Master's thesis

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Gamified Self-management Solution Supporting Healthy Eating Habits for Children

Master's thesis in Informatics: Interaction Design, Game and Learning Technology
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Statement of Co-Authorship

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DECLARATION OF CO-AUTHORSHIP

……Gorn Phetchpinkaew……………… apply for the evaluation of the following thesis:

…… Gamified Self-management Solution Supporting Healthy Eating Habits for Children ………

*) The declaration should describe the work process and division of labor, **specifically identifying the candidate's contribution**, as well as give consent to the article being included in the thesis.

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*) Declaration of co-authorship on the following chapter/section:
- Chapter 1 – Introduction
- Chapter 2 – Background
  - Section 2.2 – Motivation
  - Section 2.3 – Gamification
  - Subsection 2.3.1 Progression and Reward System
  - Subsection 2.3.2 – Avatar
- Chapter 3 – Related Work
  - Section 3.2 Similar Application
  - Section 3.3 Evaluation
- Chapter 4 – Research Design
- Chapter 6 – Prototype Development
- Chapter 7 – Prototype Presentation
- Additional organizational work (Overleaf, test documents and forms)

In addition, the works on the background, the systematic literature review, concept and development of the prototype, and the evaluation were co-contributed.

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Place, date

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*) Declaration of co-authorship on the following article:
- Chapter 1 – Introduction
- Chapter 2 – Background
  - Section 2.1 – Childhood Obesity
  - Subsection 2.3.2 – Avatar
- Chapter 3 – Related Works
  - Section 3.1 – Related Researches
- Chapter 4 – Research Design
- Chapter 5 – Systematic Literature Review
- Chapter 8 – Evaluation

In addition, the works on the background, the systematic literature review, concept and development of the prototype, and the evaluation were co-contributed.
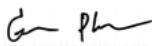
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Figure 1: Signed Co-Authorship Statement

Acknowledgements

Abstract

Overweight and obesity has been one of the problematic health issues among children around the world which could lead to other serious diseases. There has been attempts to solve the problem using digital solutions in various context and different types of technology. The thesis aims to inspect accessible resolutions for supporting families with overweight children, and to develop a concept of the solution applying user-centric design and gamification approaches, as well as the usage of the avatar in such solution. To achieve the aim, a systematic literature review were conducted to see the overview of solutions available, and an unmoderated remote usability testing for a prototype was performed by four children. The result showed that users had approving feedback in regards to its design, concept, and features. In addition, the avatar used in the prototype was much favoured and had high engagement towards the users. The discussion suggests that there is much potential in regards to using user-centric design and gamification creating such digital solution and also a high prospect to earn motivation and engagement from the users.

Sammendrag

Overvekt og fedme utgjør en av de store helseutfordringene for barn over hele verden, og kan medføre flere alvorlige sykdommer. Det er gjort flere forsøk på å løse dette problemet ved hjelp av digitale verktøy, gjennom bruk av ulik teknologi, anvendt i forskjellige kontekster. Masteroppgavens formål er å undersøke eksisterende verktøy for å hjelpe familier med overvektige barn, samt utvikle et nytt et konsept ved hjelp av tilnærminger hentet fra brukersentrert design og spillifisering, samt å bruke en avatar i denne typen konsepter. For å oppnå denne målsetningen har oppgaven gjennomført en systematisk kunnskapsoversikt for å kartlegge eksisterende muligheter, samt utført en umoderert brukertesting på fire barn. Resultatet viser at brukerne hadde positive tilbakemeldinger med hensyn til design, konsept og funksjonalitet. I tillegg fikk prototypens avatar gode tilbakemeldinger fra brukerne. Diskusjonen indikerer at det ligger mye uforløst potensial i å anvende brukersentrert design og spilifsering i denne typen digitale løsninger, da for å skape motivasjon og brukerinvolvering.

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Chapter 1

Introduction

Overweight and obesity has become one of the world's most health problems of the 21st century, especially and more extremely in children and adolescents(World Health Organization, 2020a). According a data in 2017, about 15 to 20 percent of children and 25 percent of young people in Norway were overweight or obese, and the trend were going up for both groups(Norwegian Institute of Public Health (FHI), 2017) which could lead them into many other diseases and serious health problems. As the epidemic remains, there have been attempts to solve such issue with several approaches ranging from simple to sophisticating ones. Technology has surely been used to solve many problems in the last decades, and gamification is a concept that brings many technology elements together aiming for tackle such problems. Gamified solutions has been commonly used in many fields including education, business, healthcare, and many more. Nonetheless, the researchers of the thesis would like to take a closer look of how gamification could be applied in regards to the health problem mentioned in the beginning.

1.1 Motivation

A project named *Kostverktøyet* owned by *regionalt senter for fedmeforskning og innovasjon av St. Olavs Hospital* has been addressing this issue and developing a concept since 2015. The project is a web-based tool aiming specifically for families with overweight children and health personnel providing them with preventive information and self-help tools. In addition to the project, there are many studies presenting different solutions in regards to supporting and preventing adults and children from obesity which will be mentioned later. Consequently, in regard to this thesis, the researchers cooperated with stakeholders of the project from the hospital and SINTEF, and took a closer examination of the topic if the approach of user-centric design could be applied to the project. Different theories of the design and gamification

were used to create a concept and prototypes in order to solve the problem stated.

1.2 Research Questions

The objective of the thesis was to examine available solutions for supporting families with overweight children, and to develop a concept using user-centric design and gamification. Therefore, the thesis followed the research question:

RQ: *How can we use user-centric design and gamification to develop a concept to support and assist families with overweight children?*

To answer the research question, the researchers first performed a systematic literature review (SLR) in order to understand the environment around the topic, and familiarize with other solutions performed by other researches. Then we discussed with stakeholders who worked directly with the project *Kostverktøyet* to collect relevant data and designed a concept prototype which would be tested by children and parents. The data was gathered using different methodology including questionnaires, observation, and unmoderated remote usability testing (URUT) due to the current pandemic situation which physical meetings were not suitable. Nonetheless, qualitative data data collection was mainly performed in this thesis. As for the research question, the thesis aimed to contribute a concept and design of such solution integrating with gamification and user-centric design approaches. The reseachers anticipated that the readers of the thesis could have an overview of how such solution could benefit from those approaches, the implementation, and the responses received from the users.

In addition, for the individual contribution as of the main author of this thesis, a sub research question was set into a more specific area which was the usage of avatar in gamification. More about the area will be discussed in the next chapter. With that being said, the thesis also followed the sub research question:

SRQ: *How can we applied the usage of avatar in gamification to such concept?*

To answer the sub research question, the individual researcher looked deeper into different elements of avatars, its application in regards to gamification, and its contribution towards the the concept mentioned in the main research question. The researcher would like to explore the possibilities and benefits of the use of avatar in gamification and learn if it would be advantageous for a solution to apply the use of it. The contribution for answering the sub question would be to demonstrate the use of avatar in a gamified solution, so that the readers could understand the context of use, the implication, and the feedback received from the users in the aspect of such solution.

Chapter 2

Background

In this chapter, secondary background research conducted on several topics relevant to the thesis and subsequent prototype will be presented and examined. The choices made and solution developed as part of this thesis are highly based on the results of this phase.

This chapter opens with section 2.1, presenting the current situation regarding obesity related problems experienced by the target demographic. The section also describes specific factors like Parental Habits and the impact this has on early onset obesity. Further, in section 2.2 the field of Motivation is examined, and psychological theories such as Skinner's Box and the Self Determination Theory are examined. The chapter continues in section 2.3 by examining the theory of Gamification, and describes several key techniques in addition to presenting the up- and downsides of the strategy.

2.1 Childhood Obesity

Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health (World Health Organization, 2020b). When one has high BMI (body mass index), they have high risk for many diseases such as cardiovascular diseases, diabetes, musculoskeletal disorders, and cancers citepwho2. World Health Organization (WHO) reported that in 2016, 39% and 13% of the world's adult population were overweight and obese, respectively (World Health Organization, 2020c). The situation for children and adolescents is also concerning. In 2016, 340 million children and adolescents aged 5-19, and in 2019, 38.2 million children under the age of 5 years were overweight or obese (World Health Organization, 2020c). Obesity in childhood is linked to an increased risk of adult obesity, premature death, and disability. Moreover, obese children face breathing problems, a higher risk of

fractures, hypertension, early markers of cardiovascular disease, insulin resistance, and psychological effects (World Health Organization, 2020c). This can be concluded that it is crucial to detect obesity at an early age; therefore, obesity is preventable with help from members in the family who can influence the choices of food intake and also can support them during hard times.

2.1.1 Causes and Consequences

There are several causes that could lead a person into obesity which include their food intake, exercise habits, lifestyles, genetic background, etc. One research has listed different factors specifically in children that could bring them such health condition (Sahoo et al., 2015).

- *Food portion and beverages* - A study found that children's BMI can be increased by tiny amount over the years when they had consumed sugary beverages (Anderson and Butcher, 2006). Moreover, most of the people associate sugary beverages exclusively with soft drinks and sodas, when in fact juices and other sweetened beverages also contain high amount of sugar (Sahoo et al., 2015). Many researchers has studied and found the connection between sugary beverages intake and weight which conclusively found to be one of the reasons supporting obesity status (Anderson and Butcher, 2006). In addition, portion size is another factor which could encourage obesity. It is known that portion size of meals has been significantly increased in the last decades. Not only one has high intake of calories looking at what they consume, but also how much they consume. When one can not balance the amount of food intake, it then leads to weight increase and obesity (Anderson and Butcher, 2006).

- *Activity level* - Another factor when one looks at obesity is the activities they perform in a day, and how much calories they use in such activities. One of the concerns is a sedentary lifestyle which could bring in many issues to children including obesity. A research found that the time children and adolescents spend on watching television has increased drastically in the past years (Anderson and Butcher, 2006). They also suggest that there is a correlation between hours on televisions and consumption on advertised goods including sweets, snacks, and beverages (Story et al., 2002).

- *Family factors* - It has been also known that family members has high association with obesity among children. Depending on what kind of food the family choose to buy to keep in their house along with their food preferences, it could affect children's influence and decision in what type of food they consume (Sahoo et al., 2015). Moreover, family behaviors and habits, whether they are active or not, could also influence the children (Budd and Hayman, 2008). Studies have shown

that children who live with a single mother who is overweight has association with their own overweight and obesity status (Moens et al., 2009).

- *Environmental factors* - Not only sedentary activities that could lead to obesity, but also the changes in children's environment and surroundings. In the last decades, how children travel to school has changed from walking and biking to public transportation and private cars which leads to a decrease in physical activities. Parents also concern about their children's safety and convenience which is why they choose to drive them instead (Anderson and Butcher, 2006).

- *Socio-cultural factors* - It has been seen regularly that many social events and competitions for children use food as rewards and as part of socializing (Budd and Hayman, 2008). This encourages children to consume unhealthy food and beverages unnecessarily which, again, could lead to obesity.

- *Psychological factors* - There are a long list of mental health and factors including depression, anxiety, self-esteem, body dissatisfaction, eating disorder symptoms, emotional problems, etc. which could lead children to obesity. One might not realize that these health issues could be the factor, but many studies have shown that there is a high correlation to this (Goldfield et al., 2010)(Austin et al., 2009)(Decaluwé and Braet, 2003)(Cornette, 2008).

As one can see the causes and consequences of childhood obesity, they can understand that such health condition might not come from a sole reason but a combination of many. More discussions in detail regarding this will follow.

2.1.2 Nutritional Knowledge and Dietary Behavior in Children

One important question that could be interesting to go through is that how much knowledge do children have when it comes to nutrition and food consumption, and how such knowledge has effects on their behaviors and practices. One study shows that among 4700 primary and junior high school students had unbalanced diet (low in several essential food materials, but high in some nutrients); however, their nutritional knowledge fell into acceptable level (Naeeni et al., 2014). Another study conducted questionnaires for children and concluded that they had moderate nutrition knowledge, poor dietary practices, combined with negative dietary attitude (Kigaru et al., 2015).

However, one systematic review which looked at the correlation nutrition knowledge and dietary behavior in children and adolescents found that there is, instead, a disconnect between the two (Thakur and Mathur, 2021). The review stated that most of the studies reviewed reported that it was not only the

knowledge that related to dietary behavior, but also many other factors such as age, gender, lifestyle, parent's nutrition knowledge, education, and occupation.

Some studies also found that gender of the children has a relation to their nutrition knowledge and dietary behavior. One study found that girls tend to have better nutrition attitude than boys (Choi et al., 2008), and another found that girls tend to have better nutritional knowledge than boys (Naeeni et al., 2014). The same study also found that boys have higher food intakes of meat, carbohydrates, and fat, but on the other hand, girls have more intakes of fruits and vegetables.

2.1.3   Parental Habits

In general, children tend to get influenced by their parents or guardians in many different ways. Children not only learn to talk and walk from parents, but also absorb other things like characteristics, behaviors, or even opinions and thoughts. It is no surprise that parents would also have influence on their children when it comes to dietary behavior and consumption habits, whether positive or negative ones. A research found that an enhancement in family lifestyle would have a positive influence in many perspectives including those towards obesity opposition (Gray et al., 2018), and also suggested that an intervention regarding the topic should be done at a family level rather than only a child. The same research also suggested that such interventions should be applied as early as in their childhood as possible in order to achieving larger outcome and higher chance of success rate (Gray et al., 2018). Another research found that parents might unintentionally encourage excess weight gain to their children because of their behavior in inappropriate child-feeding (Clark et al., 2007), and also recommended interventions which suit for families regarding awareness and consequences of inappropriate child-feeding behavior.

There are many behaviors that parents might inadvertently promote excess weight gain to their children. In one article, a doctor was interviewed and said that parents has failed to pay attention to what they feed their children, that they do not eat enough home-cooked meals, and that the snacks served to children are not healthy (Ehrenfeld, 2018). Other parent behaviors endorsing development of children obesity are listed in one research which includes parenting style, parent influence of feeding, control and monitoring from parents, pressure to eat, family restriction, self-efficacy, and parental role-modeling (Danford et al., 2015). On the other hand, a systematic review on parental influence on childhood obesity argues that there is no direct correlation between the two, and commented that the source of childhood obesity is still lacking (Tzou and Chu, 2012).

Regardless of the arguments, many has agreed that in order to tackle childhood obesity, it is better done as a family rather than an individual member. There are numbers of proofs suggesting that family

interventions towards childhood obesity are successful (Ash et al., 2017). Family interventions are the key strategy in the effort came from parents' influence and control over children's behaviors of their diet, physical activity, and sleep (Berge and Everts, 2011). One research even found that parents who have their children treating for obesity benefit from it that the parents has a positive effect on their BMI even though the treatment focuses on the children (Trier et al., 2016). Therefore, it is a family matter that all members in the house have to take part in in order to confront childhood obesity. It is obviously not a one man fight.

2.2   Motivation

Interaction design could be described as the field of understanding the interaction between users and end products. Designing a feature, system or application is tricky, and no one solution can satisfy every end user. Regardless of the field, however, any system designer would be wise to leverage one universal key aspect, Motivation. If end users are not motivated to utilize a potential system, it does not matter how powerful the system inherently is, how interesting the core features of the system are or how pretty it looks. To understand this better, the researchers present an introduction to core concepts and theories relevant to the development of the prototype as part of this thesis.

2.2.1   Intrinsic and Extrinsic motivation

Motivation is defined as the process of activating goal-oriented behavior in an individual, and different types of motivation are usually described as either *intrinsic* or *extrinsic*. Lepper, David Greene and Richard Nisbett stated that intrinsic motivation refers to the act of engaging in a behavior that is personally enjoyable, and as such not done with an external goal in mind. Extrinsic motivation, however, is characterized as a behavior an individual would engage in for the reward of completing the action - not for doing the action itself. The two appear as contradictions of one another, and Lepper et al. found it likely that intrinsic- and extrinsic motivation and goals were negatively correlated, with overall appreciation for an activity declining as a result of rewards. (Lepper et al., 1973).

Later studies showed, however, that the two are not mutually exclusive, where students were observed not only tending to use a combination of intrinsic- and extrinsic reasoning for engaging in academic endeavours, but likewise for setting intrinsic and external personal goals (Pintirch, 2000). Lepper later revised his claim in a future study, finding the correlation between the two (both negatively and positively) to be of small significance (Lepper et al., 2005). Other studies have corroborated this,

finding that as rewards stray from binary operand conditioning and rather become more internalized in the activities by focusing on the praise of individual accomplishments within the domain, individuals both like the activity more and perform at a higher level (Hulleman et al., 2008)(Ryan and Deci, 2002).

As a practical example of this, consider an individual doing schoolwork for a course they have no interest in, trying only to receive a good grade. This would be categorized as extrinsically motivated, because the action of studying the topic is done purely for the external reward. If the student was studying a topic they were genuinely interested in and would like to explore further, however, the action of studying the topic is intrinsically motivated as the reasoning for the behavior is the individuals own enjoyment and interest in the subject. Then, if the student has ambitions of a good grade *and* finds the subject interesting, they are experiencing a combination of extrinsic- and intrinsic motivational factors.

2.2.2   Skinner's Box

While on the subject intrinsic and extrinsic motivation, Lepper relied on the theory of *Operant Conditioning*, coined by his colleague - B.F Skinner (Ferster and Skinner, 2008)(Morgan, 2010). Operant conditioning is a widely known concept within behaviorism, and is based on scheduling of reinforcement learning. In contrast to classical conditioning (creating a link between a stimulus and an *involuntary* response), operant conditioning is based on creating a link between a *voluntary action*, and an expected consequence. To do this, one applies punishment or reinforcement to the subjects, either positively or negatively dependant on the situation. This reinforcement is applied as part of a predetermined schedule.

The Skinner Box then, was designed to facilitate and test this theory. The box is defined as a sterile space in which external stimuli is excluded, including nothing but a lever or other manipulable device the animal can interact with. An animal is then placed in the box, and observed closely. Whenever the animal pulled the lever by accident, the animal is provided with positive stimuli. At first, this occurrence was seemingly random, but over time the animal touched the lever more and more, indicating that the animal has understood that there is a link between the action of pulling the lever, and the consequence of receiving positive stimuli. This is positive reinforcement. If one on the other hand imagines the floor to be electric, the animal would likely run around attempting to escape the electricity, and would as such occasionally hit the lever, removing the discomforting factor. Soon, the animal may show signs of rushing to the lever whenever it feels discomfort, and has thus been conditioned by negative reinforcement.

2.2.3   Reinforcement

In addition to positive and negative reinforcement, punishment is another interesting strategy. While negative reinforcement concerns removing some factor in order to relieve or avoid an unwanted situation or outcome, punishment concerns the application of an unwanted outcome, as a consequence of unwanted behavior. For instance, punishing an individual if a set of predetermined criteria is not met, within a given time frame, or delivering a task with a lower level of quality than what was to be expected, is not negative reinforcement but rather the application of punishment. The threat of punishment may motivate individuals extrinsically to finish the task in order to avoid punishment, but this dynamic has been suggested (Deci and Cascio, 1972) to facilitate only short term links, additionally lowering the intrinsic motivation and subsequent intrinsic value the individual experiences for the task.

While research has suggested negative reinforcement and punishment to be effective in the short term, positive reinforcement has been suggested as being very effective both in the short- and long-term (Harter et al., 2003), (Ferster and Skinner, 2008). However, research into a combination of positive and negative reinforcement has proposed better long term results than those received by applying either strategy separately (Byiers et al., 2014) (Doughty and Shields, 2009).

Reinforcement has further been observed to be dependant on situation and timing, but most importantly scheduling. *Continuous* reinforcement (positive reinforcement every time desirable actions are executed) is most applicable during the learning stage of a newly introduced behavior, but once the subject has been conditioned a form of partial reinforcement should be applied. In the case of continued continuous reinforcement, the subjects may be exposed to overjustification (Lepper et al., 1973), or otherwise lose the perceived intrinsic value of the action. There are several forms of partial reinforcement strategies which can be applied based on individual needs, used to ensure that the new behavior will stay.

By explaining how reinforcement could be used effectively, in addition to explaining the effects different scheduling had on reinforcement strategies, Skinner's theories and experiments laid the groundwork for other psychological work in the space of behaviourism. This is especially apparent in how behaviour is learned or dissuaded.

2.2.4   Self Determination Theory

The Self Determination Theory (SDT) is a theory encompassing innate human psychological needs and their relation to motivation, personality and growth tendencies. Ryan and Deci (Ryan and Deci, 2000) conceived the theory in 2000, stating in clear distinction to previous research that human motivation

should not be a unitary concept. They suggest that one should not focus on the amounts of motivation in a given context, but rather the different types of motivation, further explaining this distinction by defining the terms *autonomous motivation* (executing a behavior with a real sense of interest, enjoyment and value.) and *controlled motivation* (executing a behavior due to feeling pressured, obliged or demanded.).

Ryan and Deci's research suggests that every human being is able to become self-determined and motivated to grow and change based on three core values: *competence* - the need to gain mastery of tasks and learning different skills, *relatedness* - experiencing the sense attachment and belonging to other people, and *autonomy* - the need to feel in control of their own behaviors and goals. Furthermore, the research suggests that individuals exhibiting autonomous motivation experience increased performance, wellness and engagement (Ryan and Deci, 2000).

Intrinsic motivation is a clear example of autonomous motivation, so much so that their definitions appear quite similar and as such, one could assume extrinsic motivation to be an example of controlled motivation by contrast. However, through further research Ryan found that individuals could internalize extrinsic motivation in such a way that they learn the intrinsic values inherent in the activities performed. Individuals identifying with the value of the performed action and integrating it in themselves in this way have therefore been shown to experience an autonomous motivation for the task, leading to positive outcomes for the individuals. (Ryan and Deci, 2020)

2.3 Gamification

As shown in Figure 2.1, the research suggests that the video game industry is the largest entertainment industry in the world by a wide margin, currently exceeding more than double the market capitalization of the movie and music industries - *combined* (Richter, 2020). While the medium of games and their differing approaches are highly subjective in nature, most games share the fact that they are designed to be engaging and entertaining for the potential end user. This is often achieved by designing experiences that target certain demographics and cultures, and can be achieved by leveraging a mixture psychological needs or motivational factors, as discussed in section 2.2. A game can therefore, in a way, be reverse-engineered and disassembled to reveal the individual elements and mechanics that make up the core of the game, and it is these elements and mechanics that are of interest when discussing the topic of gamification.

Gaming: The Most Lucrative Entertainment Industry By Far

Global revenue of selected entertainment industy sectors in 2019

$145.7b

Mobile: 45%

Console: 32%

PC: 23%

Gaming

$42.5b

Box Office

$20.2b

Music

Sources: Newzoo, Comscore, IFPI

statista
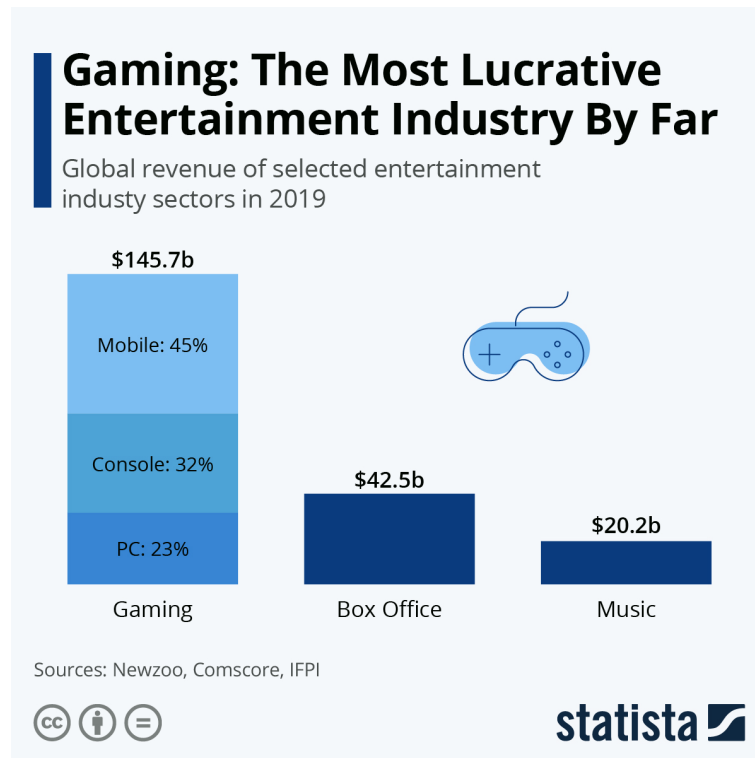
Figure 2.1: Graph showing the value of the video game industry, as opposed to the film- and music industries

While many may think that gamification is the act of incorporating games in preexisting applications or solutions, it is not that simple. Rather, gamification is a strategic concept aimed at enhancing the user experience of an interactable entity like a service or application, through the application of game elements and mechanics in non-game contexts. Since the goal of gamification is the positive alteration of a subject's increased engagement and motivation, it is applicable to many different fields. The literature suggests that gamification can be effectively utilized in a wide variety of areas such as education, health, transportation or even marketing and business. A recent market study showed that this is indeed the case (Albertazzi et al., 2019). Some fields have already followed the evolution of gamification to such an extent that certain techniques are commonplace, such as the planning strategy *planning poker* being very common in agile development fields (Haugen, 2006).

Gamification has enjoyed an exponential increase in popularity over the last decade, resulting in a market valuation of 9.1 billion USD in 2020, with estimates predicting continued growth into the future (Intelligence, 2020). Certain parts of the world has also implemented certain aspects of gamification in a much broader sense, as is the case with China's implementation of the Social Credit Score Creemers (2018).

Designers that apply gamification techniques aim to leverage the psychological predisposition humans have to engage in play, as a means to increase user engagement (Hamari and Koivisto, 2015). Design

strategies and elements from game design such as user avatars, point systems, achievements or rewards can be used in this context to create a sense of connection and progression for the end user. One of the main strengths of gamification is the ability it provides to alter a users perception of a task from a *chore* to that of a *challenge.* The techniques and elements used to facilitate this can be used in a variety of different ways depending on the target demographic and environment in which the solution is to be applied. In other words, how and when gamified techniques are used are very important for the potential end result. Research suggests that most gamified techniques rely on rewards and tactics designed to leverage a users extrinsic motivation (Ryan and Deci, 2000), as many of the most used techniques are inherently partially motivated by external factors. To realize the benefits of applying proper gamification, it is important to consider ways in which the strategy can be deployed to make the solution intrinsically motivating.

2.3.1 Progression and Reward Systems

Research suggests that *points* are the most cited game element to be utilized Intelligence (2020), perhaps due to the inherent attributes and possibilities a point system can introduce to otherwise static elements. According to the same study, the second most included game mechanic is reward- and progression systems.

The sense of progression and subsequent feeling of mastery one can experience when reaching a goal, are both powerful psychological constructs. Being able to tap into these would prove invaluable regarding user engagement in most applications, and this is where gamification comes in. By utilizing techniques that tie the users actions in the application to an overarching progression system, one can leverage both intrinsic and extrinsic motivation, by in practice creating an environment similar to that of the Skinner Box.

In gamification terms, such systems are usually based on the video-game construct of *levels*, with each level-up rewarding the user with other elements introduced in the environment. Often accompanied with clear-cut goals and progression bars, level-up systems can function as a continuous *mission* for the users, in addition to supplying new challenges when leveling up, adding a layer of interest to otherwise dull tasks.

A problem with systems like these are that they are often added as an afterthought, or otherwise implemented to already existing systems in a cheap attempt at gamifying certain aspects of the application. In some cases, this can lead to the system appearing disassociated, leading the effect to be opposite of the intention (Toda et al., 2018). However, this is a symptom of the context of which it was applied,

not the technique itself.

2.3.2 Avatars

Though people generally associate the term *avatar* with what they know today, the term itself is actually a concept in Hinduism which means *descent* and *the material appearance* or *incarnation of a god on earth* (Lochtefeld, 2002)(Parrinder, 1997). It makes a lot of sense how, in the context of computing, the word is used for self-representation of the user's character or persona in another form, a graphical form. Avatar is widely used among online communities including forums and social media, as well as our daily life devices like contacts in mobile phones, TV streaming services, and video games. Basically, avatars are used to represent who is who, so people do not get confused with one another in virtual environments. One of the purposes of avatar is for identification which could work by other forms like names; however, by using avatar, it adds personal value to such identity because it gives visual which is more relatable. As people spend more time on virtual communities or "online world" nowadays, the use of avatar has become more common and seen more often. When people use avatar in virtual environments, they can sense their presences which are related to their characteristics and perception (Nowak et al., 2008). Depending on their complication, these avatars are not only able to represent static graphical identification, but sometimes sophisticated expression like emotions or body languages. Moreover, in some circumstances, users are also allowed to customize their avatars to suit with their appearances and personalities best. One common example is from the game *The Sims* (Electronic Arts, 2014) where players are able to make full customization to their characters (or, in this case, *avatars*) both for the appearances and characteristics. Certainly, though players do not necessarily need to make their avatars to represent themselves, it is common to see one making the game version of themselves as it is always fun to "play" the game as oneself.

The application of avatar in gamification, if not in games, is also commonly used for representation of the users. Since gamification is a concept of trying to manipulate players into doing common activities, the usage of avatar seems to suit well with such concept since people tend to be motivated from the concept of using the avatars. One study uses the approach of applying such concept with gamification regarding an issue with diabetes (Mohd Tuah et al., 2019). They learn that such approach is able to provide many contributions to the theory and practice, and has promising results seen from users' performance and motivation. Similarly, another study creates a solution combining personalized health interventions with gamification including the use of avatar, and shows that the received feedback is hugely favourable since the users have relatively high involvement using the solution (Kostenius et al., 2018).

Furthermore, it is important to note that while avatars often do reflect the self, it is not a prerequisite for their inclusion, with the figures' connection to the player and sense of identity being left up to individual interpretation. Building on this sense of identity is a key point of value regarding the potential inclusion of an avatar, and oftentimes this is accentuated by the possibility of personal customization of the avatar. Letting the users carve out their own niche by personalizing the avatar may lead to a stronger sense of connection- or identification in the avatar, positively affecting the users perception of the system (Turkay and Kinzer, 2016).

Overall, the researches suggest that the use of avatars has a positive impact when used in a gamified solution; therefore, it is suggested that when one creates such solution, they should consider the application of avatar in order to gain more engagement and motivation from the users, along with other elements in the concept of gamification.

Chapter 3

Related Works

In this chapter, the researchers competitive analysis will be presented. The chapter starts by explaining the context of performing a competitive analysis in the case of this thesis. Further, section 3.1 will showcase several other pieces of research, before section 3.2 presents the results of the market analysis of related applications. The chapter will conclude with a section evaluating this process.

As mentioned in chapter 1 and as uncovered in chapter 5, the market for actual applications in the health sector targeting the younger demographic focusing on nutritional self-help solutions are lacking. The following sections therefore seek to explore the market for applications such as the researchers proposed solution.

A competitive market analysis is a research strategy aimed at analyzing and understanding the current market situation of products either directly or indirectly competing with the proposed solution. The strategy is commonly used in directly competitive environments such as the business sector, but due to the nature of software development, the strategy is highly applicable also in this field.

In the case of this thesis, the strategy has been used to review the market situation at the time of writing, by exploring the market and identifying key players in the space. Already available applications that utilize some of the techniques, elements or ideas present in the researchers concept were reviewed and further analyzed. Additionally, related work containing relevant concepts and prototypes have been reviewed to the same end.

3.1 Related Researches

In this section, the researchers have taken a deeper look at preexisting researches that relate especially closely in topic to the concept and solution presented in this thesis. The papers in question, and solutions presented within them, all relate closely to the topic of handling overweight, obesity or nutritional incognizance in children and adults, but differ in approach and proposed solutions.

3.1.1 Fammeal

Fammeal (Afonso et al., 2020) was a gamified mobile application focusing on young children's lifestyle (eating, drinking, moving, and sleeping habits) integrated with tailored suggestions for parents and serious games for children. The application was developed with collaboration among scientists, health practitioners, developers, parents, and children. The solution was meant to be a recommendation by health personnel after they have detected that the children might be overweight or obese. In addition to this, the application could also work as a preventive solution and a presentation of better lifestyles regarding children behaviors.

The application contained a prototype and a monitoring website which could be used for both parents and children in different modes. It could also be observed by the health personnel. In the children mode, the app presented a game for a child to play by taking care of an in-game character/avatar in lifestyle topics which were water/food intake, sleeping, and physical activity as seen in Figure 3.1. Though the avatar did not reflect the child's activities and behaviors, the purpose was rather to raise their awareness regarding the topic. Regardless, the avatar had different visual appearances in the game depending on what states and activities it was in. This was to indicate the avatar's needs and emotions which was the key point for the children to understand and learn how to interact with the avatar in the game, resulting in increasing awareness as mentioned.

Figure 3.1: In-game screenshots of Fammeal

The research paper included screenshots from the game showing what user interface looked like and how the user would interact with the game. Moreover, it included a table as seen in Figure 3.2 showing different states and activities the avatar is in which could be inspiring for those who looked for ideas of how avatars should appear in such health management games targeting children.
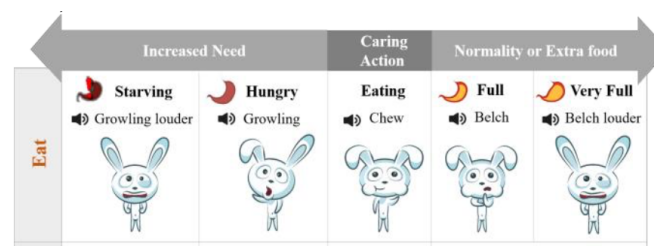

Figure 3.2: Different stages of the avatar in Fammeal

Though the research's participants were parents and children, it was not able to evaluate the acceptance by the children. This was due to the fact that the evaluation was done by the parents who also controlled the access for their children. Nonetheless, the research reported that there was no rejection of the game by the children who participated. It also reported that the health personnel and the parents accepted the innovative approach and the application, respectively.

3.1.2 Monster Appetite

Monster Appetite (Hwang and Mamykina, 2017) was a nutrition game that aimed to address certain facets of the obesity crisis by raising food consciousness, especially in terms of per-serving calories. The research looked into the difference in framing its gameplay (subversive vs. inoculation) applying the usage of monster-like avatars through the game. The game had two versions which varied on the two user groups: subversive and inoculation, or in other words, one with positively- and another with

negatively-framed messages. In both versions, the player were to choose snacks of a monster who was presented as an avatar as seen in Figure 3.3. Consequently, the player's consumption choices would have an impact on the appearance of the monster whether it was positive or negative. The player's consumption decision could also be based on the goal stated by the game which were different depending on the group. The avatars would appear in different ranges depending on its weight, from "light" to "heavy" based on what types of snacks the player had chosen to consume.
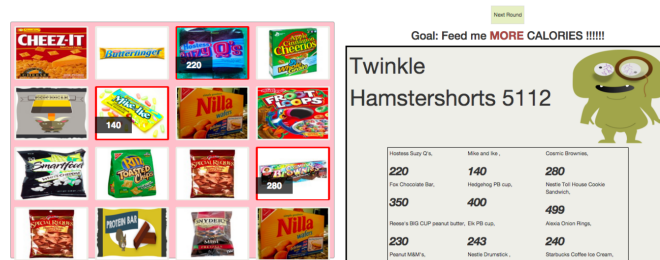

Figure 3.3: In-game screenshots of Monster Appetite

The research was obviously relative when it came to the usage of avatars in a health-themed game. The game's avatar had seven stages of its weight status which were shown visually from healthy to unhealthy, and were to make the player aware of the consumption choices one went for. However, the limitation of the research was that the avatars' appearance only changed in negative direction, but not another way round. The suggestion was that it should be possible for the player to be able to see the positive change in the avatars when the consumption decision had a positive result. By doing this, the game could increase awareness not only of the negative consequences but also the possessive ones. Nonetheless, the evaluation concluded that the players showed better decisions in the game resulting from the negative visuals through the avatars.

3.1.3 Barty

Barty (Gonçalves et al., 2020) was a game that aimed to teach players to distinguish foods based on healthiness and to consume the right foods at meals during the day. The game applied the use of an avatar to show the player different stages of player's choice in terms of healthiness, similarly to the one in the Monster Appetite game mentioned earlier. The Barty game consisted of three parts that represented various types of food to the player who needed to decide which one to be consumed, and this would consequently affect the avatar. The avatar was shown in the form of a comical carrot named "Barty" and had four different stages from being healthy to unhealthy.

The validation of the game went towards positive direction since the paper stated that they were able

to prove that the users acquired knowledge, even with limitations the game might have. The users, which consisted of children and caregivers, were motivated to play the game and learn about which food they should consume in order to sustain a healthy lifestyle. However, they found that the avatar did not reflect the progression of the players and could even discourage them, and that the results did not reflect directly from the avatar's current state. The paper suggested that the game could be used as a pedagogical tool by health personnel as educators or nutritionists, and also that it could apply the uses of databases and artificial algorithms in order to make the game more responsive and interactive.

3.1.4   Healthy Weight Game!

In comparison with previous related works, *Healthy Weight Game!* (Lentelink et al., 2013) highlighted more on the usage of rewarding system and virtual shop, in addition to the avatar. The game was operated on mobile phones and supported both single and multi players. After setting a personal workout goal based on research recommendations and personal information like weight and height, the player can start the game by inputting workout information daily to earn in-game credits. This can be done with other players in a form of competition to help players stay encouraged and motivated. There was a mini-game that players could play with others were in a form of racing comparing physical activities progress in the game, and those who won could get credits as the rewards. The game also used avatars to indicate how the player performed by different visual feedback (avatar's body shape, emotions, and body languages). Moreover, it used in-game credit as a rewarding system to compare with other players and to make a purchase in a virtual shop. Some of the items could be purchased from the shop using credits, and some could only be purchased by making progress in the game and leveling up. Overall, the game is a good example to see how it applied the concept of gamification in different aspects. Screenshots of the game can be seen in Figure 3.4.
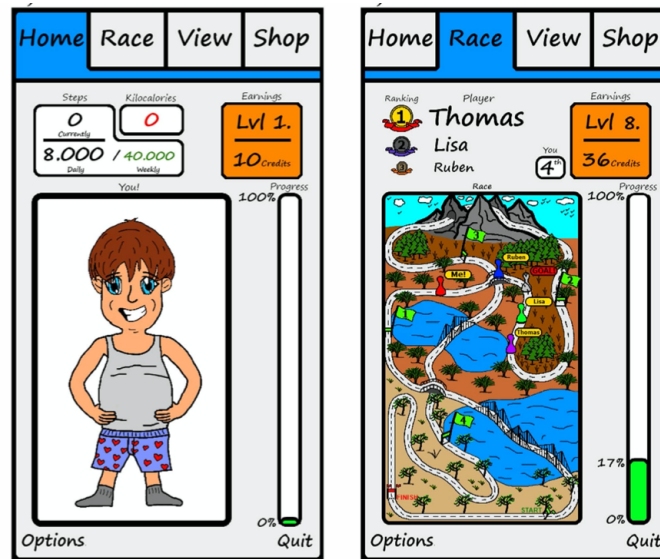
Figure 3.4: In-game screenshots of Healthy Weight Game!

The game was tested and evaluated by a group of young adults, and it concluded that the design of the game showed possibilities for improving both physical and mental health for those people who had issues with overweight and obesity. This was a result from using the game for physical exercises which also led to behavior changes. The paper ended stating that the game would like to support overweight and obesity solutions by encouraging players to perform more activities which at the same time were fun and rewarding.

3.2   Similar Applications

Health-related digital solutions and the sheer amount of mobile applications available to consumers, has grown at a massive rate in the last decade Institute (2017). In this section, the researchers will analyze some of the applications relating to the health and nutrition space, or otherwise interesting offerings on Google Play Store, subsequently reviewing them. This review will range from simple reminder-type applications to more all-encompassing systems, and will serve as a baseline the researchers can utilize as tool of reference when deciding whether or not to add potential features to the proposed solution of the thesis, as presented in chapter 6.

Several applications in the health space offer ways to track certain tasks, or create certain routines with the end goal of increasing the users nutritional balance. *5 A Day Tracker* is an example of such an app, providing a simple customizable tracker that allows the user to log how many fruits and vegetables they eat a day, without the need for concrete sample selectors or other complex nutritional value logging. In addition, the app saves the result for each day to a calendar, providing the user with an overview that

can easily be used as a tool for gauging progression.

Water Reminder is another example of a simple health-tracking app. In Water Reminder, the users recommended daily water intake is calculated based on supplied personal information, before users are prompted to set a sleep schedule and a notification interval - both of which act to facilitate the users water intake and to avoid nightly reminders. The app includes a wide selection of different types of drinks, automatically calculating the actual water content of a selected beverage. In addition, Water Reminder includes a system designed to motivate its users by awarding them with medals for sticking to the regime over time. The tangible goal of the app is to make sure the user drinks *8 Glasses A Day*, but the overarching goal is to better the users routines and overall health.

Lifesum is a nutrition-based health application that allows its users to track personal statistics, set food plans, get recipes and learn about nutrition. The app has a calm design, which features heavy use of images, icons and colors. To simplify meal tracking, a barcode scanner was integrated, and a large community all over the world help in adding products and defining common portion sizes. Additionally, any scanned food item reveals a food score, used to rank the food based on its inherent level of healthiness.

SmoresUp is a tracking application that aims to simplify household management by creating a single environment for tracking chores and events. The application allows parents to organize the family by giving chores directly to their children individually or as a group, and the family can plan their daily or weekly chores with the built in calendar. This app introduces a gamified reward system, in which the parents can give their children *S'mores* for completing custom chores, or simply being nice. These S'mores can in turn be used to unlock rewards set forth by the parents beforehand. The design features heavy usage of icons, and a comprehensive color scheme

3.3   Evaluation

While the biggest strength in apps like Water Reminder or 5 A Day Tracker lie in their inherent simplicity, this is also the biggest flaw. In 5 A Day Tracker, for example, the application allows the user to track as many fruits and vegetables as they want, upwards of tens if not hundreds every single day(something which quite clearly is unhealthy). Here, the app has a design flaw - the trackers numbers turn green to signal healthy behaviour at a certain intake amount, but does not revert or change at excessive amounts. In contrast to Water Reminder, the app also lacks any form of reward system or other motivators. Additionally, installing many different applications per routine or health habit can quickly grow tiresome. There exists several applications catered to tracking multiple things at once,

while simultaneously not overflowing the users phone with notifications, like Lifesum.

By virtue of being an app that focuses on chores, SmoresUp is an application that at first glance may not seem like it fits into the the health- and nutrition space. However, research has suggested that the introduction of routines may results in great health benefits (Taveras et al., 2013)(Fiese and Spagnola, 2007). Additionally, the application could certainly be utilized directly for the purpose of preventing health issues, by incorporating bedtime, soccer practice, et cetera with the calendar function.

Reflected by its current rating of 4.5 on the Google Play Store, Lifesum is certainly a powerful and quite well-designed application. However, the design suffers a little bit when attempting to cram too much information and too many big elements into a relatively small space. Despite the colorful and playful appearance of the app, however, it is clear that Lifesum is not intended for use by the younger demographic.

In fact, herein lies the problem that initially peaked the researchers curiosity. While performing the initial research as as part of this thesis, the researchers found interesting examples of work done in the field as described in the Related Works section, in addition to a large number of articles describing applications and solutions for children regarding health- and nutrition. The researchers quickly discovered, however, that many of these applications were either defunct, otherwise not available or seemingly left in the prototype stage.

Chapter 4

Research Design

In the following chapter, the research methodology utilized in the thesis will be presented. The chapter will give an introduction to how the research in the thesis was done, which types of data were collected, and which methods were utilized in order to gather that data.

4.1 Data Collection

The researchers conducted their research initially by collecting and reviewing secondary data, in an attempt to gain the relevant insight required to design and evaluate a proposed solution. With this, the aim was to gather the relevant primary data needed discuss and analyze the proposed research questions. In contrast to quantitative studies, qualitative studies aim to elicit the inherent *why* given a certain context. While the research team applied the quantitative data collection method, the *Likert scale*, to gauge the test subject's familiarity with digital devices, other data collections methods in the thesis where based on the qualitative approach.

As qualitative research is exploratory in nature, the decision to use this approach in the project seemed fitting, as the researchers had little to no prior knowledge of the topic with the exception of certain personal anecdotes. This conclusion was further strengthened due to the inherent nature of the space in which the study was conducted, as the fields of interaction design and gamification where perceived as highly subjective to the researchers. This, in turn, lead the researchers to rely on qualitative measures, in an attempt to uncover the human connection. Interviews and Questionnaires were used to collect the primary data for the thesis, and an expanded explanation of this process can be found in chapter 8. Additionally, the questionnaires are located in Appendix B.

4.2   Systematic Literature Review

The research for the project began with a systematic literature review, meant to facilitate the research team by improving insight into areas of scientific importance for the thesis. The process was carried out by performing a detailed review on literature relevant to the thesis. As a part of this process the team delimited the search phrase utilized for the search, by defining a search query including the projects target demographic and other areas of interest, focusing on terms like "gamification", "nutrition" and "obesity". The actual structured literature review, how it was performed and which insights were gained from it are described in more detail in chapter 5.

4.3   User-Centric Design

The researchers decided to apply user-centric design approach throughout the entire process of the solution. The process of the user-centric design can be seen in Figure 4.1. The researcher started from understanding the context of the issue from discussing with stakeholders to gain basic information. Then, the team observed an intervention hold by municipality for families with overweight children in order to gain insight information from the parents and children. The researchers brainstormed about solution alternatives, their advantages and drawbacks, and considered on one to progress on. The team made iterative prototypes and tested them with users and other stakeholders in order make improvement to the solution. Therefore, the research was heavily based on user-centric design approach which the team genuinely thought that it would suit the circumstance most.
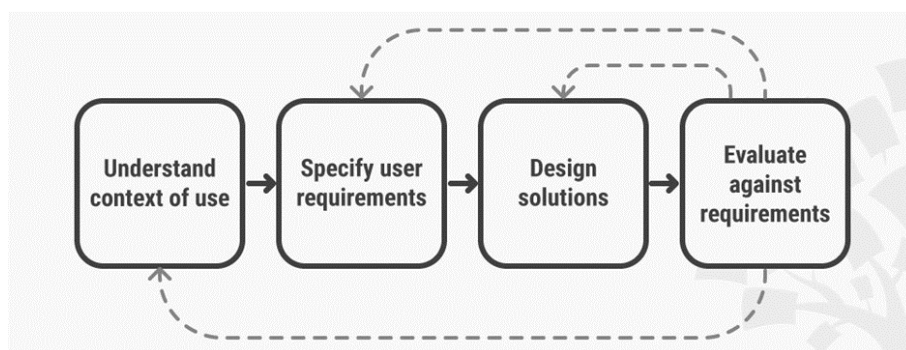

Figure 4.1: User-centric design process (Interaction Design Foundation, 2020)

During the initial research phase of this thesis, the researchers devised a concept based on the insight gained from the aforementioned data collection and literature review. In an attempt to test and subsequently evaluate this concept, a functional prototype of the envisioned solution was developed. The prototype was designed based on insights gained from interviews as well as discourse with experts, in

addition to both phases of the literature review. The prototype was designed to be tested by individuals of the target demographic, and was utilized for this purpose. This phase, including the design of the initial prototype and the redesign process for the second prototype, is described in detail in chapter 6. Additionally, representations of version one and version two are located in Appendix D.

Chapter 5

Systematic Literature Review

At the beginning of the project, the researchers wanted to acknowledge possible solutions available on other researches regarding the topic before they progressed to making their own. Moreover, they thought that the thesis would benefit from the contribution of the review in addition to the solution itself which might have some limitation due to the current pandemic. Therefore, they decided to perform a systematic literature review (SLR) which was often used to strengthen the fundamentals of a project or a research. Literature review is an important component of educational research; consequently, it helps one understands not only the context of existing studies, hypotheses, theories, evaluations, but also the disadvantages and contradictions as well (Xiao and Watson, 2019).

The review presents an overview of digital solutions used for weight management in different contexts. Therefore, the questions the researchers addressed for the literature review are:

- What types of technologies go into the digital solutions for weight management?

- What are the concepts used in such solutions?

- Which user groups are the digital solutions designed to support, and in what context are they developed?

- What are the methodological approaches to evaluate digital solutions for weight management?

- What evidence is there to support the impact of the digital solutions on health outcomes?

5.1 Method

A systematic literature review was conducted on the digital solutions available for weight management. The following search terms were used in this review: *(Obesity OR Overweight) AND (Gamification OR Gamified OR Gaming OR Game-Based) AND (Nutrition OR Diet OR Habit OR Habits OR Health OR Eating OR Management).* The researchers performed the search on the electronic database *Engineer Village* between the date of 14 and 20 December 2020. The search procedure flowchart is seen in Figure 5.1.
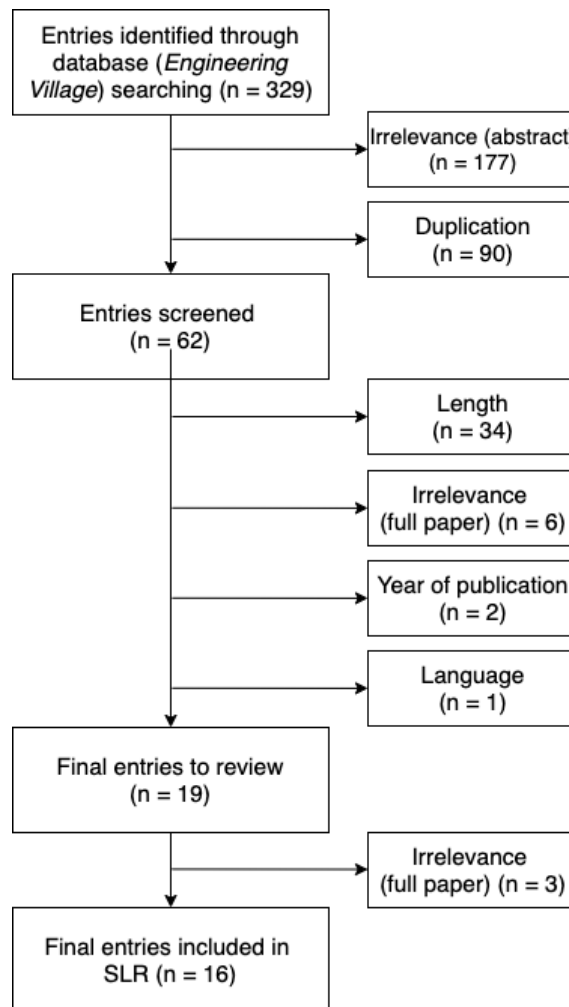

Figure 5.1: Flowchart of search procedure

5.1.1 Inclusion and exclusion

The researchers used the criteria for *inclusion* as following:

- The study's main concern is relevant to digital solutions regarding childhood overweight obesity.

- The study is described in a peer reviewed research article written in English.

- The study reports on empirical findings.

- The study is fully available and not only with abstract.

For the *exclusion*, the researchers eliminated the studies considered short (with less than 5000 words), outdated (from 2013 and earlier), and those which had main concern in general training and wellness application.

#	Authors	Title	Main research contribution	Loca-tion	Dura-tion	Technology used	Concept	User group	Method and evaluation	Outcome	
1	(del Río et al., 2019)	*Effects of a Gamified Educational Program in the Nutrition of Children with Obesity*	The project has developed a gamified educational program for healthy habits, based on active video games and motor games. It has created and validated a frame of reference for intervention, monitoring and emotional, biomedical, interactive, social, psychological and educational evaluation, based on games, applied to the treatment of childhood obesity and to preventing associated complications. It has also produced various technological products (exergames, serious games, webapps, sensory libraries, wearables, etc.).	Canary Islands	3 years	• Video games (Active video games) • Video conferences • Virtual environments	Gamified educational intervention program	46 obese children aged 6-12	• Experimental and control group • Training activities • Questionnaires	Quantitative data shows a significant improvement user group's knowledge and behaviors of healthy eating	
2	(Afonso et al., 2020)	*Fammeal - a gamified mobile application for parents and children to help health care centers treat childhood obesity*	The study presents a solution to support the prevention and treatment of childhood OB at health care centers. This solution is based on a platform that is innovative when compared with those existing because: • It is directed to both parents and young children and involves them through tailoring and gaming strategies; • It is designed to prevent or support the treatment of OB by promoting parents' skills to change the family lifestyle; and • It is designed to be used at health care centers.	Portu-gal	4 weeks	Mobile phone	• Gamification • Avatar • Rewarding system	34 children aged 3-6 (also parents)	Questionnaires (acceptance and pilot tests)	• The retention rate was 71.4%. • Health care center's professionals and parents of children with overweight/obesity accepted this innovative approach. • Not able to evaluate the acceptance by children, as the access was controlled by their parents; nonetheless, parents reported no rejection of the app by children.	
3	(Saad et al., 2018)	*Play, Learn and Eat Healthy Food: A Mobile Game for Children to Fight Obesity*	The proposed serious game allows the children to learn about the importance of taking health breakfast daily. The game helps the children to eat more fruit and vegetables, exercise daily and change their habits of just eating anything they found around them.	Qatar	7 months	Website	• Gamification • Tutorial • Avatar • Rewarding system	Children aged 6-12	Questionnaires	• The game helps the children to eat more fruit and vegetables, exercise daily and change their habits of just eating anything they found around them. • Overall, the study shows that all the children are strongly engaged with the game with minimum difficulty in understanding and playing the game, but with high educational impact in raising children's motivation to eat healthy breakfast. This study proves that this game achieves its desired goals.	

#	Authors	Title	Main research contribution	Loca-tion	Dura-tion	Technology used	Concept	User group	Method and evaluation	Outcome
4	(Vil-lasana et al., 2019)	*CoviHealth: Novel approach of a mobile application for nutrition and physical activity management for teenagers*	The main contribution of this paper is a detailed specification of an integrated mobile [app] for promoting healthy habits for young people. Additionally, it leverages the effects of gamification and medical control on stimulation education with healthy habits.	Spain	2 months	Mobile phone	• Gamifica-tion • Physical manage-ment/diary • Diet/train-ing plan	356 teenagers aged 13-18 (tentative)	N/A	*(No evaluation, though the solution is planned to be evaluated to the user group mentioned.)*
5	(Baranyi et al., 2017)	*NutritionRush - A Serious Game to Support People with the Awareness of Their Nutrition Intake*	The study provides tangible evidence that supports the creation of serious games as a tool for increasing nutritional awareness. Even though their application met mixed response, the fact remains and the idea could be executed better.	Austria	N/A	Mobile phone	• Gamifica-tion • Avatar • Rewarding system	14 people (mostly adults) aged 10 and 18-52	• Interview • Question-naires • Analysis from video records	• Qualitative • The feedback showed that there is a lot of potential for such serious games and that the prototype is a good initial starting point for different identified requirements.
6	(Filho and Eurico, 2015)	*Interactive Digital Mobile Gaming as a Strategic Tool in the Flight against Childhood Obesity*	The exergame represents a differential tool for the promotion of a healthy lifestyle among children by combining digital game elements with health awareness in a fun and motivating fashion. The tool is useful for both health professionals and children, making it possible to establish a dialogue and an exchange between scientific information and common-sense experience.	Brazil	N/A	Mobile phone	• Gamifica-tion • Avatar • Rewarding system	30 children aged 8-10	User participated in all stages of development	*(No complete "evaluation" but the solution is assumed to perform well since it was developed closely with user interaction.)*
7	(Lentelink et al., 2013)	*Healthy Weight Game!: Lose weight together. The design and evaluation of a serious game for overweight and obesity.*	A design for a serious game for improving physical, and indirectly mental health of the people who deal with overweight or obesity.	Nether-lands	1 year	Mobile phone	• Gamifica-tion • Avatar • Rewarding system	53 adults aged 18-25	Question-naires	• Quantitative • The game resulted in a design for a serious game which shows potential for improving physical, and indirectly mental, health of people who deal with overweight and obesity by focusing on increasing adherence to physical exercise programs and achieving positive behavioral change.

#	Authors	Title	Main research contribution	Loca-tion	Dura-tion	Technology used	Concept	User group	Method and evaluation	Outcome	
8	(Gonçalves et al., 2020)	*Development of a Serious Game to fight Childhood Obesity: "Barty"*	The game has a great pedagogical aspect that can be applied not only to children, but also to their care-givers, which latter have a tool of assistance in the education and accompaniment of their children.	Portu-gal	2 weeks	Mobile phone	• Gamifica-tion • Avatar	16 children aged 3-10	Question-naires	• The developed game is an impor-tant contribution because it has a great pedagogical aspect that can be applied not only to children, but also to their caregivers, which latter have a tool of assistance in the education and accompaniment of their children. • From the initial and final survey, it was possible to verify that the children acquired knowledge, and motivated to play and learn.	
9	(Hu et al., 2016)	*OB CITY—Defini-tion of a Family-Based Intervention for Childhood Obesity Supported by Information and Communi-cation Technologies*	The tool itself can be used by physicians in the future, allowing for better diagnostics and follow up not only for the children in need, but for any family regardless of obesity levels..	N/A	N/A	• Mobile phone • Wearable device	• Gamifica-tion • Avatar	Children and parents	N/A	*(No evaluation, though the proto-type is planned to be evaluated to the user group mentioned.)*	
10	(Joo and Kim, 2017)	*When You Exercise Your Avatar in a Virtual Game: The Role of Avatars' Body Shape and Behavior in Users' Health Behavior*	The results suggest that (i) a virtual game environment can be an effective intervention to in-fluence users' health behavior, and (ii) both avatars' behavior and appearance should be considered when designing an effective vir-tual intervention to increase users' health. We believe these findings suggest that health-related online courses involving thin and active avatars with a healthy lifestyle can be helpful for users to control weight in the long run by improv-ing their health behaviors.	South Korea	1 hour	Computer	• Gamifica-tion • Avatar	124 adults aged 20-29	• Question-naires • Experiment	• A virtual game environment can be an effective intervention to in-fluence users' health behavior • The findings suggest that health-related online courses involving thin and active avatars with a healthy life- style can be helpful for users to control weight in the long run by improving their health behaviors.	

#	Authors	Title	Main research contribution	Loca-tion	Dura-tion	Technology used	Concept	User group	Method and evaluation	Outcome	
11	(Guarneri et al., 2014)	*Engaging Teenagers in the adoption of Healthy Lifestyles for the Prevention of Obesity and Related Comorbidities*	The PEGASO System.	Italy, Spain, UK	N/A	• Mobile phone • Wearable device	• Gamifica-tion • Diary • Avatar	300 teenagers	N/A	*(No evaluation, though the solution is planned to be evaluated to the user group mentioned.)*	
12	(Ladwa et al., 2018)	*Towards Encouraging a Healthier Lifestyle and Increased Physical Activity – An App Incorporating Persuasive Design Principles*	• Persuasive design principles do have a positive impact on users and it has the potential to determine the success or failure of a mobile application. • Although it is difficult to assess whether the application can change behavior long-term and whether or not it assists in tackling obesity, it is evident that users are encouraged to use the application and attempt the new behavior, which is likely to change their behavior for the time being.	N/A	1 day	Mobile phone	• Route tracker • Calorie log • Rewarding system	10 adults	• Focus group • Individual "think aloud" session	• Persuasive design principles do have a positive impact on users • Although it is difficult to assess whether the application can change behavior long-term and whether or not it assists in tackling obesity, it is evident that users are encouraged to use the application and attempt the new behavior, which is likely to change their behavior for the time being.	
13	(Miller et al., 2013)	*Designing Strategies for Youth-focused Persuasive Social Health Games*	The study resulted in a lot of information about the end results of games, as designed and created by younger adolescents themselves. This gives great insight into what we may need to focus on when designing apps for said age groups.	N/A	3 years	• Wearable device • Other non-tech approach	• Partic-ipatory design • Physical game • Rewarding system	112 students	• Participa-tory design exercises • Focus groups • Interviews • Question-naires	• Qualitative • The paper described a set of design strategies, conundrums and possible paths forward for creating social media games to incentivize healthy physical activity which seemed to work out.	

#	Authors	Title	Main research contribution	Loca-tion	Dura-tion	Technology used	Concept	User group	Method and evaluation	Outcome
14	(Guimarães et al., 2015)	*AFINA-te: A Healthy Lifestyle Information Website, Online Food Diary and Exercise Log Directly Towards Children*	Afina-te is a learning platform for children consequentially leading them to better understand, apply and monitor healthy behaviors, therefore preventing and help treating obesity and overweight.	Portu-gal	N/A	Website	• Food diary • Exercise log • Infor-mational website	Children	N/A	*(It is assumed that they didn't perform user testing.)*
15	(Hwang and Mamyk-ina, 2017)	*Monster Appetite: Effects of Subversive Framing on Nutritional Choices in a Digital Game Environment*	The study showed that when positive messages were embedded in MA mixed with negative visuals through the monster avatars, participants exhibited better snack choices post-gameplay.	United States	N/A	Website	• Gamifica-tion • Avatar	225 adults aged 18 and over	Question-naires	• Quantitative and qualitative • The study showed that when positive messages were embedded in MA (the game) mixed with negative visuals through the monster avatars, participants exhibited better snack choices post-gameplay.
16	(Orji et al., 2012)	*LunchTime: a slow-casual game for long-term dietary behavior change*	• To propose an approach for developing a persuasive game for dietary interventions (goal-based approach), which allows the player to move from goal to solution. • To formulate the slow-casual game technique that combines both casual and slow attributes to induce learning, reflection, attitude and/or behavior change. • To model two recognized determinants of well-being (away-from-home foods and portion sizes) into dietary interventions. • To design, implement, and evaluate LunchTime to demonstrate the feasibility of our proposed technique for sustained learning, reflection, and attitude change.	Canada	10 days	Website	• Gamifica-tion • Rewarding system	6 adults aged 19-40	• Question-naires • Interview	• The game is capable of educating people about healthy eating in line with their health goal. • Playing the game led to a positive attitude change toward healthy eating. • Intentional slowness in the game is an important attribute to consider in any intervention intending to change behavior using education and reflection.

5.2 Results

329 titles were identified in the search. The researchers then excluded some of the studies based on the relevance from the abstracts (177) and duplication (90) which narrowed the titles down to 62. They downloaded the full papers and progressed to the next round of exclusion based on the length (34), relevance from the papers (6), year of publication (2), and the language (1). 19 full papers were read for the review; however, the researchers found that, even with the previous screening stage, 3 of the papers were irrelevant and decided to be excluded. As a result, 16 titles were in the criteria and were used for the next process of SLR. The summary of the 16 titles is seen in the previous table.

5.2.1 Types of Technology Used

The first thing the researchers wanted to find out was the types of digital solutions used for weight management, or in other words, what kind of technology went into such solutions. Based on the analysis, the majority of the papers used mobile phones as medium for their digital solutions as seen in Figure 5.2. Among these, some of them combined the use of wearable devices with mobile phones. Websites were also used in many of the reviewed papers, assumingly to be performed on a computer. Other technologies include video games, video conferences, and virtual environments.

Types of Technology Used	Reviewed Paper
Mobile phones	[2] [4] [5] [6] [7] [8] [9] [11] [12]
Websites	[3] [14] [15] [16]
Wearable devices	[9] [11] [13]
Computer	[10]
Video games/video conferences/virtual environments	[1]

Figure 5.2: Type of technology used

5.2.2 Concepts

The researchers also wanted to look into what kind of concepts or metaphors used in the digital solutions. From the review papers as seen in Figure 5.3, they found out that most of them used gamification in some way. According to Gartner(Burke, 2014), gamification is defined as *"the use of game mechanics and experience design to digitally engage and motivate people to achieve their goals."* Among these papers,

the researchers could see that the papers made uses of casual games, serious games, and simulation games. Many of them applied the uses of avatar and rewarding system in their solutions. Some of them integrated other concepts such as plans and diaries, while others did not and presented as standalone logs collecting data from training activities, food intakes, and calorie in/outtakes. Some of the papers also used informative websites as the concept of the solutions. Other concepts included route tracker, physical game, and gamified educational intervention program.

Concepts	Reviewed Paper
Gamification	[2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [15] [16]
Plans/diaries	[4] [11] [12] [14]
Tutorials/informative websites	[3] [14]
Route tracker	[12]
Physical game	[13]
Gamified educational intervention program	[1]

Figure 5.3: Concepts

5.2.3   User Groups and Context

Even though the project was aimed for finding solutions for children with overweight problems, the researchers wanted to look into solutions applied to not only this specific group but also others. As a result, they did not filter the search and anticipated to find interesting solutions regardless of the user groups. From the reviewed papers as seen in Figure 5.4, they found that half of the papers defined their user groups as children (aged 4-12), and another half as adults (aged 18-52). Some of the papers were focusing on teenagers or students (aged 13-18). Only one paper used a group of obese children as its user group for their solutions. This seemed to benefit the thesis as the researchers could see different solutions and concepts used in various user groups when it came to age; therefore, they could apply and adjust solutions seen to their own project.

User groups	Reviewed Paper
Children (age 4-12)	[2] [3] [6] [8] [9] [14]
Adults (age 18-52)	[2] [5] [7] [9] [10] [12] [15] [16]
Teens/students (age 13-18)	[4] [11] [13]
Obese children	[1]

Figure 5.4: User groups and context

5.2.4 Methodological Approaches and Evaluations

Next, the researchers analyzed what kind of methodologies and evaluations were used in those digital solutions. As seen in Figure 5.5, most of the reviewed papers stated that they used questionnaires or similar approaches to evaluate their solutions. Some of them used different questionnaires for different testing groups (pilot/acceptance) or within the same groups (before/after), and some combined questionnaires with other methods for their evaluation as well. However, there was a number of reviewed papers that did not evaluate their solutions. This was because they only suggested the solutions and planned to evaluate in the next step of their research. A number of reviewed papers used interviews and focus groups as their evaluations. Other evaluations which were each used in one review papers were training activities, analysis from video records, user participation, experiment, individual "think aloud" session, and participatory design exercises.

From those papers using questionnaires as their evaluations, the researchers learned that they were able to collect both quantitative and qualitative data, and were able to evaluate their solutions effectively. The researchers could see that questionnaires were selected as an evaluation method because it was practical in terms of time and cost, scalability, comparability and the ease of the analysis and visualization. More regarding this will be seen in the following part.

Methodological approaches and evaluations	Reviewed Paper
Questionnaires	[1] [2] [3] [5] [7] [8] [10] [13] [15] [16]
(Not available)	[4] [9] [11] [14]
Interviews	[4] [11] [13]
Focus groups	[1] [12] [13]
Others	[1] [5] [6] [10] [12] [13]

Figure 5.5: Methodological Approaches and Evaluations

5.2.5 Outcomes

When the researchers looked at the outcomes of digital solutions from reviewed papers, they could see that the papers were generally positive, supported by both quantitative and qualitative data. Overall, the users were engaged and motivated with the solutions which led them to be able to acquire knowledge and attempt new behaviors. The solutions were capable of educating users regarding the topics, and showed high potential which was a good starting point. Though they had different learning goals and objectives, they concluded that the users showed relatively positive feedback and attitude for the

solutions. This suggested that such solutions were productive and efficient for supporting and assisting families with overweight children.

However, there were five reviewed papers that did not perform any evaluation. This was because they only suggested the concept or plan for the digital solutions, and stated that they would implement them on the later stage. One of the papers [6](Filho and Eurico, 2015) stated that they developed the solution with contribution from children (users) throughout the process by way of participatory design. The children were involved in every stage of development, for example, character, plot, objective, interaction and feedback. Other papers supposed that the results would be positive supporting by different data they gathered.

5.3   Discussion

When the researchers went through all the reviewed papers and had an overview, they could see the pattern starting to form. The review of these titles could help identify as is known and highlight important contributions made to the thesis. The key points they found were as follows:

- Most of the digital solutions used applications and websites on mobile phones or computers as their selected technology.

- Most of them which applied gamification in their solutions had also integrated the use of avatar and rewarding systems as their concept.

- Children and adults who were not necessarily overweight or obese were the main user group for their evaluations for the solutions.

- Most of the solutions used questionnaires as their method for evaluation.

- The users had generally positive attitudes regarding the solutions. They also acquired knowledge and attempted new behaviors suggested from the solutions.

The reviewed papers showed many interesting concepts and development of digital solutions for overweight people which were knowledgeable and inspiring in order to develop one's own. According to the review, there were enough reasons to believe that the use of gamification as solutions for the user groups was effective and had potential for further development. Moreover, the review can help pinpoint the problems the researchers wanted to tackle and guide them to a clearer resolution. The researchers had learned about their choices and decisions regarding their solutions; therefore, it gave the researchers a wider perspective and better understanding regarding the topic.

Chapter 6

Prototype Development

In this chapter, the process behind designing the prototype used as part of the thesis will be outlined. The chapter opens with section 6.1, defining the inspiration behind the concept and describing the context in which the prototype was developed for the intended purpose. Lastly, section 6.2 presents the process behind selecting a prototyping tool that would fit the project.

6.1 Context and Inspiration

As outlined in the Background section of the thesis, previous research supports the notion that nutritional awareness, formation- and maintenance of habits, cultural factors and parental guidance all are important factors in the case of early onset obesity. Further, as explored in the Related Works section, the existing solutions in the health- and nutrition space have generally been observed as not being designed with the younger demographic. While research suggest many possible ideas for the topic, as discussed in section 3.1, there exists few solutions with the intention of allowing the younger demographic to focus on nutritional management, or otherwise allow users to focus on self-help in specific areas regarding their health. The solution presented in this chapter, intends to bridge this gap by presenting a playful environment in which children would be rewarded for their efforts, all the while nurturing their own nutritional needs through customizable challenges.

6.2 Technology

During the conceptualization phase of the application, the team had to decide on a prototyping framework with which to build the prototype. Some designers may prefer to start developing functional prototypes in the basic HTML/CSS/JS structure with some sort of frontend framework like Vue, React or React Native (depending on the platform the prototype is designed for). This approach, however, is relatively time consuming and eventual pivots in layout or design could possibly lock up resources over a longer period of time. Utilizing a prototyping software allows the designer to streamline the design process, allowing for revisions based on internal- as well as external feedback.

When selecting a tool for such a purpose, there are several important factors to take into account, ranging from how long it takes to master the proposed software, to how versatile it is in its application. Perhaps most importantly however - which level of fidelity can be expected from the final prototype given the selected software over a given time frame, and how could this in turn affect a potential end user's experience of the solution during testing?

Initially, the prototype was envisioned as a static wireframe in which simple variations of the proposed solutions would be presented to potential end users and experts alike. The researchers realized, however, that a higher fidelity interactive click-through prototype could possibly lead to more realistic test results, in turn potentially yielding a higher level of insight from the conducted experiments. After reviewing the market for prototyping and UI-design applications, the choice was narrowed down to two - *Axure RP* and *Figma.*

6.2.1 Axure RP

Axure Rapid Prototyping is considered by many to be a very robust piece of software, allowing the designer to add complex logic and state handling to the envisioned prototypes. This can give the resulting prototypes the ability to imitate real applications through experienced flow, direct interactions and user input. However, as these techniques are relatively complex, the learning curve associated with being able to utilize these advantages correctly is relatively high, something the researchers experienced firsthand after attaining a student license for the software.

6.2.2 Figma

Figma, on the other hand, is a web based vector graphics editor and design-first prototyping tool built from the ground up to focus on seamless, real-time collaboration. In contrast to Axure RP, Figma has a more gentle learning curve while simultaneously not impairing the overall quality of the end product substantially. In addition, the Figma environment includes a companion app, Figma Mirror, that seamlessly allows designers to instantly view and interact with parts of a prototype on physical devices.

At the time of writing, a recent survey (Palmer and Bowman, 2020) in which more than four thousand industry professionals and students alike partook, suggests that Figma is simultaneously the fastest growing (Figure 6.1a) and most used piece of software in the user experience- and interface-design space, reportedly exceeding the second most used primary user interface prototyping software by more than four times (Figure 6.1c). Additionally, the study suggests that Figma is an exceptionally versatile piece of software, trouncing its competition in several additional different facets of the design space (Figure 6.1b).
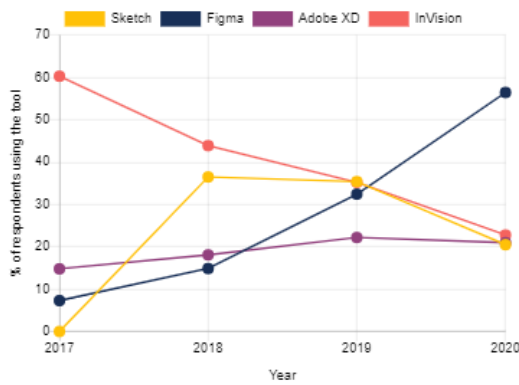
(a) The evolution of the Figma market share in comparison to competitors following its release.
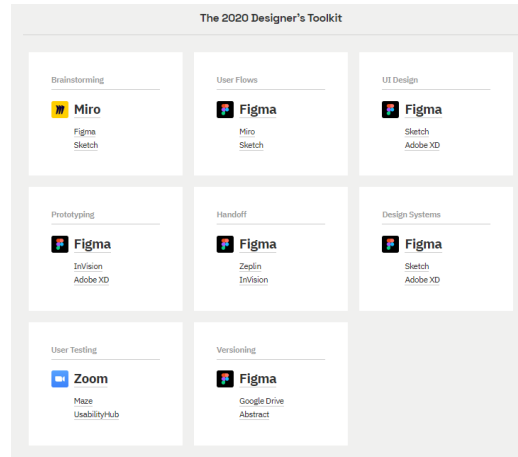
(b) Results from each individual surveyed category, showing Figma as the clear collective victor.

(c) Figma's market share for UI Prototyping, in comparison to other tools utilized for the same purpose

Figure 6.1: Results from the 2020 Design Tools Survey. Adapted from the 2020 Design Tools SurveyPalmer and Bowman (2020), by Jordan Bowman and Taylor Palmer, 2020.

While utilizing Axure RP possibly could have yielded a higher fidelity end result, potentially allowing the researchers to implement state management and let the prototype account for user input in a more real application-like way, the apparent benefits associated with utilizing Figma due to its ease of use, large industry backing, extensive plugin suite and instant physical prototype testing, made it the technology of choice for this project.

Chapter 7

Prototype Presentation

In this chapter, the design process for the two distinct prototype representations of the proposed solution, designed as part of the thesis is described and subsequently presented. The general The presentation of the first prototype was intentionally left relatively brief to focus on the improved second version, but links to working versions of both prototypes are included in Appendix D.

7.1   Prototype 1

The first prototype was a hybrid between a wireframe and click-through prototype designed in Figma, and featured a dashboard-like design intended for use with an iPad or other tablet device. As showcased in Figure 7.1, the initial design featured a green and blue color scheme, complete with big colorful collectible badges (Figure 7.2a), an icon heavy design (Figure 7.2b), emotional reactions from the avatar based on user input (Figure 7.2c), a familiarly stylized challenge-list (Figure 7.2d), flashy celebration pop-ups celebrating completed tasks (Figure 7.2e), in addition to intentionally extravagant fonts and colors (Figure 7.2f).
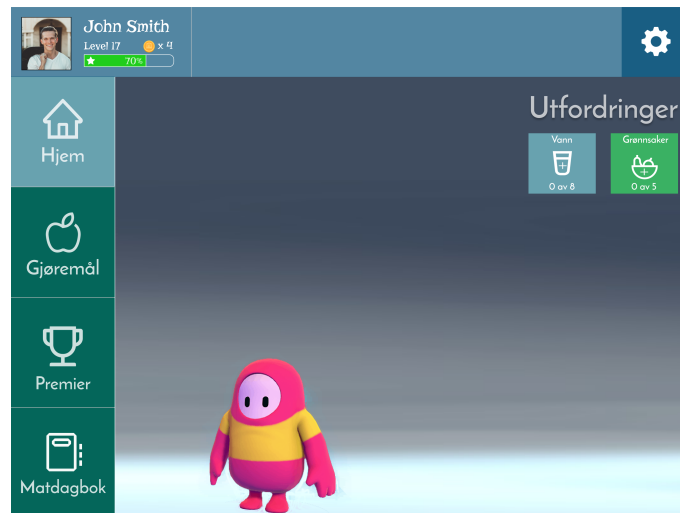
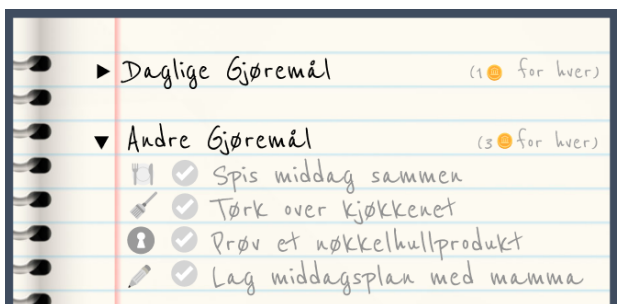*Figure 7.1: Home page of Prototype 1*
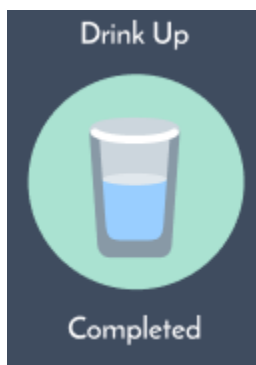
(a) Colorful, unlockable
badges
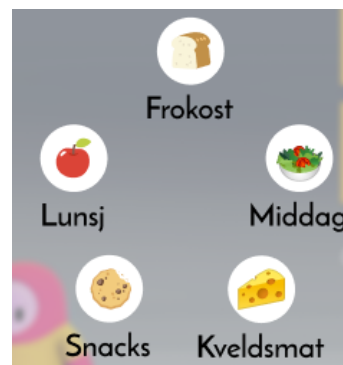
(b) The first prototype featured
heavy use of icons
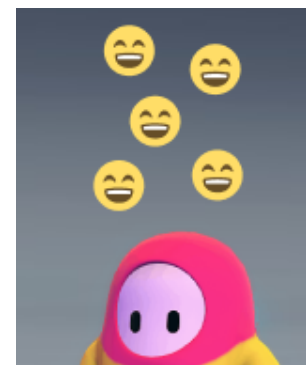
(c) The avatar reacting to
user input

(d) Tasklist, stylized to feel familiar for the target demographic

(e) Congratulatory pop-up when user finished a task

(f) Extravagant fonts and colors, included to
capture the target demographics attention.

Figure 7.2: Review of certain design decisions made in Prototype 1.

The younger demographic is used to being exposed to bright colors and loud effects through games, TV shows, commercials and so on. The main purpose behind the showcased prototype was to design an application that would resonate with the younger demographic, and to this end the aforementioned design choices were made to facilitate the potential for grabbing the attention of the children, by assimilating the prototype to other, more familiar sensory impressions. The colors chosen were based on creating a calm environment, with energetic alternative tones.

Certain features were developed to consolidate the playful approach of the design in an attempt to resonate with the children's sense of wonder and play as discussed in section 2.3, in an attempt to somewhat mask the serious undertone the proposed application tries to solve. As such, this version of the prototype included daily challenges, a progression system, a customizable task list, an avatar, a trophy collection, a food diary solution, and a settings panel for administrators to customize challenges and other settings. Most of these can be seen in the design showcase in Figure 7.2, and can be explored further in Figure D.1.

7.1.1 Reception and Evaluation

During the development phase of the proposed solution, the researchers iteratively consulted with supervisors and experts in clinical nutrition, to ensure steady development of the applications potential features and look. The group responded positively to the concept, especially liking the avatar and gamification aspects of the solution. Simultaneously, however, the prototype received remarks for looking relatively dated, and concerns were raised in relation to the amount of empty space on display. As this stage of the prototype was only meant to represent the core concept in the solution, this was relatively expected.

7.2 Prototype 2

The second prototype was developed from scratch, and featured a complete overhaul of the design with very little asset re-use from the previous version. All of the icons and avatar used in the prototype were copyright-free and free to use from the internet. The redesign prototype focused on addressing the issues uncovered during the evaluation phase of the initial prototype. Most importantly updating parts of the application that were initially deemed to look and feel dated. Additionally, during this modernization process the researchers uncovered an equipment issue, which resulted in a change of platform from tablet, to mobile. This change meant the designers had to be ingenious in their redesign to make sure

the proposed elements would fit the new format.

Another issue the designers uncovered with the first prototype, was the inherent lack of identity present in the application. To remedy this, the developers came up with the name *SuperDuper* (Figure 7.3a), a play on the expression for excellent. As discussed in subsection 2.3.2, the inclusion of an avatar was intended to facilitate the personal connection the end user could make to the avatar, which potentially could manifest as a pet, a friend, or something else based on individuals experience and predisposition. This approach was further facilitated by naming the app *SuperDuper* (Figure 7.3a), the avatar *Duper* (Figure 7.3b), and giving the users the mission to help *Duper* become *Super*. The designers hoped this approach would assist in creating a strong sense of attachment to the avatar and its quest to become a more super version of itself. Parts of this approach can be seen in the identity showcase, Figure 7.3.

(a) Welcoming screen for SuperDuper

(b) The avatar, *Duper*

(c) The avatar reacting to user customization

Figure 7.3: Showcase of application identity

7.2.1   Features and Design

The design of this prototype was more thorough than that of its predecessor. While the main color scheme for this prototype kept variations of blue and green as main colors, the placement of elements in relation to each other and the use of complementary colors assisted in creating a more united design. Yellow and purple were introduced to increase contrast and create a more cohesive look, with yellow representing collectibles (stars, lemons, experience points), highlighting and buttons, with purple acting

as a contrast in the sub-headers. The design was further improved by lowering the amount of empty space present in headers, while still keeping the breathing room between elements sizable enough to prevent the user interface being too crowded, overwhelming the end user. Further, in an attempt to improve the usage of icons, a lineal style was introduced and functioned as a standard for every icon in the prototype. This helped highlight the icons by introducing a subtle contrast, while simultaneously helping facilitate a more cohesive design experience. Lastly, smoother animations were introduced while navigating from screen to screen.

While the navigation bar stayed largely unchanged from the previous iteration, the designers opted to implement a flat navigational structure, with no state in the application going deeper than one additional layer from the navigational component (with the exception of navigating to the contents of a specific meal on a specific day, which has two layers.), utilizing modals to help the user orient themselves. As an example, the task-system was redesigned to fit this structure by introducing drop-down sections grouped together by their respective time frames, with individual tasks having associated modal windows which communicate task- and reward information to the user. An example of this new task system and the navigational structure can be seen in Figure 7.4.


(a) Task list   (b) Task information   (c) Completed task
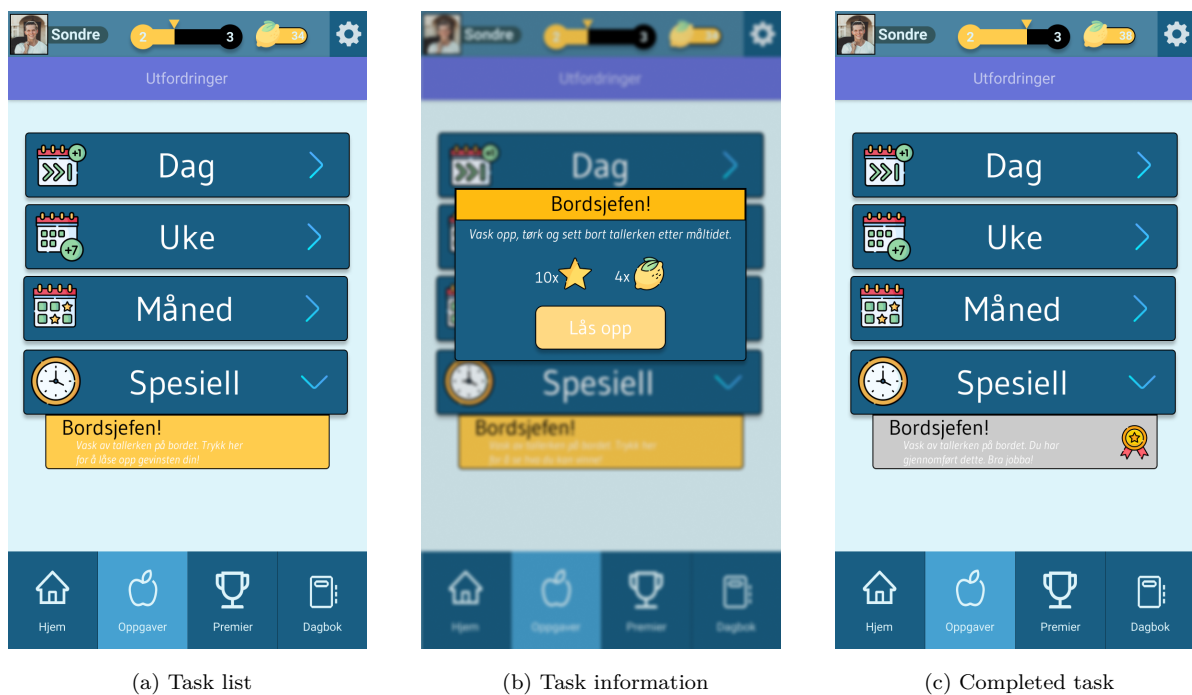
Figure 7.4: Example showing a special task being navigated to and completed, with the final state displaying the completed task.

While none of the design assets from the first prototype were directly reused, the features they represented were improved upon and transferred to the new version. The first main feature to be added in this version was an introductory tutorial acting as a guide, explaining the different user interface elements to the user. Additionally, the tutorial introduced the user to concepts such as the navigation bar (Figure 7.5a), the progression system (Figure 7.5b) and the newly added events (Figure 7.5c).
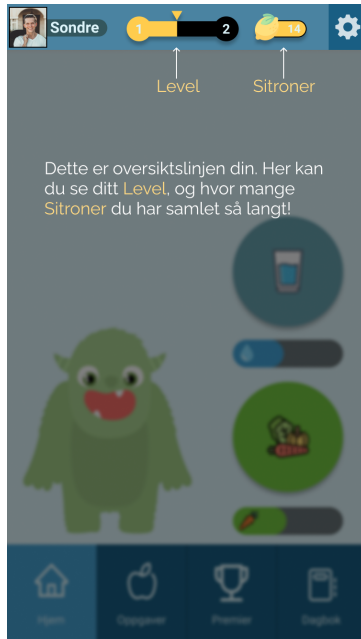
(a) Introduction to reward- and progression-systems *SuperDuper*
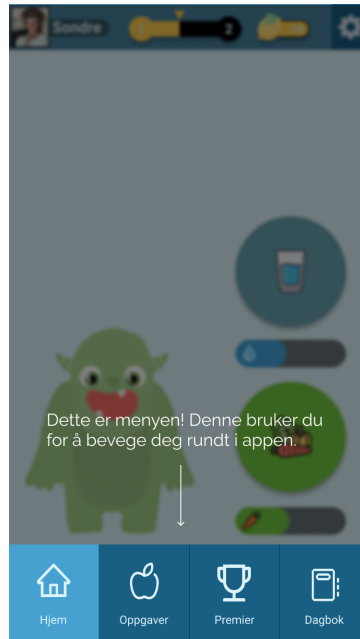
(b) Introduction to navigation

(c) Introduction to events

Figure 7.5: Showcase of the tutorial

These timed events were the second new addition to this version, and function by reminding the user a few times daily at predetermined intervals to perform simple tasks such as drinking a glass of water or eating a healthy snack like a vegetable or fruit. The user can be notified of this in one of two ways, either by the avatar telling the user that it is in need directly, or by the user noticing that the attached *status bar* is close to empty. The concept of status bars were also introduced in this iteration, giving the user the ability to track the avatars current need levels. In Figure 7.6, the process from task to completion is showcased, also showing the new avatar reactions.

(a) *Duper* notifying the user it is hungry

(b) Confirmation pop-up

(c) *Duper* being happy after eating healthy
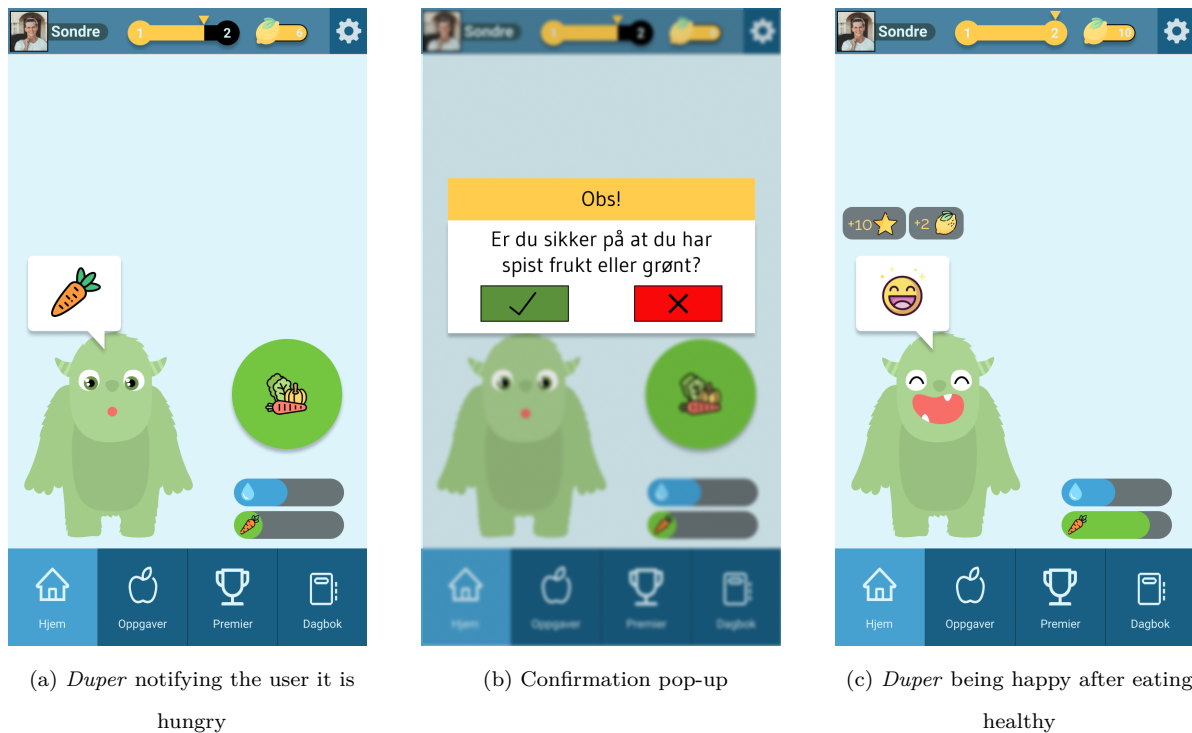
Figure 7.6: Showcase of timed events

Further, medal collecting was reworked. To unlock medals, the user would have to complete a challenge like before, but now the medals remained locked until the unlock criteria was met. The challenge and subsequent reward would be visible when interacting with the locked medal, but the medal itself would remain hidden until the challenge was completed, and then the user could collect it. This meant that the users would not know how the medals looked like before completing the challenge, adding bit of mystery and curiosity to the experience. Additionally, some tasks could now be repeated, as indicated by the small icon on the medal itself. The process of unlocking such a medal is presented in Figure 7.7.

(a) Initial state

(b) Unlocking process, displaying collected medal and associated reward

(c) New state, unlocked medal, increased experience and lemon count
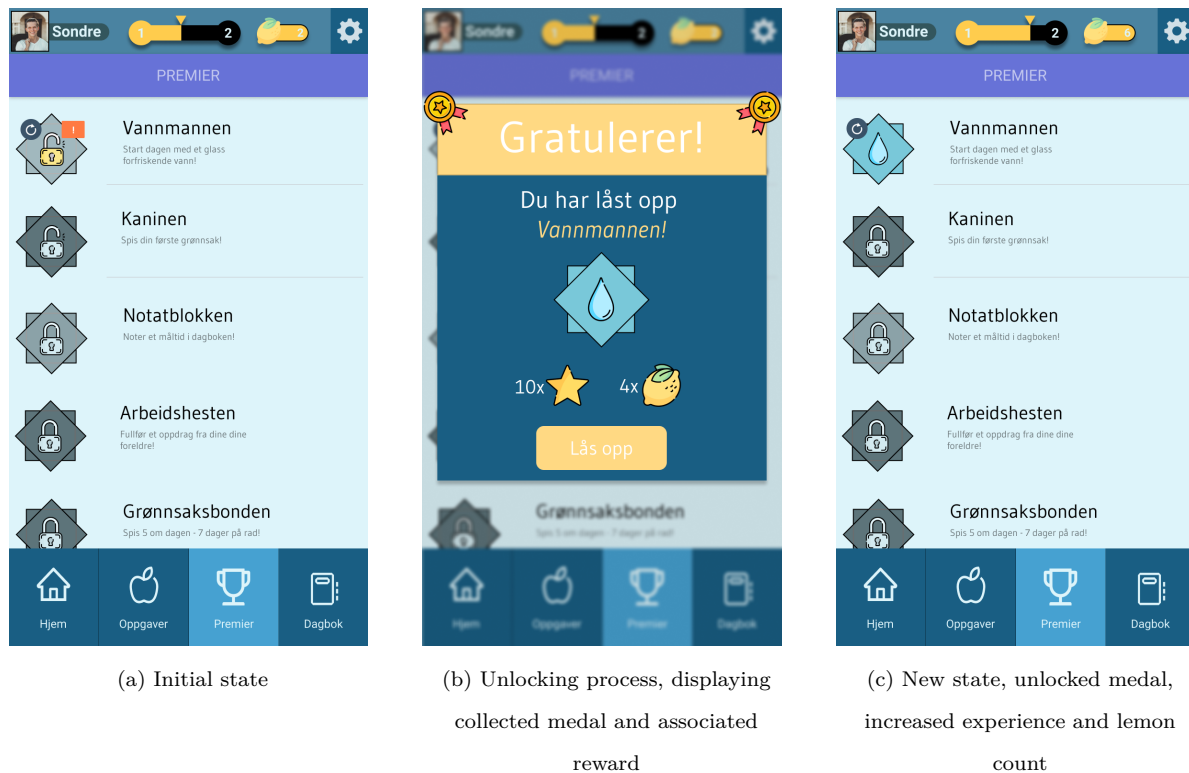
Figure 7.7: Showcase of medals

Lastly, the food diary was reworked. Going from a larger screen like a tablet to the smaller form factor of a phone meant that the diary specifically had to be redesigned quite heavily. In an attempt at staying true to the theme of the application, the designers chose to stick to the icon-on-button style that is apparent throughout the rest of the application. This version of the food diary included functionality that lets the user input a meal, select the relative size of the meal, and log at what time of day it was eaten, as can be seen in Figure 7.8.
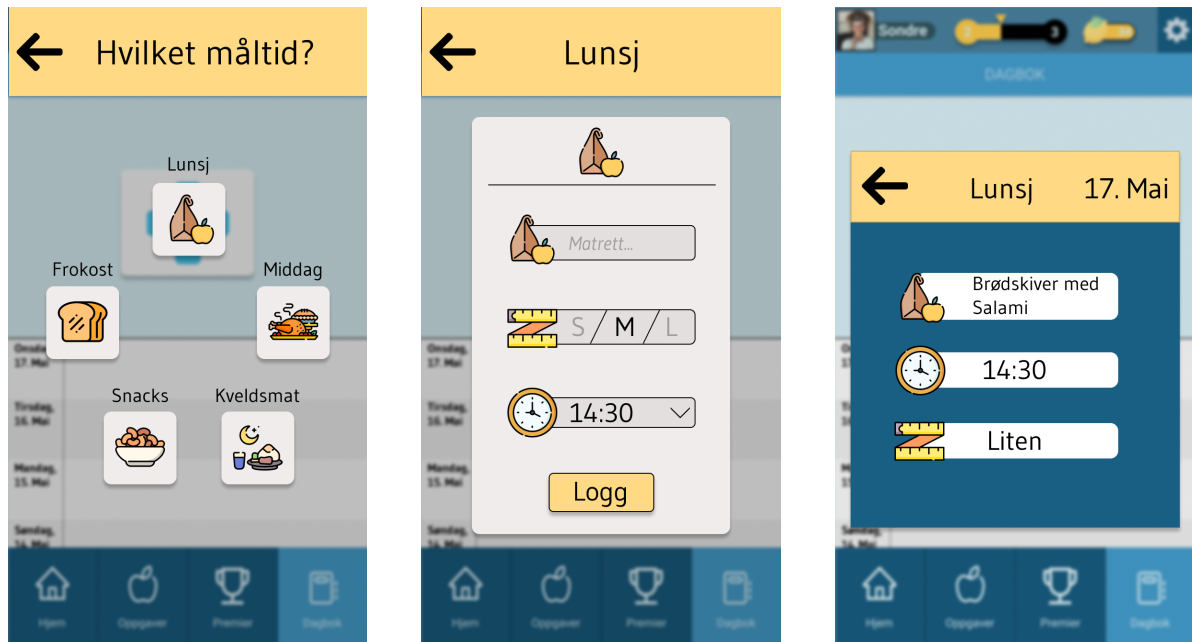
(a) Selecting the type of meal to log   (b) Filling out details about the meal   (c) Final view after filling int he diary

Figure 7.8: Showcase of the food diary

Chapter 8

Evaluation

Once the design of the prototype was completed, the researchers has set out a plan for the testing in order to collect data from the users. The testing was referred back to the research questions to identify the points the research would like to clarify. Therefore, the researchers would like to test whether the solution was designed to support and assist the healthy eating habits in families with children, as well as its performance, benefits, and further improvement.

Specifically, the researchers wish to look into the elements of the solution in more details, since it contained different parts and functions as seen in subsection 7.2.1. The researchers would like to evaluate the features of the avatar, rewarding system, task list, medals, and food diary, as well as the concept and design of the prototype.

8.1 Participants

The researchers had set a plan to test the solution with families with children aged between 6 and 13 who did not necessarily need to be overweight. The reason was that the solution was meant to serve as a preventive tool for the overweight problem supporting healthy-eating habits. As for the age group, in the beginning of the project, the researchers had discussed about which age group the solution should be made for, and it had been challenging for the researchers to come up with ones. Nonetheless, the age group was chosen because it was the group who were to be in a specific education level which was primary school, and the researchers would like to see if there would be different in perception and feedback towards the prototype because of the age difference within the group.

8.2   Methods

When the time comes to evaluate a solution, selecting a method of testing that fits the scope and situation of the project is key. The following section will discuss this process, and present the different methods and techniques the researchers utilized as part of this thesis.

8.2.1   Unmoderated Remote Usability Testing (URUT)

The idea of unmoderated remote usability testing (URUT) is that the participants could work through tasks assigned in their own environment without the need of moderator's presence(Interaction Design Foundation, 2021). This method was chosen instead of the traditional usability testing or a workshop because of the current pandemic situation which was not suitable for any form of physical meeting. The advantages of URUT are that it could be performed at participants' spaces, and that the researcher could collect the data relatively fast. Some drawbacks of the method include the less detailed of the data collected and the lack of moderator's assistance when confusion occur during the test.

8.2.2   Questionnaire

The method was chosen partly because of the nature of URUT that there would be moderators accompany with participants during the testing. Another part was that questionnaires was a commonly used method for data collection both quantitatively and qualitatively. Moreover, it has advantages for being practical, comparable, quickly collected, easy to analyze. The researchers prepared two sets of questionnaires for the evaluation: the one that would collect quantitative data (age, gender, etc.) and another that would collect qualitative data (opinion, reasons behind decisions, etc.).

8.2.3   Observation

Observation is a great data collection method when used at the right circumstances. The method allows data that users might not give intentionally to be collected which usually are informative and insightful. In this situation where URUT would be performed, the observation method would not come from the test moderator, but one participant would observe another as a parent would observe a child. The parent would be encouraged to observe the child's emotion, body language, non-verbal communication, and other elements that could be felt or visibly seen.

8.3   Testing Materials

The testing materials were created for the participant to use when performing the testing of the prototype. These documents are:

- *Test instruction* - It explained an overall concept of the prototype, the procedure they should follow, the estimated testing time, and what they should prepare or perform before, during, and after the test. The document is shown in Appendix A.

- *Task sheet* - The tasks were listed in the order that the children should perform with assistance from the parent or guardian which is shown in Appendix A. This was so test if the children understand and were able to perform the tasks with or without any issues. There was a field to fill in if the task was done or to fill in an answer for the task.

- *Personal information questionnaire* - The questionnaire were to obtain demographic information which contained only three questions: age, gender, and children's familiarity with technology. This is shown in Appendix B. Initially, health-related data like weight and height were considered, but due to the privacy issue, these information were excluded.

- *Prototype evaluation questionnaire* - This was the most important data collection point as the questionnaires asked about specific questions which varied from the reasons behind participants' decisions, the feelings towards the design, and the problem they had faced. The questionnaire is divided into different parts: concept and design, avatar, rewards, food diary, and general/overall. Most of the questions were open-ended, so that participants could express their answers as much as they wanted. At the end of each section, there was a free text field allowing participants to write frankly. The questionnaire can be found in Appendix B.

8.4   Procedure

In regards to how the test should be performed, even though the solution was made for the children and should be tested by them, and as for the nature of URUT, the one who was to perform the test would need to be the parent or the guardian in the family. The researchers had set a plan to assign them a role of moderators, so they could perform the test along with the children, guiding and assisting them through various tasks. The procedure consisted of 3 steps:

(1) Getting ready

The parent would received the testing material by email and download all the documents. In the test instruction, the parent would be asked to go through assignment in the task sheet and the prototype at least one time by themselves in order to get an overview of the whole testing. Once they would finish that, they could continue to the next step.

(2) Performing the test

The parent would start the test by explaining briefly to their child, have their device ready, and begin. With observation, the parent would ask the child to perform according to the task sheet, and let the child navigate through the prototype by themselves without intervention, unless a problem would occur. The child would to be told in advance that they would be encouraged to think aloud, meaning they would say what they would be doing, why, and how they would feel. The parent would fill in the child's answer into the task sheet, and also take notes if anything would happen, for example, if the child would get stuck and could not make progress.

(3) Filling in the questionnaires

Once the test would be done, the parent would sit down with their child and fill in the prototype evaluation questionnaire together. The parent and the child would go through the questionnaire and fill in the answers as much as they could. The questionnaires mostly would ask open-ended questions allowing the answers to be expressive. The answer to some of the questions would be from the parent's observation. The parent also would need to fill in the personal information questionnaire.

Chapter 9

Results

After all of the users had completed the testing, the results were gathered and summarized as seen in this chapter. The results were partly demographic information from the participants, and largely the results from prototype evaluation questionnaire which were divided into different sections based on the features of the prototype.

9.1 Participants

Unfortunately, the researchers did not receive high number of test participants due to the time limitation. In the end, the researchers managed to gather test data from two families with children participated in the testing of the solution. There were two adults and four children in total. The children's ages were in between 10-13 and they were all female. These data were collected from the personal information questionnaire mentioned in section 8.3. While the researchers realized that the amount and variation of test subject was not high, they proceeded to the next steps as planned regardless.

9.2 Results from Prototype Evaluation Questionnaire

The researchers managed to collect test results from all four children; however, two of the children performed the test together resulting in having a total of three sets of responses. The test result were summarized and separated as following sections:

9.2.1 Concept and Design

- All of the children did not think that the prototype was simple and intuitive to use. Two commented that the size of the text was too small.

- Most of the children did not get to do some tasks assigned, and one child did not find where to do a task.

- Three children expressed frustration or confusion during the test, while the other did not.

- One of the children experiences problems navigating through the prototype, while others did not.

- When asked about one thing they liked about the concept and design of the prototype, one said that she liked when there were messages showing what she has to do or eat, and another liked the concept of having a way to get kids eat healthier. One child said that she liked the concept of being able to buy things for the avatar.

- When asked about one thing that could be improved, one said better transition between interface, and another commented that there should be an easier way to find different tasks.

9.2.2 Avatar

- All of the children thought that the avatar was cute.

- All of the children liked that they could change the appearance of the avatar. Two of them wished that there were more hat options, and one wished that the color of the avatar could be change.

- All of the children thought it was easy to understand the link between the interactive events and their effects on the avatar's needs.

- All of the children were positive towards the avatar's ability to show emotion.

- When asked what was the relationship they had towards the avatar, two said a friend, one said a pet, and one said a character in an app.

- All of the children said they would show much interest and motivation if there would be a possibility to play a game with the avatar in the prototype.

- When asked about one thing they liked about the avatar, they all said that the avatar was cute.

- When asked about one thing that could be improved, the answers were various from the avatar evolution, customization, more purchase options from the shop. Two of the children suggested that the avatar could have a voice and would be able to say something.

9.2.3 Rewarding System

- All of the children thought that the rewarding system is appealing.

- All of the children thought receiving rewards after completing the challenges was good, because they could use it to buy an item for the avatar. One suggested that instead of receiving lemons (the in-game reward unit), they could receive an item for the avatar as a reward.

- Most of the children thought that collecting medals was fun, while one did not understand this.

- All children found it motivating to complete the challenges and receive rewards.

- When asked if they would be motivated if they would be to receive a real-life reward, all of the children said yes. One commented that she would like to get a reward from her parents from doing a housework, for example.

- When asked about one thing they liked about the rewarding system, most of them said that they liked that they could get rewards, so they could buy items (for the avatar) in the prototype. One said that she liked the experience of achieving something.

- When asked about one thing that could be improved, the answers were various. One would like to see the medal dividing to smaller parts and that she could get several rewards. Another said that she wished for the avatar evolution as a reward, while the other thought that the difference between a medal and a reward was not so clear.

9.2.4 Food Diary

- When asked if they thought that it was easy to write in the food diary, the answers were various. One said yes, another no, but both said that the dish was already decided and they could not change it. The other said that she did not write anything.

- All of the children found it mostly easy to find the food diary

- When asked about one thing they liked about the food diary, two said they liked that they could see the overview and that it was sorted by date. The other said they liked that it was possible to enter what they ate.

- When asked about one thing that could be improved, there were many suggestions. Some were a possibility to enter your own food, to enter for several days, to scroll back in time. One asked what was the propose of writing down what she ate every meal and everyday, and thought that it was too much. The other child thought the food diary was fine.

9.2.5 General

- When asked if the children would see themselves use the finished version of the app (the prototype), most of them said yes. Only one said no because she thought that it was too childish for her (she was 13).

- When asked about one thing they liked about the prototype as a whole, the answers were various. One said that she liked the avatar and had faith in the concept of the prototype, though it should be made more user-friendly and more captivating for her age group (13). Another said that she also liked the avatar, thought that it was cute, and suggested the evolution of the avatar as mentioned before. She liked the concept that made children eat more vegetable, and commented that the home screen was a bit boring which could have been more colorful or more catchy. The last child said that she liked that she could do physical exercise.

- When asked about one thing that could be improved, there were many suggestions. One suggested that there should be a function to take a picture of the food she ate and send it directly to the prototype. Another wished that she could name the avatar, and also commented that one of the two felt bored at the beginning of the testing, but eventually felt engaged and would love to use the complete version of the app. The last child suggested that there could be more items to buy from the shop.

- When asked if there was anything they want to add, one clarified that the submission was from the 13 years old. Another said that both of the children thought it was a good game and the ones who made this did a good job. The last child said it was a bit difficult to understand its use in the beginning and the connection between the tasks.

Chapter 10

Discussion

In this chapter, the researcher would look into the results from the previous chapter and interpret them based on the knowledge gained from all the work done leading to this point. The discussion would be divided into two parts: the results analysis from the evaluation, and the fulfillment of the two research questions set in section 1.2.

10.1   Result analysis

As mentioned, the result analysis would be the interpretation the results gained from the previous chapter which would also be structured the same as for the five components of the testing result.

10.1.1   Concept and Design

Though the researchers applied user-centric design approach into the concept and design of the prototype, most of the users seemed to think that it was not simple to use nor intuitive. They also expressed frustration and confusion, and they seemed to be lost in navigation. The text size was also mentioned to be too small and hard to read, while the prototype's home screen was seen as boring which could have been more colorful and catchy. This led the researchers to assume that the design of prototype did not perform well in regards to its usability. However, the users seemed to like the healthy-eat concept of the prototype.

10.1.2 Avatar

The users seemed to have much positive thoughts about the avatar in many aspect: the appearance, the ability to show emotion, and the ability to purchase items. They gave quite a number of suggestions on how to improve the concept of the avatar: the avatar evolution, the customization, more purchasing options, the voice output, and the ability to change avatar's name. They understood the link between interactive events and the avatar's needs which was prominent since it was what the researchers expected the user to acknowledge. Moreover, the users showed high interest and motivation when asked if they would be able to play a game with the avatar in the prototype. In comparison to other sections of the testing, this section is the one which received the most feedback and assumingly engagement from the users which were seen from the amount and excitement of the responses. In addition, the avatar shown in the prototype was able to form emotional and personal connections to the users as a pet or a friend; therefore, the users felt that they wanted to "help" the avatar with challenges occurring in the prototype and to achieve objectives together with the avatar. This really showed the caring the users had towards the avatar and that the avatar would have high motivation on them. The prototype could use this benefit when it needs to stimulate users into doing activities, for example, to eat healthy food, to exercise

The researchers believed that there was much potential for the concept of avatar as it confirmed the knowledge from subsection 2.3.2 that the use of avatar had a favourable impression to an overall gamified solution, and that the application of the avatar could gain more engagement and motivation from the user. Noticeably, it could be seen that the level of avatar application in the prototype was on a quite low-level, meaning it was relatively static and had only couple of expressions. Yet, it performed highly towards the users. It would be a worthwhile experience to see the further development of the prototype focusing on the avatar and other elements around it, especially on the aspect of the solution supporting healthy-eating habits in children.

10.1.3 Rewarding System

Similarly to the avatar, the user seemed to have positive thoughts about the rewarding system. The concept of the rewarding system was appealing and motivating to the users as well as receiving rewards and medals. Moreover, the users would like the idea of receiving a real-life reward and that they would be motivated if so. One said that she liked the "experience of achieving something" which was the exact concept of the rewarding system that the researchers were hoping for.

Though appealing, one child did not understand the concept and purpose of the medal and was confused with rewards. It could be concluded that the work in to developing the concept of rewards and medals could have been more refined.

10.1.4   Food Diary

From the answers received, it could not be concluded if the food diary appealed to be easy to use or not, though all of them said that it was easy to find where it located. The users also commented that they liked that they could see the overview of the food diary. Nonetheless, the food diary was the section that a misunderstanding occurred. Since it was just a prototype, the food diary only allowed users to progress with pre-entered meal information and did not allow them to enter freely. The reason for such misunderstanding could be that the instruction was not clear enough for the users. Other alternatives would be to implement the prototype more realistically with what the users would do, so it would make more sense and be more appealing for the users.

Another point was that one user did not understand the reason for entering every meals in food diary, repeatedly everyday. Even though with rewards, one might think that the process was redundant and would become boring at one point. According to the nutritionist the researchers had worked with in this project, she commented that if it would be for a patient in overweight or obesity condition, it might be valid. She told the researchers that she would ask them to do the food diary at least four days in a week, and then she would use this information to see the eating pattern in order to give appropriate consultation. Regarding the current prototype, the next step would be to find a middle ground between this and come up with a concept that would suit users better.

10.1.5   General

Most of the answers in this section were repetitive from what had been answered in the previous sections. In addition, the oldest user commented that the researchers should keep in mind and made sure that the prototype would be suitable and captivating for her age group, since she thought the prototype was too simple and childish for her. This was a good point since the prototype was made originally for the age group between 6 and 13; therefore, the feedback showed that the prototype might not be appropriately designed for the older ones in the age group. The feedback confirmed that there was a difference in perception of the prototype among different age group chosen. Even with only three years gap (in this case, 13 and 10), both of the children had quite different emotional experiences going through the testing. The learning gained would be that one should look closely to age, especially in

children, and find a balance between the complexity of the tasks and the enjoyment users might have, as well as how the design of the prototype would look like.

Another point was that it could be seen that one of the users had an interesting slope of attention throughout the testing process, since she felt bored in the beginning but much engaged at the end. This was the user who performed testing together with another one, so it might be that the experience might be more positive because of this. It would be interesting to look into how a friend could influence another using such solution and how it would affect other elements or as a whole.

10.2   Fulfillment of the Research Questions

With all the work done and the result analysis, one could understand how different components of the prototype could have different effects to users. Therefore, the researcher would like to go back to the research questions to identify the rationality of the answers. The components are as follows:

10.2.1   RQ: *How can we use user-centric design and gamification to develop a concept to support and assist families with overweight children?*

In section 2.1, it had been acknowledged that in order to support and assist families with overweight children, it could not be done solely just from the child nor the parent. Such support would need to come from cooperation from everyone in the family, and they needed to understand the disease thoroughly. There would be no one-size-fits-all solution but very much tailored ones for each person. The subsection 2.1.1 showed that they were so many factors leading to the disease, and the family would need to pay close inspection to their lifestyle, habits, mental health, and so on, and as well as those of the parent's. The subsection 2.1.3 also stated that habits of the parents could be one of the factors; therefore, one needed to look around the house and be considerate in every aspect. Once the whole family could see the big image, the right solution could be then presented.

The two approaches, user-centric design and gamification, would also needed to be considered in order to get to the research question. User-centric design is an approach to solve a problem starting from understanding the users, gaining information from their side, and developing iterative prototype to see how does it work and what people think. On the other hand, gamification is an approach to integrate gaming elements into common activities in order to rise up the user's attention and enthusiasm bars

high enough that the users maintain the balance of such activities and the enjoyment they have. In regards to the process to becoming the prototype, it could be seen that the researchers had applied the two approaches heavily as seen from the research and development procedure, and gaming components in the prototype.

In order to use user-centric design and gamification to develop a concept to support and assist families with overweight children, ones would need to comprehend the perspectives mention above, and then consider alternatives available in their environment. In the case of this thesis, the prototype was designed and developed as a preventive tool to support healthy eating habits for children which resulted in a relative success. It could be seen that the users were motivated and had high engagement towards the prototype. Considering the quality of the feedback received, though a small amount, and the learning from the whole process, it could be considered that the researchers had come the right way towards the resolution of the problem; therefore, one could study portions of the work in order to see the pattern, and apply them to create the most favourable solution of their own version.

10.2.2 SRQ: *How can we applied the usage of avatar in gamification to such concept?*

In order to answer the sub question, one would firstly need to perceive the meaning and the use of avatar in gamification. From subsection 2.3.2, it could be seen that the use of avatar was tightly connected with users in a personal and emotional level. Users would feel attached to their in-game avatar that they could be easily motivated to do activities asked. Moreover, different elements of avatars such as customization, emotion expression, personal attachment and encouragement, were factors that stood out from other gaming elements and could be the reason to use for bringing engagement in from the users. As a result, the use of avatar was applied in many environments, both for gaming and non-gaming ones.

So as to apply the usage of avatar in gamification to such concept from the main research question, one would need to, again, understand the context above. In case of the thesis, the use of the avatar *Duper* in the prototype was perceived very well. All of the users had positive feelings towards its appearance, emotion, suggestion, and even its existence. It was considered impressive how the avatar was able to create personal and emotional connection to the users in such a short period of the testing time. The avatar also needed to be able to encourage users to perform healthy habits (for example, to encourage users to drink water, or to eat vegetable) which was also perceived well. In regards to the design of the avatar, though the researchers did not design themselves but chose from the internet, the time effort

used into selecting which avatar should be used in the prototype was relatively low, yet it received much positive responses. If one were to invest much time into avatar design and development aiming to receive mentioned benefits as a gaming component, one would have quite high chance of getting them. The thesis showed that one also needed to consider who the users were and pick the choice of avatar design that would suit the user group most. By doing so, one would be successful applying the usage of avatar in their gamified solutions.

Chapter 11

Limitation

As one might see that the thesis ended with favourable results, the work surely had numbers of limitations in many aspects, and it would be equitable to list them here in this chapter to show that the researchers were aware of these flaws. The limitations are listed as follows:

Small amount of test subjects

The first and foremost limitation the thesis contained was the fact that the amount of the test subjects were very small as only four children and two adults were performing the test. Such a small number could be questionable if the data collected were sufficient enough to answers the research questions or even to make a point at all, though the thesis benefited from high amount of feedback data per test subject.

Moreover, the thesis did not use one of the advantages of using the unmoderated remote usability testing (URUT) method when collecting data. By using the method, the researchers could have gained much higher amount of test subjects considering the test could be sent to large amount of people and also consumed less time comparing to a physical usability testing. The thesis would ideally benefit from this greatly as well as for its contribution. Therefore, it was not the case for the thesis which had a time constraint, unfortunately.

Few prototype iterations

The prototype process only contained one iteration which could have been more. Iteration is an important process of user-centric design approach since one would benefit from getting closer to fixing user's needs by performing more iterations. In the case of the thesis, more iteration would make the prototype more refined and suit better with the users. For example, the researchers learned from the feedback

that the concept and design was too childish for a 13 years old. A revised prototype for the age group of 13 would be developed and different from those for the younger age group.

Weaknesses from the evaluation methods used

- Unmoderated remote usability testing (URUT)

The fact that the testing had performed remotely without moderation as stated in subsection 8.2.1 was one of the restrictions. When performing the test with no moderators, the test subjects needed to pay attention on how the testing worked which could be unclear. There would be obviously no one to ask and they must carry on the test by themselves, not knowing if they performed correctly. This led to incomplete and misinterpreting data collection. The researcher would need more time to transcribe the data and make attempts to make them sensible.

- Observation

The adult participants were asked not only to be the moderators but also observers during the test process. They needed to perform multiple tasks at once, not to mention that they performed with a child. Observation is a effort consuming tasks that one needs to pay close attention to obtain data. With that being said, combining URUT and observation might be too much work for the participant; therefore, it would reduce the testing performance as a whole.

Scope of the problem

As the thesis started with the concern for the obesity disease in children, it shifted its direction to create solution for everyone but might not the obese themselves. This was because the researchers would like to approach the problem by taking the first step first: to support healthy eating habits in children. Obesity is a serious and complex disease, and one should receive medical help from professionals; therefore, the researchers thought that it would be too complex to start from there.

Cultural issue

The thesis was written in a context of a specific country, in this case, Norway, so it only showed results and analysis from test participants who were Norwegian. Moreover, the disease relates directly to factors like eating habits, food culture, and activity level and type; therefore, it might be difficult to interpret if one comes from another countries without cultural knowledge. It was not only that the prototype was in Norwegian language, but there might be other element that only made sense in a Norwegian context. For example, one might not understand why would a child need to have supper (*kveldsmat* in Norwegian) as shown in the food diary, because in many countries, this would not be the case.

Chapter 12

Conclusion

The thesis aimed to identify: (1) a way to combine user-centric design and gamification into a concept aiming to provide support for families with overweight children; and (2) a way to apply the use of avatar to such gamified concept. Based on the discussion and the evaluation result analysis, it can be concluded that one needs to have well understandings of the two approaches and context of the health issue in order to create a suitable solution. The same goes with an aspect of the avatar as one needs to be able to extend the advantages of it to give benefit to one's solution best. Therefore, such solutions created would have high potential gaining engagement and motivation towards the users. The contribution of the thesis would be the concept and design of the prototype integrating user-centric design and gamification approaches which returned well perceived feedback from the users. The thesis also contributed a demonstration of how to apply the use of avatar to the prototype and its performance and effect towards the users. In addition, the contribution also includes the systematic literature review focusing on digital solutions for overweight people which highlighted important questions in regards to how one creates such solutions. The researcher anticipated that reader could benefit from some aspect, if not all, and use them as a part of their development of such solutions. Based upon these conclusions, it would be interesting to see future works focusing on other gaming elements than of the avatar, and on other health issues or another age groups.

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Appendices

Appendices

Appendix A

External Test Documents

Instrukser for testing av app

Så hyggelig at dere kunne tenke dere å prøve ut vår. Vi anslår at testen vil ta ca. **10** minutter.

Testprosessen inneholder 3 stadier:

1. Et **spørreskjema** for innsamling av informasjon om test-deltakerne (barn såvel som forelder/verge).
2. En **test** av selve prototypen, hvor deltakerne vil få en rekke oppgaver, og skal navigere seg til diverse mål i prototypen.
3. Et **evalueringsskjema** hvor dere sammen med deltakerne skal besvare spørsmål relatert til de forskjellige delene av appen.

Før Testen

Aller først vil dere få et informasjonsskjema, hvor dere fyller inn enkel informasjon om deltakerne. Under selve testen har vi lagt inn oppgaver for å simulere dagligdags bruk av applikasjonen. Her blir deltakerne bedt om å gjøre ting som å drikke vann, spise frukt, eller simulere oppgaver som foreldre har lagt inn på forhånd. Derfor er det greit om dere har disse tingene tilgjengelig på forhånd:

- **Et glass vann**,
- **En grønnsak/frukt**
- **En skitten tallerken** (gjerne bare en de brukte for grønnsaken)
- Utskrift/skjerm med oppgavearket klart.

I tillegg ønsker vi at dere går igjennom oppgavene en gang selv før deltakerne skal gjennomføre testen, slik at også dere får et inntrykk av appen.

Under Testen

Underveis i testen ønsker vi at barna får prøve seg fritt på oppgavene, uten hjelp fra dere som observerer. Ved visse stadier av testen skal de utføre praktiske oppgaver, før de går videre i testen og fyller inn i svararket. Her er det fint om dere passer på at de faktisk *gjør* oppgaven og ikke bare trykker seg videre.

Før de starter, er det fint om dere forklarer at de underveis i testen bør *tenke høyt*, altså snakke om oppgavene de utfører, og hvorfor de gjør valgene de gjør, f.eks: "Jeg trykker her fordi jeg tror denne knappen gjør dette". Siden det er barn som skal utføre testen, skjønner vi at denne biten kan være vanskelig for de aller yngste, og dersom det ikke går for disse så er det helt greit - men det er da viktig for observatøren å notere eventuelle utfordringer.

Dersom deltakeren ikke kommer seg videre i testen ønsker vi at dere noterer ned hvilket steg de sliter med og hvorfor, før dere hjelper de videre slik at de får fullført testen.

Etter Testen

Etter fullført test er det tid for evalueringsskjemaet. Vi ønsker her at dere prater med deltakerne og finner ut hva de synes var vanskelig og hva de synes om de forskjellige delene av appen. Deretter ønsker vi at dere bruker denne informasjonen, samt deres egne observasjoner og notater for å svare på spørsmålene som kommer frem i skjemaet. Skjemaet er delt opp i fem seksjoner, ett for hver del av appen. Det er i

denne prosessen dataen vi skal bruke kommer frem, så gjerne skriv utfyllende her. Til slutt kommer et fritekstfelt, hvor dere kan gi oss deres tilbakemeldinger, eller andre synspunkter dere har.

Oppgaveark

Velkommen til testen av SuperDuper! Fyll inn svarene deres i svarrutene underveis som dere finner de. For oppgavene som ikke er spørsmål, holder det å sett et kryss i ruten til høyre.

Nummer	Oppgave	Svar
1	Fullfør veiledningen!	
2	Duper er tørst. Hjelp han!	
3	Lås opp *Vannmannen*.	
4	Duper er sulten. Hjelp han!	
5	Lås opp *Kaninen*.	
6	Hva trengs for å låse opp *Grønnsaksbonde* medaljen?	
7	Hvilken dag ble det ikke spist frokost?	
8	Hva ble spist til frokost **17. Mai**?	
9	Hvor stor var lunsjen som ble spist **17. Mai**?	
10	Hvor mange sitroner har du?	
11	Hvor mange sitroner koster *Disney*-hatten?	
12	Hvilket level er du nå?	
13	Hvilken av hattene ser best ut på Duper?	
14	Kjøp *Italia*-hatten.	
15	Hvor mange *Sitroner* har du nå?	
16	Hva heter Oppgaven du kan gjøre èn gang i måneden?	
17	Utfør den *Spesielle* oppgaven!	

Appendix B

Data Collection Surveys

Deltakerundersøkelse

I dette spørreskjemaet ønsker vi å samle informasjon om deltakernes alder, kjønn og generelle it-kunnskaper.

Next
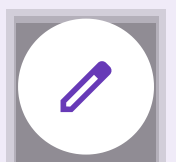
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Deltakerundersøkelse

Deltakerundersøkelse

Hvor mange skal barn skal utføre testen? *

- ( ) 1
- (●) 2
- ( ) 3

Back   Next

Google Forms
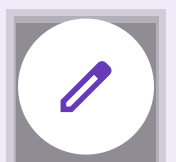
Deltakerundersøkelse

Datainnsamling for 2 deltakere

Deltaker 1 - Alder *

Choose ▼

Deltaker 1 - Kjønn *

○ Gutt

○ Jente

○ Annet
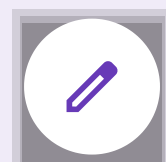
○ Ønsker ikke svare

Hvor godt kjent er deltaker 1 med bruken av digitale enheter? (mobil, tablet, pc, etc..)

	1	2	3	4	5
	○	○	○	○	○

Deltaker 2 - Alder *

Choose ▼

Deltaker 2 - Kjønn *

○ Gutt

○ Jente

○ Annet

○ Ønsker ikke svare
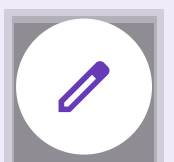
Hvor godt kjent er deltaker 2 med bruken av digitale enheter? (mobil, tablet, pc, etc..)

1	2	3	4	5
○	○	○	○	○

Back   Next

Deltakerundersøkelse

Informasjon om verge/foreldre

I denne seksjonen ønsker vi å samle informasjon om verge/foreldre.

Hva heter du? *

Your answer

Hvor gammel er du? *

Your answer

På en skala fra 1 til 5, hvor høy IT kompetanse vil du si du har? *

1	2	3	4	5
○	○	○	○	○
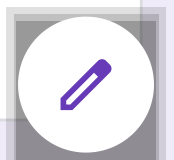
Er det noe du ønsker å legge til?

Your answer

Back Submit

Deltakerundersøkelse

Your response has been recorded.

[Submit another response](#)

Google Forms

Evalueringsskjema

I dette skjemaet vil dere få spørsmål knyttet til evalueringen av appen. Ved hvert spørsmål ønsker vi at dere skal ta utgangspunkt i deltakerens meninger, men legg gjerne også til deres egne meninger/tanker som utfyller eller forklarer deres synspunkt.

Til sist har vi et langsvarsfelt, hvor dere får muligheten til å gi oss tilbakemelding på hva dere selv synes om appen, eller vil gi annen tilbakemelding.

Page 1 of 6

Next

Evalueringsskjema

Konsept & Design

Denne seksjonen inneholder spørsmål relatert til det overordnede konseptet, og designet av appen.

Synes deltakeren at appen var enkel og intuitiv i bruk? *

Your answer

Satt deltakerne seg fast under testen, i så fall hvor og hvorfor? *

Your answer

Ga deltakerne uttrykk for frustrasjon eller forvirring under testen? *

Your answer
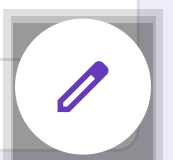
Opplevde deltakeren noen problemer med å navigere seg rundt under testen? *

Your answer

Fortell oss èn ting deltakeren likte godt med designet/konseptet. *

Your answer

Fortell oss èn ting som kunne blitt forbedret med designet/konseptet. *

Your answer

Page 2 of 6

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Google Forms

Evalueringsskjema

Avatar

Denne seksjonen inneholder spørsmål relatert til avataren i appen.

Hva synes deltakerne om Avataren? *

Your answer
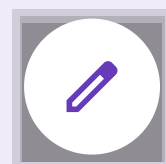
Hva synes deltakeren om muligheten til å endre utseendet til avataren? *

Your answer
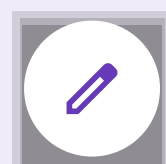
Viste deltakerne forståelse for koblingen mellom de interaktive hendelsene og deres effekt på avatarens behov? *

Your answer
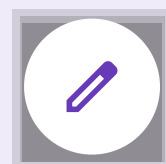
Hva synes deltakeren om avatarens evne til å vise følelser? *
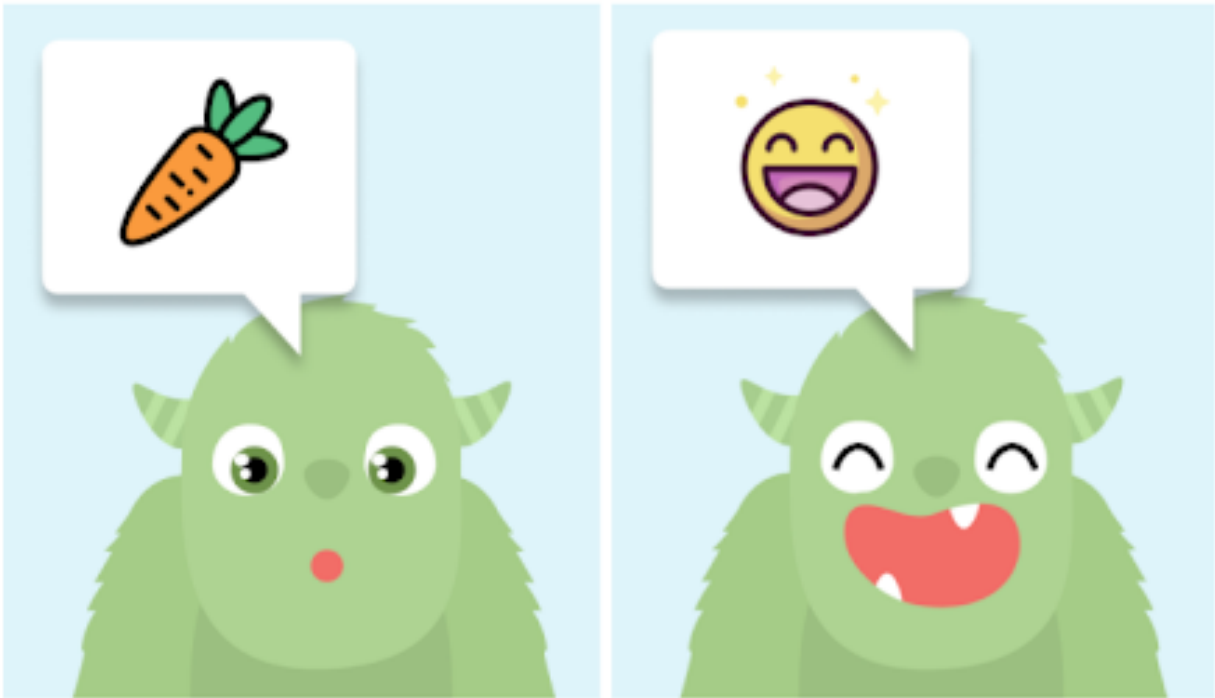
Your answer

Hvilken relasjon følte deltakeren til avataren (en selv, venn, kjæledyr, etc)? *

Your answer

Ville deltakerens interesse for motivasjon/interesse økt dersom det hadde vært mulig å spille spill hvor styrte sin avatar? *

Your answer
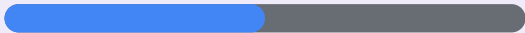
Fortell oss èn ting deltakeren likte med avataren. *

Your answer

Fortell oss èn ting som kunne vært forbedret med avataren. *

Your answer

Back   Next

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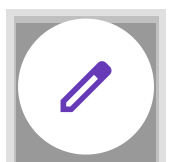
Evalueringsskjema

Belønninger

Denne seksjonen inneholder spørsmål relatert til belønningssystemet i appen.

Appellerte level- og belønningssystemet til deltakeren? *
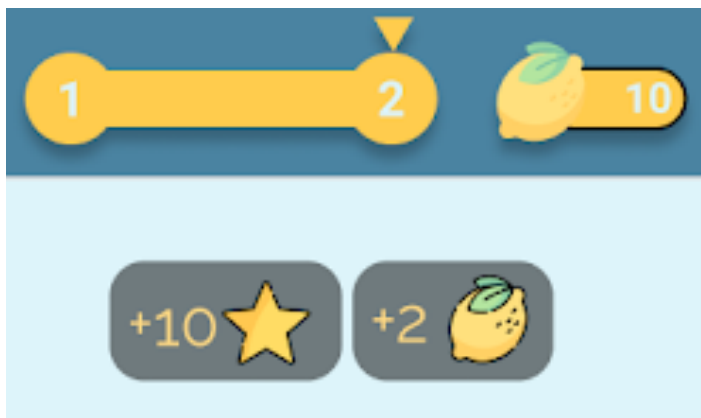
Your answer
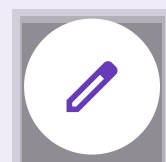
Hva synes deltakeren om å motta belønning for å fullføre utfordringer? *

Your answer
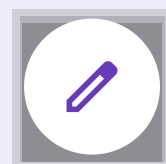
Hva synes deltakerne om å samle medaljer? *

Your answer

Synes deltakerne det var motiverende å fullføre utfordringer og motta belønninger? *

Your answer

Synes deltakeren det hadde vært motiverende å motta belønninger på ekte? *

Your answer

Fortell oss en ting deltakeren likte godt med belønningssystemet. *

Your answer

Fortell oss en ting deltakeren ville forbedret med belønningssystemet. *

Your answer

Back   Next

Evalueringsskjema

Dagbok

Denne seksjonen inneholder spørsmål relatert til belønningssystemet i appen.

Synes deltakeren det var enkelt å skrive i dagboken? *
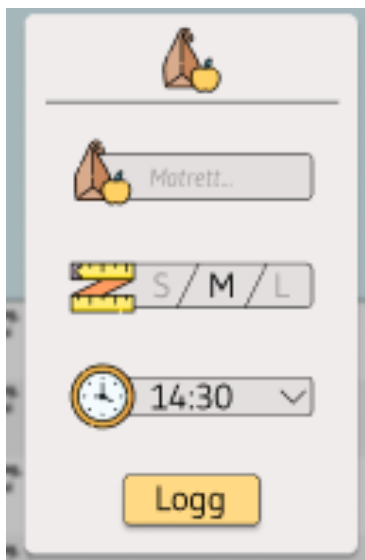
Your answer
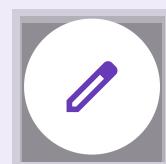
Synes deltakeren det var enkelt å finne frem i dagboken? *
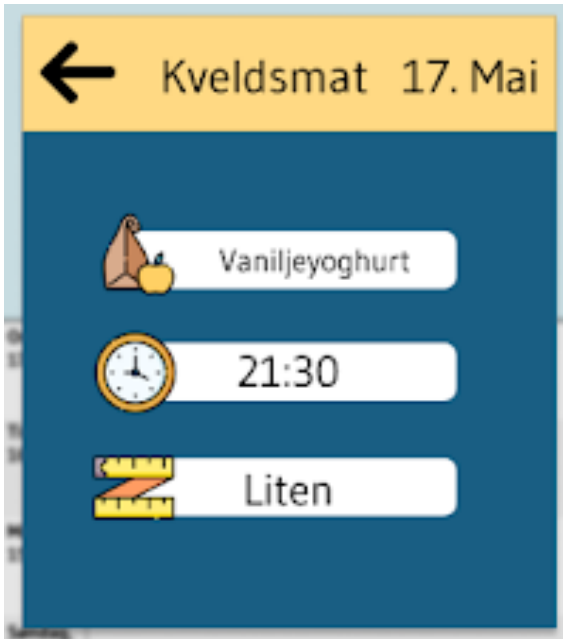
Your answer

Fortell oss en ting deltakeren likte ved bruk av dagboken. *

Your answer

Fortell oss en ting som kunne blitt forbedret ved dagboken. *

Your answer

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Google Forms

Evalueringsskjema

Generelt

Denne seksjonen inneholder generelle spørsmål om applikasjonen.

Kunne deltakeren settt for seg å ta i bruk den fullførte applikasjonen? *

Your answer

Fortell oss èn ting deltakeren likte spesielt godt med appen som helhet. *

Your answer

Fortell oss èn ting deltakeren synes kunne blitt forbedret. *

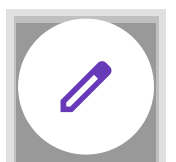Your answer
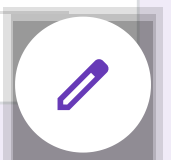
Ønsker dere å legge til noe? *

Your answer

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Appendix C

Results

Evalueringsskjema

3 responses

Konsept & Design

Synes deltakeren at appen var enkel og intuitiv i bruk?

3 responses

> Sånn passe. Det var ikke alltid like lett å vite hva man skulle gjøre videre. Det var også vanskelig å lese noe av teksten.

> Nei, den var vanskelig å forstå og finne ut hvor de ulike oppgavene var.

> Vanskelig å lese med så liten skrift. Greit å skjønne hva man skal gjøre.

Satt deltakerne seg fast under testen, i så fall hvor og hvorfor?

3 responses

> Fikk ikke til å låse opp grønnsaksbonden, og heller ikke hente gevinst for den spesielle oppgaven.

> Fant ikke hvor oppgaven du kunne gjøre en gang i måneden var.

> Fikk ikke opp spesiell oppgave. Når vi skulle ta egne valg i dagboka, så hadde appen allerede bestemt både størrelse, type mat og tidspunkt.
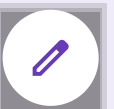
Ga deltakerne uttrykk for frustrasjon eller forvirring under testen?

3 responses

> Ja, litt innimellom.

> Ja. Vanskelig å se sammenhengen mellom de ulike oppgavene. Hvorfor skulle man plutselig kjøpe hatter. I tillegg fungerte det ikke optimalt da de "forsvant" etter at de hadde kjøpt de og gikk tilbake til de andre vinduene.

> Ja, hun ene ble litt, men den andre ikke.

Opplevde deltakeren noen problemer med å navigere seg rundt under testen?

3 responses

Litt, men det gikk greit etterhvert.

Ja. Fikk ikke til å trykke på alle knappene hun hadde behov for.

Nei, det var helt ok.

Fortell oss èn ting deltakeren likte godt med designet/konseptet.

3 responses

At man kunne kjøpe ting til Duper.

At det kom opp meldinger om hva du måtte spise/gjøre.

Likte at det var en måte for å få barn til å spise sunnere. Duper var søt.

Fortell oss èn ting som kunne blitt forbedret med designet/konseptet.

3 responses

Større og tydeligere tekst. Mer direkte overgang til/lettere å forstå hva man skal gjøre videre.

Enklere måte å finne de ulike oppgavene på.

De kjøpte hatten, men den forsvant da vi gikk inn i en oppgave og kom tilbake igjen. Da maste Duper om ny hatt.

Avatar

Hva synes deltakerne om Avataren?

3 responses

Søt.

Søt type.

Begge 10-åringene likte han godt, syntes han var søt.

Hva synes deltakeren om muligheten til å endre utseendet til avataren?

3 responses

Artig.

Bra. Kanskje flere type hatter. Kunne også få mulighet til å endre farge på avataren.

Helt ok. Kunne ønsket seg flere valgmuligheter her.

Viste deltakerne forståelse for koblingen mellom de interaktive hendelsene og deres effekt på avatarens behov?

3 responses

Ja.

Ja, men det kunne også vært skrift. Eks. Jeg er tørst!
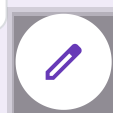
JA, det var lett å skjønne.

Hva synes deltakeren om avatarens evne til å vise følelser?

3 responses

Liker dette.

Bra.

Det var fint, ekstra gøy at han ble så glad.

Hvilken relasjon følte deltakeren til avataren (en selv, venn, kjæledyr, etc)?

3 responses

En figur i en app (7. klassingen).

Kjæledyr.

En venn/en fattig venn som vi måtte hjelp.

Ville deltakerens interesse for motivasjon/interesse økt dersom det hadde vært mulig å spille spill hvor styrte sin avatar?

3 responses

JA, det hadde vært gøy.

Ja

JA, dette hadde vært veldig kult. Da kunne de hentet seg mat og spilt.

Fortell oss èn ting deltakeren likte med avataren.

3 responses

At den var søt.

Utseende (søt).

Han var søt.

Fortell oss èn ting som kunne vært forbedret med avataren.

3 responses

At avataren kan utvikle seg når man går opp i level. Mulighet for å designe sin egen avatar, kroppsform, farge, utseende. Større utvalg i ting man kan kjøpe.

Kunne si noe (ha en stemme).

At han kunne sagt ordene, han kunne pratet og lest opp det som stod i teksten. Stemme i tillegg til bildet. Bra for de som er døve. Han kunne lese opp det de skulle gjøre, i steden for at det bare stod der som en liten skrift det var vanskelig å lese.
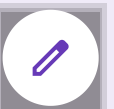
Belønninger

Appellerte level- og belønningssystemet til deltakeren?

3 responses

JA, likte dette godt. Men lurer på hvorfor dere har valgt akkurat en sitron? Det hadde vært bedre med medalje, mynter el.l. Heller eple enn sitron.

Ja

Ja, det var gøy å få belønning.

Hva synes deltakeren om å motta belønning for å fullføre utfordringer?

3 responses

Bra, fordi da kan man kjøpe ting til avataren.

Bra, slik at man fikk flere penger til å kjøpe hatter.

Bra. Man kunne fått noe utstyr eller klesplagg til Duper som belønning, istedenfor å kjøpe.

Hva synes deltakerne om å samle medaljer?

3 responses

Gøy, men fikk ikke til å låse opp alle.
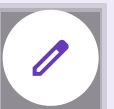
Skjønte ikke helt dette.

Det var gøy. Helt greit.

Synes deltakerne det var motiverende å fullføre utfordringer og motta belønninger?

3 responses

JA.

Ja.

Synes deltakeren det hadde vært motiverende å motta belønninger på ekte?

3 responses

Ja, men lurer på hva dette kan være? Ikke vant til å få belønning for å drikke vann og spise grønnsaker ;p

Ja, så absolutt.

JA, det hadde vært gøy. Etter at man har gjort noe bra over en periode, så kunne man fått belønning fra foreldrene. For eksempel om foreldrene gir en oppgave om å ta ut av oppvaskmaskina i en uke, så kunne man fått belønning dersom man hadde vært flink.

Fortell oss en ting deltakeren likte godt med belønningssystemet.

3 responses

Opplevelsen av å ha oppnådd noe.

At man fikk penger til å kjøpe hatter.

At man får mye belønning for å gjøre små ting.

## Fortell oss en ting deltakeren ville forbedret med belønningssystemet.

3 responses

At man kan dele opp i mindre deler, hvor man kan gjøre flere ting for å få sitroner/stjerner

Forskjellen på medalje og belønning.

Det hadde vært utrolig gøy at avataren vokser og utvikler seg for hver level, og ettersom han får mye mat. Så kan avataren få en baby når han blir ferdigvokst, og så kan man følge opp babyen på nytt igjen.

Dagbok
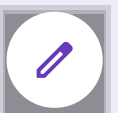
Synes deltakeren det var enkelt å skrive i dagboken?

3 responses

Nei. Matretten var allerede bestemt. Det kom opp brødskive med salami som standard, uten mulighet for å velge. Det samme for klokkeslett.

Har ikke skrevet noe.

JA, men appen bestemte innholdet. Det var dumt. Fikk ikke til å legge til snacks på 17. mai, og det synes de at man skal få på 17. mai. For eksempel is.

Synes deltakeren det var enkelt å finne frem i dagboken?
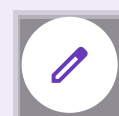
3 responses

Helt greit.

Ja

Sånn passe.

Fortell oss en ting deltakeren likte ved bruk av dagboken.

3 responses

At man kunne se en oversikt over alle måltidene.

At det går an å skrive inn "ting" du skal spise.

Det stod på rekke, sortert etter dato. Kunne vært litt enklere oversikt.

Fortell oss en ting som kunne blitt forbedret ved dagboken.

3 responses

Mye. Mulighet for å legge inn egen mat, mulighet for flere dager, mulighet til å bla tilbake i tid. Hva er hensikten med at barn skal skrive ned det de spiser? 13-åringen mener det kan være en måte å huske og spise til alle måltidene, men at det ikke må være sånn at man skal få dårlig selvfølelse for at man spiser for mye el.l.

Synes den var grei.

System eller tabell, hvor man kan bla seg frem og tilbake mellom dagene.

Generelt

Kunne deltakeren settt for seg å ta i bruk den fullførte applikasjonen?

3 responses

Nei, det ble litt for barnslig for en 13-åring.

Ja.

JA, de har lyst til å laste den ned.

Fortell oss èn ting deltakeren likte spesielt godt med appen som helhet.

3 responses

Likte Duper godt, og har tro på selve konseptet. Men det må gjøres mer brukervennlig og mer fengende for aldersgruppen 13 år.

Gjøre fysiske oppgaver.

Liker konseptet, at barn skal spise mer grønnsaker. Og avataren, som var søt. Litt kjedelig startskjerm, kunne vært mer fargerik og kulere førsteside som var fengende. Tidligere nevnt muligheten for at avataren kan utvikle seg.
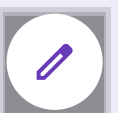
Fortell oss èn ting deltakeren synes kunne blitt forbedret.

3 responses

Skanne inn bilder av egen mat, som kan overføres til Duper på en enkel måte.

Flere "ting" å kjøpe.

Man kunne bestemt navn på avataren selv. Spillet kan fortsatt hete Superduper. Den yngste syntes først at appen var kjedelig og ville ikke bruke den, men etter at vi hadde gått gjennom evalueringen, og hun fikk komme med tilbakemeldinger på hva som kunne blitt bedre, så svarte hun JAAA på at hun ville laste ned appen.

Ønsker dere å legge til noe?

3 responses

Her er det kun 13 åringen som har svart, tar de to 10- åringene i neste pulje.

Litt vanskelig å forstå bruken av den i starten og sammenhengen mellom oppgavene.

De syntes det var et bra spill, og at dere som har laget det har vært flinke ;o)

Google Forms

Appendix D

Prototypes

Link to an interactive version of Prototype 1:

Figure D.1: QR-Code, links to Prototype 1

Link to an interactive version of Prototype 2:

Figure D.2: QR-Code, links to Prototype 2

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