom-designed controller for playing. Additionally, the use of gamification as the game genre is another reason why Guitar Hero can be defined as an alternative game. The central concept of the game can be perceived as gamification of playing guitar.

Figure 10.8: Guitar Hero controller.

Figure 10.9: Screenshot from gameplay in Guitar Hero.

10.6 Wii Fit

Wii Fit is an exercise game (exergame) created and launched by Nintendo in 2007 (IMDb, 2020). The game is only available on Nintendo Wii and requires a unique controller in addition to the regular Wii controller. Wii Fit is a collection of minigames that combine the two domains of health and entertainment. The game has four main exercise categories to choose from; strength training, aerobics, yoga, and balance (IGN, 2008).

Figure 10.10: A person doing yoga exercise in Wii Fit.

The additional controller is called the Wii Balance Board (IGN, 2008) and is one reason this game can be categorized as alternative. The board's purpose is to track the player's movement and translate it to the player's in-game avatar, as seen in Figure 10.10. A bathroom weight inspired the board's design, and it consists of four weight sensors, one in each corner. The controller connects to the console through Bluetooth, where it calculates the player's movement in real-time (Jacquot, 2010). Based on the player's motion, the game gives feedback on how the exercise is going, as seen in Figure 10.11.

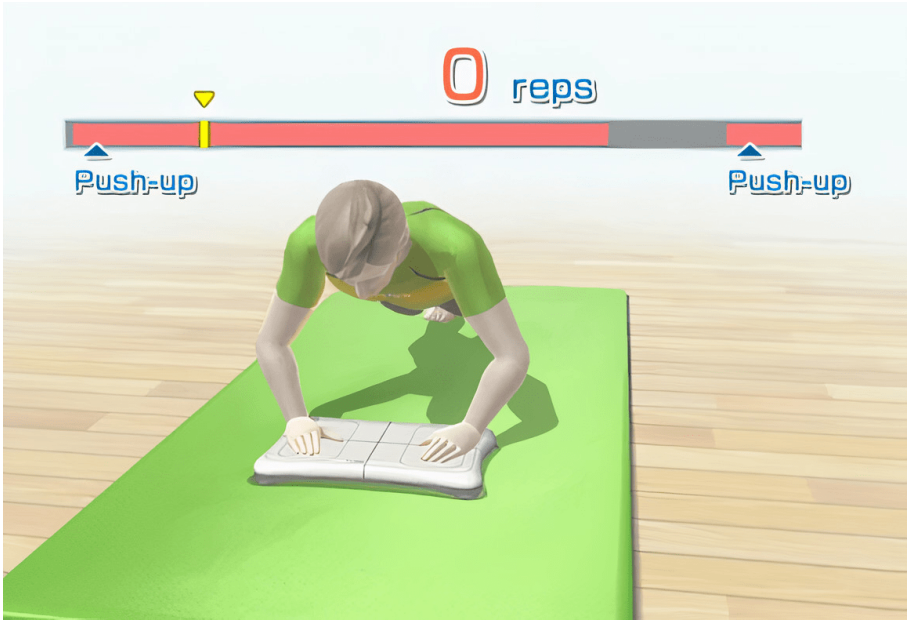


Figure 10.11: Using the board to track push-ups in Wii Fit gameplay.

In addition to the alternative input, Wii Fit is also a gamification concept exercising. The game's goal is to create a fun way to get in shape from the comfort of the player's home. Nintendo brings a comprehensive set of games that are engaging for the entire family with individual progress so all players can compare themselves against each other.

Wii Fit was initially designed as an interactive health and fitness experience for the general public. However, Wii Fit's benefits have been studied in many clinical settings, such as in multiple sclerosis patients and stroke patients (Tripette, Murakami, Ryan, Ohta, & Miyachi, 2017). A 2011 study of the health and wellness benefits of Wii Fit on university students revealed a significant change in body mass index, weight, and intrinsic and total motivation for its participants (Jacobs et al., 2011).

10.7 Mosquito Mania

Mosquito Mania is a game concept developed at NTNU in connection with a music technology bachelor thesis in 2012. The game was developed as an attempt to create a new way of entertaining people by using audio stimulation and concepts from game development.

The primary purpose of the game is to kill as many mosquitos as possible within 60 seconds. An 8-32 array of speakers is positioned in a circle around the player, emitting mosquito sounds in a 2-dimensional space, as seen in Figure 10.12. The player is then assigned the task of killing the mosquitos using a custom-made gun-like controller, measuring the direction it is pointed. A microcontroller combined with an accelerometer, compass, and gyroscope is mounted on the controller. Though the game primarily focuses on audio, the game has a dashboard for game statistics and scoreboard (see Figure 10.13).

Figure 10.12: A person playing Mosquito Mania.

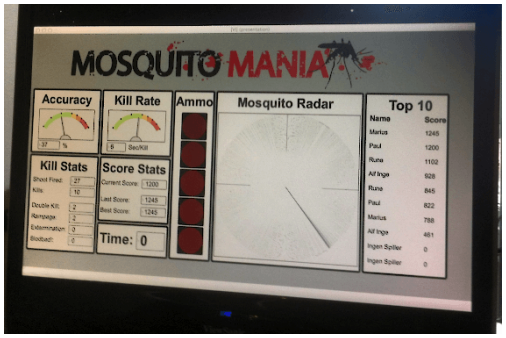


Figure 10.13: Mosquito Mania's game dashboard with game statistics and leaderboard.

The game is an alternative for multiple reasons. First of all, it uses an alternative input source, i.e., the custom controller for playing. This unique controller could by itself contribute to categorizing the game as alternative. However, the primary reason for Mosquito Mania to be an alternative game is the unusual approach of using audio as the primary output source. Regular games typically combine sounds and music as a secondary output source in addition to visual feedback. The game concept is unique, and by removing the visual aspect, a new twist is introduced to the game. Even though the game was not developed for any special target groups, it became immensely popular among people with visual impairment (Gran-Jansen, 2020).

10.8 Summary

In this chapter we have presented seven different alternative games that incorporate one or more alternative characteristics. By reviewing these existing alternative games we have a better understanding of what alternative games are and what they can be. The next chapter will categorize these games using our alternative games model; with a following analysis and comparison of each dimension.

Chapter 11

Comparison of Existing Alternative Games

To compare the alternative aspects of all the games mentioned in the previous chapter, the alternative games model presented in Chapter 9 has been used. It provides a quick overview of how the game differs and presents concrete characteristics for all the games in each of the six categories. The model in Table 11.1 is a simplified version of the complete model found in Appendix A where the unused rows have been omitted for readability.

		Ideas						
		Hold	Mario Kart Live	Pokémon Go	Just Dance Now	Mosquito Mania	Guitar Hero	Wii Fit
Input	GPS	x		x				
	Bluetooth	x						x
	Camera		x	x				
	IR					x		
	Weight sensors							x
	Custom controller					x	x	x
	Gyroscope			x	x			
	Accelerometer				x			x
Output	Sound					x		
	AR-screen		x	x				
	Custom device		x					
Game variant	Action					x		
	Adventure			x				
	Fighting			x				
	Role-playing			x				
	Simulation		x				x	x
	Sports							x
	Gamification	x					x	x
Target group	All		x	x	x		x	
	Adults	x						x
	Students	x						
	Youths							x
	Kids							x
	People with					x		
Interaction	Collaborative	x						
	Competition	x	x	x	x	x	x	x
	Online			x	x			
	Real		x	x	x	x	x	x
	Pervasive		x	x			x	
	MOOSES				x			
	PvP		x	x	x		x	
Domain	Health			x				x
	Entertainment		x	x	x	x	x	x
	Education	x						

Table 11.1: Existing alternative games characteristics.

11.1 Analysis of Input

The first section of the model shows a wide range of *input* types used in the games. The variation is likely to come from the fact that many games are developed for a mobile platform. Mobile phones today include various input sensors that can be used to create alternative game concepts. GPS, Bluetooth, and gyroscopes are examples of such sensors.

The games Hold, Pokémon Go, and Just Dance Now are totally or partially developed for mobile platforms. Hold and Pokémon Go uses the device's GPS to use the context of the player's location in the game. The location-aware feature creates a better in-game experience, and players are forced to move to unlock certain features. Pokémon Go and Just Dance Now both take advantage of the phone's gyroscope. The gyroscope can detect rotation, telling a game how the mobile device is positioned in the real world. Just Dance Now also uses the accelerometer to track the player's movement while dancing. The use of both gyroscope and accelerometer determines if the player is doing the right move at the right time, providing a fun and immersive player experience.

In the early days of computer games, custom controllers for each game were common (Overmars, 2012). Using different controllers was adverse for the players because it forced them to buy new ones for every game. Furthermore, non-custom controllers can cause a poor user experience if it does not have an optimal or logical design. Nowadays, custom controllers are rare, and games are often produced for specific consoles rather than unique controllers. However, there exist games today with custom controllers, and Guitar Hero, Wii Fit, and Mosquito Mania are all examples of this. In these games, it makes sense to use a custom controller more suited for the game's purpose since a regular game controller would make it hard to create a realistic game. Using a special controller as input is a classic example of an alternative game.

11.2 Analysis of Output

The second section of the model looks at the alternative use of *output* in games. Even though today's games often use sound effects and music, this does not make them alternative. The use of sound in Mosquito Mania is more alternative as it is the only output. The game focuses on the player's ability to sense the sound's direction, which is

an alternative way of challenging the player's hearing instead of the eyesight.

Furthermore, Pokémon Go and Mario Kart Live use the camera as an input to produce an Augmented Reality (AR) output. AR technology is alternative in games because projecting artificial objects onto the real world is based on interpreted input. In both games, players use a handheld device. AR in mobile devices is more available to the consumers but creates a less immersive gaming experience than an AR headset.

11.3 Analysis of Game Variant

A selection of *game variants* is listed in the third section of the table. These game variants themself do not make games alternative; although, they do tell something about what type of game it is. There is one exception to this: gamification. Gamification is alternative because it uses game design principles to make activities and tasks fun and engaging while motivating the player. Hold, Guitar Hero, and Wii Fit are all gamification concepts. Hold gamifies and rewards players for putting the phone down, Guitar Hero gamifies playing the guitar, and Wii Fit gamifies and motivates working out. Furthermore, games can also be classified within several variants, making the game more alternative, though this is not implied.

11.4 Analysis of Target Group

The identified *target groups* can be found in the fourth section of the model. All games have one or more dedicated target groups, corresponding to everyone or a distinguished set of users. The target groups might overlap or intersect; for instance, students and young adults intersect. Mario Kart Live, Just Dance Now, and Guitar Hero are examples of games where the target group is "all". Still, these games might be more addressed towards a younger crowd. Mosquito Mania is also a game that most people can play; however, it is especially applicable for people with visual impairment who may have trouble playing ordinary games.

11.5 Analysis of Interaction

The fifth section of the model displays the types of *interactions* that have been identified in the existing games studied in Chapter 10. Interaction types can be found in all ordinary games and do not imply that a game is alternative. However, how the interaction is accomplished may be categorized as alternative. All seven games use a combination of interaction methods, and all games include some degree of interaction through competition. Competition can be conducted in numerous ways, e.g., by utilizing a scoreboard. Just Dance Now offers, like many other games, different player modes. Players can play alone, against friends in the same physical or virtual room in real-time, or online through the global scoreboard. These gameplay variations make the game very flexible, and players can play in the way they want. The other games offer similar but not so extensive features as Just Dance Now. Mario Kart Live, Pokémon Go, and Guitar Hero all include the competitive elements of PvP interaction. In these games, players communicate in the real world, but the gameplay happens in the virtual world.

Hold is the only game that includes a collaborative mode where players can connect their device with their friends' to boost points. If one player quits, the player will not only lose his or her focus but also stop the boosting for the collaborating players. This interaction feature is likely to strengthen the player's motivation for not using their phones.

11.6 Analysis of Domain

The sixth and last section of the model displays the *domain* of the games. Traditionally speaking, games often belong to the domain of entertainment, and therefore the use of other domains can classify a game as alternative. The exercise game Wii Fit is directly connected to the domain of physical health. Pokémon Go also exploits the benefits of physical health from having players move around. Hold is not like a traditional game and thus classifies only in the educational domain since its primary target group is students.

11.7 Summary

This chapter has focused on showcasing multiple different and typical examples of alternative games (based on our definition presented in Chapter 9). The examples

have been shortly described and compared with each other to highlight their differences. A table with the characteristics of each game has been presented and analyzed. The next chapter will shift the focus from the concept to the technical aspect of alternative games.

Chapter 12

Technology Review

In this chapter, we will study technology relevant to the development of alternative games, increasing our understanding of the possibilities in this field. The learning will come in handy when we are going to invent new alternative game concepts and later when we are going to develop our chosen concept.

The diversity of alternative games today is considerable. Based on our definition from Chapter 9, many games can be categorized as alternative. A few examples were given in Chapter 10, but many more exist. Because there are numerous unique alternative game concepts, there are also a lot of variations in the technology they use. Thus covering everything is outside the scope of this project. Therefore, we decide to focus on the type of technology that is directly relevant to us. As described in our motivation in Chapter 1, our goal is to create an application that can reach as many users as possible. As a consequence of this, we will mainly consider mobile development tools. However, we will first briefly examine the possibilities of technology that alternative games explore today.

12.1 Diversity in Alternative Game Technology

The technology used in alternative games can, in principle, consist of almost anything. The limits in what can be done are often affiliated with the game developers' imagination rather than the technology. A common way of creating alternative games, as described in the model in Chapter 9 is to explore custom-designed input or output devices. A typical example is a specific controller custom-designed for the game. Alternative games often bundle the game together with the needed controller. A concrete example of such a game is Singstar, a karaoke game where players compete to get the highest score by hitting as many notes as

Figure 12.1: Singstar microphones.

possible. The game includes a custom microphone, as seen in Figure 12.1, that the players use when singing. By using this microphone, the player gets an increased real-world experience. Some other examples of games that use custom controllers as input are Wii Fit, Guitar Hero, and Mosquito Mania, all of which were described in Chapter 10.

Augmented Reality (AR) and Virtual Reality (VR) are examples of technologies where uncommon input and output are used. The technologies have become increasingly popular in the last couple of years and are expected to continue to be available to more people in the coming years as well (Petrock, 2020). Both technologies are great platforms for developing alternative games.

VR is a technology based on simulating an environment for users where they become a part of that virtual experience. The situation could be based on a simulated version of the real world or an imaginary one. VR games give another level of immersion in the game because everything the player sees is dependent on the fictional environment. Consequently, more parts of the game experience can be controlled by the developer. An example of a player immersed in a VR game can be seen in Figure 12.2. The corresponding in-game look for the player could be similar to the view in Figure 12.3. The screenshot is captured from an actual game-play session in "The Climb" for Oculus Quest, a popular VR headset.

Figure 12.2: A person playing VR games using Oculus Quest 2.

Figure 12.3: Screenshot of Oculus Quest gameplay from The Climb.

AR is similar to VR, but instead of projecting elements to a simulated environment, AR uses the real world. Simulations can be created using specially developed glasses, as illustrated in Figure 12.4, or more commonly, with a mobile phone screen and camera. Similar to VR, AR creates another game experience than regular games. One of the most common examples of an AR game is Pokémon Go, described in Chapter 10.

Figure 12.4: Real world projection with AR glasses.

In addition to using custom controllers, AR, and VR, mobile phones are commonly used to develop alternative games. Mobile devices have a lot of sensors that developers can utilize to create a game. Also, mobile applications' distribution is relatively simple because the popular operating systems have pre-made tools for distributing applications. The simplicity of distribution makes it more likely for users to download an application to their mobile phone than they are to buy some kind of custom device only for that game.

As mentioned in the motivation, we have focused on developing a concept that can reach as many users as possible. Mobile technology is by far the easiest and most available way to do this today. Therefore, the rest of this technology review will focus on which tools can be utilized to create the best mobile applications. The content presented in the rest of the chapter is used later to decide how we will develop our application.

12.2 Mobile Application Development Tools

Today, most smartphones on the market use Android or iOS as their operating system (StatCounter, 2020). The development can be done mainly in two different ways: native or using a cross-platform framework. The native development method uses the APIs and languages provided by Apple or Google. The cross-platform framework method uses third-party tools for creating an application that can be run on both platforms. There are strengths and weaknesses in using either of the approaches, which should be carefully considered before choosing one of them. Early decisions affect evolvability and can be hard or costly to change later (Ford, Parsons, & Kua, 2017).

Alternative games often utilize the mobile phone's sensors, such as GPS, Bluetooth, and

gyroscope, as a central aspect of the game. It is, therefore, essential that the frameworks considered for alternative games have good support for accessing data from these sensors. Obtaining data from the devices is not an issue in the native approach since they are continuously updated with the latest and most detailed data available to the developer.

12.2.1 Native Solutions

The obvious drawback of using the native approach is that Android and iOS applications need to be developed separately. Since the native solutions for Android and iOS are based on two different programming languages, Java/Kotlin and Swift, code cannot be shared between both applications. The developers then have to implement and maintain both solutions, resulting in "double" amount of work.

The main strength of the native solution is that you always have access to the latest and greatest APIs provided by the companies developing the operating systems. Every time a new OS gets released, the developers have access to the latest features instantly. Availability of new features can be valuable for developers when working with special features that are not commonly utilized and create a faster implementation loop when new features become available.

Another strength of the native solution is maturity. The APIs and tools provided are usually well documented and tested. Developing an application using this approach is not dependent on third-party developers writing documentation and updating their framework.

If performance is critical for the application, the native approach is also preferred. While different frameworks' performance varies significantly, based on what operations are done, native solutions are usually more performant than cross-platform frameworks (Biørn-Hansen, Rieger, Grønli, Majchrzak, & Ghinea, 2020).

12.2.2 Cross-Platform Solutions

There are several variants of cross-platform solutions for mobile applications, each with different strengths and weaknesses. In this section, we will consider general-purpose and game-focused frameworks. The primary benefit of all of these approaches is the ability to share codebase between the Android and iOS applications. In theory, this should decrease

development and maintenance costs since the developers can focus on only one framework. Another benefit of using cross-platform solutions is that they often utilize other languages than those supported by Google and Apple. Consequently, a developer can choose a language that fits better to their expertise.

General cross-platform frameworks focus on creating a simple application that can run on both Android and iOS. The different frameworks have their own approach, but they provide similar services. Three of the most known frameworks are React Native, Flutter, and Xamarin. When deciding on which general-purpose framework one should choose, the developer preferences are often central. But of course, it is necessary to make sure the framework supports what you plan to do in the application. General cross-platform application frameworks are suitable for most applications that do not include too much complicated graphics.

Game focused mobile framework focuses more directly on creating applications with 3D elements. The frameworks provide tools that make the creation of game elements and complex visualization easier. Thus they are perfect when working with this. However, they might be unnecessarily complex and not fit for developing applications that are simpler graphically. Two of the best-known examples of game-focused mobile frameworks are Unity and Unreal Engine.

12.2.3 Choosing Between Native and Cross-Platform

So whether a native approach or a cross-platform approach is best essentially comes down to the situation. If performance and access to the latest and greatest the operating system can offer, a native solution is preferable. If a shared codebase between Android and iOS or minimizing development time is crucial, a cross-platform solution is probably the way to go. And last, if you are developing 3D intensive applications, a game-specific framework should be the preferred option.

12.3 Data Solutions

An important aspect of game development is how the data should be stored and managed. The social element in games is crucial to create an enjoyable experience for the player (Sweetser & Wyeth, 2005). A way of authenticating users and a central storing mechanism

to keep player data is essential to provide this. There are many approaches to do this.

Previous to cloud services, writing a custom API that handled requests from the application was the way to go. However, in the last couple of years, cloud service solutions called Backend as a Service (BaaS) are frequently used in mobile applications. The idea here is that the solution should provide all necessary backend solutions for mobile applications. All the big cloud providers, Microsoft, Google, and Amazon, offer this kind of service.

12.3.1 Backend as a Service (BaaS)

As mentioned above, BaaS provides all the necessary backend services for a mobile application, including authentication, storage, insights, and more. Such a solution is supposed to simplify mobile application development since the developers do not need to spend much energy on planning, creating, and maintaining a custom backend. They can instead focus on improving the application. All the big cloud providers, Microsoft, Google, and Amazon, offer similar services with Azure Mobile Apps, Firebase, and AWS Amplify, respectively. Choosing between these is usually subjected to taste and preferences, but the mobile application's technology could influence the choice. For example, if Xamarin is used as a mobile application tool, Azure Mobile Apps is a great fit because Microsoft provides both. Consequently, the developer gets a lot "for free."

In addition to the solutions from the big cloud service providers, there exist other alternatives that could be used as a replacement or extension. Two of the ones that caught our interest during this work are Parse and Hasura. Parse is an open-source backend framework. It aims to create a more straightforward backend development process and has a large community base. Parse could be a great alternative to Azure Mobile Apps, Firebase, or AWS Amplify. Hasura is a more specialized database solution. The service provides a PostgreSQL database with a GraphQL API and built-in authentication. The main selling point for Hasura is the use of GraphQL, as opposed to the more common REST style. The main benefit of using GraphQL is the ability to specify which data properties you want to fetch, limiting the amount of data transferred, and thus is perfect for mobile applications. Hasura is not a complete BaaS and probably needs to be used in coherence with another service.

12.3.2 Custom API

The next approach for creating a backend solution is to write a custom API. Developing such a system is a widespread solution and was the preferred one for almost all client-server-based applications for a long time. By creating a custom API, the developer can tailor the system for the application's needs. It is also simpler to integrate a custom API with an existing system if that is a requirement.

There exists a large diversity of different frameworks for creating a custom API. In general, all major languages have at least one tool for developing a web API. Examples of some tools are Flask in Python, ASP.NET in C#, and Express in Node.js.

12.3.3 Choosing Between BaaS and Custom API

The choice of backend solutions often depends on the developers' preferences. If the application's goal is to create something that does not require a lot of business logic and a complex backend, BaaS is probably the way to go. A custom API may be the best solution for larger companies where the backend needs to integrate with the existing system and contain complex logic.

12.4 Summary

This chapter started by briefly looking at today's diversity in the technology used in alternative games. After that, relevant mobile application development tools were discussed and compared. This knowledge will be helpful when deciding on how the application should be developed. As explained in the motivation in Chapter 1, we want to create a game that should "be available to as many users as possible." Thus, a cross-platform mobile application with a BaaS data solution will probably be the preferred solution. Chapter 18 presents more concrete details on which tools we chose and why they were selected.

Chapter 13

Ideas for New Alternative Games

In this chapter, a description and evaluation of six alternative game concepts invented during our prestudy work will be presented. Previously (in Chapter 9), we have defined and constructed a model to establish what an alternative game is. The model was used to develop new ideas, as illustrated in Figure 13.1.

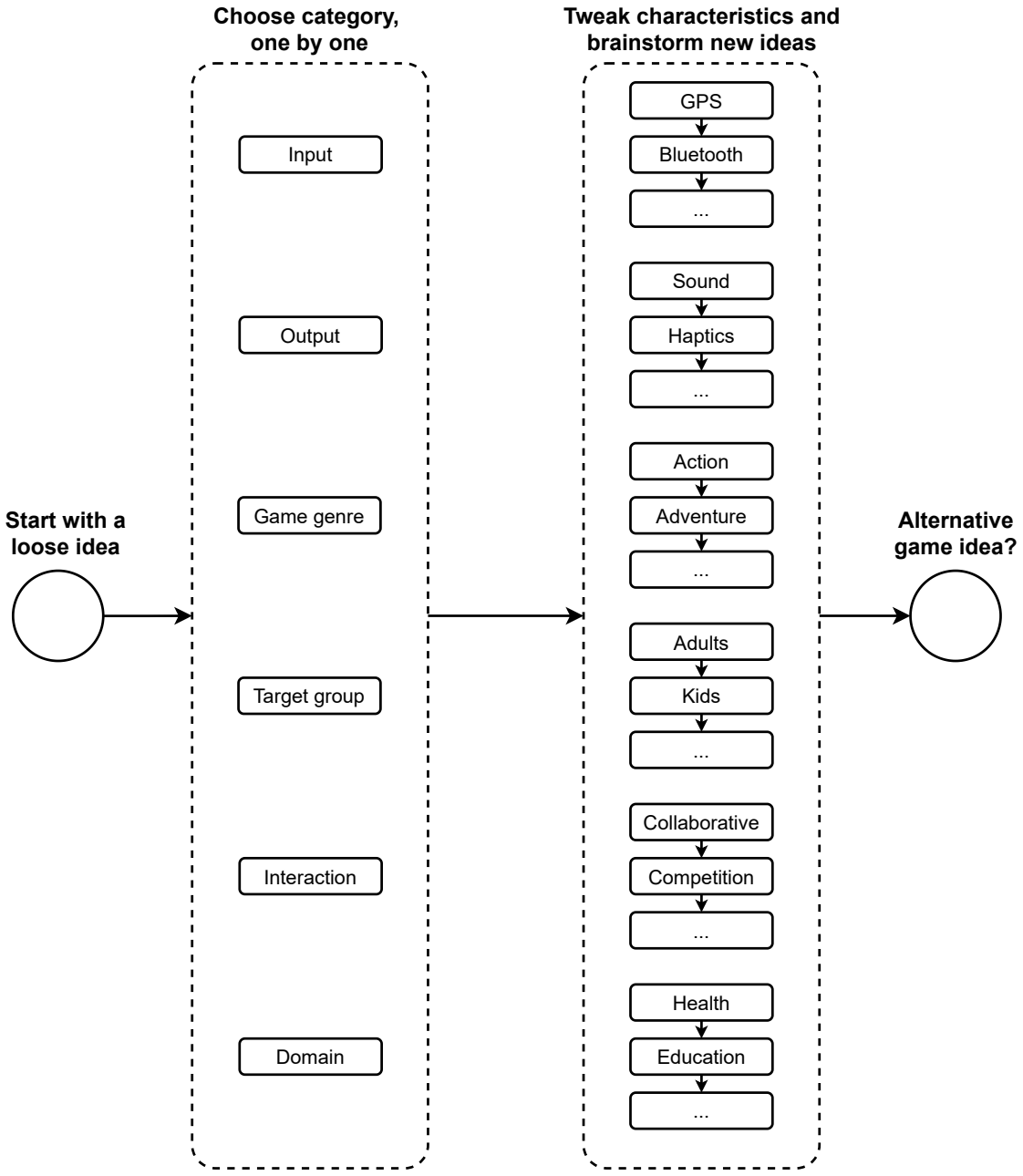


Figure 13.1: Inventing new ideas with our alternative games model.

We started with a loose idea and then tweaked the characteristics to invent new concepts that we otherwise would not have considered. This process is a generalized approach that can generate alternative games from ideas that are initially regular games or as an iterative process to add more alternative features.

Later, we studied literature explaining how to create an enjoyable game, reward systems, and player types in chapters 6, 7, and 8. The knowledge obtained from this work gave us insight into game design. Finally, Chapter 10 gave us an overview of existing alternative games. This research showed us examples of the current possibilities and stimulated our fantasy to invent even more ideas.

After outlining and evaluating the six ideas, the model defined in our prestudy will be used to compare them. This comparison will, similar to Chapter 10, help us describe the differences between the games and why they characterize as alternative.

Our primary motivation for choosing this specific task was the opportunity to create an application with a socially beneficial purpose. The concepts should preferably introduce something valuable to society while still exploring the genre of alternative games. Also, the goal was to make the application available to as many users as possible. Based on these factors, we decided early that the game had to be based on the mobile platform. Consequently, the concepts described later in this chapter are invented with this in mind. Over three billion people own a smartphone today (O'Dea, 2020). By targeting the smartphone market and these two operating systems, we can reach many potential users. Furthermore, smartphones have a variety of sensors that can be used in alternative games.

Another important consideration during the invention process was that the concept needed to be easy to test. The application's testability is an essential consideration when we are going to develop our chosen concept. We want to find out how people are using the application and whether or not they are enjoying it.

13.1 Hover

The first alternative game idea we invented is named *Hover*. The concept is inspired by the existing application *Hold*, described in Chapter 10. In short, players get points in Hold for not using their phones. Hover uses the same principle, but the points are

awarded based on their location. Meaning the players get points when they are located at certain spots in the real world. The points can result in awards and achievements. As discussed in Chapter 7, rewards create positive experiences for players and improve the game's enjoyability.

The spots are based on areas that could improve a person's well-being, such as training centers, schools, libraries, museums, and art galleries. The locations are classified according to their purpose, e.g., *exercise*, *education*, and *culture*. For example, training centers will be categorized as health, schools as knowledge, and museums as culture. The rewards and points will be summarized both for the individual categories and to a total score. In this way, the players can focus on doing their best in a specific category or getting the best overall score.

A crucial part of the game concept is to get people to use the application. The social interaction in the game is an important aspect to achieve that. One way of doing this is by introducing more points if a player is using the application while being together with friends. For example, if two or more players study together, they get double the amount of points. This aspect is particularly relevant in today's situation with the Covid-19 pandemic in the world. Papers are suggesting that more people are struggling with loneliness (Groarke et al., 2020). The application can contribute to improving mental health by motivating people to engage socially.

The game's social aspect is also essential to increase player enjoyment in the game, as described in the GameFlow article in Chapter 6. One way of encouraging competition is to introduce challenges where the players can compete against each other. An example of a challenge could be "first person to get 1000 points". Another way of encouraging competition is a high score list, enabling players to compare themselves against others.

The game concept can be more enjoyable for the players by including elements of fantasy, as discussed by Malone (see Chapter 6). A suggestion here is to include a virtual character that evolves depending on the number of points the player has earned during a period, e.g., the last 30 days, for the different categories. An example of how the virtual character could evolve when improving the health category is illustrated in Figure 13.2.

Figure 13.2: Example of how the virtual character could evolve as a result of training.

To register when the players are positioned at locations where they should earn points, geofencing will be used. Geofencing is based on defining areas on the map (illustrated in Figure 13.3) where one can check whether or not the player is inside (Rouse, 2016). If the GPS location corresponds to a spot within the area, the player will be awarded points.

Figure 13.3: A geofence surrounding Sit Gløshaugen training center in Trondheim.

Evaluation

Hover is equivalent to Hold, categorized as an alternative game primarily based on two reasons: Exploring alternative games variants by using gamification and using location data (GPS) as input in the gameplay.

The idea tries to increase people's well-being by motivating people to improve health, mental capabilities, socialize, and more. If the game concept is successful, it is valuable for both society and the individual.

Another important aspect when evaluating the concept is testability. Hover is easy to test because it has an extensive target group. Everyone owning a smartphone is a potential test subject. In addition to this, we think it will be easy to get people who agree to test this application because minimal extra time (despite answering a questionnaire) is required.

13.2 Guess Where

Guess Where is a challenge game, where players get to test how well they know their city. To earn points, players have to solve the challenges presented. A challenge consists of a street view picture where the player needs to figure out at which location it is captured; see Figure 13.4). To complete the challenge, players must navigate to the correct site where their position is verified using GPS. The game is intended to reward completed challenges with fun facts about the area and in-game points.

The concept can allow social interaction, both in the game and the real world. Players are encouraged to team up to boost their points. Accomplishments can also be shared with friends in a social feed inside the application. Social interaction through likes and comments can be motivating for further use. The concept is excellent for people that already have some knowledge of the city. However, by enabling hints, players can more easily complete the challenges.

Figure 13.4: A street view photo used as a hint in Guess Where.

Evaluation

The concept fits into the alternative game model for several reasons, one being that the game is pervasive because it extends to the real world. As input, the game utilizes GPS for verifying a player's location. In addition to this, the game fits into the domain of both entertainment and education. The game can also be categorized as gamification in the game variant category.

The game concept is socially beneficial because it encourages social activities in the form of physical movement and collaboration while players can get to know the area better. One example where the game could be helpful is for educational purposes. Teenagers could team up and use this game for orientation in their gym classes. This approach could lead to improving cooperation skills while getting to know the city better. In terms of testability, this concept could easily, as in the example, be tested in a school class.

13.3 Puzzle With Friends

Puzzle With Friends is a game concept where the goal is to complete a puzzle together with your friends, as illustrated in Figure 13.5. Each player is responsible for one piece they can move using their real-world position and rotating their mobile phone. All participants can watch the other players' positions and the pattern they are supposed to puzzle in the application. The goal is to complete the puzzle, fit all the pieces in the correct spot, and rotate them correctly before the time is up. The number of pieces depends on how many players are collaborating on the same puzzle. Eight friends mean eight pieces, and so on. Thus the game will become increasingly challenging as the number of players increases. For the game to not become too easy, there should probably be a limitation on the minimum number of players.

Figure 13.5: People collaborating to try to solve a puzzle in Puzzle With Friends.

GPS location will be used to determine the player's position. Because of the limitation in GPS accuracy (Merry & Bettinger, 2019), a large outdoor area is required for the game to work as intended. Parks or football fields are good examples. Also, the more players that are included in the game, the more space is needed. Hence, there probably should exist a maximum number of players per game. The gameplay should also have a suitable mechanism for "snapping" pieces into the correct place when they are almost correctly aligned. This tool will make the game more delightful to play when minor location errors are present.

As there probably will be some delay between the player's movement and the application's view, the gameplay needs to introduce some mechanism to hide this. One way to do this is by introducing some sort of radar view, see Figure 13.6, to illustrate that the other players' position will only update at regular time intervals.

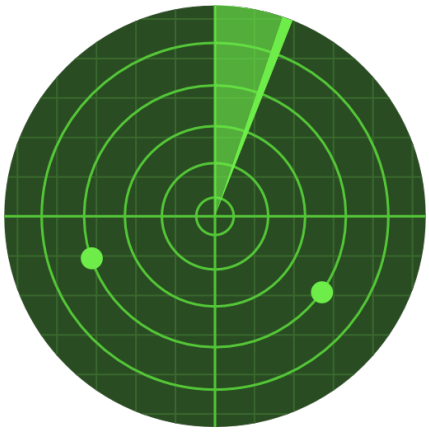


Figure 13.6: A typical radar view. The "dots" will update every time the beam passes by.

Evaluation

Puzzle With Friends is a typical alternative game because it uses alternative inputs to create a unique game concept. By utilizing the player's position and heading in the real world to control the gameplay, the game is differentiated from other well-known puzzle games.

Developing the game should be manageable in the limited time we have during our master's project. However, inaccurate location data and real-time requirements may cause issues if not handled appropriately. Testing the application should be easy as long as we find some volunteers who agree to devote some hours of their day to test the application.

13.4 Challenge Accepted

Challenge Accepted is a social game that mixes social interaction with playful actions in the real world. The idea is based on a verbal game, often played among youths, called "What are the odds?". The game is usually played between two players where one player (A) gives the dare, and another player (B) receives it. The challenges often occur in the

moment, for instance, "What are the odds of you asking that stranger to try his crutches?" To extend the concept a bit, players can publish challenges on a location that pops up when their friends walk by.

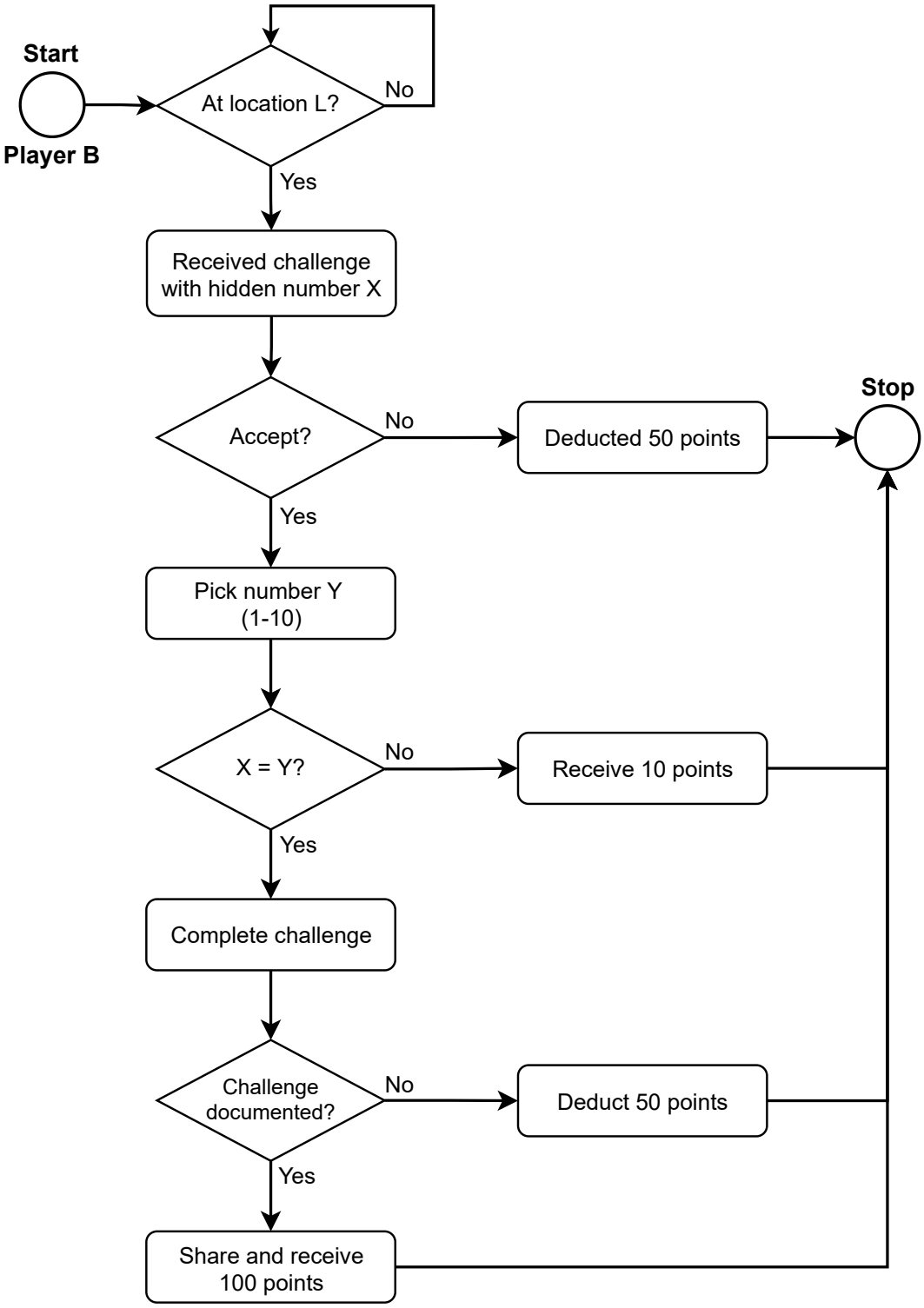


Figure 13.7: Flow chart illustrating a simplified game flow in Challenge Accepted.

Figure 13.7 shows a simplified game flow. The diagram is based on the following scenario:

- Player A adds a challenge to a location L, along with a number X between 1 and 10.
- A friend of player A, player B, walks by the location and receives a push notification.
- Player B has to either decline or accept the challenge. If the player chooses to decline, 50 points are lost. If the challenge is accepted, player B has to guess a number between 1 and 10.
- If the numbers are different, the player will not need to complete the challenge and receive 10 points for being courageous.
- However, if the numbers are equal, player B needs to do it. The challenge is considered completed when it is documented and shared in the application.

The goal of the game is to create spontaneous and surprising enjoyment between friends. The range of odds is set 1-10 because the risk of having to complete a challenge should not be too high nor too low. Also, challenges should be moderated to prevent them from being harmful. The game should include social interaction through likes and comments on in-game posts. Players should also see their friends' game statistics and medals. Both these design elements are likely to have a positive effect on the competitiveness among friends.

Evaluation

The idea classifies as alternative in the categories of input, game variant, and interaction. Besides location tracking, the concept also utilizes the camera for documenting challenges. Though the game is based on a verbal game, the game is categorized as gamification because players can be motivated through likes and comments on recent activities.

The game is a pervasive game that utilizes location-tracking to create a bond between the virtual and the real world. The use of constant tracking of location contributes to the suspense of not knowing when, where, and what the next challenge will be. This suspense can also increase the players' curiosity, and therefore their willingness to participate.

The concept does not necessarily benefit society directly. However, it is a social game that has value for a smaller group of people. For testing purposes, it is advantageous to test the game on people with a pre-existing relationship, to enhance the players' motivation to complete the challenges.

13.5 Secret Posts

Secret Posts is an extension and gamification concept based on the social app Jodel, where players can share anonymous posts in their city. Since the posts are anonymous, people tend to post their secrets, embarrassing stories, and pictures. Our concept involves posting digital notes, drawings, or images in the real world, which only can be seen using Augmented Reality (AR) technology. All players can share posts attached to the location where they are posted. An example can be a sticky-note with a secret message lying on a table in a cafeteria. To find posts, players use a map to locate nearby ones, as seen in Figure 13.8. Although the posts' location is visible on the map, the content is only available through the mobile camera. As illustrated in Figure 13.9, players use their mobile camera to read new posts in their current area. Since the posts only are visible to the players, a secret society is created where "only those who know, know."

Figure 13.8: The map-view in Secret Notes showing nearby posts.

Figure 13.9: AR view of the content of a note found in Secret Notes.

Evaluation

The concept is alternative in its usage of input, output, game genre, and concept. The game uses the phone's camera as input, which it uses to project a note, image, or drawing. This usage of AR is not too common as of 2021; hence, the input method is alternative. The concept is also alternative because it uses location to attach anonymous posts. Tangible objects like notes, posters, and graffiti are not unfamiliar in the real world. However, the fact that the posts are only visible for those who search for them makes the game alternative.

The concept is suited for AR glasses and as a mobile application. The benefit of using AR glasses is that the users can walk around and discover notes without actively looking. However, in terms of testability, the AR glasses approach has a clear disadvantage compared to a mobile application in terms of equipment available and the project's time scope. As a mobile application, the concept should be straightforward to develop and test.

13.6 Free Ticket to Ride

The purpose of *Free Ticket to Ride* is to incentivize having a valid ticket when using public transport. The idea is to create an application that gamifies the ticket system used on public transport. It could be adopted as an alternative or addition to normal ticket controls used today.

The application will need to integrate with the existing application to validate tickets. People who have paid for a valid ticket will be given points in the game when traveling. After earning a set amount of points, the user can "purchase" free items or get discounts. One suggestion is to use free or discounted single tickets as rewards. For example, twenty rides with a valid ticket could qualify for one free ticket. A prerequisite for this is, of course, a partnership with a public transport company, such as AtB in Trondheim. Even though the concept is invented and conceptualized based on the public transport system in Trondheim, the same ideas could be adopted in other cities with similar ticket systems as well.

The application can communicate with a Bluetooth access point to check if a user is located in a public transport vehicle and award points accordingly (illustrated in Figure

13.10). A secondary registration option using the camera and scanning QR codes could also be an alternative to situations where the bus does not have a Bluetooth access point, or the user does not consent to Bluetooth usage.

Figure 13.10: Illustration of people using Free Ticket to Ride on public transport.

Evaluation

Free ticket to ride is an alternative game concept because it uses Bluetooth as input. Additionally, the idea explores the gamification variant. By the definition of an alternative game (see Chapter 9), exploring these two categories of characteristics define this as alternative.

The game introduces a fun way of validating the user's ticket when using public transport, which could lead to fewer fare evasions. Getting more people to pay for their ride will result in more income for the public transport company, which can improve the service.

One of the main problems with this idea is the need for tight integration with the current public transport company. The concept requires integration with the ticket system to check the validity of the ticket.

13.7 Comparison of Game Concepts

Similarly, as in Chapter 11, when existing alternative game concepts were presented, our new ideas are compared using the alternative games model described in Chapter 6. All of the game concepts are categorized using the model of alternative games (see Table 13.1).

		Ideas					
		Hover	Guess Where	Puzzle with friends	Challenge Accepted	Secret Posts	Free Ticket to Ride
Input	GPS	x	x	x	x	x	
	Bluetooth	x					x
	Camera		x		x	x	x
	Gyroscope					x	
	Accelerometer					x	
	Magnetometer		x	x		x	
Output	AR-screen					x	
	SMS						x
Game variant	Adventure		x			x	
	Puzzle			x			
	Role-playing			x			
	Strategy				x		
	Gamification	x	x		x		x
Target group	All	x	x	x			x
	Students				x	x	
	Youths				x	x	
Interaction	Collaborative		x	x			
	Competition	x					
	Real	x	x	x	x	x	x
	Pervasive		x	x	x	x	
	PvP				x		
Domain	Health	x	x				
	Entertainment		x	x	x	x	
	Education	x	x				
	Government						x
	Industry						x

Table 13.1: Comparison of new game concepts.

In contrast to the comparison of existing alternative games, our new concepts have a lot in common and often tick the same boxes in the model. The existing alternative games were picked partly based on their difference, so this is expected. As mentioned at the beginning of this chapter, we limited ourselves to concepts based on the mobile platform. Thus all the games are restricted to input and output provided by a smartphone. For input, a selection of the available sensors in a mobile phone has been used. GPS for location tracking is the most common, with four out of six concepts using it. Output

possibilities on a mobile phone are more limited. There are not a lot of possible outputs that we would categorize as alternative. Two exceptions are found in Secret Posts and Free Ticket to Ride. These games respectively use an AR screen for displaying the notes and SMS to verify users and notify them of important events.

One of the most notable similarities in the comparison is the use of gamification as the game variant. This similarity is related to our goal in the project; trying to do something socially beneficial. We found it easier to invent gamification ideas with a socially beneficial purpose than other game variants.

As we also described in our motivation (Chapter 1), an influential factor when inventing ideas was trying to reach as many users as possible. Therefore, the applications are usually targeted at all user types. However, two of the concepts have youths and students as the primary target group.

The last two categories address interaction and domain. In the interaction category, we see that all games include aspects of the real-world. Four of the games are also pervasive, meaning that they mix reality and virtuality. The most common domain in the applications is entertainment, with four of six applications characterized as it. Hover and Free Ticket to Ride are the only ones that are not categorized as entertainment. They fall into the health/education and government/industry domain, respectively.

13.8 Summary

In this chapter, our ideas for new alternative game concepts were described. A brief description of all of the concepts and an evaluation of them were conducted. We looked at why the concepts can be categorized as alternative games and how they fit with our goal and motivation in the project. Additionally, we looked at the testability of the ideas. Last, we compared the concepts and looked at differences using the alternative games model defined earlier. The next chapter will use these observations and evaluations when we will choose the concept we are going to develop in our master's thesis.

Part III

Our Game Concept: Hover

In this part, further details on Hover as a game concept will be presented. First, the selection process and our rationale for choosing Hover will be explained. Then, we describe game details with screenshots from the actual application and elaborate on the game design elements used. Last, game requirements and more technical aspects are described, including the development process and software architecture.

Chapter 14

Concept Selection Process

The previous chapters have discussed game design theory and existing alternative games, which resulted in the six game concepts *Hover*, *Guess Where*, *Puzzle With Friends*, *Challenge Accepted*, *Secret Posts*, and *Free Ticket to Ride*. This chapter will deliberate on the process of selecting **Hover** as the concept to develop. The selection process steps, illustrated in Figure 14.1, will be explained.

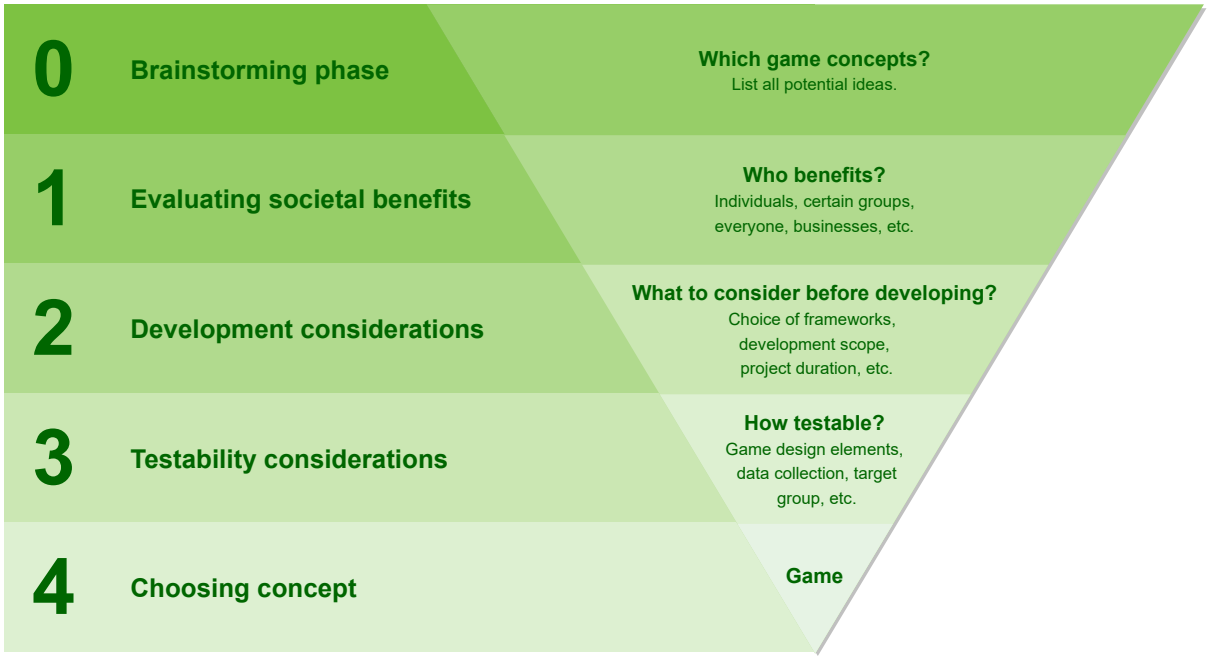


Figure 14.1: A graphic representation of our concept selection process.

14.1 Evaluating Societal Benefits

The first criteria for selecting a concept is to comply with the project's research goal, namely, developing a concept that has a socially beneficial purpose (as described in Chapter 3). Even though the concepts introduced in Chapter 13 are developed with social benefits in mind, some have more potential than others. We consider a concept as socially beneficial if it, to some degree, can help an individual, a group, or society as a whole.

Secret Posts seem to have personal benefits that the player gains from moving around and being entertained by the secret posts. Likewise, *Free Ticket to Ride* includes individual

benefits; however, it also benefits the business. *Challenge Accepted* and *Guess Where* are concepts with both individual and group benefits; however, there seem to be no benefits for society. Likewise, *Puzzle With Friends* focuses on group benefits, such as improved group dynamics, and collaborative skills, rather than individual benefits.

Hover seems to be the concept that has the most substantial societal benefits. The concept motivates players to do something in the real world as individuals or as groups. It is also reasonable to argue that the concept can benefit society because it influences the local businesses or community. For instance, a player who goes to a museum benefits from gained knowledge. Moreover, the museum also benefits directly or indirectly from increased income or higher attendance.

14.2 Development Considerations

A part of the research goal is that the concept needs to be developable and testable to prove the social benefits. Additionally, due to the thesis's time constraint, a related concern is the scope of development and testing. The introduction in Chapter 13 discussed the background for our concepts and shed light on the fact that mobile applications are highly available to users. For this reason, all the game concepts are created for the mobile platform.

The development concerns include both technical and complexity challenges. Technical concerns can be the choice of frameworks in regards to supporting various input and output sources. Chapter 18 addresses these technical concerns for Hover, and presents the chosen frameworks. Complexity concerns include project duration in regards to the development scope for creating a testable prototype. Some of these concerns are disclosed under the evaluation sections in Chapter 13. Secret Posts, for instance, may have challenges with location accuracy in multistory buildings. Puzzle With Friends may prove difficult to develop within the project duration due to the many input sensors and real-time requirements. Free Ticket to Ride may also prove challenging to develop because the concept itself is based on collaborating with an existing bus company. Initiating such collaboration can become challenging if they do not want to expose their APIs. Hover will use geofencing and location tracking, which are mature technologies in most frameworks. Additionally, the concept's scope can be scaled up if needed; however, at least a minimum

viable product (MVP) seems to be within the project scope.

14.3 Testability Considerations

Although the game concepts will be equally available on mobile platforms for test subjects, other testability concerns must be recognized. Testability considerations may pose questions and concerns such as:

- *What* should be tested? (user experience/user interface, player experience, behavior, enjoyment, reward mechanisms, software, etc.)
- *What* is the appropriate duration of testing? (minutes, hours, days, weeks, etc.)
- *How* should the testing be conducted?
- *How* will data be accumulated? (interviews, questionnaires, usage data, etc.)
- *How* can data and feedback be analyzed? (quantitatively or qualitatively)
- *How* can we acquire test subjects within the target group?
- *How* do we ensure demographic variation in the test subjects?
- *Who* is the target group?

In regards to our concept ideas, potential testing could be conducted very differently. Secret Posts, for instance, should require a multitude of users that can post and consume content. The testing should study enjoyment and network effects through techniques like interviews and questionnaires. Challenge Accepted and Guess Where are games that should be tested in a longer period, such as weeks or even a month. Data can be accumulated from questionnaires and observations and should measure effects on enjoyment, motivation, and player experience, preferably on multiple groups of friends. Free Ticket to Ride should also be tested over a greater period to see the long-term effect. A questionnaire would presumably collect quantitative data and feedback that may be valuable for the business from the business's perspective. Puzzle With Friends should be tested through observations of multiple sessions with groups of a specific size. To measure player experience, one can use techniques like questionnaires and interviews. Observing the collaborating game-play could, for instance, give insight into player enjoyment through studying facial expressions and body language. Hover should be tested over weeks,

preferably on players with demographic differences. The test subjects should preferably have some preexisting relationships to be able to measure the social reward mechanisms, such as likes and comments. Data can be accumulated through questionnaires and interviews.

14.4 Choosing a Concept

The evaluation of the concepts in Chapter 13 reveals that several of them are promising. The evaluation of Hover suggests that this idea seems especially interesting, and it appeals to us for several reasons. Due to the ongoing pandemic, the concept seems like a fun game to play as it encourages activities that can improve the player's well-being. Additionally, the concept has the potential to grow in functionality and features. If the game proves successful, it could be interesting to explore and develop the concept further. Consequently, Hover is our chosen concept.

14.5 Summary

In this chapter, we have deliberated on selecting what game concept to develop and test. The selection process included studying the concepts' social benefits and addressing concerns for development and testing. Out of the six, the evaluation suggests that Hover fulfills the research goal of being a socially beneficial alternative game that can be developed and tested. Lastly, we addressed personal motivations for the choice. The next chapters will describe Hover in more detail and present how game design theory has been used to develop an enjoyable game.

Chapter 15

Game Description

In this chapter, a descriptive overview and screenshots from the mobile application will be presented. Figure 15.1 shows the bottom navigation bar in Hover, displaying the five main screens: *Feed*, *Challenge*, *Hover*, *Leaderboard*, and *Profile*. Additionally, there are signup and login screens that unauthenticated users face when they open the application.

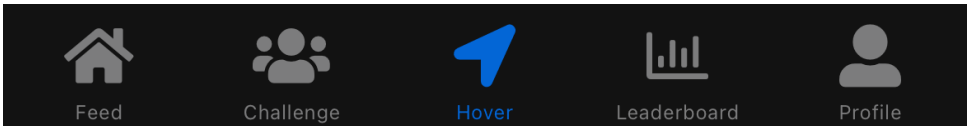


Figure 15.1: Bottom navigation bar

The first time a user opens the application, they are presented with a login screen as seen in Figure 15.2. If the person does not have an account, they can navigate to the signup screen and create a new one. The user needs to select their chosen avatar, preferred username, and password to sign up. When they are satisfied with their selection, a new user is created by pressing the "Sign up" button, shown in Figure 15.3.

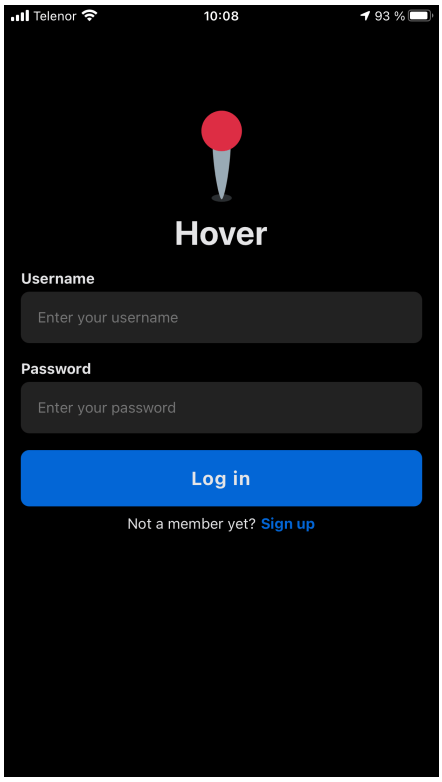


Figure 15.2: Login screen.

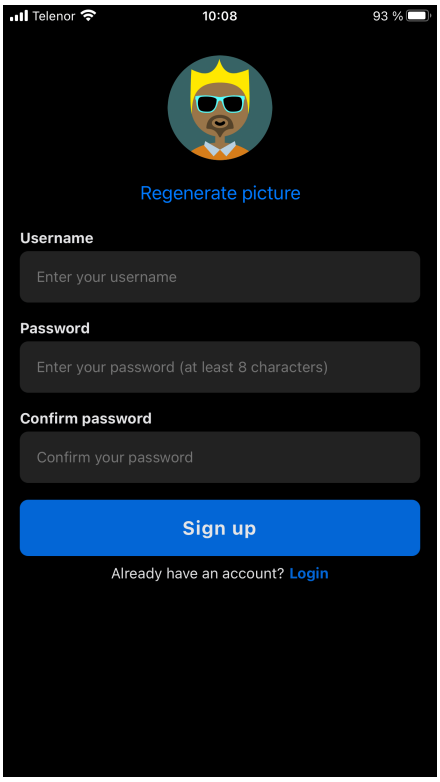


Figure 15.3: Sign up screen.

15.1 Feed Screen

The feed is the first of five main screens. It is used to showcase posts of new activities, earned achievements, and completed challenges for all users in the application. A screenshot of the feed is shown in Figure 15.4. At the top, Conrad's newly published activity, where he has been at "Studentersamfundet" in Trondheim together with Tomine, is shown. Below is Bjørn's new "1000 points in total" bronze achievement. The bottom post announces Tarzan as the winner of a challenge against Kimmy, Herman, and Morten.

The user can also show their tribute to elements in the feed by pressing the "clap emoji." In the figure, we can see that the user has reacted to Tarzan's challenge win.

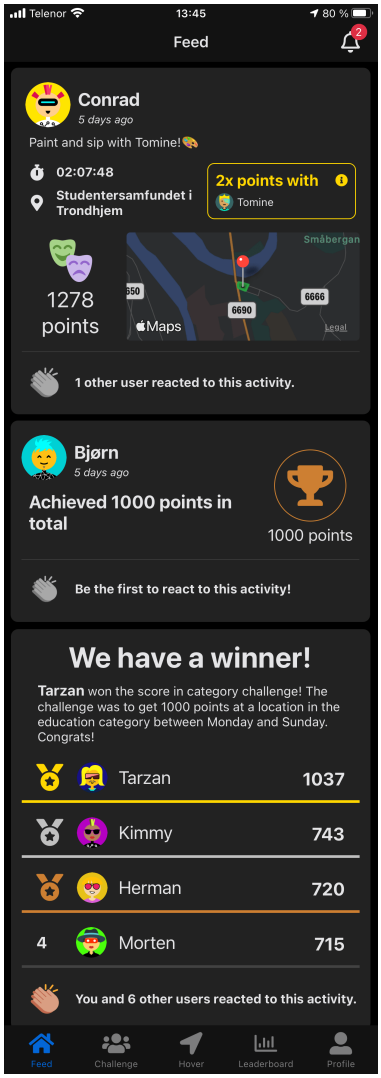


Figure 15.4: Feed screen.

Notifications List

A closer look at the top right corner of the feed screenshot (Figure 15.4) reveals a notification icon with a badge illustrating two new notifications. When pressing this button, the user will be directed to a new page, giving an overview of all notifications (see Figure 15.5). The items are sorted by the time and date and categorized whether or not they are read. New ones are listed at the top, while earlier ones are displayed below. Pressing the various items redirects the user to a specific part of the application relevant to the type of notification.

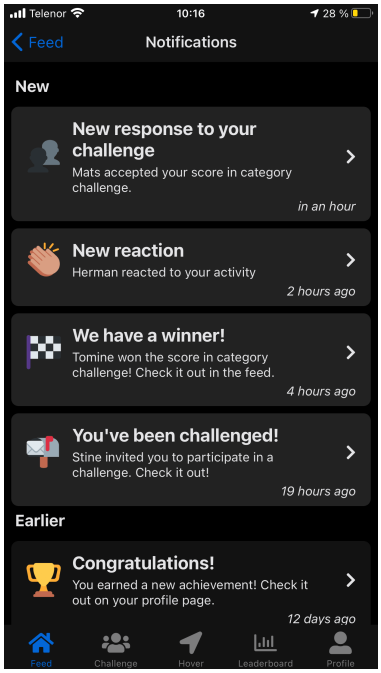


Figure 15.5: Notifications screen.

15.2 Challenge Screen

The challenge screen allows players to see their challenge progress, pending invites, and create new challenges. A challenge is a user-defined competition between two or more players where the goal is to meet a set of requirements before a specified date. An example is the *score in category* challenge, where the goal is to get a specified amount of points in a specific category before a chosen date, determined by the creator.

Figure 15.6 shows an example of how the challenge screen may look. In this screen, players can see the challenges they are invited to and those they are currently participating in. Both the pending invites and the ongoing challenges include a description of the challenge rules.

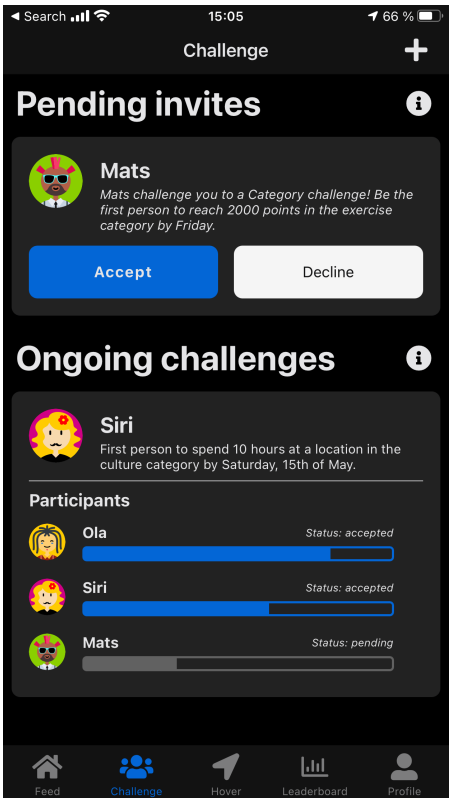
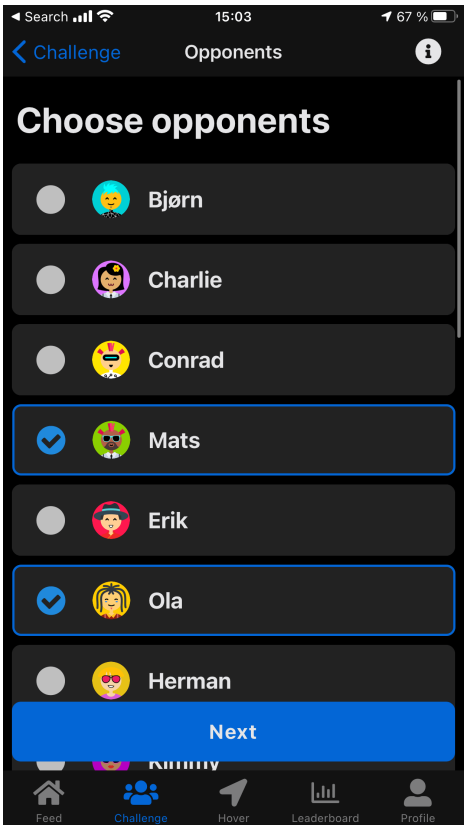


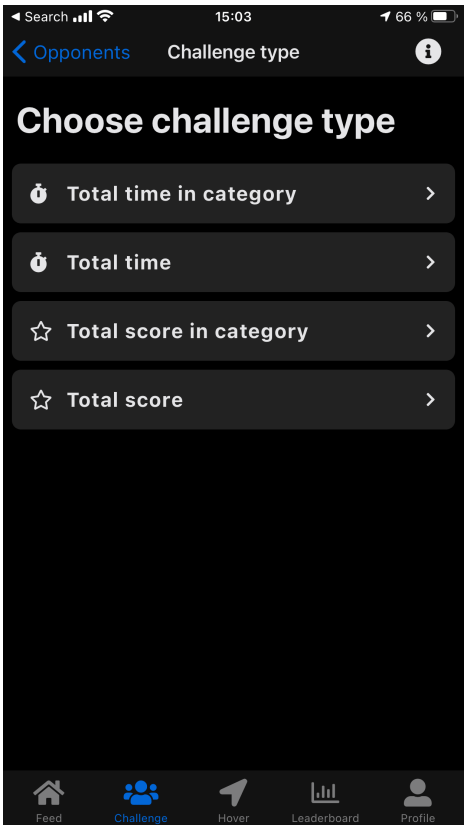
Figure 15.6: Challenge screen.

Creating a New Challenge

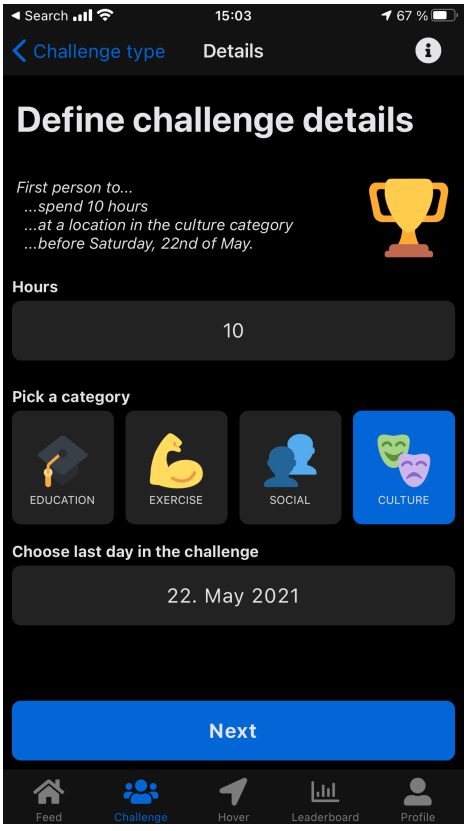
As mentioned above, players can create new challenges. Figure 15.7 illustrates this process. The first step is to choose one or more opponents, as seen in Figure 15.7a. Next, the type of challenge is selected (Figure 15.7b). Then the challenge rules are set, before an overview is presented and the process is completed (figures 15.7c and 15.7d). When pressing the "Create challenge" button, the challenged users will get a new notification to let them know they have been invited.



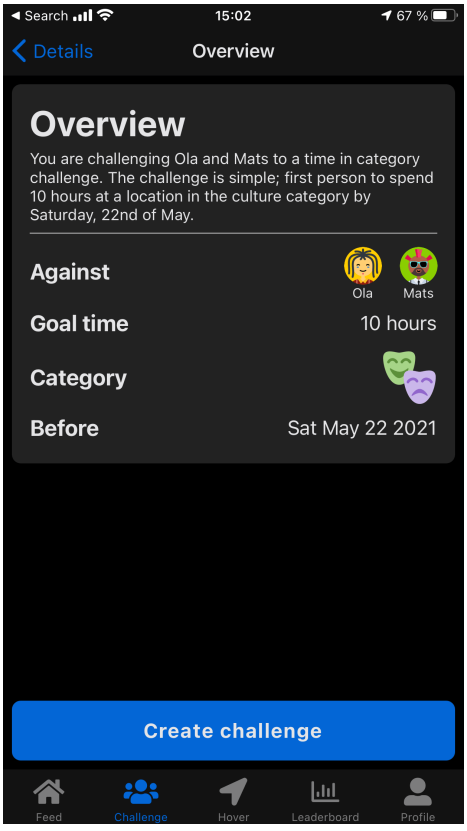
(a) Choose opponents



(b) Choose challenge type



(c) Define challenge rules

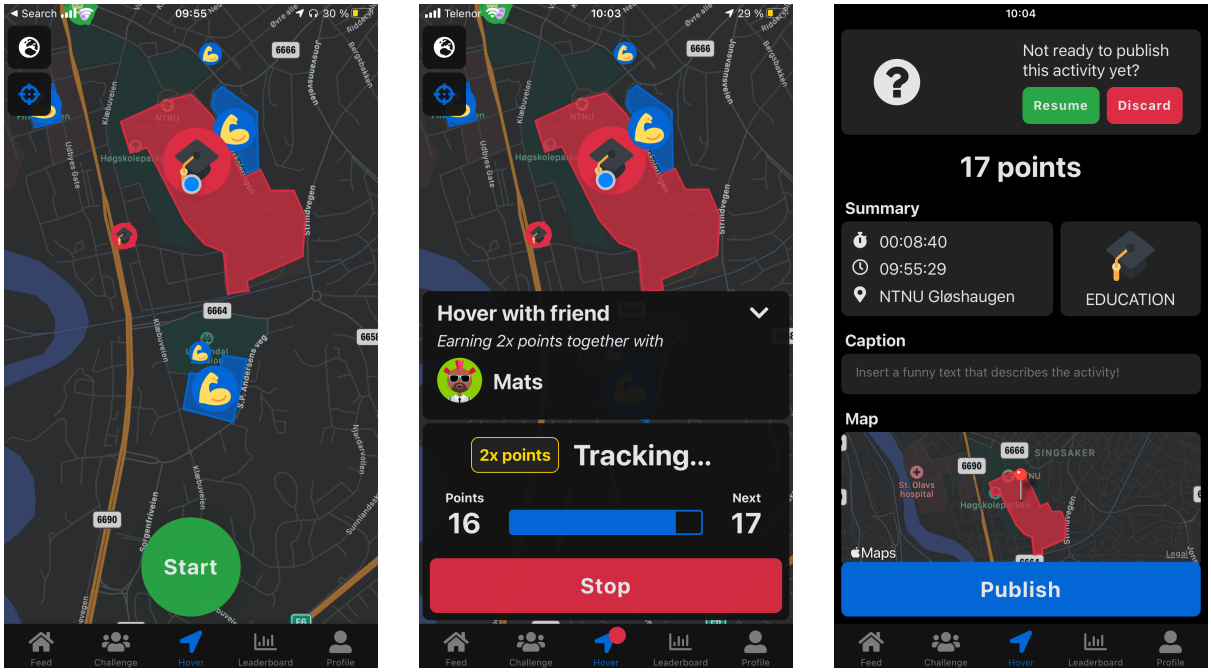


(d) Challenge overview

Figure 15.7: The process of creating a new challenge.

15.3 Hover Screen

The third main screen in the application incorporates Hover's central game functionality. Here, the user can see geofence zones (also known as Hover zones) and track activities. We use the word *hover* or *hovering* as a name for the tracking functionality to create a more authentic game experience. Figure 15.8 presents the three potential Hover screens. The first one shows the initial screen (see Figure 15.8a) where the user can pan and zoom to explore potential Hover zones. When inside a valid zone (as seen in the figure), the start button will be green, and the user can start hovering. Figure 15.8b shows how the Hover screen is presented during that session. In this example, the user is also hovering together with a friend, a game feature that enables the possibility to earn double points. To start a "Hover with friend" session, the player exchanges a generated code with another player when they are inside the same zone. The codes are composed of a color and animal name (e.g., "silver donkey"), making them easy to understand and share. Both players will then earn double points during this session.



(a) Explore page. **(b)** Hovering in progress. **(c)** Publishing Hover session.

Figure 15.8: Hover screen.

When the user is ready to publish the activity, the stop button is pressed, and a new publish page is presented (see Figure 15.8c). The page includes a summary of the activity, displaying earned points and other information. The user can also add a caption to customize their post, further describing what they did. Pressing the publish button processes the activity and posts it to the feed.

15.4 Leaderboard Screen

The leaderboard introduces the ability for the users to compare themselves against others. Figure 15.9 shows an example where the top 10 players are listed. The leaderboard can be filtered by both time and category, depending on the user's interest. Streaks, illustrating the number of days in a row a user has published an activity, are also displayed. Additionally, the rows in the list can be pressed to navigate to that player's profile.

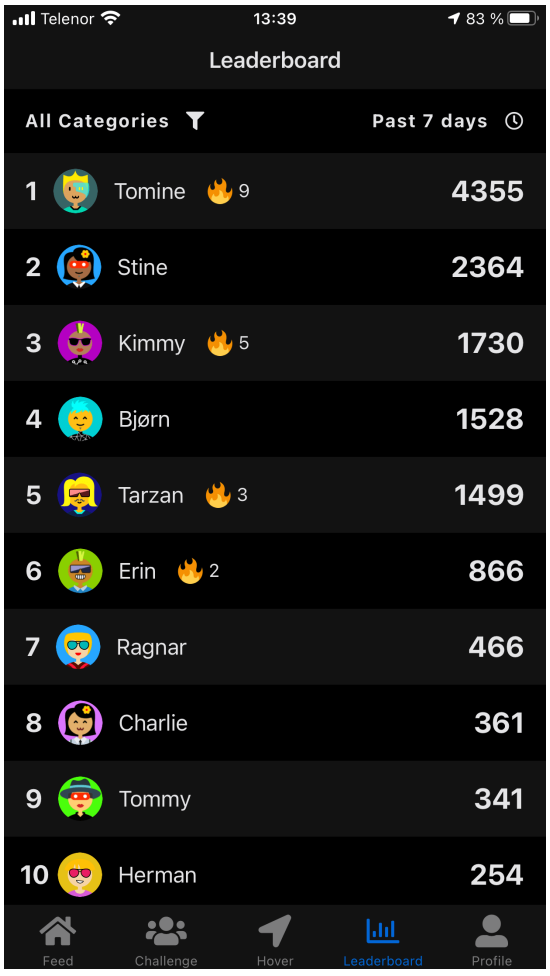


Figure 15.9: Leaderboard screen.

15.5 Profile Screen

Figure 15.10 shows a profile screen example, displaying an overview of user-related data. The profile link in the bottom bar directs to the logged-in user's profile page. However, as described earlier, other user's profiles can be navigated to in particular parts of the application, such as the leaderboard.

At the top of the screen, the name, avatar, and a short biography are found. The user can customize this information in the settings. Underneath the top card, the profile is divided into three main sections: *Achievements*, *Score*, and *Activities*.

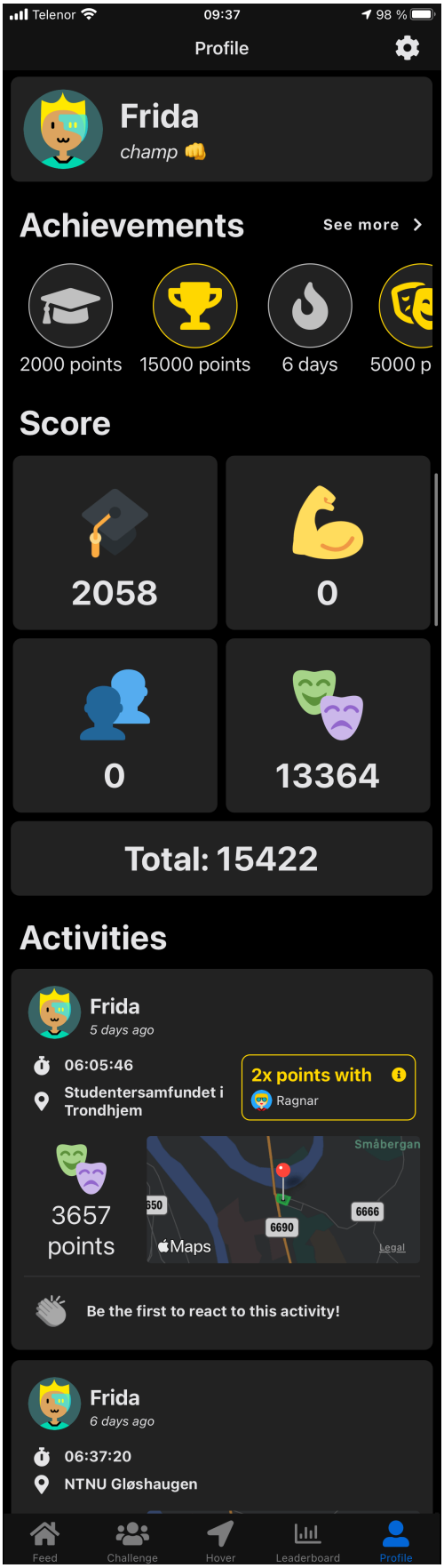


Figure 15.10: Profile screen.

The achievements section displays all earned achievements, with the newest one on the left. The horizontal list is scrollable to view all achievements the user has obtained. Pressing the "see more" button reveals a new page (see Figure 15.11) with a more extensive overview. Here, the user can see all achievements, including the progress towards the one they have not received yet.

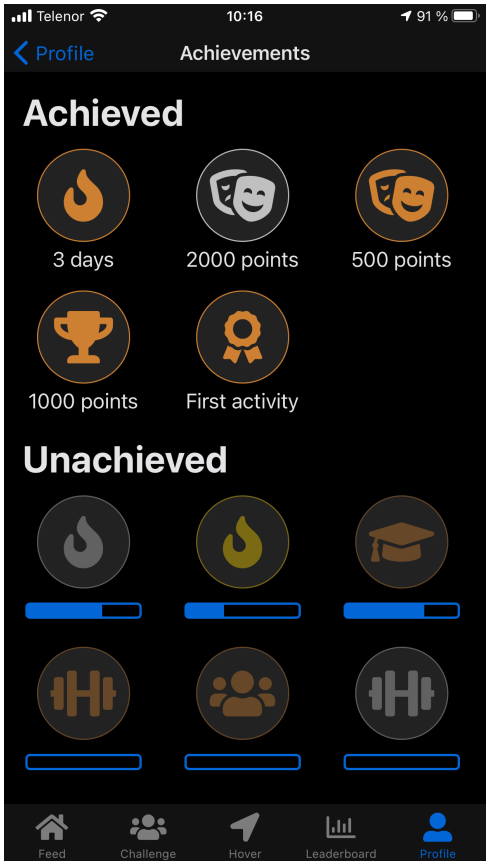


Figure 15.11: Achievements page.

Below the achievements (in Figure 15.10), the user's score is displayed. The overview consists of points in each category, together with a total, summarizing the points in all categories. Last, a list of all the current user's previous activities is displayed. This section is a convenient tool to get an overview of one person's activities instead of scrolling through all activities, achievements, and completed challenges in the feed.

Settings Menu

In the top right corner of Figure 15.10, there is a button for navigating to the settings in the application. As seen in Figure 15.12, the screen includes various less important functions such as edit profile (name, avatar, and biography), suggest a new location, give feedback or read legal information.

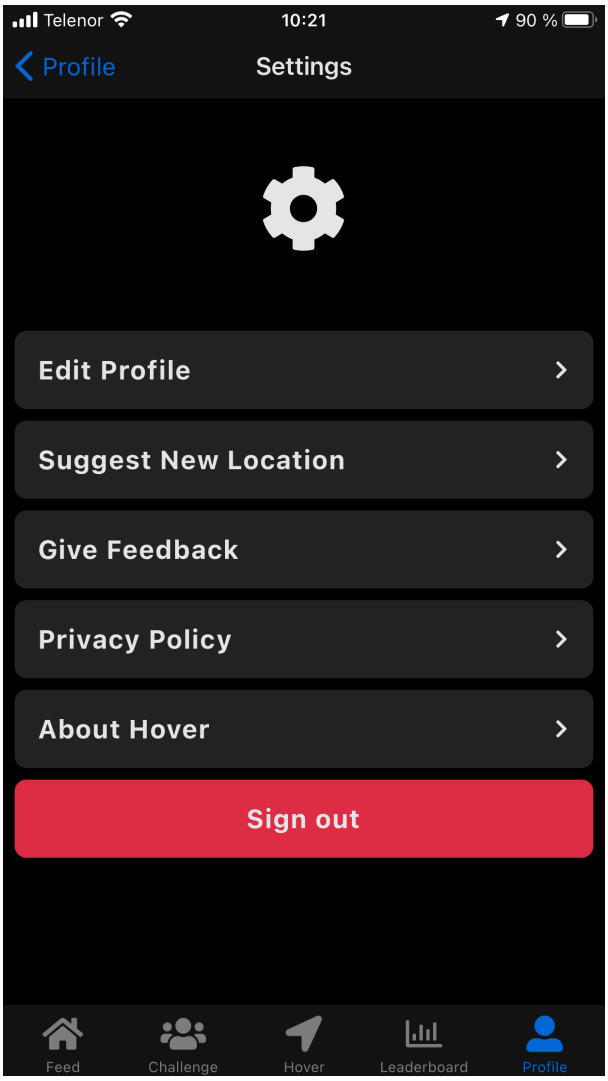


Figure 15.12: Settings menu.

15.6 Summary

This chapter was meant to give a solid overview of the application, describing and presenting screenshots from central parts of it. The next chapter presents how game design theory from Part II has been used as the foundation for designing Hover.

Chapter 16

Game Design

In chapters 6 - 8, we studied game design principles. This chapter presents how the theories from that study are used in Hover by mapping them to concrete elements in the game. Since Hover is a gamified concept, not all theories are directly relevant. Consequently, only applicable content is mentioned.

16.1 Reward Systems in Hover

A suitable reward system is a crucial part of game design, particularly in gamified applications. The theory presented in Chapter 7 lays the foundation for the rewards implemented in Hover. The goal of the rewards is to facilitate motivation, engagement, and enjoyment. This section presents a description of the forms of rewards used in Hover and the design consideration associated with implementing them.

16.1.1 Forms of Rewards

The work of H. Wang and Sun, presented in Chapter 7, suggests that games can include eight types of rewards. In Hover, three of these are implemented.

Score system

There are two types of score systems in Hover, namely the points system and the streak system. We consider these to be different types of scores, where both rely on the player's effort in the game.

The points system lets the players earn points based on the time they have spent tracking. For example, a player training for one hour at a sports center will receive 300 points as a reward. The points are regulated according to the geofence location's category. Education and social locations generate one point per minute, while cultural and exercise locations generate five points per minute. The distribution of points was structured like this because players are likely to spend more time in social and educational locations than in exercise and cultural ones.

In the leaderboard, players can see and compare their ranking in the game. The players can filter on both category and time intervals, as seen in Figure 16.1.

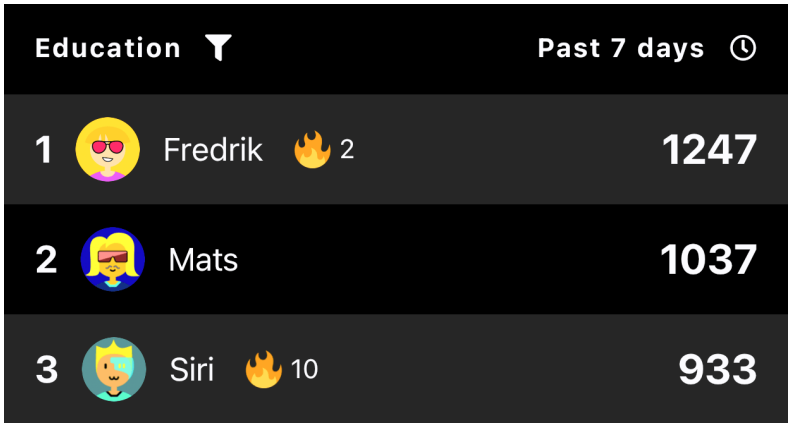


Figure 16.1: Top part of the leaderboard.

The scores are also visible on the players' profiles. Figure 15.10 in Chapter 15, shows how the categories are used as score segments along with the total score. By dividing the categories into different score segments, players can see and compare the scores that matter to them. For instance, players that do not exercise or go to a university will probably not be interested in these scores.

The point system also has a boosting feature that enables cooperation. Players can hover together to get double points during their session. This feature can motivate players to do activities together, engage other players to play, and positively affect the player's enjoyment.

The streak system is the second score system in Hover. It counts the number of days in a row that a player has been hovering and is independent of the player's accumulated points. This particular score system builds on the player's long-term commitment because the streak is lost if a player goes a day without hovering. The goal of the streak system is to encourage users to do something beneficial every day. The streaks are visible on the leaderboard next to the player's name, as seen in Figure 16.1.

Achievement systems

Another important form of reward is achievement systems. In Hover, achievements are found on the players' profile as badges (see Figure 15.10). The player's effort has to meet certain requirements to earn achievements. The types implemented are *score*, *score in category*, and *streak* achievements. In addition to these achievements, players are

rewarded with a *first activity* achievement to welcome their first published activity. The achievements are also weighted based on their difficulty. The color of the achievement implies its difficulty level; gold, silver, and bronze (see Figure 16.2). The difficulty levels are designed to be increasingly hard to get; for instance, *score* achievements are weighted 1000 points for bronze, 5000 for silver, and 15000 for gold.

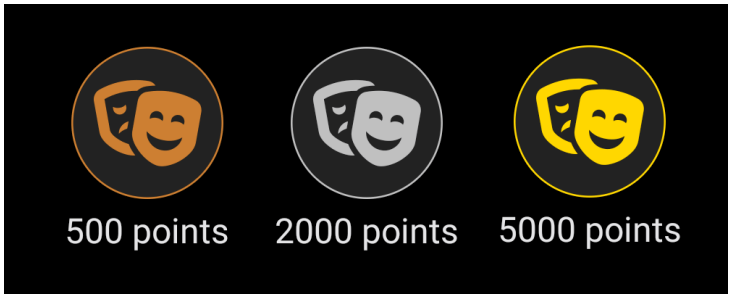


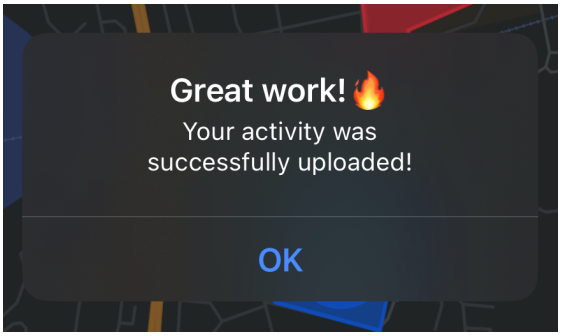
Figure 16.2: Achievement's difficulty level.

In addition to being visible on the profile, new achievements are published to the feed (as seen in Figure 15.4 in Chapter 15). Concrete examples of achievements are "5000 points in the exercise category" and "12-days streak".

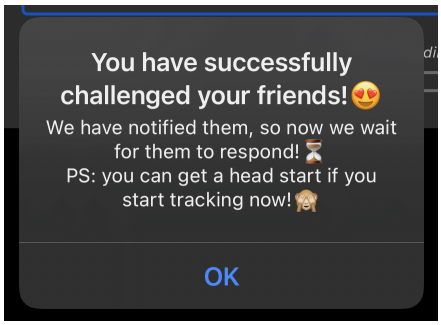
Feedback messages

The last type of reward implemented in Hover is feedback messages. Players are given feedback before, during, and after hovering, both when the app is foregrounded and backgrounded. Animations, emojis, colors, and sounds are used to give feedback.

When players complete an activity or invite others to a challenge, they are prompted with feedback messages that appear as a confirmation message (see figures 16.3a and 16.3b). The messages are decorated with emojis to make them more playful and positive.



(a) Activity feedback.



(b) Challenge feedback.

Figure 16.3: Feedback messages.

16.1.2 Reward Design Considerations

H. Wang and Sun's article on reward systems presents seven design considerations for developing reward systems. Four of these were directly relevant to us during the development of Hover:

Balance

Time spent on activities and the points given needs to be balanced. The players will experience the game as frustrating if not enough points are rewarded and boring if too many points are rewarded, for the activities they complete. As mentioned previously, it is easier to spend eight hours on campus than be at a sports center training for eight hours. Thus the points should be distributed based on the geofence category (culture, education, exercise, and social). A consequence of this is that the points will not change based on the experience but rather on effort. Hence, experienced players might feel that it is easier to earn points than beginners because there is no increase in difficulty.

The balance between player experience and difficulty is incorporated in the achievement system. The three achievement levels, *bronze*, *silver*, and *gold*, are designed to be increasingly more difficult to earn. This balance gives the player an incentive to strive for the next achievement level because it is not too easy nor too hard to achieve.

The three rewards systems in Hover facilitate three ways of advancing, as compared in Table 16.1. The *point system* lets the player climb the leaderboard; however, points are partly volatile and non-volatile. The *streak system* is volatile and requires a committed and consistent player, while the *achievement system* is non-volatile. The balance between volatile and non-volatile rewards ensures that the player always has something to fall back on when returning to the game.

	Volatile reward	Non-volatile reward
Point system	Leaderboard focuses on the *Last 7 days*, and points are out of focus after a week.	The player's all-time points are shown on their profile. Players can filter on pre-defined time intervals to find other score segments on the leaderboard.
Streak system	Streaks are lost if a player goes a day without hovering.	
Achievement system		Once acquired, the player has permanently earned the achievement.

Table 16.1: Categorizing the three types of rewards in Hover as volatile and non-volatile.

There are benefits derived from utilizing multiple reward systems. One is that competitiveness can be captured amongst players in different spectrums of the experience scale. Another one is the ability to create a competitive environment between players of similar experience levels.

Uncertainty and secrecy

Uncertainty and secrecy are necessary to impose curiosity in a game. In Hover, the achievements are somewhat hidden. Through the player profile, players can view their earned achievements and progress toward the next (see Figure 16.4). However, detailed information such as the name and the requirements for the achievements are hidden. Instead, a progress bar gives intrinsic feedback on their progress towards the new achievement. By utilizing secrecy, players have to put in work and use their imagination to reveal the achievement.

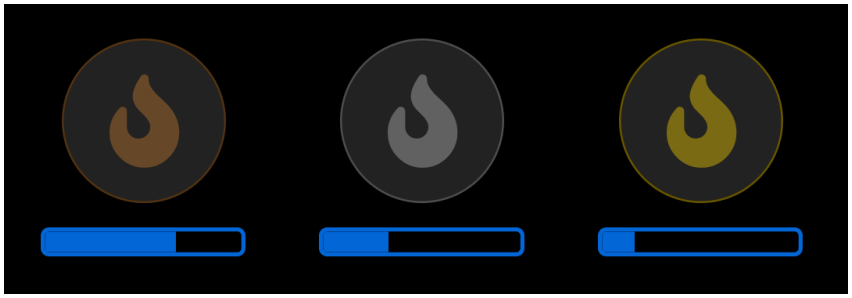


Figure 16.4: Progress towards new achievements.

Social purpose

The social aspect is crucial in Hover because it gives purpose to the points and the achievement. Players' social status is based on the accumulated rewards that are shared with other players. Points, streaks, progress, and achievements are visible in the feed, the leaderboard, and the player profiles. This focus on social status enhances competitiveness and gives players incentive. The playing frequency revealed by the streak and the hard-to-get achievements distinguishes advanced and casual players. These types of rewards also serve as a symbol to increase unity between skilled players.

16.2 Player Types in Hover

The seven dimensions of player types found in Hamari and Tuunanen (2014) primarily focus on online games. However, the categories are still valid for gamification concepts like Hover. Hover's players will presumably have different interests and motivations for engaging in the game. Therefore, they will not be categorized as one player type but rather as a combination of the seven dimensions.

According to Hamari and Tuunanen (2014), the dimension of *achievement* focuses on single-oriented players. Achievers will likely be present in Hover because of the reward systems. The mechanisms used in these systems can motivate, track progress, allow accumulation of badges, and contribute to in-game status. Yee (2007) suggested that achievers are likely to respond to game elements that measure the players' performance, for instance, progress bars, streaks, leaderboards. In Hover, these measurable mechanics are implemented in the *unachieved achievements* screen, the *ongoing challenges* screen and the *leaderboard* (see figures 15.6, 15.9, and 15.11 in Chapter 15).

The *sociability* dimension focuses on community-oriented players. Hover is a community-based game that facilitates social interaction through reactions, hovering with friends, and competing in challenges. Reactions are a social reward mechanism that gives socializers a reason to engage because they can motivate players, express support, and increase in-game status. Socializers often have an interest in viewing other players, and Hover enables this through the feed, the ongoing challenges, the leaderboard, and the player profiles. Viewing other players' activities can also have a motivating effect and inspire them to do new interesting activities.

Though the dimension of *exploring* is not too prominent in Hover, viewing other player's activities, exploring unachieved achievements, and finding new locations on the map can be regarded as exploring.

The leaderboard in Hover enables the dimension of *domination* because some players enjoy dominating the leaderboard. Many MMORPGs have various aspects of domination, such as provocative behavior. However, domination for players in Hover is more concerned with getting more points than their friends. Some players might only take an interest in dominating specific categories, such as education and health. For that reason, enabling leaderboard-filtering on categories and time intervals enhances the experience of domination.

16.3 Use of Malone's Theories on Intrinsic Motivation

Malone's "What Makes Things Fun to Learn?" article presents three essential elements in his article: challenge, fantasy, and curiosity. All of them are, to some degree, related to Hover's game design.

Challenge

For a game to be enjoyable, appropriately designed challenges are necessary. As mentioned in the section describing reward systems earlier in this chapter, the game must balance difficulty and player experience in the score and achievement systems.

Another aspect of the game, which is not mentioned in the reward systems section, is the importance of an appropriate degree of challenge in the "in-game challenges" where users compete against each other. Since the creator can customize the in-game challenges, they can select an appropriate difficulty based on previous experience. Additionally, ongoing in-game challenges have hidden information and a goal.

Players do not precisely know their progress. Instead, the description and the progress bar give the player a clear goal and indicate their progress (see Figure 15.6 in Chapter 15). The progress is also not updated before the player

Figure 16.5: Challenge progress.

publishes a new activity. Therefore, players cannot be entirely sure if they are leading the in-game challenge or not. Hiding details and information like that gives uncertain outcomes, which balances the difficulty.

Fantasy

Fantasy in games makes them more appealing. In Hover, players have an avatar representing them. The avatars are randomly generated; however, players can regenerate until they find an avatar they like. Examples of avatars are illustrated in Figure 16.6. The avatar creates an extrinsic fantasy where players accumulate points for their avatar.

Figure 16.6: Player avatar examples.

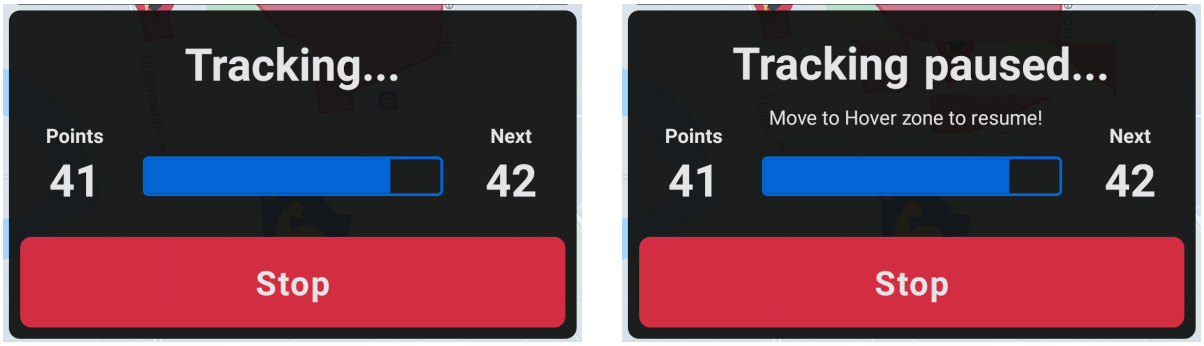
Curiosity

Curiosity is a central element in game design used to encourage exploration and draw players' attention. Curiosity was mentioned in the game reward systems section under the "uncertainty and secrecy as a design consideration" part. According to Malone, this type of curiosity can be categorized as cognitive curiosity, which is one of two elements of curiosity. In Hover, cognitive curiosity is found in the achievement system. Since the requirements of the unachieved achievements are hidden from the player, they may be triggered by their curiosity to explore that achievement further.

Sensory curiosity is mentioned as the other category of curiosity. Particular graphical elements, sounds, and similar attract the player's attention. In Hover, sensory curiosity is

present as decoration and as a representation system. Icons, emojis, and colors are used throughout the application to decorate the game elements and feedback messages.

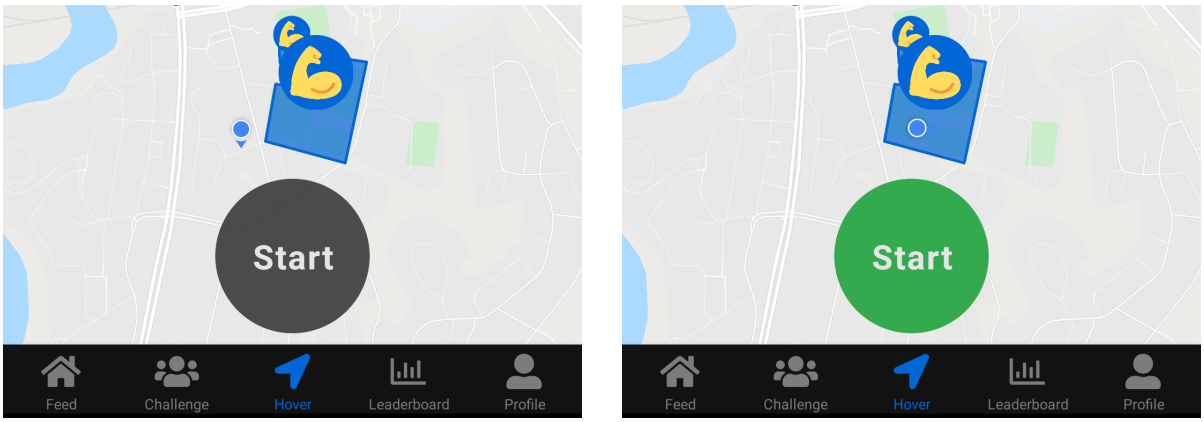
For the representation system, progress bars are used to represent the progress toward the next point while tracking. Hence the progress bar represents the time it takes between points, instead of using text. If the player moves outside the geofence, the progress bar stops moving to illustrate that the tracking has paused (see Figure 16.7b).



(a) Tracking in progress. **(b)** Tracking paused.

Figure 16.7: The progress bar, used as a representation system for time.

Furthermore, to start tracking, players have to be located within a geofence. To indicate that tracking is restricted to valid hover zones, gray and green buttons are used to illustrate whether this functionality is disabled or not.



(a) Hovering disabled. **(b)** Hovering enabled.

Figure 16.8: The *Start* button when the user is outside and inside a Hover zone.

16.4 Use of the GameFlow Framework

The concept of flow, described in the GameFlow article by Sweetser and Wyeth, is to some degree applicable to Hover. Since Hover is a gamification concept and not a conventional

game, some elements are not relevant. Many of the GameFlow elements correlate with aspects mentioned earlier in this chapter, and consequently, these will only be discussed briefly here.

Challenge and Player Skills

Both of these aspects have been mentioned earlier, but to summarize, a central consideration in game design is to balance challenge and player skill. The challenge in a game must not be too hard or too easy. Such games will create frustration and boredom, respectively, decreasing player engagement. In Hover, this balance is vital in the achievement system because players should be rewarded according to their effort.

Another aspect related to the concept of challenge is the in-game challenges that players can invite to and participate in. Since the players themselves define the rules, it can be difficult for them to understand what the challenge requires them to do. Thus, a description is generated to give the player a better understanding of what a challenge requires during the creation process (see Figure 16.9).

Figure 16.9: Challenge description, generated from the rules defined by the player.

Control

Control is also a central element of game design; players should feel a sense of control over their actions in the game and transfer their intentions to in-game behavior. To incorporate the element of control in Hover, it was essential to design and build intuitive user interfaces. We followed common design principles and patterns. Examples include utilizing a horizontal process flow when creating challenges and tracking (see figures 15.7 and 15.8 in Chapter 15). Utilizing such a flow can provide a sense of progress. Additionally, players cannot proceed to the next step in the flow before all sub-steps are finished, indicated by using disabled "Next"-buttons.

Furthermore, Sweetser and Wyeth (2005) also suggests that players should be able to

recover from their mistakes; thus, the game should support this. If a player mistakenly kills the app while hovering, Hover automatically resumes tracking on restart. This particular functionality lets players recover from a mistake that would otherwise cause players to lose their activity and disturb the gameplay. Another mechanism that lets players recover from mistakes is that players may resume or discard their activities when tracking is stopped, as illustrated in Figure 16.10.

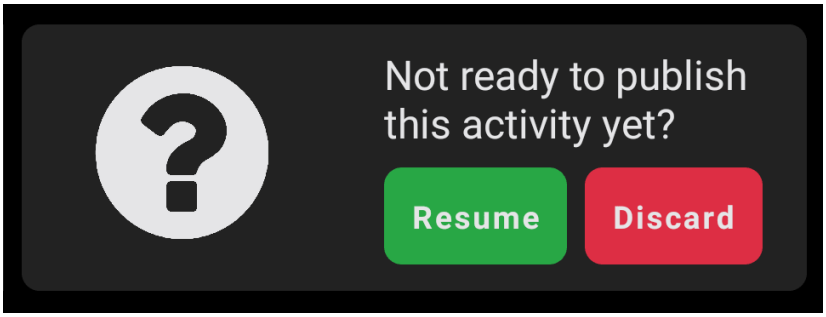


Figure 16.10: Resume or discard activity selection.

Clear goals

Clear goals in games are essential to improve player engagement. In Hover, the main goal is to accumulate points while hovering. Consequently, the application launches to the "Hover screen" (Figure 15.8 in Chapter 15) to encourage players to start hovering if they are inside a valid zone. Additionally, players receive a push notification when they enter a valid hover-zone, as shown in the bottommost notification in Figure 16.11.

Moreover, the concept of clear goals is also used for the challenges. All challenges include a generated description of the challenge's rules (as illustrated in Figure 16.9).

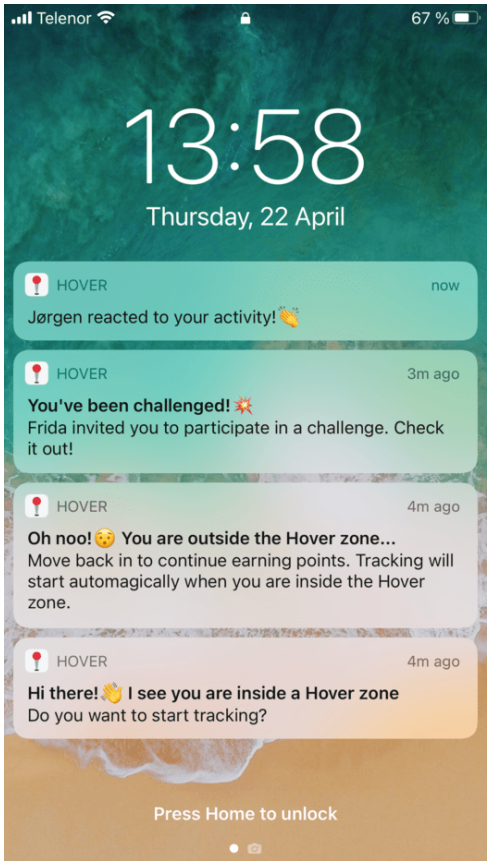


Figure 16.11: Examples of push notifications used in Hover.

Feedback

As briefly described in the reward system section, feedback is vital as a reward. Moreover, Sweetser and Wyeth also suggests that feedback is important to improve player enjoyment. In Hover, players can always see their score and progress, both while they are tracking and not tracking.

Feedback is essential while hovering to ensure that the players understand whether or not they receive points (inside or outside the zone) at all times. Thus, players get either visual or textual feedback when they have left a zone or when they have started a "Hover with friend" session (see figures 16.7b and 16.12).

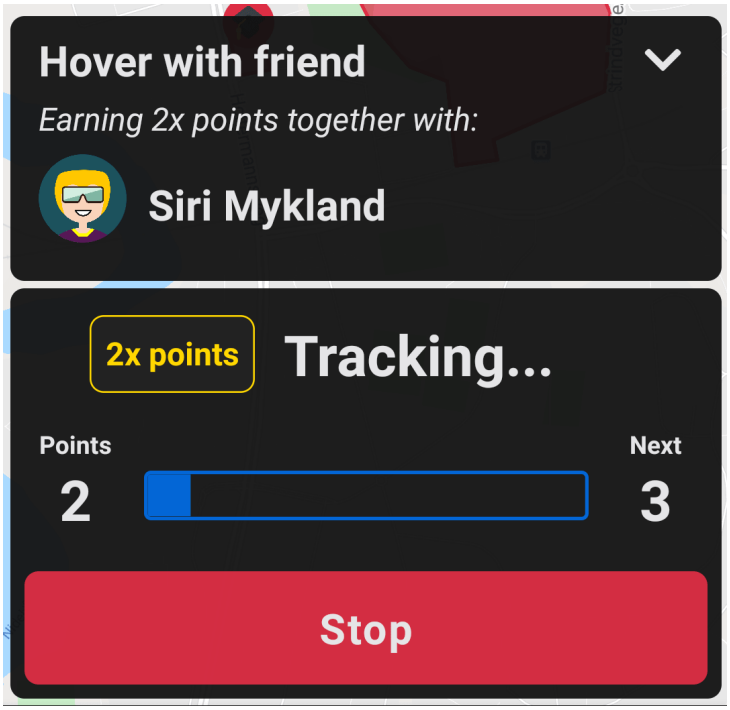


Figure 16.12: Hover with friend, indicated by "2x points", player name, and avatar.

In addition to in-game feedback, players are given push notifications on their location status (inside or outside a geofence), updates on challenges (invites, responses, wins, and loses), and rewards (achievements and reactions). These push notifications are decorated with emojis to be more playful and informative. The third notification in Figure 16.11 gives direct feedback that suggests that the player should move back into the area. The message is also an indirect reminder for them to publish their activity when they leave a location.

Social Interaction

Interaction between players was discussed in the social purpose part of the reward systems section and in the player types section. Social interaction in games increases player engagement and fun in a game, enhancing the purpose of the game. Hover includes competitive and cooperative interaction through the challenges and friend-tracking features. In addition to this, players can interact by showing support through reacting to each others' activities and achievements. The game's meaning is also improved by including the possibilities to share achievement and compare points against friends.

16.5 Summary

This chapter has described Hover's game design based on the theories from chapters 6, 7, and 8. Reward systems, player types, the use of Malone's theories, and elements from the GameFlow framework have been presented. The next chapter describes Hover's functional requirements.

Chapter 17

Functional Requirements

To organize and prioritize features in Hover, we have created three sets of functional requirements (FR) based on their importance; *high*, *medium*, and *low*. This chapter will present and briefly explain the idea behind the categories.

17.1 High Priority FRs

High-priority Functional Requirements are needed for the game to function as intended. Consequently, the requirements in Table 17.1 are the ones that we categorize as a must-have in the application before testing it on real users. Thus, all high-priority FRs are implemented in Hover.

#	Functional Requirement
FR1	Users should be able to create an account and log in.
FR2	Users should be able to view hover zones (geofences) on a map.
FR3	Users should be able to track activities.
FR4	Users should be able to publish activities to the feed.
FR5	Users should be able to create new challenges.
FR6	Users should be able to accept or decline challenge invites.
FR7	Users should be able to see their progress in ongoing challenges.
FR8	Challenges should be validated and checked for expiry when needed.
FR9	Challenges should be published to the feed when finished.
FR10	Users should be able to earn achievements based on their activities.
FR11	Achievements should be published to the feed.
FR12	Users should be able to view activities, achievements, and completed challenges in the feed.
FR13	Users should be able to compare their score with friends on a leaderboard.
FR14	Users should be able to view their profile (displaying achievements, scores, activities, etc.).

Table 17.1: High priority functional requirements.

17.2 Medium Priority FRs

Medium priority FRs are requirements that should be implemented if we have time. They improve the game experience but are not crucial for the game to function as intended. Most of the medium priority FRs in Table 17.2 have been implemented. The only two

exceptions are FR23 and FR24.

#	Functional Requirement
FR15	Users should be able to track together with a friend to boost their points.
FR16	Users should be able to pause, resume and discard ongoing activities.
FR17	Users should be notified of important events (when entering or leaving a hover zone, etc.).
FR18	Users should be able to interact with feed elements (react to, open profiles, etc.).
FR19	Users should be able to customize their profile (name, bio, avatar).
FR20	Users should be able to visit other players' profiles.
FR21	Users should be able to earn streaks for tracking daily.
FR22	Users should be able to view information about hover zones.
FR23	Users should be able to compete in open challenges.
FR24	Users should be able to see their completed challenges.

Table 17.2: Medium priority functional requirements.

17.3 Low Priority FRs

Low priority functional requirements are nice to have features. They could improve the game, but not in a dramatic way. In this project, the requirements categorized with low priority have not been implemented (see Table 17.3). However, they serve as good suggestions for further work, as we will describe later in Chapter 31.

#	Functional Requirement
FR25	Users should be able to customize their list of friends.
FR26	Users should be able to sign up for in-game clubs.
FR27	Users should be able to earn real-world awards.
FR28	Users should be able to evolve a character based on their score.
FR29	Users should be able to log in using external services (Facebook, Google, etc.)
FR30	Users should be able to comment on feed elements.

Table 17.3: Low priority functional requirements.

17.4 Summary

In this chapter, the functional requirements for Hover have been listed and prioritized. These requirements were used to plan and prioritize the development, as we will describe further in Chapter 19. The next chapter will focus on the tools we used to develop Hover.

Chapter 18

Chosen Development Technologies

In this chapter, the tools we used to develop Hover and the process of selecting them will be presented.

18.1 Technology Selection Process

Chapter 12 gave an overview of relevant technologies used as the basis for the selection process. There were essentially two main choices we needed to undertake: Decide what mobile application development approach and what backend solution we wanted to adopt.

Our decision was to choose a cross-platform framework for developing the mobile application and a Backend as a Service (BaaS) solution for managing data, users, and analytics. Selecting a cross-platform framework for developing the mobile application was based on the opportunity to create a game that could target as many people as possible. Since the development time in a master's thesis period is limited, a BaaS solution was chosen because of its simplicity.

After choosing our mobile development and backend approach, we needed to select the specific tools we wanted to utilize. Three main evaluation criteria guided this process:

Support for required functionality: The chosen tools needed to support the necessary functionality in Hover. Location tracking, map integration, and authentication are some of these requirements.

Previous experience: Prior knowledge of a tool counts positive because it will increase the development speed.

Maturity: A tool that has been tested, experienced, and used in many applications is positive. It is also essential that the solution is undergoing active development and maintenance.

Based on the criteria, we selected *React Native* with *Expo* as the mobile application framework and a combination of *Hasura* and *Firebase* for BaaS providers.

18.2 React Native as Mobile Development Framework

React Native is a cross-platform framework developed by Facebook (Occhino, 2015). One of the main differences between React Native and other similar frameworks is its use of native components. A button declared in a React Native application will be presented as an Android-type button when the application is run on Android and an iOS-type button when it is used on iOS. Most other frameworks have a different approach where the application provides a common Android and iOS application experience. In this way, a React Native application feels more like a native application than other frameworks like Flutter and Ionic. We decided to use React Native in combination with Expo. Expo is a set of tools that improves the building and deployment process of Android and iOS applications (Vatne, 2021). As described in the previous section, we used three main evaluation criteria when choosing React Native as the mobile development framework:

Support for required functionality: Libraries and support for the functionality we needed to develop Hover, including location tracking and map integration, exists in React Native.

Previous experience: We do not have much experience with mobile development, except for some limited experimentation and prototyping in conjunction with the technology review process. However, we have experience working with React, and this is a definite plus when developing using React Native.

Maturity: React Native is a mature mobile development framework, and a handful of large companies use it for their mobile applications. The framework is open-source and under active development and maintenance. Because React Native is based on React and JavaScript, the framework also has access to NPM's extensive collection of packages of open-source code.

Although we chose React Native as our development framework, other frameworks such as Flutter and Xamarin would also have been great options. In summary, the decision was based on a combination of minor differences, where our previous experience with React was the deciding factor.

18.3 Combining Firebase and Hasura as BaaS

Combining Firebase and Hasura as BaaS Firebase is a Backend as a Service (BaaS) solution provided by Google (Tamplin, 2014), including tools for storage, analytics, cloud functions, authentication, and more. Its main selling point is simplicity for developing mobile applications.

We could have used Firebase for all the back-end functionality but decided to use Hasura as a database instead of the storage solution found in Firebase. Hasura is a tool providing an instant GraphQL API based on data in the database, removing the need to define schemas and resolvers manually. It also allows more flexibility in how the data is stored. Additionally, it integrates well with Firebase. The three main evaluation criteria were also used for this decision:

Support for required functionality: Firebase has support for the backend tools needed to develop Hover, such as authentication and analytics. Authentication will be used to verify users, while analytics will be used to see how they utilize the application during the test period. Hasura will be used to save game data.

Previous experience: Firebase was the only BaaS we had some prior knowledge of. Thus, choosing this service over the other ones was relatively easy. Our experience with Hasura was minimal. However, we had some previous experience with GraphQL and PostgreSQL, two central parts of this specific storage setup.

Maturity: Released back in 2011, Firebase was one of the first backend solutions explicitly designed to support mobile applications (Metz, 2012). Companies worldwide use the solution, and it is consequently highly maintained and developed. Hasura is a relatively new tool, launched in 2017 (Hall, 2018). However, it is tested and used by multiple large companies and has received a large number of stars on GitHub.

In summary, it was our previous experience with Firebase that was the deciding factor for choosing it. Together with the added storage flexibility in Hasura, the combination seemed like the ideal choice for our purpose.

18.4 Summary

In this chapter, we have presented the technologies chosen for developing Hover. We decided on React Native with Hasura and Firebase, based on maturity, prior knowledge and support for required functionality. The next chapter will explain in more detail how the application was built.

Chapter 19

Game Development

The first three months of working with this project were primarily dedicated to developing Hover. The following sections will explain the development process and how the software architecture was designed.

19.1 Development Process

The first step in the development process was to set up code repositories, choose tools and agree on conventions. We used Git and Github as our version control system and collaboration tool. Conventions and other development information, such as setup and deployment processes, were stored in a Wiki in our repository on Github. To ensure that the code conventions were easy to follow, we utilized a linter in our editor and added a continuous integration check on Github. Additionally, we used pull requests and code reviews to catch errors, potential improvement possibilities and make sure both of us understood the code. Figure 19.1 shows a screenshot from one of many completed pull requests during the development phase.

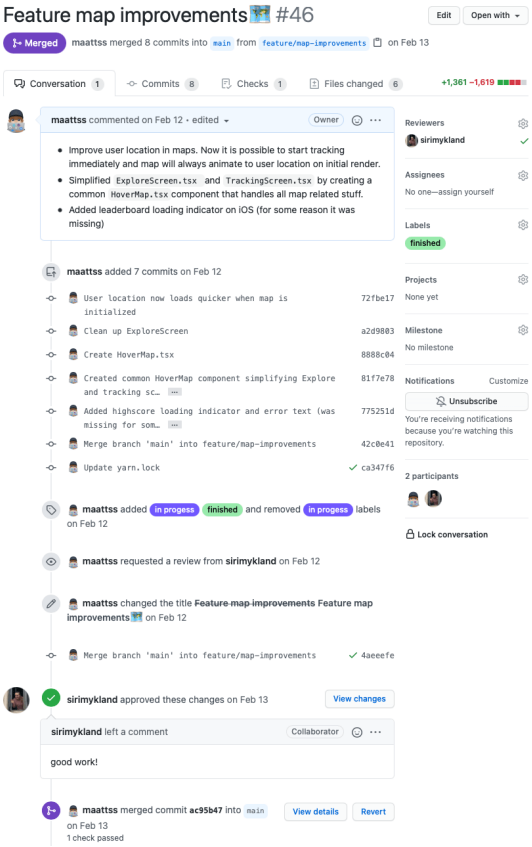


Figure 19.1: Typical pull request on Github from the development process.

After conventions and tools had been settled, the next step was to plan how the game should be implemented and which features we should prioritize. The functional requirements (see Chapter 17) were used as the foundation for creating development tasks. To keep track of the tasks during the agile development process, we utilized a Kanban board. Figure 19.2 shows a screenshot from the board during the development period. The tasks are categorized depending on their priority, and the ones up next are found in the "committed"

list. The Kanban board made it easier for us to organize and keep track of all the tasks and remove possible uncertainty of what the other person was doing. In addition to the Kanban board, we had daily standups and discussions to keep the other person up to date on the task progress and potential problems. Because of the Covid-19 situation, we were sometimes forced to work remotely, collaborating using remote communication tools. The board and daily discussion showed their value in these periods.

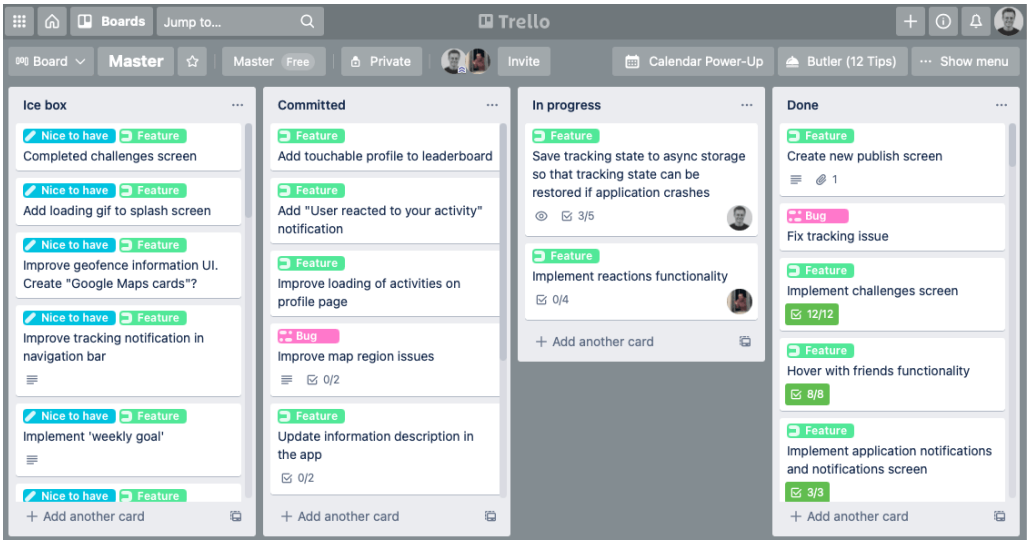


Figure 19.2: Kanban board from the development process.

As in every development process, we tried to prevent unwanted bugs. Various best practices, such as keeping entities small and decreasing cognitive complexity, were used to improve code quality. In addition to this, we let selected friends and family, that were not supposed to be a part of the test group, try the application during the development process. Continuous testing was an effective way to clear bugs and other issues that we had not experienced ourselves. We also got some other general feedback that helped improve the application from these people.

Testing of the code was not implemented in this project. We had a discussion early on whether or not to include it. The decision became that it was not worth the effort since the goal of this development was to create a working prototype and not a full-fledged application. The focus was to implement as many features and game elements as possible during the limited time we had available.

The development period resulted in a working implementation of the game Hover deployed to App Store and Google Play. The process took approximately three months of full-time

work with around 36500 lines of code produced and more than 100 pull requests completed.

19.2 Software Architecture

Designing the software architecture is a crucial phase in the development of every modern system. In this section, a brief overview of the architecture of Hover will be given. We will not go into details of how the specific parts are developed. However, since all code is open-source, interested readers can dive deeper into how the system is structured by visiting repositories for the mobile application and the supporting backend on Github.

As illustrated in Figure 19.3, the system consists of four main parts: the application, a Hasura storage solution, the Firebase backend, and Expo for handling notifications and over-the-air (OTA) updates. The communication between the parts, illustrated with the dotted lines, is encrypted and secured. The arrow shows which direction the information is mainly traveling.

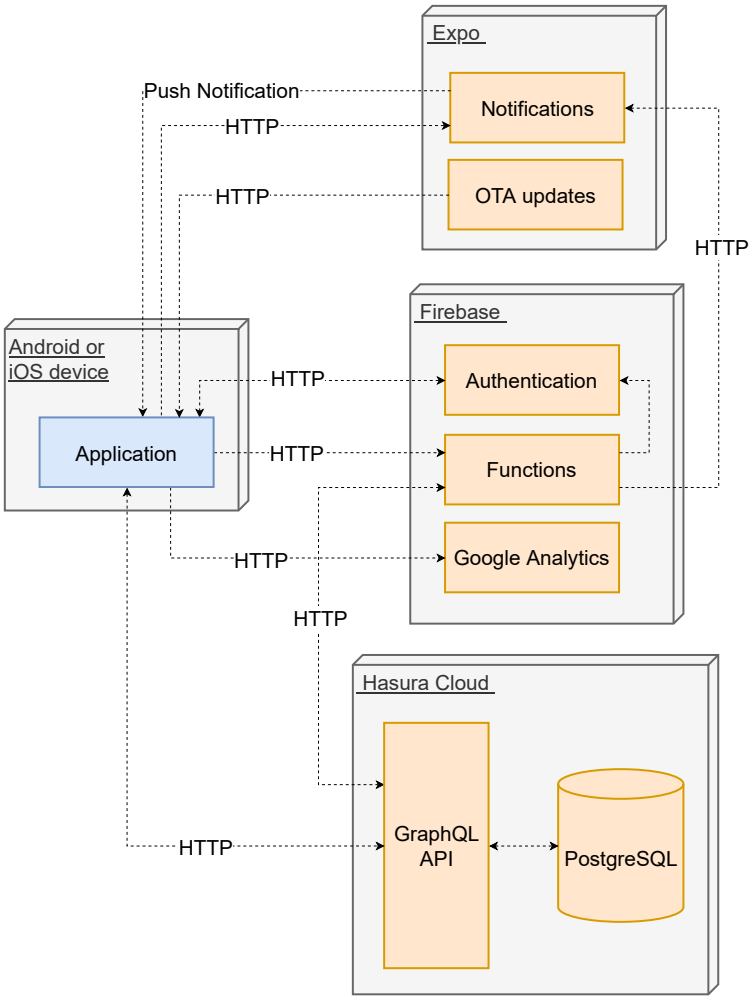


Figure 19.3: Simplified architectural overview.

19.2.1 The Application

Hover was developed using React Native and Typescript. The cross-platform framework made it easy to create an application that could be distributed to both iOS and Android using the same codebase. Sometimes there was a minor difference in how the operating systems handled implementation details, which meant we needed to write specific code for both operating systems. However, this was usually not the case, and most of the code functioned very well on both operating systems. Target code to a specific platform is also easily solved in React Native by checking which operating system the phone is running.

The application communicates with all three services in the solution. Most of the application data is communicated through the GraphQL API in Hasura, except for authentication information which Firebase is responsible for. Expo provides push notifications and OTA updates. Additionally, the application sends analytics data to Google Analytics.

19.2.2 Hasura Storage Solution

Hasura was used as the storage solution in this project. The solution consists of a GraphQL API and a PostgreSQL database where the API is autogenerated based on content in the database. This API and the flexibility of GraphQL allowed us to instantly access the data without needing to develop a custom API. We configured Hasura to use JSON Web Token (JWT) authorization to authorize all incoming requests, as illustrated in Figure 19.4. The authentication server issues a JWT to the client application, sending the token as a part of the request. The GraphQL engine then decodes and evaluates this token according to predefined control rules (Hasura, 2021). By utilizing this authorization mode we were able to define role-based access control rules, as column and row-level permissions, to ensure that users only could access and modify the data they were authorized to.

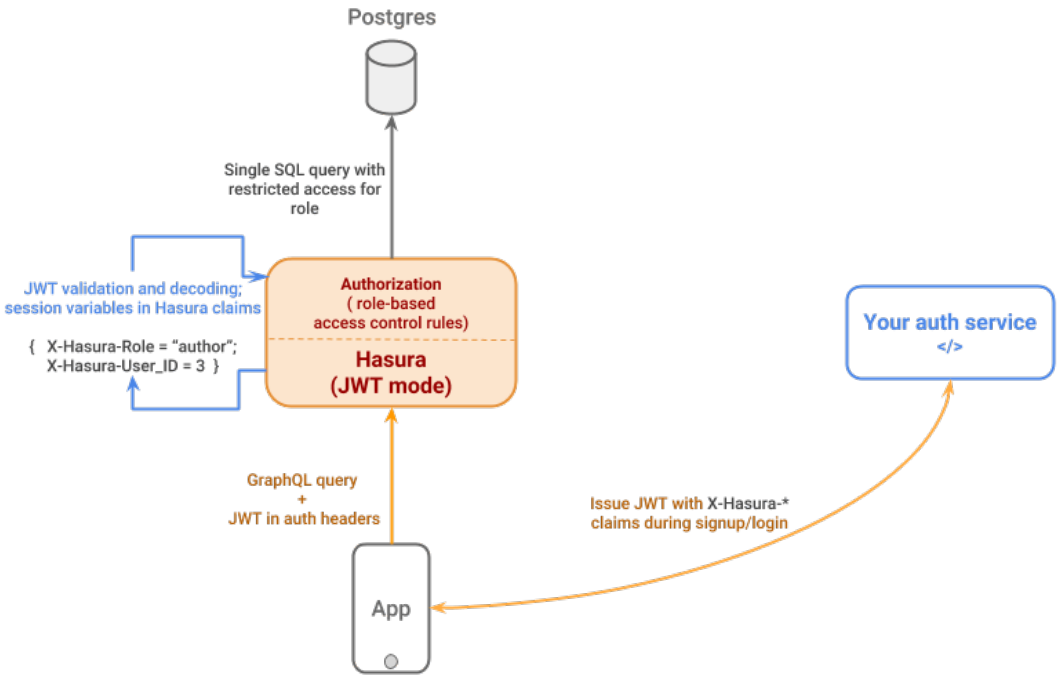


Figure 19.4: Hasura JWT authorization flow (Hasura, 2021).

19.2.3 Firebase Backend

Firebase is used for three main functions in Hover: authentication, back-end provider, and analytics. The authentication solution is integrated with Hasura which creates an easy developer experience. We configured it to issue custom JWTs to the client app which was sent as part of the requests to Hasura. It is possible to customize the authentication process to include popular login options such as Facebook and Google. But, in this project, we opted for the standard username and password combination because of privacy concerns raised by NSD.

For doing typical backend operations, we choose to use Firebase Cloud Functions. The backend was responsible for business logic that was either too complex for the application or dependent on specific events in the database (insert, update, delete). By utilizing the *event trigger* feature in Hasura, specified table events would automatically trigger our Firebase functions. Examples of such tasks were validating achievements and challenges and sending push notifications to the user.

The last Firebase service we used in this project was Google Analytics. This service was set up with the sole purpose of collecting usage data during the test period. Firebase provides a solution for displaying analytics from the application. The type of data is

highly customizable. In our project, this included screen views, notification engagement, game events, and more. This data is good content for the next part (Part V), where we describe the testing results.

19.2.4 Expo Updates and Notifications

For deployment and sending push notifications, Expo was used. Using this tool, we can send OTA software updates of the application without having to rebuild and resubmit the application to App Store and Google Play. OTA updates were a nice feature to have available to quickly deploy bug fixes or critical features. Push notifications are also easily handled using Expo without dealing with the different push notification services for Android and iOS.

19.3 Summary

In this chapter, a description of the development process and tools we used has been presented. A general overview of the software architecture and its specific components has also been explained. The chapter wraps up Part III, the description of Hover. The next part will focus on the experiment where we will test the application on real users.

Part IV

The Experiment

Before conducting empirical studies, a proper understanding of methods is crucial to perform good quality research. Previously, in Chapter 4 we looked at general research methods. In this part, we will use that knowledge to describe how the study of Hover was conducted and which data was collected. Central factors that could threaten the validity and reliability of the research will also be highlighted. This part lays the foundation for Part V where our study's empirical results will be presented.

Chapter 20

Execution of Experiment

In this chapter, a description of how the testing of Hover was designed and conducted will be explained.

20.1 Picking Test Participants

Before testing Hover, a crucial consideration was which type of people we tested the game on (sampling frame and size) and what method (sampling technique) we would use to select participants. Choosing a sampling frame and size depends on the target group and accuracy a researcher wants to obtain. Sampling techniques are usually chosen depending on which data you are interested in getting. There are two main categories of sampling techniques (Oates, 2006):

- *Probability sampling:* Choose people who are believed to be representative of the overall population being studied.
- *Non-probability sampling:* When it is not necessary or feasible to have a representative sample, this technique can be used.

In this project, participants were picked using a non-probabilistic approach where we used convenient hand-picked participants that are likely to produce good data. Our priority was to get concise feedback from users with a behavioral pattern that could benefit from using Hover. Additionally, we picked groups of friends to test the game's social aspect realistically. Thus we also prioritized gathering participants we knew to ensure this.

20.2 Designing the Experiment

The experiment was designed mainly to answer the research questions defined in Chapter 3. Hence, the purpose was to test Hover on real users to get feedback on their experience using the application. We picked nineteen people using a non-probabilistic approach and gathered multiple types of data (triangulation) to improve the research's validity and reliability. Specifically, four different data types were gathered and analyzed: *questionnaire*,

interviews, *in-game observations*, and *application usage data*. A detailed description of the content and purpose of collecting these data types is further discussed in Chapter 21.

20.3 Conducting the Experiment

The experiment took place in the two weeks between the 12th and 25th of April 2021. We wanted to test the effects Hover may have on people's habits, and consequently, we wanted a test period that was as long as possible. Due to limited time in the Master Thesis project, we decided that two weeks would be sufficient.

Before the experiment started, the participants were asked to watch a 4:34 minutes long introduction video. The purpose of this was to ensure users would start on the same level of knowledge and illustrate all the game features. We initially planned to give the introduction physically, but because of the ongoing Covid-19 situation, we decided it was best to adapt the presentation to an online video instead.

To distribute information to the participants efficiently, we had created a website to gather everything. The page included a what to do guide, links to the survey and introduction video, and other essential information. The application was distributed to iOS users via App Store and to Android users via Google Play.

When the two weeks of testing came to an end, all participants were asked to complete a survey with questions based on our research questions. The survey took five to ten minutes to answer and included an introduction question that identified users that had not been using the application. Answers from these users were discarded.

As a gratitude for everyone taking their time to participate in this study, five gifts were given to randomly picked participants. The gifts helped us ensure that as many people as possible participating in the survey would complete the whole period of testing and answer the questionnaire at the end. We choose to pick random winners not to stimulate the users' interest in Hover.

20.4 Summary

In this chapter, we described how the experiment was executed. This included elaborating on how participants were chosen, and how the experiment was designed and conducted.

Next, Chapter 21, will look at how and describe what types of data we collected in more detail.

Chapter 21

Data Collection

In Chapter 3, our research questions studying players' engagement, motivation, enjoyment, and habits were presented. This chapter will discuss the data collection methods used in our experiment, which are essential to answer these research questions. Four different data collection methods, *questionnaire*, *interview*, *observations*, and *application usage data*, will be described. Additionally, the chapter will highlight some important ethical considerations of collecting data.

21.1 Questionnaire

The participants answered a questionnaire consisting of 33 statements and 25 questions grouped into five categories corresponding to the research questions. Despite the statements and questions written in English in this chapter, they were originally given and answered in Norwegian (complete questionnaire found in Appendix C).

A 5-point Likert scale was chosen for the statements, where the respondents had the alternatives: *strongly disagree*, *disagree*, *neutral*, *agree*, and *strongly agree*. This type of ordinal data can be tested using the Mann-Whitney test. The nonparametric test is used to compare differences between two independent groups, with a null hypothesis that the distributions in the two sample groups are equal (LaMorte, 2017).

General questions for the participant

The questionnaire started by gathering general data about the participants, including demographics and overall game experience. Additionally, a last question collecting general feedback on the testing experience concluded the questionnaire. These questions are listed in Table 21.1.

#	Questions
Q1	What is your gender?
Q2	Are you a student?
Q3	What is your age?
Q4	What is your email address?
Q5	What is your username in Hover?
Q6	Did you use the application at least once during the test period?
Q7	Did you experience any technical challenges during the test period?
Q8	Have you used Hold, Strava, or Pokémon Go before?
Q9	Does your phone run iOS or Android?
	...
Q25	Do you have any other feedback?

Table 21.1: General questions.

21.1.1 Questions Related to Players' Engagement

The subjects were given six statements and six questions to collect data on the players' perceived engagement. The statements were based on the game metrics and social features in the game. Table 21.2 presents these statements.

#	Statements
S1	I was curious about the medals I could achieve during the game.
S2	I received new medals and rewards throughout the test period.
S3	The game gave me enough challenges.
S4	Challenges between friends inspired me to use the application more.
S5	I often reacted to other players' activities and achievements.
S6	The notifications made me use the application more.

Table 21.2: Statements related to players' engagement.

Furthermore, we asked the subjects to quantify their use of the game and particular features. These questions can indicate how the metrics trigger players' competitiveness and willingness to engage in the game. The questions on player engagement are presented in Table 21.3.

#	Questions
Q10	How many of the days during the test period did you use Hover?
Q11	On average, how long did you use Hover every day during the test period?
Q12	How many times during the test period did you accept challenges from friends?
Q13	How many times during the test period did you challenge friends?
Q14	On average, how many reactions did you give per day during the test period?
Q15	Do you have any other comments related to your engagement in Hover?

Table 21.3: Questions related to players' engagement.

21.1.2 Questions Related to Players' Motivation

The participants were asked nine statements and four questions to investigate the effect game metrics and social interaction had on their motivation. The statements were focused on how the different reward systems affected the players' motivation to do activities. Table 21.4 presents these statements.

#	Statements
S7	I was motivated to carry out activities by the opportunity to win medals.
S8	I was motivated to carry out activities by the opportunity to earn points.
S9	I was motivated to carry out activities because others did it.
S10	I was motivated to carry out activities to keep my streak alive.
S11	Reactions to my activities inspired me to use the application more.
S12	The leaderboard motivated me to get as many points as possible.
S13	The ability to earn double points by using the application with a friend inspired me to use it more.
S14	Challenges between friends inspired me to use the application.
S15	I was inspired to use Hover by other players' activities.
S16	I opened the application when I received a notification.

Table 21.4: Statements related to players' motivation.

Furthermore, the participants were asked to quantify how often they felt inspired to do activities based on the game's different features. For questions Q16-Q18 the participants were given four options: *Every day*, *sometimes*, *a few times* and *never*. Q19 was more of a feedback question to ensure that the players felt that the time they invested was rewarded appropriately. Q20 gave the participant the option to air out any other remarks they had on their motivation to play. The questions on player motivation are presented in Table 21.5.

#	Questions
Q16	How often during the test period were you inspired by your friends to use Hover?
Q17	How often during the test period were you inspired by challenges to use Hover?
Q18	How often during the test period were you inspired by medals to use Hover?
Q19	Was the number of points in each category correct, in relation to your effort?
Q20	Do you have anything else you want to say related to your motivation to Hover?

Table 21.5: Questions related to players' motivation.

21.1.3 Questions Related to Players' Enjoyment

The participants were given nine statements to gather data on perceived enjoyment. Since the game is designed using game design theory of chapters 6-8, the statement provides data to investigate if the game elements have the desirable effect on the player's enjoyment. Statements S17 and S18 directly address the player's feelings towards Hover, whereas S19-S25 deals with the perceived enjoyment towards specific game elements that we have prioritized to incorporate in our game. The statements directed towards specific game elements are based on the GameFlow concepts of *challenge*, *clear goals*, and *feedback*. Table 21.6 presents the statements related to player enjoyment.

#	**Statements**
S17	I liked the concept of Hover.
S18	It was sad to stop using Hover after the test period ended.
S19	I felt that the progress in the game was always clear.
S20	There was an appropriate degree of difficulty to achieve medals.
S21	My status in the game increased the more I played.
S22	The challenges I participated in had clear goals.
S23	I felt attached to my unique avatar.
S24	I was happy to get reactions to my activities and medals.
S25	I was curious to see what my friends had been up to.

Table 21.6: Statements related to players' enjoyment.

Moreover, to collect additional data about the participants' perceived enjoyment, we asked them to describe any other remarks they had. The question on enjoyment is presented in Table 21.7.

#	**Questions**
Q21	Do you have any other comments related to your enjoyment in Hover?

Table 21.7: Questions related to players' enjoyment.

21.1.4 Questions Related to Players' Habits

To investigate if and how players changed their habits, we included statements and questions relating to habits and perceived usefulness. The participants were asked to state whether or not they felt a change in habits and if they were inspired to do more activities during the two weeks. These statements (see Table 21.8) are used to study if the concept has a positive effect on individuals.

#	Statements
S26	Hover has changed my habits about how often I use cultural offerings.
S27	Hover made me want to use cultural offerings more often.
S28	Hover has changed my habits about how often I exercise.
S29	Hover made me want to exercise more often.
S30	Hover has changed my habits about how often I visit my educational institution.
S31	Hover made me want to visit campus more often.
S32	Hover has changed my habits about how often I am social.
S33	Hover made me want to visit social zones more often.

Table 21.8: Statements related to change in habits.

Moreover, we also asked the participants to state whether they would like to continue using a game like this, as it reveals how they perceive the usefulness of such a concept. Due to the ongoing pandemic, there were several concerns that it would affect the results or conditions for testing the game. Changes in local and national restrictions, such as closed campuses, training centers, and restaurants, could happen on short notice. Additionally, it was also realistic to think that the participants' habits and willingness to do activities outside their home deviated from their pre-pandemic behavior. For that reason, Q23 was included to collect data that potentially could support this underlying concern. The questions on habits and usefulness are presented in Table 21.7.

#	Questions
Q22	Would you like to continue using a game like this?
Q23	Do you think you would have used Hover more if it had not been for an ongoing pandemic?
Q24	Do you have any other comments related to your habits before, during, or after using Hover?

Table 21.9: Questions related to change in habits.

21.2 Interviews

To collect qualitative data on the user's perception, we invited some test subjects to participate in individual and group interviews. Our interviews were semi-structure, and the purpose was to discover new information and triangulate other data sources. The combination of individual and group interviews has several advantages. Group interviews are suitable for generating "more responses, and more varied responses, as one participant's views are challenged by others or stimulate others to new ideas" (Oates, 2006). On the

other hand, single interviews are reliable as it lowers the barrier for voicing opinions that deviate from the masses. An essential consideration for group interviews is making sure that the group participants are of similar status so they feel comfortable sharing their opinions and thoughts. Thus, the groups were put together with this in mind.

The semi-structured interviews, individual and group, were focused on the topics related to our research questions (see interview guide in Appendix E).

We chose to take quick field notes and record audio using Microsoft Teams to collect data from the interviews. This method allowed us to structure the interviews as a natural conversation rather than a formal interview setting.

21.3 Observations

The observations in this project were a variant of *participant observation*. We found that the best way to observe the subjects was to participate passively during the testing. This presence allowed us to observe how the test subject played and interacted from inside the game. The test subjects were informed beforehand of our passive participation; thus, categorizing the observations as overt. We chose the role of passive observers to not compromise the results. Our goal was to refrain from creating challenges and reacting to activities so that the players would not feel pressured to play the game.

21.4 Application Usage Analysis

To collect data on application usage, we added Google Analytics for Firebase to the game. This SDK captures several key events in the app that gives insight into user behavior. The toolkit also allows the configuration of custom events. These custom events let us capture events triggered by the players' application usage. Examples of such events are: tracking what screens the players visit, how they interact, and how they respond to push notifications. The events also give insight into how players handle the "tracking" and "create new challenge" processes. This insight can indicate where in the process a player's attention is lost.

Additionally, some of the data was directly gathered from the database. Examples are the number of activities the users choose to publish, the number of challenges they have

participated in, and the number of reactions. These numbers can be used to support or invalidate the participants' engagement in the testing period.

21.5 Data Collection Ethics

Due to the need for user testing, we focused, throughout the project, on issues that could occur related to privacy. Therefore, it was important to be transparent with the participants with how we collect and present their data in the thesis. It was a priority to develop an application that stored as little privacy sensitive data as possible. However, for the purpose of the study and the game concept, some information such as locations, activity, and user data was necessary.

As the project is dependent on user testing we started a dialogue with the Norwegian Centre for Research Data (NSD) to ensure that our research was completed in a secure, rightful, and ethical manner. NSD later approved our research plan. This early adoption of communication resolved potential GDPR and privacy issues early on in the project's phase.

Before launching the game on App Store and Google Play, we saw the need for creating a privacy policy (see Appendix B) required by said platforms. The privacy policy discloses how, why, and what data we collect, and we made it available on our website and in the settings menu inside the application.

21.6 Summary

This chapter has described what data we collect and our methods for data collection. Four data sources were chosen to triangulate the data. Each method description included what data we collect, how it is collected, and what it should answer. Last, we discussed some of the ethical issues encountered during this project. Part V will use the methods presented in this chapter.

Chapter 22

Reliability and Validity Concerns

In this chapter, we will look at some of the factors that may impact our research results.

22.1 The Hawthorne Effect

The Hawthorne effect refers to "... the improvement in performance solely due to the subject's knowledge that he or she is being studied" (Fox, Brennan, & Chasen, 2008). When people know that they are being observed, it is proven that they change their behavior.

In our research, we used in-game observations to monitor the participants during the testing. This monitoring could impact how the test participants used the game. Some might have used the application more actively only because they knew that we were observing them.

22.2 Familiarity Bias

Another factor we need to consider when analyzing the results from our study is the familiarity bias. As explained in Chapter 20, the study participants were selected from our friends and acquaintances. While this presumably will increase the amount of feedback we get, the feedback might be biased. People testing the application could give results that do not represent their actual experience of the game because they are trying to be friendly. Consequently, the results might illustrate more engagement and positivity than what would have been the case if a random method was used to select participants.

To prevent this, we asked all the participants to use the application as if they did not know us and give us their honest opinion in the survey. However, the familiarity relationship between the test users and us might still influence the results.

22.3 The Covid-19 Pandemic

The ongoing Covid-19 Pandemic is also a factor that might influence the results of our study. As explained earlier, the purpose of Hover is to inspire people to do socially beneficial activities such as going to the gym or socializing with friends. Socially beneficial arenas are mapped, and the user gets points for staying at these locations. Social restrictions where people are told to limit their interaction with others and remain at home as much as possible will probably decrease people's movement away from home. Thus, the pandemic may have negatively influenced how much people have been using the application. The participants were asked the following question to help us investigate the scope of the problem:

"Do you think you would have used Hover more if it had not been for an ongoing pandemic?"

The results from the survey and this question will be discussed further in the next part of this thesis.

22.4 Summary

In this chapter, we addressed potential factors that can affect the reliability of the data collected in our experiment. The impact of the Hawthorne Effect and the Familiarity bias are tough to discover, and consequently, the factors will be omitted from the discussion of the results. However, this does not mean that they are not important; quite the opposite. The Covid-19 pandemic's influence will be considered when discussing our results in Chapter 28. This chapter wraps up Part IV, describing the experiment, data collection methods, and validity concerns. In the next part, we will begin to present the results of the experiment.

Part V

Results

This part presents the results from testing Hover on a selection of users. The results answer our research questions and are based on the data collection methods presented in Chapter 21. Findings from this part will be discussed in Chapter 28. Additional results material can be found in appendices C - G.

Chapter 23

Test Population

The composition and selection of a test group is an important part affecting the result of a study. As described in Chapter 20, we wanted to choose participants that could provide valuable data. Therefore, we present the type of people who tested the application before describing the results. Figure 23.1 and Figure 23.2 display the participants' gender distribution and age segments gathered from the questionnaire.

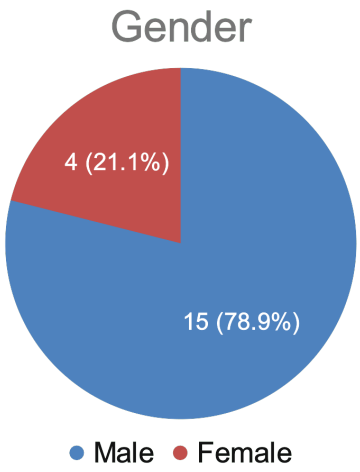


Figure 23.1: Test group gender distribution.

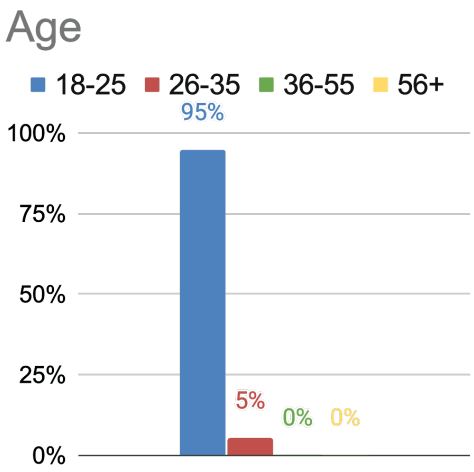


Figure 23.2: Test group age distribution.

There were 19 participants in the study, 15 men and four women. All of them were students based in Trondheim, with a dominant age group of 18-25, and only one participant above this age.

23.1 Sub-populations

Since Hover is a concept highly dependent on the social aspect, we wanted to test it on people who knew each other before testing the application. We decided to choose two groups of people from our network in Trondheim, one based on student society volunteers, and another one consisting of classmates. The two groups gave us insights on how the social aspect affects the application usage, as described in *RQ2*, *RQ3*, and

RQ4. Differences between these groups can be determined using the Mann-Whitney test (discussed in Section 21.1).

Student society volunteers

The first group of participants is volunteers at the Student Society (Studentersamfundet) in Trondheim. The participants consisted of 11 men and one woman. The group is tightly connected, working together a lot, including approximately three regular meetings every week. Thus, their social relationship is strong.

Classmates

The second group consists of seven people recruited from our study program at NTNU, four men and three women. Participants in this group know each other to various degrees. Some of them are very close and meet each other every day, while others are less connected. The overall relationship within this group is a lot weaker than in the student society group.

23.2 Interview Population

As a part of the testing, we also conducted single and group interviews to get more concrete feedback and statements from the participants. The subjects for these interviews were recruited from the population of people who had tested the application. In total, five people were interviewed.

23.3 Summary

In this chapter, an overview of which people the application was tested on has been described. The following chapters will introduce the result from the test period, presenting them according to the research questions.

Chapter 24

Results on Player Engagement

This chapter presents results related to the players' engagement in Hover. The results answer *RQ2: "How do game design elements and social interaction in our game concept affect the players' engagement?"*. Described data will be used in Chapter 28 to discuss and evaluate the result of this research question.

Player engagement results are best expressed in numbers and figures, describing how and what mechanisms engage the players. Thus, the chapter is primarily based on quantitative data from the questionnaire and usage data from the application gathered from the database and Google Analytics.

Note that the ongoing pandemic strongly influences the participants' behavior during the testing period. Consequently, the results related to players' engagement in Hover are also affected.

24.1 Results on Engagement from Questionnaire

Table 24.1 shows responses from the questionnaire's section on engagement, where the participants were given six statements. Though the statements in the questionnaire were originally a 5-point Likert scale (strongly disagree, disagree, neutral, agree, and strongly agree), we have synthesized these into a 3-point Likert scale for readability (disagree, neutral, and agree).

#	Statements	D	N	A
S1	I was curious about the medals I could achieve during the game.	47%	26%	26%
S2	I received new medals and awards during the entire test period.	26%	21%	53%
S3	The game gave me enough challenges.	58%	37%	5%
S4	Challenges between friends inspired me to use the application more.	32%	11%	58%
S5	I often gave reacted to other players' activities and achievements.	58%	21%	21%
S6	The notifications made me use the application more.	26%	26%	47%

D: Disagree. **N**: Neutral. **A**: Agree.

Table 24.1: Results from statements related to players' engagement.

The responses to the statements were broadly distributed with both positive and negative results. Answers from S2 revealed that 53% agreed that they continually got new

achievements and rewards during the test period. Earning achievements increase the incentive for playing and thus are positive for player engagement. Challenges between friends also positively impacted engagement, with 58% answering that it made them use the application more (S4). In addition to this, almost half of the respondents answered in S6 that notifications made them use the application more.

On the other hand, answers from S1, S3, and S5 were more on the negative side of the spectrum. 47% disagreed that they were curious about which achievements they could earn in the game (S1). In S3, 58% of the participants answered that the game was not challenging enough. At last, answers from S5 reported that many of the users did not use reactions much.

Mann-Withney tests were run for all statements to test for differences between the two groups. Only one statement showed statistically significant differences between the two groups: the classmates were to a larger degree than the student society group inspired by challenges between friends to use the application (see Table 24.2).

#	Statements	Group	*n*	D	N	A	p
S4	Challenges between friends inspired me to use the application more.	Student society	12	42%	17%	42%	0.0287**
		Classmates	7	14%	0%	86%	

n: Number of participants. **D**: Disagree. **N**: Neutral. **A**: Agree. **p**: results from Mann-Whitney test.
* $p < 0.1$ ** $p < 0.05$

Table 24.2: Noticeable differences in engagement for the two sample groups. Full table in Appendix G.

The participants were also asked to answer how many days during the test period they used Hover (Q10). The results from this question are illustrated in Figure 24.1. Most of the respondents stated that they used Hover *a couple of days each week*. There are minor differences in the two groups' answers, but they are not significant ($p = 0.4013$).

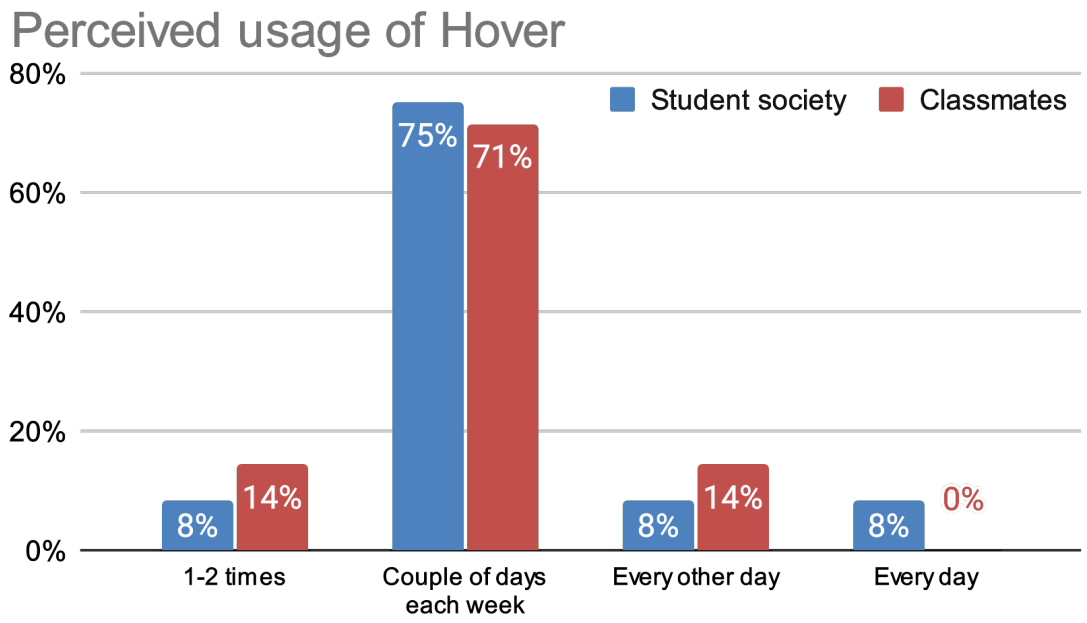


Figure 24.1: The perceived usage of Hover.

Table 24.3 combines the responses from Q11-14. Columns *Avg S* and *Avg C* show the calculated average for the two groups, while *Avg All* shows the average for the entire test group. Q14 is the only question where the two groups differed by a considerable number. The student society group stated that they gave an average of 2.2 reactions, whereas the classmates had an average of 0.6 reactions.

#	Questions	Avg S	Avg C	Avg All	Unit
Q11	On average, how long did you use Hover every day during the test period?	5.7	4.3	5.2	minutes
Q12	How many times during the test period did you accept challenges from friends?	1.3	1.4	1.3	times
Q13	How many times during the test period did you challenge friends?	0.4	0.4	0.4	times
Q14	On average, how many reactions did you give per day during the test period?	2.2	0.6	1.6	reaction

S: Student society. **C**: Classmates.

Table 24.3: Results from questions related to players' engagement.

In the questionnaire, respondents were given an option to leave additional comments regarding their perceived engagement. One participant wrote that they appreciated the push notification that reminded them to hover when they entered a valid area.

*"It's very nice that you get push alerts when you are in a zone where you can use Hover."**

*Translated from Norwegian

Another participant was not aware of this feature, likely because they did not provide appropriate permissions to the application. However, the player states that such a feature would have made them play the game more.

*"I think I would have used the app more if I had been notified when I was within a zone."**

24.2 Results on Engagement from Usage Data

Data from Google Analytics and the database reveals how the players have engaged in the game during the two weeks of testing. The usage data also presents the most used features in the application.

Figure 24.2 shows the number of daily users. Meaning the number of users that have opened the application at least once during that day. The data shows a clear tendency that the number of active users was decreasing during the test period. Day 1 is the peak, and day 13 the lowest point. Both Mondays, days 1 and 8, are the peaks of their respective weeks. Another tendency is that there are fewer active users during the weekends (days 6, 7, and 13). Additionally, there appears to be a correlation between the number of active users and the number of published activities, with days 6 and 14 being the exceptions. The spike on day 14 was likely due to the distribution of the questionnaire that day.

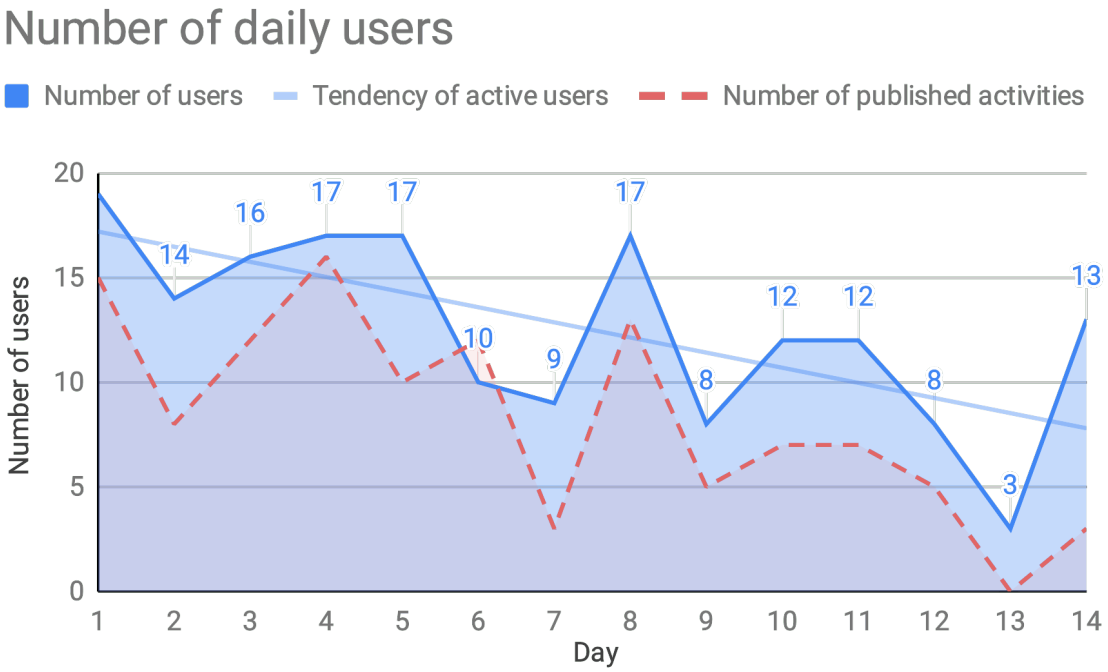


Figure 24.2: The number of daily users during the 14 days of testing.

*Translated from Norwegian

Google Analytics allowed us to identify what parts of the application the users spent their *active time*. Active time describes an application state where it is foregrounded, and the screen is unlocked. Figure 24.3 shows what screens (described in Chapter 15) the users engage in. The numbers show that the feed, tracking (hover), and leaderboard screen are where the users spent the most time.

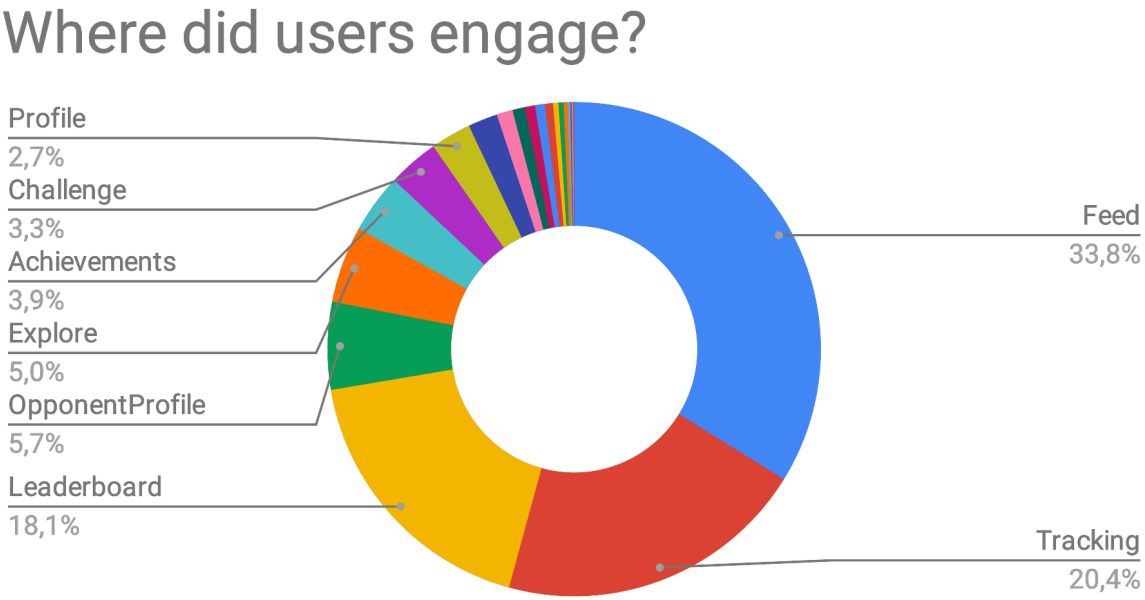


Figure 24.3: A pie chart of the most used screens in Hover.

Activities

Figure 24.4 shows how many activities were published during the two weeks of testing. The figure reveals that users were more eager to hover during the first week. Both of the weeks have in common that Monday has a higher number of activities published. Other than the peek on Mondays, the graphs show that the number of activities decreased through the period. Consequently, there seems to be a correlation between the number of active users and published activities.

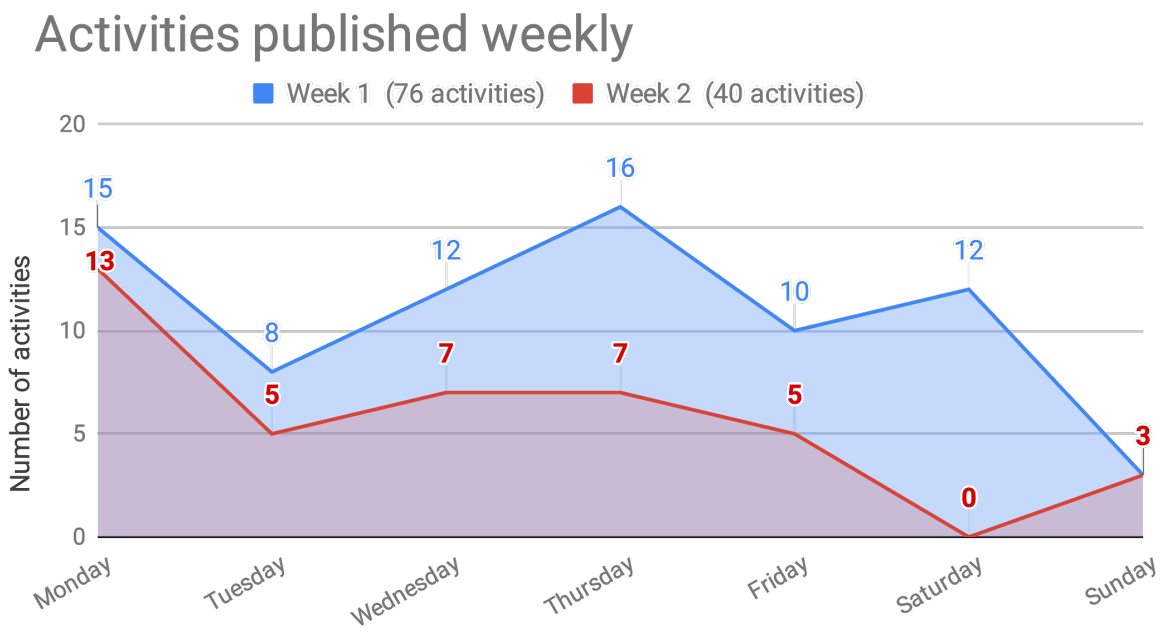


Figure 24.4: A comparison of the activity level between the two weeks.

The next figure, Figure 24.5, shows the different events recorded by Google Analytics while tracking (hovering). The "Start tracking" event reveals that the players started hovering a total of 141 times during the test period. Out of these, 116 were published, 19 discarded, and 6 lost.

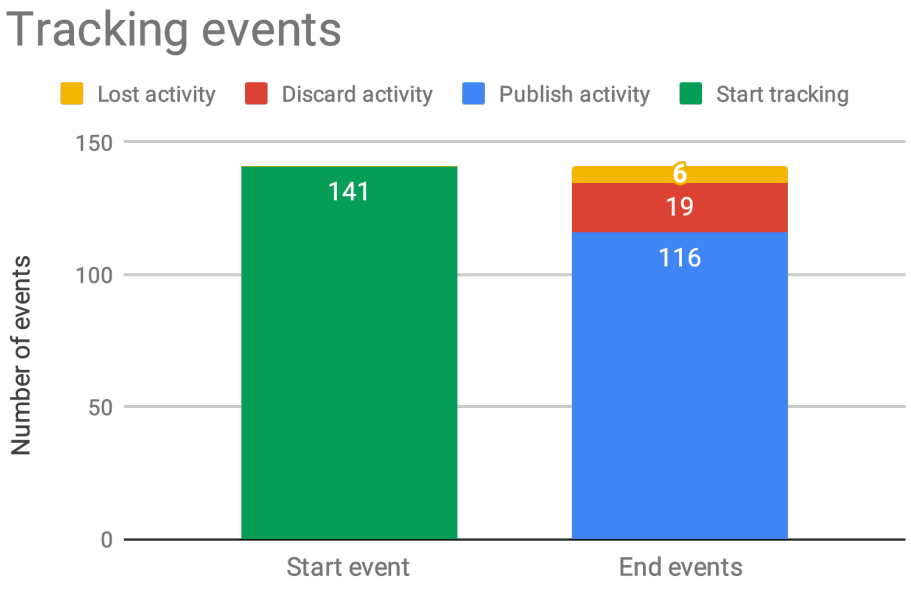


Figure 24.5: The tracking events recorded by Google Analytics.

Of the 116 activities published, 69% were completed by the participants at the student

society and 31% by the classmates (see Figure 24.6). Since the participants at the student society make 63% of the total test population, this difference is expected.

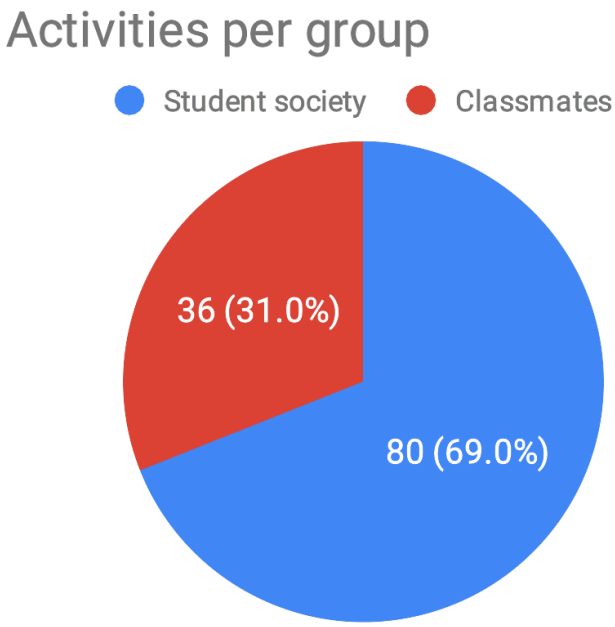


Figure 24.6: The number of activities published by the two groups.

Figure 24.7 shows the distribution of activities published per user. The bar chart shows that all but one user have performed between 2 and 8 activities each. The number of activities performed by user 1 deviates from the rest of the data set, with a peeking number of 24 activities. This deviation is remarkable as it increases the average number of activities among the Student society group from 5.1 to 6.7. However, the difference in the two groups is not significant (with outlier $p = 0.3821$, without outlier $p = 0.5000$).

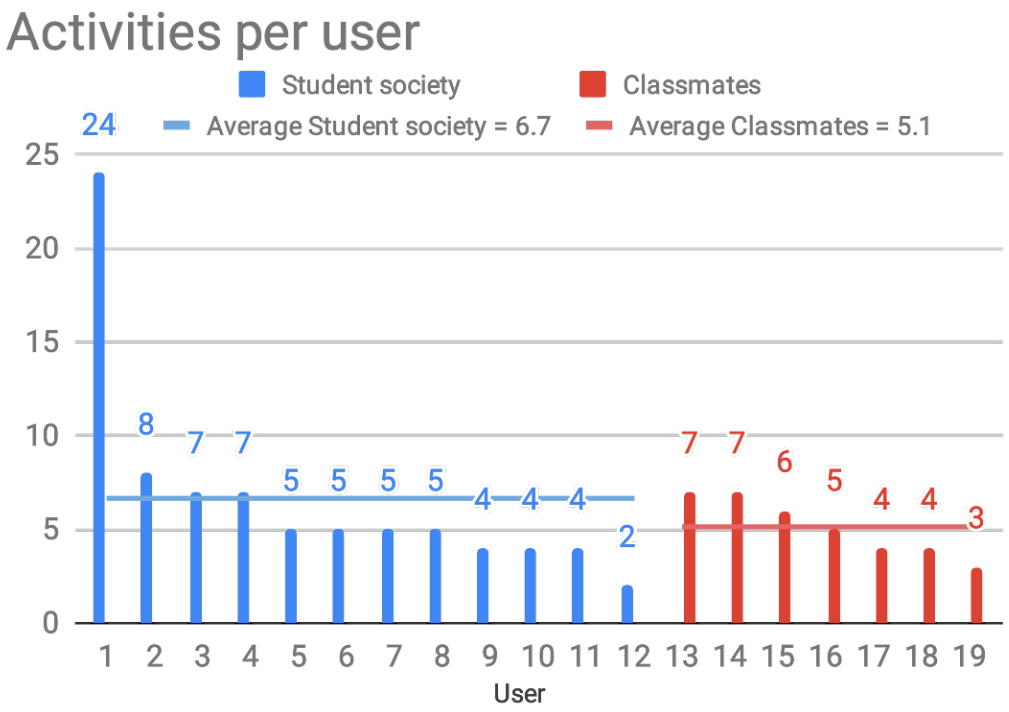


Figure 24.7: The number of activities published by each participant.

Table 24.4 reveals how the friend tracking feature has been used. 43 of the 116 activities published utilized friend tracking, which makes 37% of all activities. 14 out of 19 participants used the feature at least once, where the student society group used it more frequently than the classmates, with an average of 2.7 times per participant. However, this difference is not significant.

Hover with friend usage	Student society	Classmates	Combined
Number of activities utilizing it	32/80 (40.0%)	11/36 (30.6%)	43/116 (37.1%)
Number of participants using it at least once	10/12 (83.3%)	4/7 (57.1%)	14/19 (73.7%)
Average number of use per participant	2.7	1.6	2.7
Result from the Mann-Whitney test	p = 0.1660		

Table 24.4: Use of Hover with Friend.

Locations

Figure 24.8 shows the hover zones used during the two test weeks. The users visited only five locations, even though there were 46 hover locations in the Trondheim region. Out of the five locations, NTNU Gløshaugen and the Student Society in Trondheim were the most visited zones.

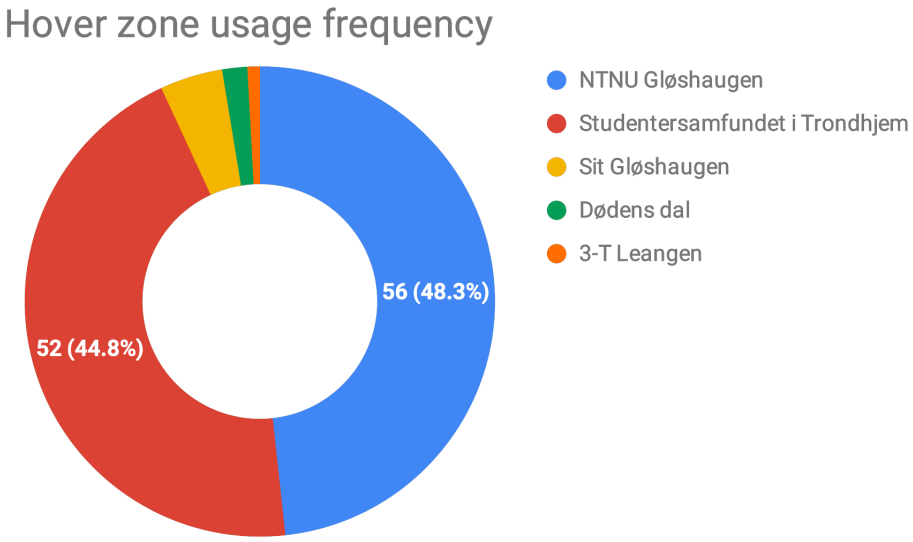


Figure 24.8: Usage frequency of Hover zones.

Between the two groups, there is a difference in where they have been hovering. Figure 24.9 reveals that the student society group published all of the activities in the cultural zones. Both groups have used the education and exercise zones, and none of them used the social category.

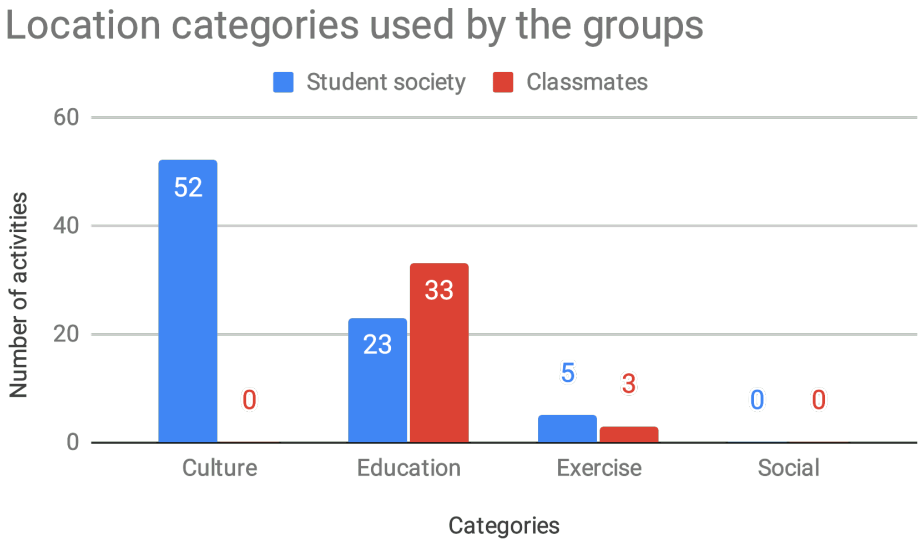


Figure 24.9: The difference in locations used by the two groups.

Score and Duration

Figure 24.10 shows the average time the participants have spent hovering in each category. The student society group had an average of 10 hours and 52 minutes, whereas the classmates had an average of 10 hours and 14 minutes. The groups spent most of their time in the culture category and educational category.

Figure 24.11 shows the average score in each category for the participants in the two groups. The average in the student society was more than three times the average of the classmates. Figure 24.10 revealed that the average time spent hovering was approximately the same for the two groups.

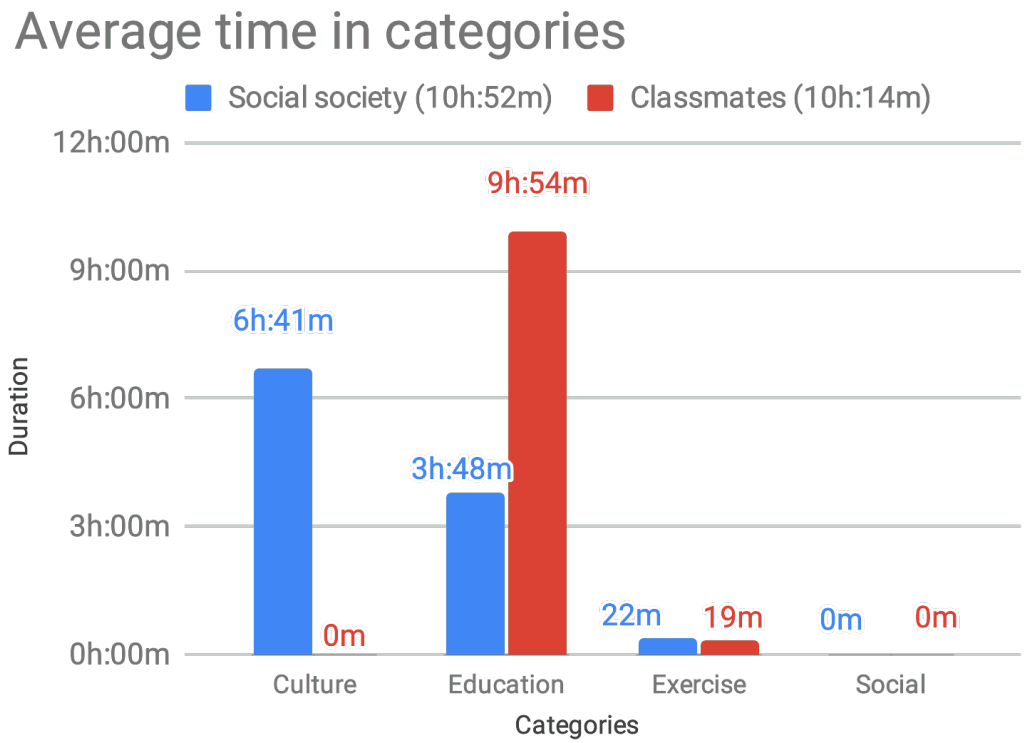


Figure 24.10: Average time spent hovering in the four categories.

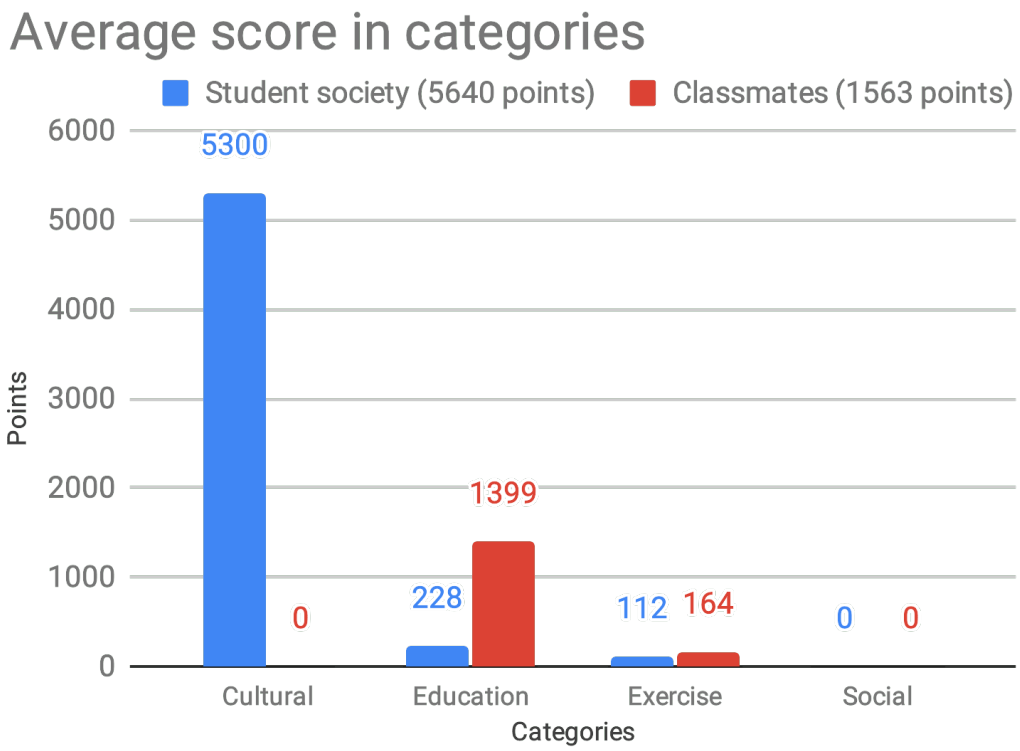


Figure 24.11: Average score for the two groups in each category.

Achievements

Achievements earned by the participants are presented in Figure 24.12. The color of the bar symbolizes the difficulty level of the achievement. They are also grouped according to their type. Due to the design of the achievement system, there is naturally an abundance of bronze achievements and a low number of gold achievements. All players earned two or more achievements, and thus, all 19 players received the *First activity* achievement. 15 players accumulated 1000 points or more. Out of the four *points-in-category* achievements, the cultural category has been awarded to the highest number of players.

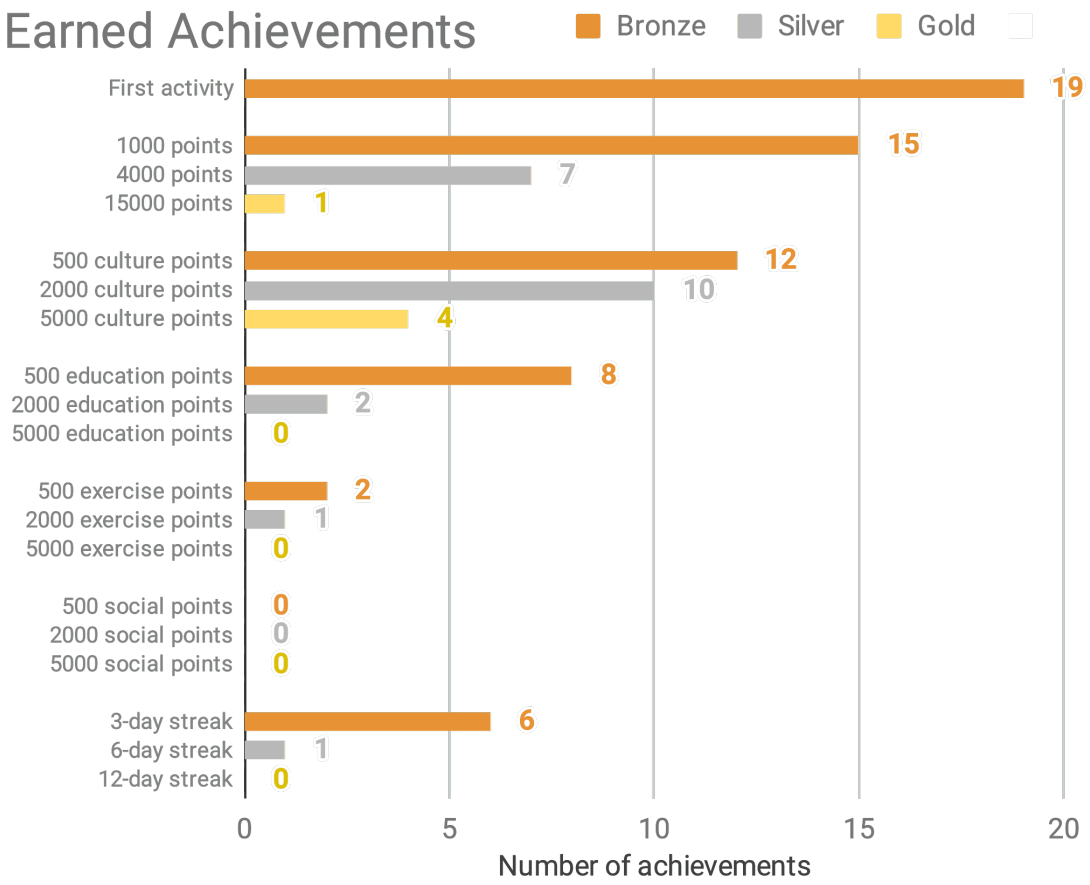


Figure 24.12: The number and types of achievements earned.

The number of achievements earned by the two groups (see Figure 24.13) shows a considerable difference, where the student society group earned almost three times as many achievements as the group of classmates.

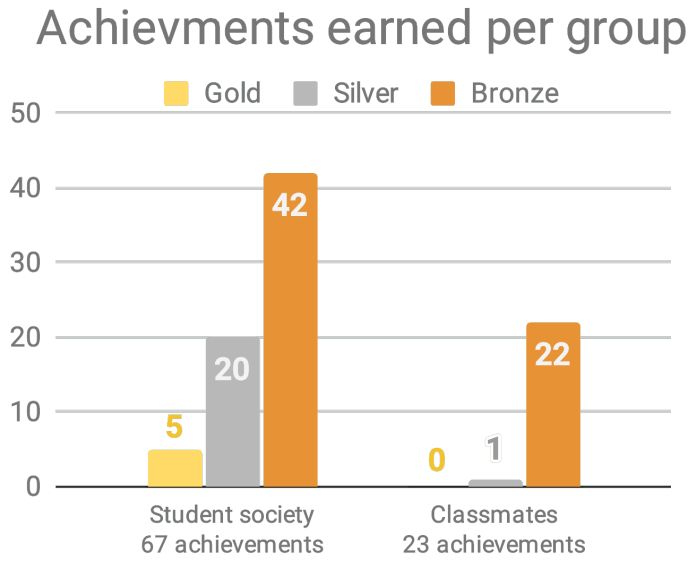


Figure 24.13: The number of achievements earned by the two groups.

Challenges

Figure 24.14 shows the seven challenges created in the test period. We observed that only three challenges were started during the first week of testing and that these only engaged four unique players. To ensure that all participants were familiar with the in-game challenges, we created three challenges in the beginning of the second week (*Developers* in the figure). Two of the challenges were created for the student society and one for the group of classmates. However, the challenges did not enhance the players' engagement, with many either ignoring or declining the invites, especially in the student society group.

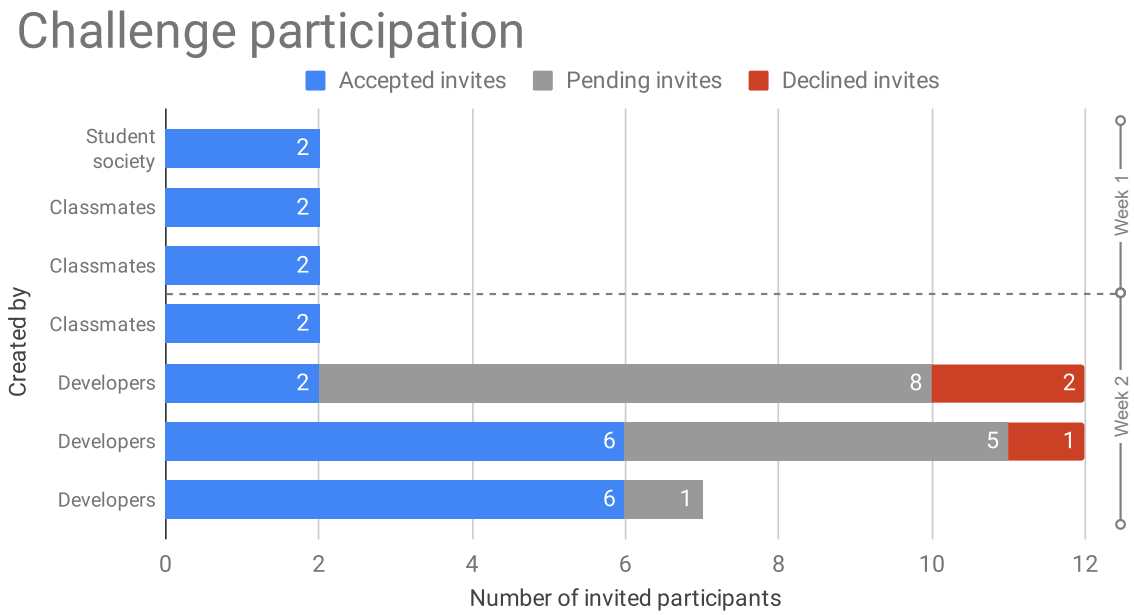


Figure 24.14: The number of participants in each challenge.

Reactions

The reactions given by the users are shown in Figure 24.15. The student society group accounted for 89% of the reactions, while the group of classmates generated 11%. The student society group is larger than the group of classmates, and naturally, they represent a larger number of the given reactions. However, the average number of reactions given by the two groups shows that the student society group gave reactions more frequently (see Figure 24.16).

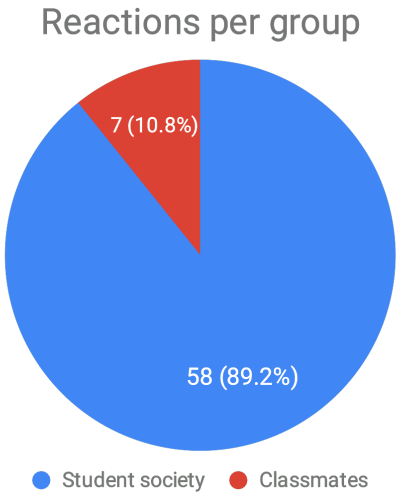


Figure 24.15: The difference in reactions given by the two groups.

Figure 24.16 shows the average number of reactions given by each user. The student society group gave 4.8 reactions per participant, and the classmates gave one reaction per participant. The blue and red linear graphs in the figure are the averages. There were six users, three from each group, who did not react to any posts at all. Additionally, there was one user (1) that used the reaction feature remarkably more than any other participant, reacting to a total of 25 posts. This outlier increased the average result per user in the student society group from 3.0 to 4.8. Even if we ignore the outlier, the student society reacted to three times as many posts as the classmates (with outlier $p = 0.0643$, without outlier $p = 0.0951$).

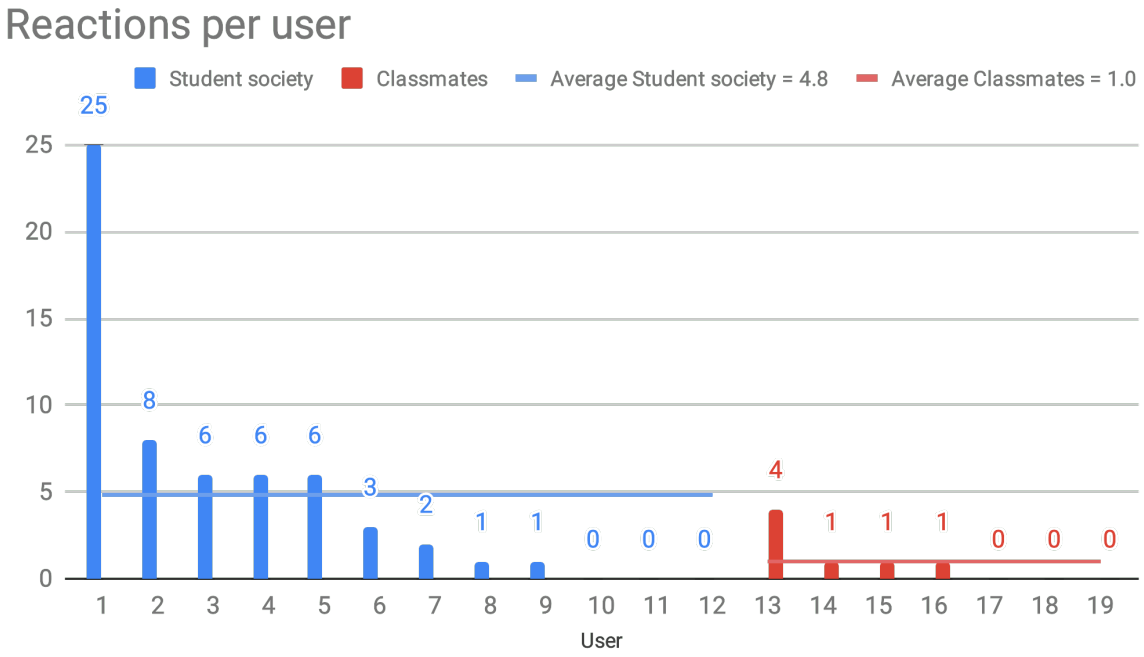


Figure 24.16: A bar chart showing the number of reactions given by each user.

24.3 Summary

This chapter described results relevant to RQ2, based on data collected from the questionnaire and the application. The results also highlighted remarkable differences in engagement among the student society group and the group of classmates. The next chapter presents results related to the next research question (RQ3), describing the players' motivation.

Chapter 25

Results on Player Motivation

In this chapter, we will continue presenting results from the study relevant to *RQ3: "How do game design elements and social interaction in our game concept affect the players' motivation?"*. Results from the questionnaire, interviews, and observations of participants will be described.

25.1 Results on Motivation from Questionnaire

The questionnaire includes ten statements and three questions related to the players' motivation (presented in Table 25.1). Similar to the previous chapter, a 3-point Likert scale is used.

#	Statements	D	N	A
S7	I was motivated to carry out activities by the opportunity to win medals.	58%	11%	32%
S8	I was motivated to carry out activities by the opportunity to earn points.	16%	5%	79%
S9	I was motivated to carry out activities because others did it	16%	11%	74%
S10	I was motivated to carry out activities to keep my streak alive.	58%	21%	21%
S11	Reactions to my activities inspired me to use the application more.	63%	21%	16%
S12	The leaderboard motivated me to get as many points as possible.	0%	16%	84%
S13	The ability to earn double points by using the application with a friend inspired me to use it more.	11%	5%	84%
S14	Challenges between friends inspired me to use the application.	16%	11%	74%
S15	I was inspired to use Hover by other players' activities.	21%	16%	63%
S16	I opened the application when I received a notification.	74%	5%	21%

D: Disagree. **N**: Neutral. **A**: Agree.

Table 25.1: Results from statements related to players' motivation.

Based on the answers, there were mainly four elements that seemed to have less effect on increasing the players' motivation. Only 32% agreed that winning medals (S7) increased their motivation for playing the game. The inclusion of streaks (S10) and the possibility of reacting to posts in the feed (S11) did not either increase the players' motivation. Additionally, the last statement (S16) revealed that notifications did not influence most tester's use of the application. Almost three-quarters answered that they did not open the application when they received a notification.

On the other side, six of the game elements had a motivating effect. Earning points (S8) and influence from friends (S9) positively impacted the participants' motivation. However, the possibility for users to view their position in a leaderboard (S12), and get double points when hovering together with a friend (S13), had the highest impact. As much as 84% percent of the participants agreed that these affected their motivation. In addition to these aspects, challenges between friends (S14) and the ability to follow other people's activities in the feed (S15) positively influenced the players' motivation.

The two groups responded differently to some of the statements. Table 25.2 shows the most remarkable differences, with statements S11 and S13 showing statistically significant values ($p < 0.05$).

#	Statements	Group	*n*	D	N	A	p
S7	I was motivated to carry out activities by the opportunity to win medals.	Student society	12	67%	17%	17%	0.0694*
		Classmates	7	43%	0%	57%	
S11	Reactions to my activities inspired me to use the application more.	Student society	12	83%	17%	0%	0.0233**
		Classmates	7	29%	29%	43%	
S13	The ability to earn double points by using the application with a friend inspired me to use it more.	Student society	12	0%	0%	100%	0.0495**
		Classmates	7	29%	14%	57%	
S14	Challenges between friends inspired me to use the application.	Student society	12	25%	17%	58%	0.0749*
		Classmates	7	0%	0%	100%	

n: Number of participants. **D**: Disagree. **N**: Neutral. **A**: Agree. **p**: results from Mann-Whitney test.
* $p < 0.1$ ** $p < 0.05$

Table 25.2: Noticeable differences in motivation for the two sample groups. Full table in Appendix G.

As described at the beginning of this subsection, four questions were asked to the participants. The results from the first three are presented in Figure 25.1.

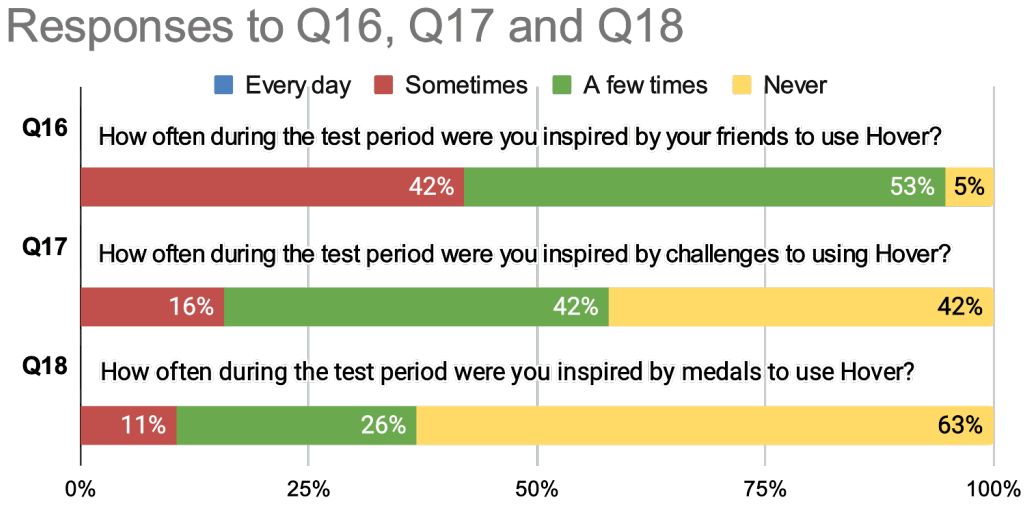


Figure 25.1: Motivation question (Q16, Q17, and Q18) answers.

The questions give more insight into how often the users were motivated by friends (Q16), challenges (Q17), and achievements (Q18). The first question confirms the answers in S12 and S13, proposing that the social aspect of Hover motivates the players. The last question also (Q18) coincides with the associated statement (S7). The participants were not particularly inspired by the possibility to earn achievements. In question Q17, 84% of the participants answered that they were never or only a few times motivated by challenges to use Hover.

Additionally, the next question (Q19) asked the participants, "Was the number of points in each category correct in relation to your effort?". As seen in Figure 25.2, two-thirds of the players thought the points were distributed fairly. The people responding "No" to this question mentioned that the points awarded in the culture zones should have been lower:

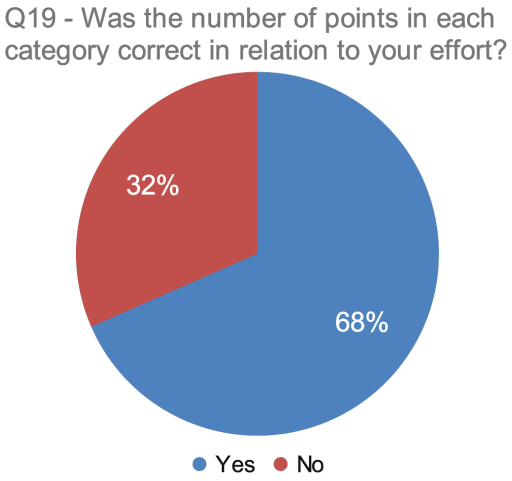


Figure 25.2: Answers to question Q19.

"The educational points were a bit too low, compared to culture." *

"A bit too many points to collect at Samfundet (culture category)" *

"Somewhat demotivating that you got a lot more points for culture than school" *

At the end of the motivation part of the questionnaire, the participants were allowed to write additional comments or feedback they might have. These questions gave us multiple positive reactions to the concepts:

"Very cool concept that I will continue to use to motivate me to go to school" *

"The challenges motivated me to go to school" *

"A very cool concept with a lot of potentials" *

*Translated from Norwegian

25.2 Results on Motivation from Interviews

In the interviews, we got some more feedback on which elements of the game motivated the players. The data confirmed the results obtained in the questionnaire, but we also got some additional reactions and perspectives.

All the participants mentioned points and friends as essential motivation factors. While these answers were in line with the results from the questionnaire, other ones did not correspond that well. As mentioned in the previous section, some participants expressed in the questionnaire that the number of points sometimes was distributed unfairly. Consequently, the distance between participants in the leaderboard could become substantial, decreasing the motivation for some players.

"In the first 3-4 days, I did not get a lot of points. After that it was already so far up to the top of the leaderboard that it was kind of demotivating." *

The response to challenges between friends was also mixed. Some users described them as motivating, while others did not feel the same way. One of the participants said:

"When I was invited to challenges, I felt I had to get to school to use the app to win. It was motivating." *

Another one mentioned that the challenges would become more fun if the rules were not as customizable. By allowing everyone to set their own rules for the challenges, people could create one they were sure to win themselves. Making it less fun for others.

"The challenges did not work as well for me. Because if I were to make one, I would be sure that I made one that I was certain to win. [...] It would probably be better to not make them as customizable." *

Another proposal for enhancing the player's motivation was to add more incentives for earning points. One of the participants suggested that adding some sort of real-life rewards in exchange for points would increase the motivation for hovering. Another participant wished they could use their score on in-game elements.

"The rewards did not give me sufficient incentive for playing. [...] I think I would have been more motivated if I could spend it on something in the cafeteria." *

*Translated from Norwegian

"I wish I could use the score to buy background color in the app or a cooler hat for my avatar. Such things work very well for me." *

25.3 Results on Motivation from Observations

Observations of participants playing the game again confirmed how important the social aspect was for the motivation. There were multiple situations of someone mentioning the game to others, sometimes almost forcing them to play. Without the social incentive and pressure to play, players' motivation would decrease. Apart from this confirmation, the observations did not reveal anything worth mentioning.

25.4 Summary

The results related to the players' motivation has been presented in this chapter. We have highlighted the participants' perceived motivation through answers given in the questionnaire and interviews. We also presented in-game observations and identified differences between the two groups. In the next chapter, we will shift focus to the players' enjoyment and look at data that can be used to answer the next research question, RQ4.

*Translated from Norwegian

Chapter 26

Results on Player Enjoyment

The focus in this chapter is similar to the previous two. We will present data related to *RQ4: "How do game design elements and social interaction in our game concept affect the players' enjoyment?"*. Chapter 28 will use this data to discuss and evaluate the results.

A player's enjoyment in games is challenging to measure appropriately. Quantitative data from the application does not describe enjoyment in a good way. Thus, the primary data sources in this chapter are answers from the questionnaire and qualitative data from interviews and observations.

26.1 Results on Enjoyment from Questionnaire

Table 26.1 summarizes the results from the nine statements related to the players' enjoyment. As in the previous two chapters, the results use a 3-point Likert scale for improved readability.

#	Statements	D	N	A
S17	I liked the concept of Hover.	11%	32%	58%
S18	It was sad to stop using Hover after the test period ended.	37%	37%	26%
S19	I felt that the progress in the game was always clear.	21%	26%	53%
S20	There was an appropriate degree of difficulty in achieving medals.	21%	47%	32%
S21	My status in the game increased the more I played.	11%	47%	42%
S22	The challenges I participated in had clear goals.	0%	32%	68%
S23	I felt attached to my unique avatar.	79%	5%	16%
S24	I was happy to get reactions to my activities and medals.	26%	42%	32%
S25	I was curious to see what my friends had been up to.	53%	5%	42%

D: Disagree. **N**: Neutral. **A**: Agree.

Table 26.1: Results from statements related to players' enjoyment.

Looking at the answers, we can see that the results are generally good, with a clear positive shift in many statements. A lot of the participants were either neutral or agreed. The first exception is in S18, where the answers are evenly distributed between the three possibilities; disagree, neutral, and agree. However, the most prominent deviation is S23, where most participants disagreed that they felt attached to their unique avatar. Additionally in S25, opinions were splitted on how they perceived their curiosity towards

their friends' activities in Hover. Answers here had a clear overweight on the edge cases, either disagree or agree.

The most noticeable results from running the Mann-Whitney test on the two groups are shown in Table 26.2. S18, S21, S23, and S25 have statistically significant values with $p < 0.05$.

#	Statements	Group	*n*	D	N	A	p
S18	It was sad to stop using Hover after the test period ended.	Student society	12	42%	50%	8%	0.0495**
		Classmates	7	29%	14%	57%	
S19	I felt that the progress in the game was always clear.	Student society	12	33%	25%	42%	0.0885*
		Classmates	7	0%	29%	71%	
S21	My status in the game increased the more I played.	Student society	12	17%	67%	17%	0.0064**
		Classmates	7	0%	14%	86%	
S23	I felt attached to my unique avatar.	Student society	12	100%	0%	0%	0.0233**
		Classmates	7	43%	14%	43%	
S25	I was curious to see what my friends had been up to.	Student society	12	67%	8%	25%	0.0418**
		Classmates	7	29%	0%	71%	

n: Number of participants. **D**: Disagree. **N**: Neutral. **A**: Agree. **p**: results from Mann-Whitney test.
* $p < 0.1$ ** $p < 0.05$

Table 26.2: Noticeable differences in enjoyment for the two sample groups. Full table in Appendix G.

As part of the questionnaire, the respondents were asked if they had any additional comments related to their enjoyment. One of the respondents stated that it was satisfying to earn points, while another one enjoyed comparing points against friends:

"It was satisfying to earn points." *

"I enjoyed comparing my points against other people I knew." *

Technical problems?	Yes	No
All	47.4%	52.6%
iOS	0.0%	100.0%
Android	66.7%	33.3%

Table 26.3: Percentage of people who had technical problems.

In addition to the statements directly related to enjoyment, answers from one of the general questions in the questionnaire are relevant to this topic. The participants were asked if they encountered any technical issues during the test phase. As seen in Table 26.3, almost half of the respondents answered *"yes."* All of these used Android as their operating

*Translated from Norwegian

system. Technical problems can result in frustration for players and thus decrease their enjoyment. An example is explained in a comment from one of the participants:

*"I lost the points I had earned one day because of a technical error, which made me sad."**

26.2 Results on Enjoyment from Interviews

In the interviews, we got some more insights into how the participants enjoyed the application. One of the participants thought it was a fun concept to try in an otherwise boring life, where many events and meetings were canceled or postponed because of Covid-19.

Participants also mentioned that the social interaction between friends was something they enjoyed. Especially related to the "Hover with friend" functionality. Multiple interviewees mentioned that they thought this part of the application was fun. According to one of the participants, whether or not people wanted to hover together was often a question.

However, not all enjoyment feedback brought up during the interviews was positive. Some participants reported aspects of the game that decreased their enjoyment. The most vital of these is related to the social part of the game. Multiple people mentioned that there should be a social system for categorizing friends and what the users see in the feed.

"I did not recognize all people publishing activities in the feed. Browsing the feed was, therefore, less fun." *

Two of the interviewed participants also told us that they were forced to stay at home in the first week of testing due to national quarantine regulations. When they started to use the application, one week after everybody else, the enjoyment of hovering was less because they felt winning was unrealistic. One of them said:

"It was a bit depressing to see people earn points and get a head-start the week I was in quarantine." *

*Translated from Norwegian

26.3 Results on Enjoyment from Observations

Observations of players confirmed some of the aspects of players' enjoyment revealed during the interviews. While observing people using the application, the social interaction seemed to cause the most enjoyment from the participants. People were talking about the game and planning who should hover together. Apart from that, the observations did not reveal anything of significance related to the players' enjoyment.

26.4 Summary

This chapter has presented results on player enjoyment gathered from the questionnaire, interviews, and observations. Overall, the majority of the participants enjoyed Hover, especially the social features of the game. Perceived differences between the two groups were also described. Statistically significant differences were revealed using Mann-Whitney tests. The next chapter will present results related to RQ5, investigating how Hover affected peoples' habits.

Chapter 27

Results on Change in Habits

In this chapter, results related to *RQ5: "How does the use of our game concept affect the players' habits?"* will be presented. As in the previous three chapters, data from the chapter will be used to discuss this research question in Chapter 28.

It can be difficult to find reliable and objective data that reveals changed habits in a project of this size because it requires observations to be made over an extended period. Measuring the different activity levels between the two weeks is insufficient. Thus, we depend on the players' perceived change in habits. The data described below are collected from the questionnaire and conducted interviews.

27.1 Results on Change in Habits from Questionnaire

The questionnaire included eight statements and two questions to investigate changes in players' habits. The statements, presented in Table 27.1, are grouped by their respective categories (culture, education, exercise, and social). For each of these categories, the participants had to state whether they felt their habits were changed and if the game made them want to visit such locations more often. Like the previous chapters, a 3-point Likert scale is used for improving readability.

#	Statements	D	N	A
S26	Hover has changed my habits about how often I use cultural offerings.	95%	0%	5%
S27	Hover made me want to use cultural offerings more often.	84%	5%	11%
S28	Hover has changed my habits about how often I exercise.	100%	0%	0%
S29	Hover made me want to exercise more often.	90%	5%	5%
S30	Hover has changed my habits about how often I visit my educational institution.	68%	5%	26%
S31	Hover made me want to visit campus more often.	68%	16%	16%
S32	Hover has changed my habits about how often I am social.	74%	21%	5%
S33	Hover made me want to visit social zones more often.	79%	11%	11%

D: Disagree. **N**: Neutral. **A**: Agree.

Table 27.1: Results from statements related to change in habits.

As seen in the table, the results are very one-sided, and the majority of the participants disagree with all eight statements. However, there is a clear difference between the two

groups, revealed by the values in Table 27.2. The differences in answers from the two groups are statistically significant for S27 and S30-S33. S28, on whether Hover changed their exercise habits, shows a significant difference between the two groups, but also a 100% disagreement result in both groups. This result might seem strange; however, it has a natural reason. As explained earlier in the chapter, the table uses a 3-point Likert scale for improved readability. Consequently, there can be a significant difference based on the possibility of answering *strongly disagree* and *disagree*. Further investigation confirms that this is the case in S28, with the student society group answering *strongly disagree* to a larger degree than the classmates.

#	Statements	Group	*n*	D	N	A	p
S26	Hover has changed my habits about how often I use cultural offerings.	Student society	12	100%	0%	0%	0.0694*
		Classmates	7	86%	0%	14%	
S27	Hover made me want to use cultural offerings more often.	Student society	12	100%	0%	0%	0.0344**
		Classmates	7	57%	14%	29%	
S28	Hover has changed my habits about how often I exercise.	Student society	12	100%	0%	0%	0.0951*
		Classmates	7	100%	0%	0%	
S29	Hover made me want to exercise more often.	Student society	12	92%	8%	0%	0.0951*
		Classmates	7	86%	0%	14%	
S30	Hover has changed my habits about how often I visit my educational institution.	Student society	12	100%	0%	0%	0.0023**
		Classmates	7	14%	14%	71%	
S31	Hover made me want to visit campus more often.	Student society	12	100%	0%	0%	0.0023**
		Classmates	7	14%	43%	43%	
S32	Hover has changed my habits about how often I am social.	Student society	12	92%	8%	0%	0.0113**
		Classmates	7	43%	43%	14%	
S33	Hover made me want to visit social zones more often.	Student society	12	100%	0%	0%	0.0064**
		Classmates	7	43%	29%	29%	

n: Number of participants. **D**: Disagree. **N**: Neutral. **A**: Agree. **p**: results from Mann-Whitney test.
* $p < 0.1$ ** $p < 0.05$

Table 27.2: Noticeable differences in habits for the two sample groups. Full table in Appendix G.

The players were given two closed (yes/no) questions at the end of the questionnaire (see Figure 27.1). Q22 examines if the player wants to continue using a game like Hover. The results from this question were split between the two groups. The student society leaned towards *"no"*, while the group of classmates was more on the *"yes"* side. In total, a slight majority of 53% stated that they would not like to continue using a similar game concept.

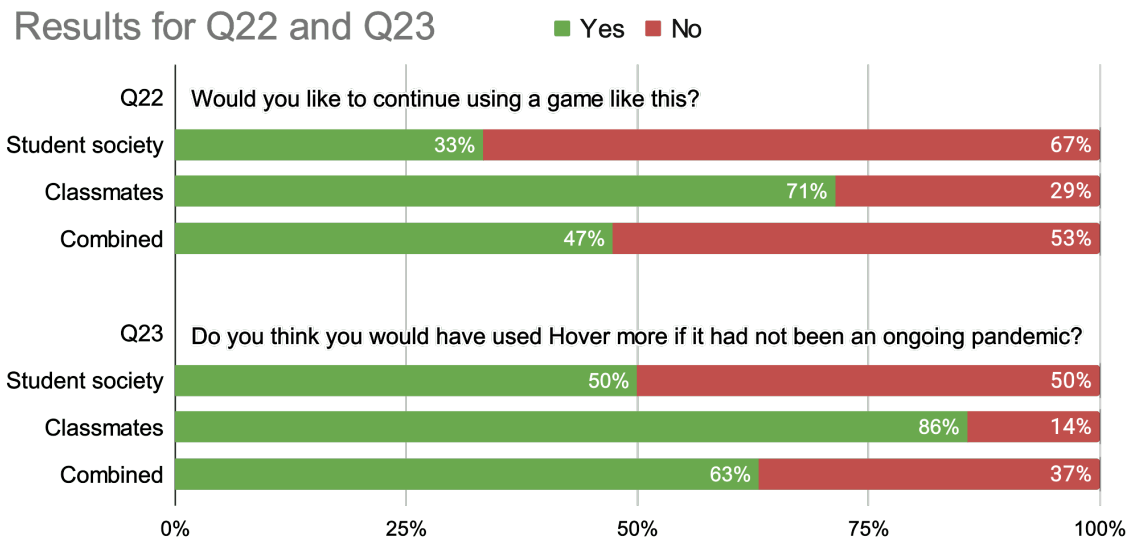


Figure 27.1: Answers to Q22 and Q23.

Q23 asked the participants if they thought they would have used the game more if it had not been an ongoing pandemic. Similar to the previous question, the results are not united between the groups. 86% in the group of classmates responded *"yes"* to the question, while only 50% in the student society group did the same. In total, more than half of the respondents (63%) answered *"yes"*.

For the participants responding *"yes"*, a follow-up question of "Why?" was asked. Common for most of the responses was that they would have visited more places, such as concert venues, restaurants, and training centers.

"Normally I would probably go to campus almost every day, but during the test period, I did not go at all." *

"In a normal situation, there would be more activities to do. A lot is closed, and people are more at home than usual." *

One participant reported that they avoided campus due to infection control and felt there was a higher threshold for going to cultural events:

"I worked at home the first week of the test period because I wanted to avoid campus due to infection control. Also, there is a higher threshold for going to any type of cultural happenings." *

Similar to the other topics in the questionnaire, the participants could also leave general

*Translated from Norwegian

comments regarding their change in habits. One participant stated that it was difficult to change habits because they did not use the game continuously. Another reported that they thought their habits could change if the testing would have lasted longer.

"Since I did not use Hover continuously during the test period, it was difficult to change habits." *

"My habits could probably change more if I used the app for a longer period than two weeks." *

Two of the participants commented that though Hover did not change their habits, they felt that it induced more value to the activities.

"It did not change my habits directly. More so that it gave schoolwork an extra added value." *

"I do not think Hover got me to visit the Student Society/campus/training centers more frequently, but it was a nice addition that made these activities more rewarding." *

27.2 Results on Change in Habits from Interviews

In the interviews, we tried to investigate to what degree the participant's habits were affected by the pandemic. All of the interviewees stated that they, to a large degree, were affected by the national restrictions and what they felt comfortable doing. One participant said that their activity level was probably around 20% of their normal non-pandemic behavior.

27.3 Summary

This chapter described results related to change in habits (RQ5) from the questionnaire and interviews. The results also presented differences between the two groups and a selection of statements made by the participants regarding their perceived change in habits. The chapter is the last one in Part V, concluding the presentation of data gathered during the test period. In the next part, we will discuss and evaluate the results presented in this part, conclude the project, and elaborate on possibilities for further work.

*Translated from Norwegian

Part VI

Discussion & Conclusion

This part presents a discussion of our results and concludes the project by answering the research questions given in Chapter 3. Additionally, the part presents a project retrospect and suggestions for further work in this project.

Chapter 28

Discussion

In Part V the results from testing Hover on a selection of users were presented. This chapter will compare and discuss those findings, revealing elements of the study necessary for answering the research questions. The described knowledge will help us conclude the project in Chapter 29.

28.1 Discussing Results on Player Engagement

Chapter 24 presented results on player engagement collected from the questionnaire and application usage data. The screen engagement data revealed that the feed, tracking screen, and leaderboard are where the participants spent the most time. This result was expected as these screens hold the core game design elements and interaction mechanisms. The screen engagement measurement only considers the time where the application is foregrounded. Since the gameplay in Hover is passive (tracking typically runs in the background), it is not surprising that the engagement in the tracking screen has approximately the same fraction of use as the feed and leaderboard.

Though screen engagement reported that the participants spent most of their time in the feed, we found that the participants did not use the reaction functionality much. 58% of participants disagreed that they often reacted to other players' activities and achievements. One reason for this, which the participants in the interviews mentioned, is that the users refrained from interacting with participants who did not have a screen name they recognized. Because of privacy concerns raised by NSD, we could not encourage the tester to use their real names. Consequently, the participants were free to choose their screen names, affecting their willingness to interact with other players.

Moreover, the prototype did not include the concept of friends or groups. All players could, therefore, potentially interact with everyone. Some participants mentioned in the interviews that they felt uncomfortable interacting with people they did not know, thus influencing their reaction frequency.

We also saw that the participants in the student society group reacted on average three times as much as the group of classmates. Internal relationships within the group can explain this difference. We know that the people in student society have a stronger connection than the classmates.

Out of 141 started activities, 19 were discarded, and six were lost. The number of discarded activities was not surprising compared to the number of participants in the experiment. Several scenarios could result in a participant not wanting to publish their activity. One example is that the participant started an activity only out of curiosity when exploring the application. The six lost activities are caused by user errors or technical issues with the device or application. However, the number of lost activities is not remarkable considering it only makes up 4% of the total activities. The 116 published activities gives an average of 6 activities per participant, which roughly equals one activity every other day. If we consider the circumstances, this is a solid number.

The usage data also revealed that the participants played more during the first week (76 activities) of testing than the second week (40 activities). The decrease was somewhat unexpected, and we had hoped the numbers would increase in the second week instead. In addition to this, the numbers also showed a reduction in the activity count during the weekends. This pattern was expected due to the national guidelines encouraging people to stay at home.

Out of the 46 possible Hover locations, only five were used. This result was somewhat disappointing but expected due to the national regulations and recommendations at the time. Four of the five locations are popular spots for students in Trondheim, and therefore the small diversity among locations was not unexpected considering the test population. None of the participants visited any of the social category locations, e.g., restaurants and cafes. However, this was not surprising as many of these were either closed or restricted to some degree.

The application also gave participants location-based notifications reminding them to hover when they were inside a zone. These notifications positively affected the engagement in the game, with 47% (S6) agreeing that notifications made them use the application more. Several of the participants stated that they appreciated the reminders. Even though we consider this share a high number, we expected it to be even higher. One

reason for this result was that some participants did not receive location reminders due to incorrect location permissions. This lack of permission prevented them from experiencing the reminder and consequently they disagreed with the statement.

The in-game challenges had a low engagement, with only four challenges created by the participants. For that reason, we found it necessary to set up three challenges to make sure all players were familiar with the feature. Despite the low engagement, above half of the participants agreed that challenges between friends inspired them to use the application more (S4). This result is a bit conflicting with the game's usage data illustrating little use of in-game challenges. Unfortunately, based on the limited data from the survey, we did not find an apparent reason for this conflict.

Difference between the two groups

The only significant difference between the two groups was found in the statement evaluating the in-game challenges. 86% of the classmates agreed that challenges inspired them to use the application more. In contrast, only 42% of the participants from the student society group agreed to the same question. Since there was no difference in actual challenge engagement, as described above, it was hard to find a logical explanation for the difference.

There were also clear differences between the two groups in some aspects of the usage data. One of those was the difference in the average score accumulated by the two groups. While the student society group participants had an average of 5640 points, the classmates only earned 1563 points on average. Despite this, the time spent hovering did not differ much. The average time per player in the student society group was 10 hours and 42 minutes, while the group of classmates had an average of 10 hours and 14 minutes. Thus, the difference in the score is influenced by something other than the time spent hovering. One apparent reason is that the student society tracked 65% of their activities in the cultural category, earning 5 points per minute. In contrast, the classmates tracked 91% of their activities in the educational category, where only 1 point was given per minute. In addition to this, the student society used the friend tracking feature more, resulting in frequent double points.

A considerable difference in the number of achievements earned by the two groups was

also presented in the results. The student society group received almost three times as many achievements as the group of classmates. This difference is reasonable because 15 of the 19 rewards are directly related to the player's points—the student society accumulated on average 3.6 times more points per participant than the group of classmates.

Overall the student society group had a higher engagement in the application than the classmates. We think the internal bond, which we know is stronger in the student society group, is the main reason for the difference.

28.2 Discussing Results on Player Motivation

Chapter 25 presented the results related to the players' motivation from the testing of Hover.

The questionnaire in the chapter revealed that the leaderboard, double points, and other social elements increased the players' motivation to use the application. The social aspect of Hover was a large motivation factor for a lot of players. This finding was expected, as social elements are a common method to increase motivation in many applications today.

Additionally, the interviews revealed points as a central mechanism for motivating players. As described in Chapter 7, points reward systems are common game design elements. Thus, points motivating the players was an expected result.

On the other hand, the results also described how some game design elements did not increase the motivation for the players. The results from the questionnaire detailed that *reactions*, *achievements*, *notifications* and *streaks* did not impact the players' motivation for most of the participants.

Based on the topics discussed in the players' engagement section, negative feedback on the *reactions* was expected. People are less interested in giving feedback to people whom they do not know. Thus, they were also less motivated to react to their posts in the feed.

The low score of *achievements* was a bit unexpected. Similar to points, achievements are a common element in game reward systems. However, according to the results from the questionnaire, this element scored low on increasing the motivation for the players. It is hard to think of a specific reason for this result, but it is probably a combination of many factors. Maybe there were too few achievements, or perhaps they were too obvious.

More research and expansion of the achievement system should be done to investigate and improve this functionality further.

Notifications also scored unexpectedly low on motivation, despite notifications being a common element in many applications today. However, because notifications are such a natural part of other applications, people are used to getting lots of them daily. Consequently, a few notifications from Hover could blend in among all the others, thus not motivating the players as much as we expected.

Streaks did not impact the participants' motivation to use Hover. Only 21% agreed to the statement asking the participants if streaks motivated them to carry out activities in the game. This result was unexpected since streaks in Snapchat are proven to increase the use of the application (Hristova, Dumit, Lieberoth, & Slunecko, 2019). However, usage data from the application show that only six participants experienced a streak of 3 days or longer. Thus, negative feedback on this statement is rational since most users did not experience a meaningful streak. During the discussion and analysis of data, we recognized that the questionnaire should have collected data on how frequently the players experienced the feature. This additional data would make it easier to conclude whether or not streaks affected the players' motivation.

Chapter 25 also revealed that two of the questions had a conflicting result. In question Q17, 84% of the participants answered that they were never or only a few times motivated by challenges to use Hover. While in S14, 74% agreed that challenges between friends inspired them to use the application. It is impossible to be motivated by challenges without having used the feature. In retrospect, we realized that the formulation of S14 is slightly wage, and some of the participants might have misunderstood the statement referring to the in-game challenges. The answers from Q17, related to the in-game challenges, are more in line with other numbers presented in Chapter 24.

In the last question (Q19), one-third of the participants answered that they did not think the points in all categories were correct based on their effort in the game. The primary problem was too many points given in the culture category. This category was meant for players attending theater shows, musicals, and concerts; thus, the point system was designed with this in mind. The idea was that one typical event in this category should generate a similar amount of points as one day at school, a standard workout, etc. We

somehow missed how the volunteers at such places naturally would spend a lot of time there. Though the algorithm for calculating points could have been changed during the test period, we decided it was fairest to let it stay as is, despite its shortcomings.

Difference between the two groups

As presented in the results, two of the statements in the questionnaire had a statistically significant difference in the answers between the group of classmates and the student society group.

The first difference found in the statement asked the participants whether or not they felt reactions to their activities inspired them to use the application more (S11). The participants in the student society group generally disagreed, while the classmates mostly agreed. We found no apparent reason for this difference. However, comparison with other data collected indicates that the student society's answers are most representative.

The second difference revealed that the student society group more strongly agreed to the statement investigating if double points (using Hover with Friend) made them use the application more (S13). As explained earlier in Chapter 23, the student society group has three regular weekly meetings. Consequently, their possibility of using the Hover with Friend functionality and earning double points increases and becomes more natural. Many in the group of classmates did not meet at all during the two weeks of testing.

28.3 Discussing Results on Player Enjoyment

Chapter 26 described results related to players' enjoyment of the game. The findings were generally good, indicating that many of the participants enjoyed the game. We were pleased to see that the majority of participants confirmed that they liked the concept (S17). Certain game elements had a clear positive influence on the player's enjoyment. One example is the Hover with Friends functionality, which participants described as fun in the interviews.

However, as expected, some of the answers did not reflect the general response. Users disagreed with: *"It was sad to stop using Hover after the test period ended"* (S18). We believe the reason is related to the formulation of the statement and that the result could have been different if the question was asked in another way. Something similar to *"I*

missed using Hover after the test period ended" would have been better.

In another of the statements, most participants disagreed with: *"I felt attached to my unique avatar"* (S23). This result was expected since the functionality is not yet implemented. FR28 in Chapter 17 specified that: *"Users should be able to evolve a character based on their score."* However, since this functional requirement was a low-priority one, the feature was dropped from our implementation plan. Despite this, we still wanted to include a question in the survey to get feedback on how such an implementation could work. However, in retrospect, we regret that we did not alter the question slightly to get more direct feedback.

As the last question in this part, the participants were asked if they had any technical problems during the test period. Surprisingly, more than half of the respondents answered "*yes.*" However, the problem was only related to the Android version of the game. Even though we did not expect this result, we recognize how it could have been avoided. During the development of Hover, our approach involved primarily testing the application on emulators and physical iOS devices. Since both of us use an iPhone, it was natural to use these as our test devices. At this time, the test participants were not confirmed, and thus, we did not know that the majority would use the application on Android. Based on our testing, we knew that there were some differences between the two operating systems, but we did not anticipate that the issues would impact the user experience. In retrospect, we realize that the application should have been tested more on physical Android devices.

Difference between the two groups

Answers in four of the statements (S18, S21, S23, and S25) revealed statistically significant differences between the two groups. However, we could only find valid reasons for the difference in one of the four statements. More data and additional testing are needed to explain the differences in the other three.

The statement (S21) asked the participants if their status in the game increased the more they played. The responses had an extraordinarily low p-value of 0.0064. The majority of the student society group participants answered neutral, while almost all of the classmates agreed to the statement. We believe the reason the more neutral answers in the student society group is their higher number of published activities per person than the classmates

(see results in Chapter 24). Since the number of points in Hover does not increase based on experience or usage, the players might feel more excitement and value of the points earned initially. Because the student society generally played more, it is probable that they felt points increased their status in the game to a lesser degree than their classmates.

28.4 Discussing Results on Change in Habits

The last research question, RQ5, investigated how the players' habits were affected by their use of Hover in the test period. The answers from the statements (presented in Chapter 27) were generally negative. Most participants answered that Hover did not affect their habits in any of the four categories (culture, social, exercise, or education). Even though we would have liked to see another result, it was not unexpected. Forming and changing people's habits takes a long time. Usually, considerably longer than two weeks (Lally, Jaarsveld, Potts, & Wardle, 2010). Thus, to test if someone has changed their habits appropriately, the testing period should last more than two weeks. Unfortunately, we did not have time for an extended test period in this project.

In addition to the statements, there were two questions in the questionnaire investigating change in players' habits:

The first one (Q22) asked the participants: *"Would you like to continue using a game like this?"* The answers were split, with around half of the respondents answering *"yes"* and the other half *"no."* The group of classmates was generally more positive. This result was a bit unexpected since the participants from the student society used the application most, and thus, we had hoped to see better results from them. However, the answers are likely influenced by the Covid-19 situations, as the next question (Q23) highlights.

The second question (Q23) investigated the effect the Covid-19 pandemic had on the use of Hover. Above half of the respondents answered that they think they would have used Hover more if it had not been for the pandemic. The answers are important since it confirms our perception of how the pandemic has influenced the results. The application should be tested when society is back to normal to get an improved depiction of how people's habits are affected.

Difference between the two groups

All the statements related to the participants' change in habits had a considerable difference in the results between the two groups (five were statistically significant). However, the difference primarily illustrated that some of the participants in the group of classmates agreed that Hover changed their habits. In the student society, none of the participants agreed that their habits had changed as a result of using the application. We did not find an apparent reason for the difference, but the results illustrate that it is potential for Hover to change habits in some groups. Despite this, we cannot conclude why there was a difference in the answers. Hover needs to be tested in a longer period to investigate how the players' habits have changed.

The two questions in this part of the questionnaire also illustrated a clear difference between the groups. The classmates were more positive about continuing using a game like Hover, with 71% answering *"yes"* to: "Would you like to continue using a game like this?" (Q22). In contrast, only 33% of the people in the student society answered *"yes"* to the same question.

Additionally, the questions revealed that the usage of Hover in the group of classmates was more affected by the pandemic than in the student society group (Q23). 86% of the classmates told us that they had used Hover more if there had not been an ongoing pandemic. In the student society group, the answers were split equally between the two options, *"yes"* and *"no."* This impact on application usage explains why the classmates were positive about the concept, despite the usage data showing that they used the application less than the student society in the test period. It also explains why the classmates were more eager to continue using the application as many felt that they had not gotten the whole experience yet because of the pandemic.

28.5 Summary

In this chapter, we have discussed and compared the results from testing Hover on users. We have explained and identified synergies between the data collected on players' engagement, motivation, enjoyment, and habits. The discussion described how existing relationships between players and points affected their motivation to use the game. The majority of the participants also liked the concept, but it had no clear impact on their

habits. The knowledge from this chapter will be used in the next chapter to answer our research questions and conclude the project.

Chapter 29

Conclusion

In this thesis, our concept Hover has been invented, described, and tested. Based on the topics presented, the conclusion to the project and the research questions are:

RQ1 asked *which **background knowledge** was needed for developing an alternative game concept.* Part II answered this research question by defining alternative games and describing relevant game design principles, including how to design enjoyable games, reward systems, and player types. Six alternative game concepts were invented, which led to our decision to develop Hover.

RQ2 studied *how game design elements and social interaction in our game concept affect the players' **engagement**.* The results show that existing relationships between players affected their willingness to engage in the game. Out of the social game design element, the friend tracking functionality (Hover with Friend) engaged players the most, while reactions and challenges had the least effect. Social screens, such as the feed and the leaderboard, are where the participants spent the most time. Notifications also positively affected the engagement, as they reminded players' to use the application. Lastly, the results revealed that rewards such as points and rewards did not, to a large degree, affect the players' engagement.

RQ3 looked at *how game design elements and social interaction in our game concept affect the players' **motivation**.* The conclusion is that points and social factors significantly impacted the players' motivation. The results show that players were motivated to use the Hover with Friend functionality, as double points gave them an incentive for hovering. The social pressure among friends and the position on the leaderboard affected the players' motivation to hover. However, suggestions indicate that implementing ways to spend the points would even further enhance players' motivation.

In **RQ4**, the focus was *how game design elements and social interaction in our game concept affect the players' **enjoyment**.* Overall, the majority of the participants enjoyed Hover. The social interaction between players and certain game elements had a considerable impact on the participants' enjoyment of the game. One concrete example is the Hover

with Friend functionality that multiple participants mentioned they liked. However, some game design elements, such as reactions and challenges, did not affect the participants' enjoyment. Most participants were neutral to these elements.

Finally, **RQ5** looked at *how the use of our game concept affects the players'* ***habits***. Based on the results, Hover did not change the participants' habits. The most prominent reasons for this were the duration of testing and the ongoing pandemic. The short period of testing resulted in a shorter time where the participants could use the application. At the same time, the ongoing pandemic decreased the number of potential situations where the application could be used.

The overall conclusion is that social game design elements in Hover affect players the most and that the social bond between players affects engagement. Unfortunately, the testing and conclusion are to a large degree influenced by the short testing period and the Covid-19 pandemic. Consequently, we suggest conducting a new experiment under normal circumstances, with the propositions for further work given in Chapter 31.

Chapter 30

Project Retrospective

In retrospect, we recognize that many things in the project went well, while others could have been done better. This chapter will reflect on what worked as expected and what did not. We will evaluate six essential aspects of the project: *The prestudy*, *technological choices*, *development process*, *testing phase*, *results*, and *our collaboration*.

Prestudy

The prestudy part of this master's thesis builds on the findings from our specialization project. As for almost any research, a thorough prestudy can be remarkably valuable, as it lays the foundation for which new ideas and areas of study can emerge. Our specialization project gave us invaluable knowledge on what alternative games are, leading to the development of our *alternative game framework*. The knowledge and framework were particularly helpful for the creative process, as it led to the game concept *Hover*, without forcing the creative process.

Technological choices

During the specialization project, we studied technologies that could be used to develop Hover. This study allowed us to make an informed choice for our technology stack. We used this knowledge as evaluation criteria, in addition to previous experience and the framework's maturity.

Since we chose a cross-platform framework, we did not exclude any potential test participants. The data from our test population revealed that 63% used Android and 37% iOS. Thus, if we had chosen a native framework, it would probably be more challenging to recruit testers through our network.

The technology stack we used ended up working as expected, with only minor hiccups. Most of the issues were related to the tracking (hovering) functionality in the game. It proved challenging to identify and test all edge cases that could occur while hovering due to varying factors such as the device, permission, software weaknesses, and simulator limitations.

Development process

The development phase includes several matters that we potentially could have executed better. However, we are satisfied with how it turned out. Though the team only consisted of two developers, we benefited greatly from using agile methodology because it enforced structure and order to the process. Using Trello was beneficial as it visualized the tasks, improved communication, and helped us identify and prioritize tasks. Completing tasks on the board also proved to be a motivational factor.

Before we began developing, we agreed on code conventions and architecture. This decision was very beneficial as it made us focus on functionality without building up technical debt. We also used pull requests to ensure that we conveyed the conventions and the quality of code we were aiming for. Additionally, the code reviews helped us catch errors, find potential improvements, and make sure both of us understood the code.

Due to the Covid-19 situation, remote work was sometimes necessary. In these situations, consistent use of digital collaboration tools proved its value and ensured that the development continued smoothly and efficiently.

Testing phase

The ongoing pandemic also affected the testing phase. It did bring a lot of uncertainty leading up to and during testing. We considered pushing the testing back and also extending it to ensure that we had enough data for the results. However, the uncertainty could be confusing for the participants, so we were careful to communicate transparently. We also thought it would be beneficial to stick to the initial testing plan for the sake of the participants' satisfaction and the project's progress. Even though we ideally would prefer a considerably longer test period, two weeks of testing provided sufficient data to move forward in the project.

During testing, we discovered that some of the Android users experienced minor issues that abrupted their hovering experience. One of these issues caused the leaderboard to re-render every second, causing it to blink. Since the issues only appeared on some Android devices, it was difficult to reproduce and identify. From that, we learned that we should have tested the application more on different Android devices.

Results

When we began processing the results, we discovered that we could have put more thought into the questionnaire. We found that some of the statements and questions could have been formulated better, removed, or added. In addition, one participant stated that they wished there was a *not applicable* (N/A) option for the statements. Including this option might have resulted in different answers.

We choose to focus more on the two groups in the results than what we originally planned. Consequently, the questionnaire could have been improved to acquire further insight into how the relationship between the participants affects the players' engagement, motivation, enjoyment, and habits.

Our Collaboration

The collaboration between us has been solid and transparent throughout the project. Before we started, we discussed our motivation for the project and agreed on expectations for the collaboration. We also created a project plan that we followed and used Trello to verify our progress. The open communication helped us identify obstacles as they occurred. We also had weekly digital meetings with our supervisor, whose experience, guidance, and good ideas helped us through all project phases.

Chapter 31

Further Work

In this chapter, we will present our suggestions for what is next for Hover. The concept has a great potential for expansion. However, some improvements and further testing are left for the future because of the project's time limitations.

31.1 Game Improvements

Our priority in this project has been to develop a working prototype according to our functional requirements (see Chapter 17). Thus, features of lower priority were intentionally left out to focus on the more important requirements. Additionally, as a result of our experiment we became aware of new areas of improvements. The expansion possibilities in the application are categorized into four main areas: *improved social features*, *location expansion and category improvements*, *further incentives for earning points*, and *technology improvements*.

Improved social feature

Based on the feedback from the test participants (see Part V), the most prominent area of improvement to the application is enhancing the social features. The current implementation does not include a social network. Thus, users cannot customize who they want to interact with. A social network would create a more personalized game experience.

In addition to a customizable social network, new features could also enrich the social aspects of the game. An example is customizable clubs for friends or coworkers that can create better cohesion and relationships between players. These groups could then compete in various challenges, such as getting the most points in a certain period. Current implemented social features should also be extended to include this change. For instance, it should be possible to filter the leaderboard based on groups.

With an improved social network, the social experience could be enhanced by implementing more ways to interact. Comments on activities and direct messages are the most prominent

examples of such improvements.

Location expansion and category improvements

Hover zones are currently only found in the Trondheim area. Locations for other cities and places in Norway should be added to expand the game's target group. The concept has the potential to grow internationally by adding locations around the world.

The location categories can also be extended by adding new ones that categorize locations not belonging to any of the four existing categories. The game could then be appealing to more players. An example of such a category is "outdoor life," including parks, ski resorts, and hiking areas. Additionally, the points awarded per minute of hovering in each category should be adjusted based on feedback.

Further incentives for earning points

The results in Part V revealed that the incentives for earning points should be improved. One way to do this is to implement the possibility to buy in-game items. For example, the avatar could be extended with customization possibilities, using items bought using points earned in the game. The more points the player spends, the cooler their avatar will look.

In the initial concept description in Chapter 13, we presented avatar evolvability as an incentive for playing. By including this feature, we exploit Malone's element of fantasy, where a player's character depends on the number of points earned in a period. For instance, the more points a player gets in the exercise category, the more sporty the avatar will look. Moreover, if the player stops engaging in that category, their avatar will become less sporty.

Another solution is to add a possibility to use the points earned in the application to buy real-world rewards. Companies interested in people visiting their branches could be willing to provide prizes to the users. Examples include gift cards or various other sponsored items.

Additionally, new competition types, pre-defined challenges, and an improved achievement system can further increase the incentives to earn points. An example of a new type of competition is "player of the week." Pre-defined challenges are in-game challenges created by the application targeted at a specific group of users. They will lower the barrier for

users to compete with friends. The achievement system is already implemented, but as discussed in Chapter 28 it should be re-evaluated and extended.

Technology improvements

The last area of improvement is related to the technology and implementation details in the game. The process of tracking and publishing an activity (hovering) should be as simple as possible to incentivize usage. There are multiple ways the tracking process can be simplified.

The first suggestion is to improve the process of hovering together with a friend. Instead of using a shareable code, this feature can be implemented using Bluetooth technology. The application could then automatically boost points if players are within a certain distance of each other.

Another useful enhancement is to fine-tune the notifications and suggestions from the application. An auto-sensing feature starting a hover session when a user is inside a geofence could be implemented. Then, if the player decides to start tracking, they will get points for the entire period inside the Hover zone, not only from the moment they began the session.

In addition to this, the game should be tested on more device types. Due to the limited resources available in this project, the game has mainly been tested on personal devices. Unfortunately, both our devices run iOS, and thus, Hover was primarily tested on this operating system during development. The application should be extensively tested on multiple phones from different manufacturers to ensure everything is working as expected on all devices.

31.2 Additional User Testing of Hover

The user testing phase of Hover has been influenced by multiple factors impacting the value of the research (as discussed in Chapter 30). The two most considerable ones were the current Covid-19 situation and the limited time available in this project. Consequently, the concept should be tested again when society is fully reopened, and people return to normal behavior. The duration of the testing should also be extended to get a better sense of the participants' change of habits. More extensive testing could produce other results

than our testing and provide feedback on newly developed features. It will also provide better insight into how the point and achievement systems are working and whether or not they should be further adjusted.

31.3 Concept and Business Potential

We believe that our game concept has the potential to become a fully-fledged game with users and businesses as the platform actors. By having two types of actors, the application becomes a two-sided platform facilitating interaction between users and businesses (as illustrated in Figure 31.1). However, growing a two-sided platform can be a complex task, and it is necessary to create demand and target both types of actors. Additionally, it must be attractive for both actors to be present on our platform for this to work.

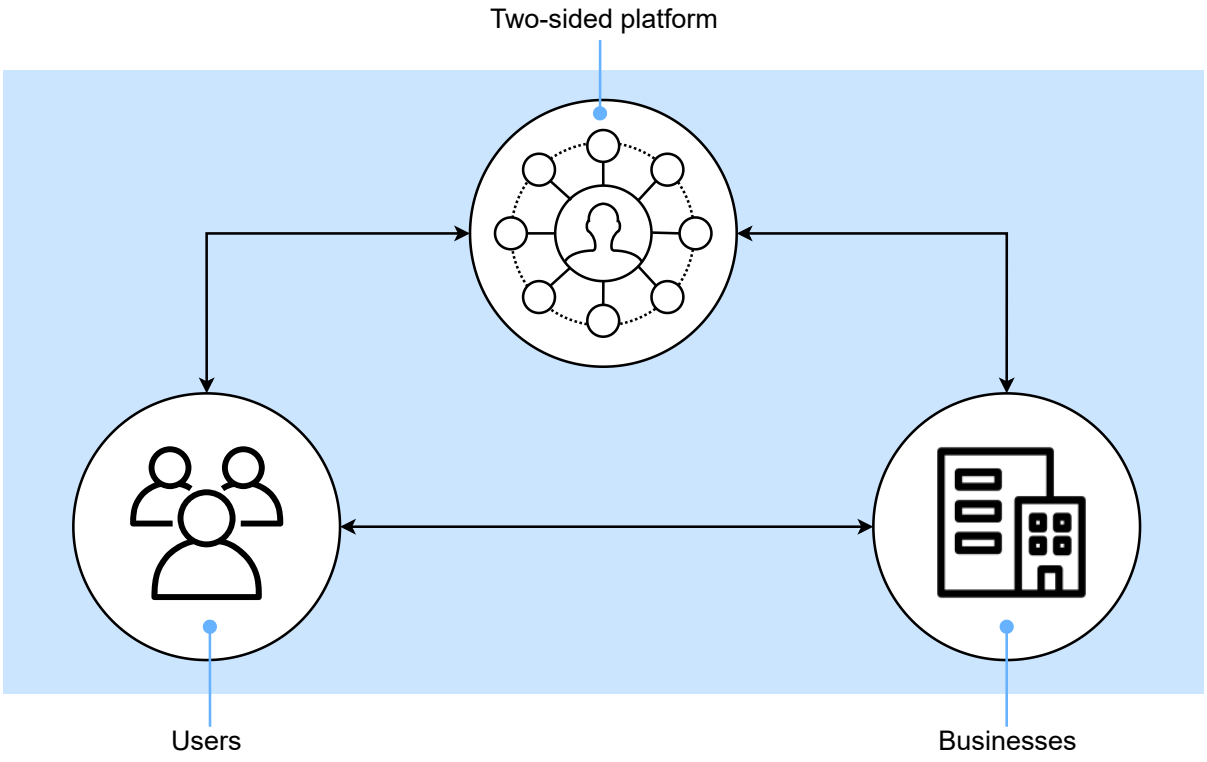


Figure 31.1: Hover as a two-sided platform with users and businesses interacting with each other and the platform.

The businesses that can become actors in Hover are typical *brick-and-mortar* businesses that provide face-to-face services in a physical location within Hover's categories, such as gyms, cinemas, and cafes. The platform must generate some value for the businesses;

being present as a Hover location can help promote the business, and thus, affect revenue through new hovering customers. For the users, it is essential that the location suits their needs and that the rewards and offers are valuable for them. One can, for instance, let businesses give personalized offers to recurring visitors.

Moreover, it is positive for users that there are many Hover locations, and it is positive for businesses that there are many users on Hover. However, since both types of actors are dependent on each other, it can be challenging to grow both simultaneously. Therefore further work should focus on creating strong cross-side network effects through marketing (Øverby & Audestad, 2018). Before this, a lot of business and product development needs to be done. Relevant questions for further business development are: *who our goal audience is*, *how we attract businesses*, *what is valuable for our actors*, and *how we can monetize our business model*.

This is big thinking; however, we need to start in smaller steps to create a viable game. First and foremost, we need to investigate if the concept is of interest to users and businesses through a feasibility study. If the findings are positive, adding more team members with development and marketing skills is necessary to make the team more composite. One should also consider applying for soft funding or funding from potential stakeholders. Simultaneously, we should reevaluate our architecture to create a sustainable system focusing on scalability, modifiability, and usability. Additionally, we need to design and implement business logic and implement new and improved game functionality that will further improve the game experience and value proposition for Hover's users.

A challenge when upscaling the user base is that the game is location-based. Therefore it is necessary to focus on establishing the game in one region at a time. It will be time-consuming and costly to launch the service in new areas. Because the value from the platform depends on having actors on both sides, it is necessary to focus on onboarding new businesses and users in one region at a time to create a viable game. Centering our attention will enable us to develop strong cross-side network effects within that region.

31.4 Summary

This chapter has presented our suggestions for further work in the project. The topics discussed were related to how the application could be improved and suggesting a more

extensive test phase under normal circumstances. Additionally, we elaborated on how Hover can be commercialized. The chapter is the last one in the thesis, wrapping up the project by proposing ways of expanding and improving the concept.

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Appendices

The following appendices contain supplementary material to this report. It can provide a more comprehensive understanding of the project.

Appendix A

Alternative Games Model

		Ideas
Input	GPS	
	Bluetooth	
	Camera	
	SMS	
	Phone calls	
	RFID-tags	
	Microphone	
	IR	
	Weight Sensor	
	Radar	
	Laser	
	Internet/IP	
	Custom controller	
	Magnetometer	
	Gyroscope	
	Accelerometer	
Output	Sound	
	Haptics	
	VR-headset	
	AR-screen	
	SMS	
	Physical reward	
	Phone calls	
	Custom device	
Game variant	Action	
	Adventure	
	Fighting	
	Puzzle	
	Role-playing	
	Simulation	
	Sports	
	Strategy	
	Gamification	
Target group	All	
	Adults	
	Kids	
	Elderly people	
	Students	
	Youths	
	People with disabilities	
Interaction	Collaborative	
	Competition	
	Online	
	Real	
	Pervasive	
	Pervasive	
	PvP	
Domain	Health	
	Entertainment	
	Education	
	Government	
	Industry	

Table A.1: Alternative games characteristics and categories.

Appendix B

Application Privacy Policy

Mats Tyldum and Siri Mykland built the Hover app as a Free app. This service is provided by Mats Tyldum and Siri Mykland at no cost and is intended for use as is. This page is used to inform visitors regarding our policies with the collection, use, and disclosure of Personal Information if anyone decided to use our Service. If you choose to use our Service, then you agree to the collection and use of information in relation to this policy. The Personal Information that we collect is used for providing and improving the Service. will not use or share your information with anyone except as described in this Privacy Policy. The terms used in this Privacy Policy have the same meanings as in our Terms and Conditions, which is accessible at Hover unless otherwise defined in this Privacy Policy.

Information Collection and Use

For a better experience, while using our Service, we may require you to provide us with certain personally identifiable information. The information that we request will be retained on your device and is not collected by us in any way.

Account, Profile and Activity

Activity and use information is collected about you when you choose to upload an activity (including date, time and geofence-location information). We use your contact information so we can respond to your support requests and comments.

Location Information

We collect and process location information when you sign up for and use the Services. We do not track your device location while you are not using Hover, but in order to provide Hovers' core service, it is necessary for us to track your device location while you use Hover. You may at any time adjusting your device settings if you would like to stop the device location tracking.

Content You Share

We gather information from the activities and reactions you share on the Service, including when you create or participate in challenges.

Log Data

We want to inform you that whenever you use our Service, in a case of an error in the app we collect data and information (through third party products) on your phone called Log Data. This Log Data may include information such as your device Internet Protocol ("IP") address, device name, operating system version, the configuration of the app when utilizing our Service, the time and date of your use of the Service, and other statistics.

Cookies

Cookies are files with a small amount of data that are commonly used as anonymous unique identifiers. These are sent to your browser from the websites that you visit and are stored on your device's internal memory. This Service does not use these "cookies" explicitly. However, the app may use third party code and libraries that use "cookies" to collect information and improve their services. You have the option to either accept or refuse these cookies and know when a cookie is being sent to your device. If you choose to refuse our cookies, you may not be able to use some portions of this Service.

Service Providers

We may employ third-party companies and individuals due to the following reasons:

- To facilitate our Service;
- To provide the Service on our behalf;
- To perform Service-related services; or
- To assist us in analyzing how our Service is used.

We want to inform users of this Service that these third parties have access to your Personal Information. The reason is to perform the tasks assigned to them on our behalf.

However, they are obligated not to disclose or use the information for any other purpose.

Security

We value your trust in providing us your Personal Information, thus we are striving to use commercially acceptable means of protecting it. But remember that no method of transmission over the internet, or method of electronic storage is 100

Links to Other Sites

This Service may contain links to other sites. If you click on a third-party link, you will be directed to that site. Note that these external sites are not operated by me. Therefore, we strongly advise you to review the Privacy Policy of these websites. We have no control over and assume no responsibility for the content, privacy policies, or practices of any third-party sites or services.

Children's Privacy

These Services do not address anyone under the age of 13. We do not knowingly collect personally identifiable information from children under 13 years of age. In the case we discover that a child under 13 has provided me with personal information, we immediately delete this from our servers. If you are a parent or guardian and you are aware that your child has provided us with personal information, please contact me so that we will be able to do necessary actions.

Changes to This Privacy Policy

We may update our Privacy Policy from time to time. Thus, you are advised to review this page periodically for any changes. we will notify you of any changes by posting the new Privacy Policy on this page. This policy is effective as of 2021-03-10.

Contact Us

If you have any questions or suggestions about our Privacy Policy, do not hesitate to contact us at:

contact.hoverapp@gmail.com

Appendix C

Questionnaire - English

General questions

ID	Questions
Q1	What is your gender?
Q2	Are you a student?
Q3	What is your age?
Q4	What is your email address?
Q5	What is your username in Hover?
Q6	Did you use the application at least once during the test period?
Q7	Did you experience any technical challenges during the test period?
Q8	Have you used Hold, Strava, or Pokémon Go before?
Q9	Does your phone run iOS or Android?

Table C.1: General questions.

Players' Engagement

ID	Statements
S1	I was curious about what medals I could achieve during the game.
S2	I received new medals and rewards throughout the test period.
S3	The game had sufficient challenge.
S4	Challenges between friends inspired me to use the application more.
S5	I often reacted to other players' activities/medals.
S6	The notifications made me use the application more.

Table C.2: Statements related to players' engagement.

ID	Questions
Q10	How many of the days during the test period did you use Hover?
Q11	On average, how long (number of minutes) did you use Hover every day during the test period?
Q12	How many times during the test period did you accept challenges from friends?
Q13	How many times during the test period did you challenge friends?
Q14	On average, how many reactions did you give per day during the test period?
Q15	Do you have any other comments related to your engagement in Hover?

Table C.3: Questions related to players' engagement.

Players' Motivation

ID	Statements
S7	I was motivated to carry out activities by the opportunity to win medals.
S8	I was motivated to carry out activities by the opportunity to earn points.
S9	I was motivated to carry out activities because others did it.
S10	I was motivated to carry out activities to keep my streak alive.
S11	Reactions to my activities inspired me to use the application more.
S12	The leaderboard motivated me to get as many points as possible.
S13	The ability to earn double points by using the application with a friend inspired me to use it more.
S14	Challenges between friends inspired me to use the application.
S15	I was inspired to use Hover by other players' activities.
S16	I opened the application when I received a notification.

Table C.4: Statements related to players' motivation.

ID	Questions
Q16	How often during the test period were you inspired by your friends to use Hover?
Q17	How often during the test period were you inspired by challenges to use Hover?
Q18	How often during the test period were you inspired by medals to use Hover?
Q19	Was the number of points in each category correct, in relation to your effort?
Q20	Do you have anything else you want to say related to your motivation to Hover?

Table C.5: Questions related to players' motivation.

Players' Enjoyment

ID	Statements
S17	I liked the concept of Hover.
S18	It was sad to stop using Hover after the test period ended.
S19	I felt that the progress in the game was always clear.
S20	There was an appropriate degree of difficulty to achieve medals.
S21	My status in the game increased the more I played.
S22	The challenges I participated in had clear goals.
S23	I felt attached to my unique avatar.
S24	I was happy to get reactions to my activities and medals.
S25	I was curious to see what my friends had been up to.

Table C.6: Statements related to players' enjoyment.

ID	Questions
Q21	Do you have any other comments related to your enjoyment in Hover?

Table C.7: Questions related to players' enjoyment.

Players' Habits

ID	Statements
S26	Hover has changed my habits about how often I use cultural offerings.
S27	Hover made me want to use cultural offerings more often.
S28	Hover has changed my habits about how often I exercise.
S29	Hover made me want to exercise more often.
S30	Hover has changed my habits about how often I visit my educational institution.
S31	Hover made me want to visit campus more often.
S32	Hover has changed my habits about how often I am social.
S33	Hover made me want to visit social zones more often.

Table C.8: Statements related to change in habits.

ID	Questions
Q22	Would you like to continue using a game like this?
Q23	Do you think you would have used Hover more if it had not been for an ongoing pandemic?
Q24	Do you have any other comments related to your habits before, during, or after using Hover?

Table C.9: Questions related to change in habits.

Feedback

ID	Questions
Q25	Do you have any other feedback?

Table C.10: Feedback question.

Appendix D

Questionnaire - Norwegian

Generelle spørsmål

ID	Spørsmål
Q1	Hva er ditt kjønn?
Q2	Er du student?
Q3	Hva er din aldersgruppe?
Q4	Hva er din e-post?
Q5	Hva er kallenavnet ditt i Hover?
Q6	Brukte du applikasjonen minst en gang i løpet av testperioden?
Q7	Opplevde du noen tekniske utfordringer av særlige betydninger underveis i testperioden?
Q8	Har du brukt disse tjenestene/spillene tidligere?
Q9	Bruker du iOS eller Android?

Table D.1: Generelle spørsmål.

Spillerens engasjement

ID	Utsagn
S1	Jeg var nysgjerrig på hvilke medaljer jeg kunne oppnå underveis i spillet.
S2	Jeg fikk nye medaljer og belønninger underveis i hele testperioden.
S3	Spillet gav meg tilstrekkelig med utfordringer.
S4	Utfordringer mellom venner gav meg inspirasjon til å bruke applikasjonen mer.
S5	Jeg gav ofte reaksjoner til andre spilleres aktiviteter/medaljer.
S6	Notifikasjonene gjorde at jeg brukte applikasjonen mer.

Table D.2: Utsagn om spillerens engasjement.

ID	Spørsmål
Q10	Hvor mange av dagene i testperioden brukte du Hover?
Q11	Gjennomsnittlig, hvor lenge (antall minutt) brukte du Hover hver dag i løpet av testperioden?
Q12	Hvor mange ganger i løpet av testperioden tok du i mot utfordring fra venner?
Q13	Hvor mange ganger i løpet av testperioden utfordret du venner?
Q14	Gjennomsnittlig, hvor mange reaksjoner gav du per dag i løpet av testperioden?
Q15	Har du noen annet enn det som er tatt opp i spørreskjemaet du vil si tilknyttet til din opplevelse eller engasjement i Hover?

Table D.3: Spørsmål om spillerens engasjement.

Spillerens motivasjon

ID	Utsagn
S7	Jeg ble motivert til å gjennomføre aktiviteter av muligheten for å oppnå medaljer.
S8	Jeg ble motivert til å gjennomføre aktiviteter av muligheten for å oppnå poeng.
S9	Jeg ble motivert til å gjennomføre aktiviteter fordi andre gjorde det.
S10	Jeg ble motivert til å gjennomføre aktiviteter for å opprettholde "streaken" min.
S11	Reaksjoner på mine aktiviteter gav meg inspirasjon til å gjennomføre flere.
S12	Poenglisten motiverte meg til å få flest mulig poeng.
S13	Muligheten for å oppnå doble poeng ved å bruke applikasjonen sammen med en venn inspirerte meg til å bruke den mer.
S14	Utfordringer mellom venner inspirerte meg til å bruke applikasjonen.
S15	Jeg ble inspirert til å bruke Hover av andre spilleres aktivitet.
S16	Jeg åpnet alltid applikasjonen når jeg fikk en notifikasjon.

Table D.4: Utsagn om spillerens motivasjon.

ID	Spørsmål
Q16	Hvor ofte i testperioden ble du inspirert av vennene dine til å bruke Hover?
Q17	Hvor ofte i testperioden ble du inspirert av utfordringer til å bruke Hover?
Q18	Hvor ofte i testperioden ble du inspirert av medaljer til å bruke Hover?
Q19	Var antallet opptjente poeng per minutt i hver kategori riktig i forhold til innsats?
Q20	Har du noen annet du vil si tilknyttet din motivasjon til å Hover?

Table D.5: Spørsmål om spillerens motivasjon.

Spillerens glede

ID	Utsagn
S17	Jeg likte konseptet Hover.
S18	Det var trist å slutte å bruke Hover etter at testperioden var ferdig.
S19	Jeg følte at fremgangen i spillet hele tiden var klar.
S20	Det var passende vanskelighetsgrad for å oppnå medaljer.
S21	Statusen min i spillet økte jo mer jeg spilte.
S22	Utfordringene jeg deltok i hadde klare mål.
S23	Jeg fikk tilhørighet til min unike avatar.
S24	Jeg ble glad av å få reaksjoner på aktivitetene og medaljene mine.
S25	Jeg var nysgjerrig på å se hvilke aktiviteter/utfordringer/medaljer mine venner hadde fullført.

Table D.6: Utsagn om spillerens glede.

ID	Spørsmål
Q21	Var det noe annet enn det som er tatt opp i spørreskjemaet som ga deg glede (eller ikke) av å bruke Hover i løpet av testperioden?

Table D.7: Spørsmål om spillerens glede.

Spillerens vaner

ID	Utsagn
S26	Hover har endret mine vaner om hvor ofte jeg benytter meg av kulturtilbud.
S27	Hover har endret mine tanker om hvor ofte jeg ønsker å benytte meg av kulturtilbud.
S28	Hover har endret mine vaner om hvor ofte jeg trener.
S29	Hover har endret mine tanker om hvor ofte jeg ønsker å trene.
S30	Hover har endret mine vaner om hvor ofte jeg fokuserer på min utdanning.
S31	Hover har endret mine tanker om hvor ofte jeg ønsker å fokusere på utdanningen min.
S32	Hover har endret mine vaner om hvor ofte jeg er sosial.
S33	Hover har endret mine tanker om hvor ofte jeg ønsker å være sosial.

Table D.8: Utsagn om spillerens endring i vaner.

ID	Spørsmål
Q22	Kunne du tenke seg å fortsette å bruke spill som dette?
Q23	Tror du at du hadde brukt Hover mer om det ikke hadde vært en pågående pandemi?
Q24	Har du noen annet enn det som er tatt opp i spørreskjemaet du vil si tilknyttet til vaner før, under eller etter Hover?

Table D.9: Spørsmål om spillerens endring i vaner.

Tilbakemelding

ID	Spørsmål
Q25	Har du noen andre tilbakemeldinger?

Table D.10: Spørsmål om tilbakemelding.

Appendix E

Interview Guide

For semi-structured interviews. Used for individual and group interviews.

1. What thoughts do you have about the game?
2. What motivated you to use the Hover?
3. How were you affected by points, ranking leaderboard, and reactions?
4. How were you affected by the presence of friends?
5. How was your use of the game affected by the national restrictions?
6. Anything else you want to address?

Appendix F

Questionnaire Results

Resultat fra «Evaluering av spillkonseptet Hover».

Antall leverte svar: 19.

Dataen er blitt anonymisert.

* - Obligatorisk å svare på.

Generelle spørsmål

Q1 - Hva er ditt kjønn? *

Svar	Antall	Prosent
Mann	15	78,9%
Kvinne	4	21,1%
Annet	0	0%

Table F.1: Resultat for Q1.

Q2 - Er du student? *

Svar	Antall	Prosent
Ja	19	100%
Nei	0	0%

Table F.2: Resultat for Q2.

Q3 - Hva er din aldersgruppe? *

Svar	Antall	Prosent
18-25	18	94,7%
26-35	1	5,3%
36-55	0	0%
56+	0	0%

Table F.3: Resultat for Q3.

Q4 - Hva er din e-postadresse? *

E-postadressen vil kun brukes om det er behove for å ta kontakt.

[Anonymisert]

Q5 - Hva er kallenavnet ditt i Hover? *

Kallenavnet vil brukes til å koble sammen svar og applikasjonsdata. Denne identifikatoren vil anonymiseres etter prosjektet er ferdig (11.06.21).

[Anonymisert]

Q6 - Brukte du applikasjonen minst en gang i løpet av testperioden? *

Svar	Antall	Prosent
Ja	19	100%
Nei	0	0%

Table F.4: Resultat for Q6.

Q7 - Opplevde du noen tekniske utfordringer av særlige betydninger underveis i testperioden? *

Svar	Antall	Prosent
Ja	11	57,9%
Nei	8	42,1%

Table F.5: Resultat for Q7.

Hvilke? Og hadde det innflytelse på din motivasjon, engasjement eller glede av spillet?

- Appen brukte mye strøm da jeg hovera.
- Fikk ikke varsler på mobilen når jeg kom inn i en Hover-sone. Glemte derfor ofte å starte en session.
- Registrering av tur etter at jeg forlot området. Nei.

- Ja, mistet en dag med poeng. Hadde litt innflytelse.
- Leaderbordet var brukket på min mobil, sto bare flashet inn og ut så den var umulig å bruke. scrollen av feeden føltes litt tregt og hakkete Jeg har en samsung s8.
- Jeg trodde jeg skrudde på at GPS skulle være på hele tiden, men tydeligvis ikke. Så jeg mistet en del "Hovers". Leaderboard var også blinkende for min del (Android, Oneplus 6T, Android version 10, OxygenOS version 10.3.9).
- Hvis jeg glemte å skru av hover når jeg gikk, og det gikk en tid til jeg husket det, så mista jeg de poengene jeg hadde samlet opp denne session.
- Siri fikset det så da det gikk fint. Ellers hadde det nok hatt litt negativ innvirkning.
- Av og til fikk jeg ikke push-varsler når jeg var på campus, som gjorde at jeg glemte å logge poeng. En gang forsvant alle poengene jeg hadde samlet opp da jeg skulle publisere poengene mine som jeg hadde samlet en hel skoleøkt.
- Leaderboard ble ikke oppdatert umiddelbart etter at en Hover-sesjon var ferdig; mangelen på resultat gjorde at jeg ble mindre motivert til å hovre mer.
- veldig ofte fikk jeg push-varsel om at jeg hadde forlatt en sone mens jeg fortsatt var i den. Det hendte også at push-varselet som skal gi beskjed om at jeg er i en sone var veldig forsinket (1-2 timer) eller ikke dukket opp i det hele tatt.

Q8 - Har du brukt disse tjenestene/spillene tidligere?

Svar	Antall	Prosent
Hold	10	52,6%
Strava	10	52,6%
Pokémon Go	14	73,7%

Table F.6: Resultat for Q8.

Q9 - Bruker du iOS eller Android? *

Svar	Antall	Prosent
iOS	7	36,8%
Android	12	63,2%

Table F.7: Resultat for Q9.

Spillerens engasjement

Utsagn knyttet til ditt engasjement ved bruk av Hover

ID	Utsagn	VU	U	N	E	VE
S1	Jeg var nysgjerrig på hvilke medaljer jeg kunne oppnå underveis i spillet.	1	8	5	3	2
S2	Jeg fikk nye medaljer og belønninger underveis i hele testperioden.	0	5	4	9	1
S3	Spillet gav meg tilstrekkelig med utfordringer.	2	9	7	0	1
S4	Utfordringer mellom venner gav meg inspirasjon til å bruke applikasjonen mer.	2	4	2	7	4
S5	Jeg gav ofte reaksjoner til andre spilleres aktiviteter/medaljer.	6	5	4	4	0
S6	Notifikasjonene gjorde at jeg brukte applikasjonen mer.	2	3	5	7	2

VU: Veldig uenig. **U**: Uenig. **N**: Nøytral. **E**: Enig. **VE**: Veldig enig.

Table F.8: Svar på utsagn om engasjement fordelt på antall.

ID	Utsagn	VU	U	N	E	VE
S1	Jeg var nysgjerrig på hvilke medaljer jeg kunne oppnå underveis i spillet.	5,3%	42,1%	26,3%	15,8%	10,5%
S2	Jeg fikk nye medaljer og belønninger underveis i hele testperioden.	0%	26,3%	21,1%	47,4%	5,3%
S3	Spillet gav meg tilstrekkelig med utfordringer.	10,5%	47,4%	36,8%	0%	5,3%
S4	Utfordringer mellom venner gav meg inspirasjon til å bruke applikasjonen mer.	10,5%	21,1%	10,5%	36,8%	21,1%
S5	Jeg gav ofte reaksjoner til andre spilleres aktiviteter/medaljer.	31,6%	26,3%	21,1%	21,1%	0%
S6	Notifikasjonene gjorde at jeg brukte applikasjonen mer.	10,5%	15,8%	26,3%	36,8%	10,5%

VU: Veldig uenig. **U**: Uenig. **N**: Nøytral. **E**: Enig. **VE**: Veldig enig.

Table F.9: Svar på utsagn om engasjement fordelt på prosent.

Q10 - Hvor mange av dagene i testperioden brukte du Hover? *

Svar	Antall	Prosent
Hver dag	1	5,3%
Annen hver dag	2	10,5%
Noen dager hver uke	14	73,7%
1-2 ganger	2	10,5%

Table F.10: Resultat for Q10.

Q11 - Gjennomsnittlig, hvor lenge (antall minutt) brukte du Hover hver dag i løpet av testperioden? *

Her menes det tid du aktivt var inne i appen og ikke mens du tracket en aktivitet i bakgrunnen. Tips: er du usikker kan du sjekke skjermtid i mobilens innstillinger.

- 20-30 min
- 10
- 10
- 10 min
- 5 min
- 5
- 5 min
- 5
- 5
- 5
- 3
- 3 min
- 2-3 min
- 1
- 1
- 1
- 1
- 0.25

Q12 - Hvor mange ganger i løpet av testperioden tok du i mot utfordring fra venner? *

- 3
- 2
- 2
- 2
- 2
- 2
- 2
- 1
- 1
- 1
- 1
- 1
- 1
- 0
- 0
- 0

Q13 - Hvor mange ganger i løpet av testperioden utfordret du venner? *

- 2
- 2
- 1
- 1
- 1
- 0
- 0
- 0
- 0
- 0
- 0
- 0
- 0
- 0
- 0
- 0

Q14 - Gjennomsnittlig, hvor mange reaksjoner gav du per dag i løpet av testperioden? *

- 10
- 8
- 5
- 2
- 2
- 1
- 1
- 1
- 0.5
- 0.2
- 0.1
- 0.1
- 0
- 0
- 0
- 0
- 0
- 0

Q15 - Har du noen annet enn det som er tatt opp i spørreskjemaet du vil si tilknyttet til din opplevelse eller engasjement i Hover?

Gjerne svar utfyllende, hvis du har noe å tilføye.

- Noe demotiverende at man fikk veldig mye mer poeng for kultur enn skole, men et veldig kult konsept med mye potensialet! Likte spesielt utfordringene og at man kan være mange personer i samme utfordring.
- Tror jeg hadde brukt appen mer om jeg hadde fått varsel når jeg var innenfor en sone.
- Utfordringene med venner var med på å motivere meg til å dra på skolen, men noen ganger når jeg var på trening og skolen glemte jeg dessverre å Hover.
- Synes det var veldig fint design, som gjør det mer engasjerende å bruke appen. I tillegg var det enkelt og oversiktlig å finne frem til funksjonene som appen tilbyr.
- Gj!
- Kult konsept, skulle gjerne ha noe å bruke poengene til, slik som på hold.
- Var ikke veldig motivert til å Hovre dessverre. Hadde ikke stor motivasjon til å gjøre det. Ble kun motivert hvis andre i samme rom sa "nå må vi hovre!, hvem vil joine en session".
- Veldig bra at man får push varsler for å vite når man er i en sone man kan bruke Hover på. Det er veldig lett for å glemme at man bruker Hover når man er ferdig med en aktivitet og jeg glemte ofte å publisere poengene mine da jeg var ferdig aktiviteten og gikk ut av sonen.
- Visste ikke at det var utfordringer eller notifikasjoner, burde vært et NA-alternativ.

Spillerens motivasjon

Utsagn knyttet til din motivasjon for å bruke Hover

ID	Utsagn	VU	U	N	E	VE
S7	Jeg ble motivert til å gjennomføre aktiviteter av muligheten for å oppnå medaljer.	2	9	2	5	1
S8	Jeg ble motivert til å gjennomføre aktiviteter av muligheten for å oppnå poeng.	2	1	1	10	5
S9	Jeg ble motivert til å gjennomføre aktiviteter fordi andre gjorde det.	2	1	2	9	5
S10	Jeg ble motivert til å gjennomføre aktiviteter for å opprettholde "streaken" min.	5	6	4	3	1
S11	Reaksjoner på mine aktiviteter gav meg inspirasjon til å gjennomføre flere.	4	8	4	2	1
S12	Poenglisten motiverte meg til å få flest mulig poeng.	0	0	3	8	8
S13	Muligheten for å oppnå doble poeng ved å bruke applikasjonen sammen med en venn inspirerte meg til å bruke den mer.	0	2	1	7	9
S14	Utfordringer mellom venner inspirerte meg til å bruke applikasjonen.	1	2	2	10	4
S15	Jeg ble inspirert til å bruke Hover av andre spilleres aktivitet.	3	1	3	10	2
S16	Jeg åpnet alltid applikasjonen når jeg fikk en notifikasjon.	3	11	1	3	1

VU: Veldig uenig. **U**: Uenig. **N**: Nøytral. **E**: Enig. **VE**: Veldig enig.

Table F.11: Svar på utsagn om motivasjon fordelt på antall.

ID	Utsagn	VU	U	N	E	VE
S7	Jeg ble motivert til å gjennomføre aktiviteter av muligheten for å oppnå medaljer.	10,5%	47,4%	10,5%	26,3%	5,3%
S8	Jeg ble motivert til å gjennomføre aktiviteter av muligheten for å oppnå poeng.	10,5%	5,3%	5,3%	52,6%	26,3%
S9	Jeg ble motivert til å gjennomføre aktiviteter fordi andre gjorde det.	10,5%	5,3%	10,5%	47,4%	26,3%
S10	Jeg ble motivert til å gjennomføre aktiviteter for å opprettholde "streaken" min.	26,3%	31,6%	21,1%	15,8%	5,3%
S11	Reaksjoner på mine aktiviteter gav meg inspirasjon til å gjennomføre flere.	21,1%	42,1%	21,1%	10,5%	5,3%
S12	Poenglisten motiverte meg til å få flest mulig poeng.	0%	0%	15,8%	42,1%	42,1%
S13	Muligheten for å oppnå doble poeng ved å bruke applikasjonen sammen med en venn inspirerte meg til å bruke den mer.	0%	10,5%	5,3%	36,8%	47,4%
S14	Utfordringer mellom venner inspirerte meg til å bruke applikasjonen.	5,3%	10,5%	10,5%	52,6%	21,1%
S15	Jeg ble inspirert til å bruke Hover av andre spilleres aktivitet.	15,8%	5,3%	15,8%	52,6%	10,5%
S16	Jeg åpnet alltid applikasjonen når jeg fikk en notifikasjon.	15,8%	57,9%	5,3%	15,8%	5,3%

VU: Veldig uenig. **U**: Uenig. **N**: Nøytral. **E**: Enig. **VE**: Veldig enig.

Table F.12: Svar på utsagn om motivasjon fordelt på prosent.

ID	Spørsmål	Hver dag	Av og til	Et par ganger	Aldri
Q16	Hvor ofte i testperioden ble du inspirert av vennene dine til å bruke Hover? *	0	8	10	1
Q17	Hvor ofte i testperioden ble du inspirert av utfordringer til å bruke Hover? *	0	3	8	8
Q18	Hvor ofte i testperioden ble du inspirert av medaljer til å bruke Hover? *	0	2	5	12

Table F.13: Resultat for Q16, Q17 og Q18 fordelt på antall.

ID	Spørsmål	Hver dag	Av og til	Et par ganger	Aldri
Q16	Hvor ofte i testperioden ble du inspirert av vennene dine til å bruke Hover?	0%	42,1%	52,6%	5,3%
Q17	Hvor ofte i testperioden ble du inspirert av utfordringer til å bruke Hover?	0%	15,8%	42,1%	42,1%
Q18	Hvor ofte i testperioden ble du inspirert av medaljer til å bruke Hover?	0%	10,5%	26,3%	63,2%

Table F.14: Resultat for Q16, Q17 og Q18 fordelt på prosent.

Q19 - Var antallet opptjente poeng per minutt i hver kategori riktig i forhold til innsats?

Svar	Antall	Prosent
Ja	13	68,4%
Nei	6	31,6%

Table F.15: Resultat for Q19.

Hvorfor synes du poengene ikke var rettferdige, og hvordan burde de vært justert for å bli rettferdige?

- Syntes at educational poengene var no lave i forhold til culture.
- Virket som at man tjente mye mer poeng på å være på den «kulturelle» sonen enn på den «akademiske», dette hadde litt negativ påvirkning på min motivasjon til å spille spillet da det virket umulig å slå de som var i «kulturelle» soner ved å bruke appen når man satt på skolen. Jeg mener man derfor burde tjent mer poeng på å være på skolen.
- Var veldig mange poeng å hente på samf.
- Vet ikke.
- Tenker at de som var på samfundet kunne få litt vel mange poeng, ettersom man gjerne er der sammen med andre og i mange timer av gangen.
- Sjukt OP å vøre to stk på Samfundet.

Q20 - Har du noen annet du vil si tilknyttet din motivasjon til å Hover?

Gjerne svar utfyllende, hvis du har noe å tilføye.

- Utfordringene var ekstra motiverende!
- Kjempemorsomt konsept som jeg vil fortsette å bruke for å motivere meg på skolen.
- nei.
- Topplisten fungerte nesten mot sin hensikt da jeg var så langt fra toppen etter 2-3 dager at jeg ikke gadd å bry meg om å komme høyt opp siden jeg ikke kom til å vinne uansett.

Spillerens glede

Utsagn knyttet til din glede av å bruke Hover

ID	Utsagn	VU	U	N	E	VE
S17	Jeg likte konseptet Hover.	0	2	6	8	3
S18	Det var trist å slutte å bruke Hover etter at testperioden var ferdig.	3	4	7	5	0
S19	Jeg følte at fremgangen i spillet hele tiden var klar.	0	4	5	8	2
S20	Det var passende vanskelighetsgrad for å oppnå medaljer.	0	4	9	6	0
S21	Statusen min i spillet økte jo mer jeg spilte.	0	2	9	8	0
S22	Utfordringene jeg deltok i hadde klare mål.	0	0	6	8	5
S23	Jeg fikk tilhørighet til min unike avatar.	10	5	1	3	0
S24	Jeg ble glad av å få reaksjoner på aktivitetene og medaljene mine.	3	2	8	3	3
S25	Jeg var nysgjerrig på å se hvilke aktiviteter/utfordringer/medaljer mine venner hadde fullført.	3	7	1	5	3

VU: Veldig uenig. **U**: Uenig. **N**: Nøytral. **E**: Enig. **VE**: Veldig enig.

Table F.16: Svar på utsagn om glede fordelt på antall.

ID	Utsagn	VU	U	N	E	VE
S17	Jeg likte konseptet Hover.	0%	10,5%	31,6%	42,1%	15,8%
S18	Det var trist å slutte å bruke Hover etter at testperioden var ferdig.	15,8%	21,1%	36,8%	26,3%	0%
S19	Jeg følte at fremgangen i spillet hele tiden var klar.	0%	21,1%	26,3%	42,1%	10,5%
S20	Det var passende vanskelighetsgrad for å oppnå medaljer.	0%	21,1%	47,4%	31,6%	0%
S21	Statusen min i spillet økte jo mer jeg spilte.	0%	10,5%	47,4%	42,1%	0%
S22	Utfordringene jeg deltok i hadde klare mål.	0%	0%	31,6%	42,1%	26,3%
S23	Jeg fikk tilhørighet til min unike avatar.	52,6%	26,3%	5,3%	15,8%	0%
S24	Jeg ble glad av å få reaksjoner på aktivitetene og medaljene mine.	15,8%	10,5%	42,1%	15,8%	15,8%
S25	Jeg var nysgjerrig på å se hvilke aktiviteter/utfordringer/medaljer mine venner hadde fullført.	15,8%	36,8%	5,3%	26,3%	15,8%

VU: Veldig uenig. **U**: Uenig. **N**: Nøytral. **E**: Enig. **VE**: Veldig enig.

Table F.17: Svar på utsagn om glede fordelt på prosent.

Q21 - Var det noe annet enn det som er tatt opp i spørreskjemaet som ga deg glede (eller ikke) av å bruke Hover i løpet av testperioden?

Gjerne svar utfyllende, hvis du har noe å tilføye.

- Å sammenligne mine poeng med andre jeg kjenner.
- Det var litt tilfredsstillende å få poeng. Hover hjalp meg ingen ting på å komme meg oftere ut av huset, men kanskje gjorde det at jeg ble litt lenger når jeg først var ute.

Spillerens vaner

Utsagn knyttet til endring av dine vaner

ID	Utsagn	VU	U	N	E	VE
S26	Hover har endret mine vaner om hvor ofte jeg benytter meg av kulturtilbud.	10	8	0	1	0
S27	Hover har endret mine tanker om hvor ofte jeg ønsker å benytte meg av kulturtilbud.	10	6	1	2	0
S28	Hover har endret mine vaner om hvor ofte jeg trener.	10	9	0	0	0
S29	Hover har endret mine tanker om hvor ofte jeg ønsker å trene.	10	7	1	1	0
S30	Hover har endret mine vaner om hvor ofte jeg fokuserer på min utdanning.	9	4	1	5	0
S31	Hover har endret mine tanker om hvor ofte jeg ønsker å fokusere på utdanningen min.	9	4	3	3	0
S32	Hover har endret mine vaner om hvor ofte jeg er sosial.	9	5	4	1	0
S33	Hover har endret mine tanker om hvor ofte jeg ønsker å være sosial.	9	6	2	2	0

VU: Veldig uenig. **U**: Uenig. **N**: Nøytral. **E**: Enig. **VE**: Veldig enig.

Table F.18: Svar på utsagn om spillerens vaner fordelt på antall.

ID	Utsagn	VU	U	N	E	VE
S26	Hover har endret mine vaner om hvor ofte jeg benytter meg av kulturtilbud.	52,6%	42,1%	0%	5,3%	0%
S27	Hover har endret mine tanker om hvor ofte jeg ønsker å benytte meg av kulturtilbud.	52,6%	31,6%	5,3%	10,5%	0%
S28	Hover har endret mine vaner om hvor ofte jeg trener.	52,6%	47,4%	0%	0%	0%
S29	Hover har endret mine tanker om hvor ofte jeg ønsker å trene.	52,6%	36,8%	5,3%	5,3%	0%
S30	Hover har endret mine vaner om hvor ofte jeg fokuserer på min utdanning.	47,4%	21,1%	5,3%	26,3%	0%
S31	Hover har endret mine tanker om hvor ofte jeg ønsker å fokusere på utdanningen min.	47,4%	21,1%	15,8%	15,8%	0%
S32	Hover har endret mine vaner om hvor ofte jeg er sosial.	47,4%	26,3%	21,1%	5,3%	0%
S33	Hover har endret mine tanker om hvor ofte jeg ønsker å være sosial.	47,4%	31,6%	10,5%	10,5%	0%

VU: Veldig uenig. **U**: Uenig. **N**: Nøytral. **E**: Enig. **VE**: Veldig enig.

Table F.19: Svar på utsagn om spillerens vaner fordelt på prosent.

Q22 - Kunne du tenke seg å fortsette å bruke spill som dette?

Svar	Antall	Prosent
Ja	9	47,4%
Nei	10	52,6%

Table F.20: Resultat for Q22.

Hvorfor ikke?

- For min del blir det en ekstra ting jeg må gjøre, jeg trenger ikke en app for å gjøre ting jeg vil. Det å måtte passe på at jeg bruker appen blir for meg mer arbeid enn det jeg får ut av den
- Spillet ga meg ikke så mye.
- Var ikke engasjerende for meg.
- Hadde det vært noe jeg kunne brukt poengene til hadde jeg kunne fortsatt å bruke den.
- Hadde blitt mer motivert hvis poengene betydde noe. Det må ha hatt et aspekt som Hold hvor jeg kan få en liten sjokolade eller skrapelodd.
- Det blir fort bare enda en greie du må styre med. Jeg har nok distraksjoner i hverdagen fra før av.
- Jeg er generelt lite interessert i mobilspill.
- Jeg husker aldri å starte og stoppe ting, og jeg er ikke så glad i å publisere ting heller.

Q23 - Tror du at du hadde brukt Hover mer om det ikke hadde vært en pågående pandemi?

Svar	Antall	Prosent
Ja	12	63,2%
Nei	7	36,8%

Table F.21: Resultat for Q23.

Hvorfor?

- Hadde nok vært på mer kulturelle og sosiale områder.

- Hadde vært mer på de kulturelle sonene som Samf osv.
- Da hadde jeg sikkert vært mer på treningssenter og på skolen.
- Da hadde det vært flere aktiviteter å være med på. Mye er stengt og man holder seg mer hjemme enn vanlig...
- Mer "sosialt press" kanskje?
- Flere muligheter til å dra ut.
- Jeg hadde vært mer ute, og på skolen.
- Flere tilfeller hvor det hadde vært mulig å bruke det.
- Jeg hadde hjemmekontor hele første uken av testperioden pga. jeg ville unngå campus pga smittevern. Også høyere terskel for å bruke noen former for kulturtilbud. Flere treninger ble avlyst pga corona.
- Fordi jeg da ville ha flere arenaer å benytte meg av Hover på.
- Hadde mest sannsynlig dratt på skolen (nesten) hver dag. I denne testparioden var jeg ingen dager på skolen.

Q24 - Har du noen annet enn det som er tatt opp i spørreskjemaet du vil si tilknyttet til vaner før, under eller etter Hover?

Gjerne svar utfyllende, hvis du har noe å tilføye.

- Endret ikke vanene mine direkte. Mer sånn at det ga skolearbeidet en ekstra tilleggsverdi.
- Vanene mine hadde kanskje endret seg mer dersom jeg fikk bruke appen i en lengre periode enn 2 uker.
- Jeg tror ikke Hover fikk meg til å benytte meg mer av samfundet/skole/trening, men det ble et fint tillegg som kunne gjøre disse aktivistene noe mer givende.
- Ettersom jeg ikke brukte Hover så jevnt under testperioden, var det vanskelig å endre vaner.

Tilbakemelding

Q25 - Har du noen andre tilbakemeldinger?

Dette kan være alle typer tilbakemeldinger som f.eks. om gjennomføring av testing, appen, konseptet o.l.

- Syntes det er et kult konsept, og en veldig godt gjennomført applikasjon! De sosiale aspektene er kule og det som motiverte meg mest.
- Merket at det var en del uinteressante hendelser som foregikk i appen i og med at jeg var "Venner" med absolutt alle.
- Synes Hover har et veldig fint design som gjorde appen lett å forstå og lett å ta i bruk og ikke minst morsom å bruke.
- Veldig bra laget!
- Bra jobba!
- Jeg følte at det var en del av spørsmålene jeg ikke hadde opplevd premisset bak, jeg visste f.eks. ikke at det varsr notifikasjoner eller utfordinger, så det hadde vært fint med et "Ikke relevant"-alternativ også.

Appendix G

Mann-Whitney Test Results

Below is the results from the statements in the questionnaire for the two groups who participated in testing. Column p contain the results from running the Mann-Whitney test to determine if the distribution is equal among the two groups. The results are considered significant for $p < 0.05$ (marked **).

#	Statements	Group	n	D	N	A	p
S1	I was curious about the medals I could achieve during the game.	Student society	12	50%	33%	17%	0.2358
		Classmates	7	43%	14%	43%	
S2	I got new medals and awards during the entire test period.	Student society	12	25%	33%	42%	0.3228
		Classmates	7	29%	0%	71%	
S3	The game gave me enough challenges.	Student society	12	67%	33%	0%	0.1093
		Classmates	7	43%	43%	14%	
S4	Challenges between friends gave me the inspiration to use the app more.	Student society	12	42%	17%	42%	0.0287^{**}
		Classmates	7	14%	0%	86%	
S5	I gave often reactions to other players' activities / medals.	Student society	12	50%	25%	25%	0.1977
		Classmates	7	71%	14%	14%	
S6	The notifications made me use the application more.	Student society	12	25%	33%	42%	0.3050
		Classmates	7	29%	14%	57%	

n: Number of participants. **D**: Disagree. **N**: Neutral. **A**: Agree. **p**: results from Mann-Whitney test.
$^{*}p < 0.1$ $^{**}p < 0.05$

Table G.1: The differences in engagement for the two sample groups.

#	Statements	Group	*n*	D	N	A	p
S7	I was motivated to carry out activities by the opportunity to win medals.	Student society	12	67%	17%	17%	0.0694*
		Classmates	7	43%	0%	57%	
S8	I was motivated to carry out activities by the opportunity to earn points.	Student society	12	25%	0%	75%	0.1357
		Classmates	7	0%	14%	86%	
S9	I was motivated to carry out activities because others did it	Student society	12	17%	0%	83%	0.4681
		Classmates	7	14%	29%	57%	
S10	was motivated to carry out activities to keep my streak alive.	Student society	12	67%	25%	8%	0.2358
		Classmates	7	43%	14%	43%	
S11	Reactions to my activities inspired me to use the application more.	Student society	12	83%	17%	0%	0.0233**
		Classmates	7	29%	29%	43%	
S12	The leaderboard motivated me to get as many points as possible.	Student society	12	0%	25%	75%	0.3050
		Classmates	7	0%	0%	100%	
S13	The ability to earn double points by using the application with a friend inspired me to use it more.	Student society	12	0%	0%	100%	0.0495**
		Classmates	7	29%	14%	57%	
S14	Challenges between friends inspired me to use the application.	Student society	12	25%	17%	58%	0.0749*
		Classmates	7	0%	0%	100%	
S15	I was inspired to use Hover by other players' activities.	Student society	12	25%	17%	58%	0.3050
		Classmates	7	14%	14%	71%	
S16	I opened the application when I received a notification.	Student society	12	75%	8%	17%	0.4483
		Classmates	7	71%	0%	29%	

n: Number of participants. **D**: Disagree. **N**: Neutral. **A**: Agree. **p**: results from Mann-Whitney test.
* $p < 0.1$ ** $p < 0.05$

Table G.2: The differences in motivation for the two sample groups.

#	Statements	Group	*n*	D	N	A	p
S17	I liked the concept of Hover.	Student society	12	17%	33%	50%	0.1190
		Classmates	7	0%	29%	71%	
S18	It was sad to stop using Hover after the test period ended.	Student society	12	42%	50%	8%	0.0495**
		Classmates	7	29%	14%	57%	
S19	I felt that the progress in the game was always clear.	Student society	12	33%	25%	42%	0.0885*
		Classmates	7	0%	29%	71%	
S20	There was an appropriate degree of difficulty to achieve medals.	Student society	12	17%	50%	33%	0.3520
		Classmates	7	29%	43%	29%	
S21	My status in the game increased the more I played.	Student society	12	17%	67%	17%	0.0064**
		Classmates	7	0%	14%	86%	
S22	The challenges I participated in had clear goals.	Student society	12	0%	33%	67%	0.4325
		Classmates	7	0%	29%	71%	
S23	I felt attached to my unique avatar.	Student society	12	100%	0%	0%	0.0233**
		Classmates	7	43%	14%	43%	
S24	I was happy to get reactions to my activities and medals.	Student society	12	33%	42%	25%	0.1762
		Classmates	7	14%	43%	43%	
S25	I was curious to see what my friends had been up to.	Student society	12	67%	8%	25%	0.0418**
		Classmates	7	29%	0%	71%	

n: Number of participants. **D**: Disagree. **N**: Neutral. **A**: Agree. **p**: results from Mann-Whitney test.
* $p < 0.1$ ** $p < 0.05$

Table G.3: The differences in enjoyment for the two sample groups.

#	Statements	Group	*n*	D	N	A	p
S26	Hover has changed my habits about how often I use cultural offerings.	Student society	12	100%	0%	0%	0.0694*
		Classmates	7	86%	0%	14%	
S27	Hover made me want to use cultural offerings more often.	Student society	12	100%	0%	0%	0.0344**
		Classmates	7	57%	14%	29%	
S28	Hover has changed my habits about how often I exercise.	Student society	12	100%	0%	0%	0.0951*
		Classmates	7	100%	0%	0%	
S29	Hover made me want to exercise more often.	Student society	12	92%	8%	0%	0.0951*
		Classmates	7	86%	0%	14%	
S30	Hover has changed my habits about how often I visit my educational institution.	Student society	12	100%	0%	0%	0.0023**
		Classmates	7	14%	14%	71%	
S31	Hover made me want to visit campus more often.	Student society	12	100%	0%	0%	0.0023**
		Classmates	7	14%	43%	43%	
S32	Hover has changed my habits about how often I am social.	Student society	12	92%	8%	0%	0.0113**
		Classmates	7	43%	43%	14%	
S33	Hover made me want to visit social zones more often.	Student society	12	100%	0%	0%	0.0064**
		Classmates	7	43%	29%	29%	

n: Number of participants. **D**: Disagree. **N**: Neutral. **A**: Agree. **p**: results from Mann-Whitney test.
* $p < 0.1$ ** $p < 0.05$

Table G.4: The differences in habits for the two sample groups.

Mykland & Tyldum

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