

GAMIFIED GOAL SETTING FOR ENCOURAGING PHYSICAL ACTIVITY IN CHILDREN

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ABSTRACT

Physical inactivity in children is a growing issue worldwide. The use of apps and interactive methods may be used to tackle this problem. However, to do this effectively, methods which are grounded in literature should be used. Meanwhile, children may need support in setting appropriate physical activity goals for themselves. In this project, a gamified, goal setting approach was implemented, in the creation of 'Active Quest', an app for children aged 12 to 14, with the goal of encouraging effective goal setting in a fun and engaging way. A prototype of this app was developed and tested with five children. The findings indicated that using custom characters, a skill tree, and a three step goal setting approach, is an effective way to support children in setting better goals for themselves. Children expressed that they found this approach to be motivating, fun, and rewarding. In particular, the implementation of characters was well received, with findings suggesting that it was an effective way to support intrinsic motivation during the goal setting process.

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1 INTRODUCTION

1.1 Context

Physical inactivity in children is a growing issue worldwide. This, in turn, may lead to serious health-related repercussions. Between the years 2006 and 2014, the percentage of youth and children in the Netherlands who did not meet the national physical activity guidelines has increased significantly. In the year 2018, only 56% of children reached the recommended national physical activity level (Takken & Jong, 2018). Similarly, when looking at the issue from a global perspective, in 2016, 81% of adolescents between the ages of 11 and 17 were insufficiently active (WHO, 2020). Inaction during leisure time, as well as the growing popularity of sedentary behaviours, is the suggested cause for this according to the WHO (2020). In the Netherlands, the time which is spent on sedentary activities is steadily increasing, with 41% of children spending two or more hours a day in front of the television, and 44% of children spending two or less hours on different on-screen activities (Takken & Jong, 2018). The growth of sedentary activities may be linked to the growing presence of television, video games, and social media in childrens' and adolescents' lives (Anderson et al., 2008; Salmon et al., 2006; Vandewater et al., 2004, as cited in Garde et al., 2015).

Increasingly, research suggests that the issue of physical inactivity in children may be addressed through various technologies. Developments in the field, such as sensors, wearables, smartphones (Murnana et al., 2020), and technologies that children are generally familiar with (Garde et al., 2015) are especially promising. Schoeppe et al. (2017) believe that this may be of great use in promoting easily accessible interventions, particularly in the format of apps, as they are characterized by wide-spread popularity. However, with regards to apps that aim to improve the health of children and adolescents, there is a need for the development of research-based apps (Schoeppe et al., 2017). Schoffman et al. (2013) stated that, while some apps for children did implement valid methods, such as gamification and goal setting, they often were not grounded in research and lacked the recommendations of experts. Tackling these challenges was the purpose of this project, in the form of developing a solution for children, aged 12 to 14, which would encourage physical activity goal setting, through gamification.

In this project, two literature-based concepts were investigated, namely *goal setting* and *gamification*, and leveraged in the development of an app called Active Quest, for children aged 12 to 14, to support physical activity. Through a literature review it was found that goal setting is a promising approach (Lee & Earley, 1992; Miner, 2003; Pinder, 1998, as cited in Locke & Latham, 2019; Locke & Latham, 2019) which, at its core, aims to support achievement motivation (Locke & Latham, 2019). Goals may affect performance in four ways: *directing effort*, *energizing*, *influencing persistence*, and *enticing discovery and*

research (Locke & Latham, 2002). A good goal, as explained by Shilts et al. (2004), is: *difficult, specific, and short term*. The author of this project, however, suggests the addition of a fourth component of good goal setting: *customization*. This was supported by findings in literature that emphasized the positive impact of collaborating, or giving power to, users during the goal setting process (Costa et al., 2017; Shilts et al., 2004; Vroland-Nordstrand et al., 2016).

Gamification is a process of enhancing existing experiences through the inclusion of game-like elements (Deterding et al., 2011; Huotari & Hamari, 2012). Many researchers believe that this approach may increase *social interaction, user engagement, productivity and quality of actions, and overall user activity* (Hamari et al., 2014; Huotari & Hamari, 2012; Nacke & Deterding, 2017). Several frameworks and guidelines exist, supporting the beneficial implementation of gamification. One of these are the recommendations made by Rapp (2017), who provides nine ways which may support the creation of gamified designs with a long-lasting appeal. A different framework is that of Korhonen et al. (2009) who provide a number of playful experiences which a user may have, with the goal of providing a clearer understanding of the experiences of users, as compared to vague terminology such as ‘fun’ and ‘pleasure’ which was used to describe them before. During research on the topic of gamification, the importance of play was also emphasized, suggesting an approach to gamification which encourages intrinsic motivation by making users want to interact with a gamified system from their own free will (Nicholson, 2015). Nicholson (2015) proposes an approach towards gamification which may encourage long-term behaviour change in his RECIPE model. Here, the author provided a number of recommendations to create a gamified experience which strays away from a reward-based gamified experience, but rather one which users wish to come back to and actively use. Overall, a need was identified for the systematic investigation of the impact of gamification on different contexts (Nacke & Deterding, 2017), which this project aimed to accomplish through implementing the concept in a goal setting based approach.

1.2 Research Questions

The primary research question which guided this project was:

RQ: How can a gamified approach be used to support children through the physical activity goal setting process?

The purpose of this research question was to connect goal setting and gamification theory, in the design of a solution which would support children in the physical activity goal setting process. Through answering the question, the aim was to explore this design space, and identify findings which could be of use for future designers who would wish to develop a system incorporating these theories.

Two sub-questions were also investigated. The first of these was:

SQ1: What components are important to helping children, aged 12-14, set appropriate physical activity goals?

This sub-question aimed to explore the existing literature, as well as apps within the existing design space, to determine which elements of goal setting were relevant for the design of this project's solution. Answering this question would incorporate defining goal setting, exploring different ways of implementing it, and investigating ways in which it has been implemented in current apps.

SQ2: What is the role of gamification in physical activity interventions for children?

The aim of this sub-question was to explore the ways in which gamification could be implemented in the design of an app which encourages physical activity in children. To answer this question, the concept would have to be defined, and existing frameworks and implementations were explored in order to determine optimal methods for the implementation of this strategy.

Additional research questions were formulated in Chapter 7. These were developed based on findings from literature and conclusions made during the development of the concept.

1.3 Report Outline

This section summarizes the various chapters of the report. Chapter 2 focuses on the *Background*, and contains the literature research which was performed as a part of this project. Here, the topics of goal setting and gamification are explored. Chapter 3 describes the *Method* which was implemented during the execution of this project, namely, Design Thinking. The approach is described, along with the variations to it which were made for the sake of this project. Chapter 4 summarizes the *Empathise & Define* stage of the project. Here, the aim was to consider the literature which was investigated, alongside existing apps in the design space which were looked at, and extract findings which would guide the ideation process. The *Ideation* process in itself is described in Chapter 5. The primary aim of this chapter is to describe the process of developing the idea for the project. Chapter 6, on the other hand, explores the *Prototype*, including a description of the technical process of creating it, and more importantly, the flow which users experienced when interacting with the designed solution. Chapter 7 describes the *Test*, during which the prototype was evaluated, and users were invited to give feedback on the concept. The analysis, as well as, findings of this test can also be found in this chapter. Chapter 8 explores the *Discussion*, in

which the project is summarized, and connected to literature. Furthermore, the research questions of the project are answered. Additionally, limitations and possible areas for future development are identified. The final chapter of the report is the *Conclusion*, which recaps the report (Chapter 9).

Several parts of this report include parts of, or are taken from, the researcher's Research Topics report done as a part of the Master Thesis project (Jarosinski, 2021). This assignment was graded as a standalone report. These sections contain disclaimers.

2 BACKGROUND

2.1 Introduction

In order to better understand the theoretical and practical design space which surrounded this project, a literature review was performed. The review aimed to explore specific methods which could be used to encourage goal setting in children, with regards to physical activity, through the use of game-inspired elements. Goal setting and gamification were therefore the two primary topics which were explored. The first topic which was explored was that of goal setting (2.2), with the purpose of understanding what goal setting is, the features of good goals, categories of goals, and how to design goal setting for children. The second topic which was explored was that of gamification (2.3). Similarly, the aim was to understand what gamification is, and to explore existing frameworks surrounding this concept.

2.2 Goal Setting

This section uses parts from the Research Topics report done by the researcher (Jarosinski, 2021).

2.2.1 Understanding Goal Setting

Goal setting theory is fundamentally focused on achievement motivation (Locke & Latham, 2019), and is based on the premise that conscious goals affect action (Ryan, 1970, as cited in Locke & Latham, 2002). The authors explain that it aims for people to not settle on the lowest level of achievement, but to strive for excellence. It builds on the idea that human actions are often purposeful and based on conscious goals, and, by setting differing performance goals, individuals can achieve various levels of performance, with varying levels of motivation (Locke & Latham, 1994). As a theory, goal setting theory has withstood the test of time (Locke & Latham, 2019), and has been rated as the most practical and most valid theory of work motivation (Lee & Earley, 1992; Miner, 2003; Pinder, 1998, as cited in Locke & Latham, 2019).

A goal is defined as the aim or object of an action (Locke & Latham, 2002). An example of a goal is to reach a certain level of proficiency with regards to performance, typically within a limited time frame. Locke and Latham (2002) present four mechanisms through which a goal affects performance. The first mechanism is that goals direct the effort and attention towards activities related to the goal. The second mechanism is that goals serve an energizing function, as larger goals result in greater effort, as compared to smaller goals. The third mechanism is that goals affect performance by influencing persistence. In

situations where participants could control the time which they dedicated to a task, it was found that difficult goals prolonged effort (LaPorte & Nath, 1976, as cited in Locke & Latham, 2002). The fourth mechanism is that goals can indirectly affect performance, by enticing the discovery and research of strategies and task-relevant knowledge (Wood & Locke, 1990, as cited in Locke & Latham, 2002). Shilts et al. (2004) present an overview of what makes a good goal, based on existing literature. Three goal properties were identified: (1) *difficulty*, (2) *specificity*, and (3) *proximity*, alongside two goal components: (1) *feedback*, and (2) *rewards*. Each of these properties and components will be discussed below.

Difficulty contributes to an effective goal. In order to induce more effort, the goal should be difficult, while remaining attainable. Such goals require more effort, and increase performance (Locke & Latham, 1990, as cited in Shilts et al., 2004). Locke and Latham (2002), explain how they found difficult, specific goals to consistently yield the highest performance, as compared to instructing individuals to do their best. They hypothesise that this is due to the fact that ‘do-your-best goals’ are rather vague and have no clear definition of success. The authors specify that the performance levels started decreasing only when commitment to the goal faltered, or the limits of ability were reached. The argument that difficulty increases effectiveness is also supported by Locke et al. (1981), who, having reviewed studies from the years 1969-1980, found that 48 studies either partially or completely supported the claim that difficult goals lead to better performance, as compared to easier or medium ones, with nine studies failing to support the hypothesis.

The *specificity* of a goal can improve its effectiveness, as it provides a clearer target, alongside a well defined level of effort required to accomplish it (Bandura & Simon, 1977, as cited in Shilts et al., 2004). The authors expand on this, stating that specific goals assist in regulating one’s effort, while pursuing a goal. The belief that goal specificity influences effectiveness is supported by Locke and Latham (2019), who provide several examples of specific goals surpassing ‘do-your-best goals’ or other, less specific goals. An older source which also supports this is that by Locke et al. (1981), in which 51 studies either partially or completely supported the hypothesis that specific hard goals lead to superior performance as compared to ‘do-your-best goals’ or no goals at all. The authors found that two studies did not support this claim.

The third goal property which affects effectiveness is *proximity*. Goals are typically classified as either distal, meaning long-term, or proximal, meaning short-term (Shilts et al., 2004). The authors, based on a literature review surrounding the subject, have concluded that proximal goals may be assumed to be more effective, as compared to distal goals, as they can be perceived as more difficult to postpone and more tangible. Furthermore, when dealing with long-term distal goals, it may be of value to implement proximal subgoals (Latham & Locke, 2007, as cited in Locke & Latham, 2019). These may assist in breaking down a bigger or more complex goal into more easily attainable pieces.

The first of the two components of an effective goal, as proposed by Shilts et al. (2004), is *feedback*. Locke and Latham (2019) identify four moderators of goal-performance effects, stating that feedback is one of them, and that it is essential to goal effects as it enables individuals to track progress in order to adapt both their strategies and efforts. The authors state that goals and feedback work best when combined, as compared to implementing them individually. The second component of an effective goal are *rewards* (Shilts et al., 2004). These are described as a motivator to encourage progress, and can be classified as either internal or external (Locke & Latham, 1990, as cited in Shilts et al., 2004).

2.2.2 Goal Types

Goals can be categorized. Shilts et al. (2004) propose five types of goals, based on relevant literature, two of which are proposed by the authors. These types include: *self-set goals*, *assigned/prescribed goals*, *participatory/collaborative goals*, *guided goals*, and *group-set goals*, with the last two being the types proposed by the authors.

Self-set goals are defined as ones which are chosen and designed by the participant (Shilts et al., 2004). *Assigned/prescribed goals*, on the other hand, are goals which are created by the practitioner, when referring to study-related contexts, with no input from the participant. The third goal type is classified as *participatory/collaborative*. Here, the goals are designed both by the participant, as well as the practitioner. *Guided goals* are those in which the participant can select from an existing list of goals, whereas *group-set goals* are those which apply to not only the participant, but a whole group of participants. Shilts et al. (2004) state that, based on their literature review, a conclusion cannot be drawn as to which type is superior. Instead, the authors suggest that the selected goal type should depend on factors such as the type of behaviour which is targeted, age, and readiness to change. They state that further research is recommended.

Another distinction can be made, between *learning* and *performance* goals. As explained by Seijts and Latham (2005), a performance goal is one which places the focus on performance, e.g. improving efficiency, or turning a bigger profit during a specified period of time. Learning goals, on the other hand, are goals which focus on skill or knowledge acquisition. This, in turn, leads to goals such as learning new methods to complete a task, or discovering effective strategies which can be implemented in the future.

As stated by Seijts and Latham (2005), performance goals can lead to immediate results, resulting in significantly improved performance. The authors highlight case studies which have shown that high goals lead to high performance in a variety of contexts. It is also mentioned that in some instances, individuals would set significantly higher goals for themselves as compared to goals which were assigned to a group unilaterally. The authors also mention performance goals being implemented for health related behaviour change,

stating that such goals allow individuals to evaluate their goal-related behaviour as they are acting upon it, allowing them to monitor progress. On the other hand, it is also mentioned that specific challenging performance goals may have a detrimental effect on an individual's effectiveness, in the early stages of learning and pursuing such a goal (Kanfer & Ackerman, 1989, as cited in Seijts & Latham, 2005). It is explained that prior to learning and being able to implement effective techniques and strategies, it is of importance to focus on discovering and mastering such techniques which enable effective performance, as compared to immediately attempting to reach specific performance milestones. Furthermore, when trying to attain a highly challenging task, the effort required to attempt to accomplish it can often leave no time or energy to discover superior approaches. Therefore, it could be said that performance goals may distract from learning effective strategies and methods. Conclusively, if an individual lacks knowledge about how to complete a task, setting a high performance goal may impede progress (Seijts & Latham, 2005).

Seijts and Latham (2005) differentiate between performance and learning goals based on mindset. The authors clarify by explaining that performance goals focus on motivation, while learning goals focus on ability. It is stated that learning goals frame instructions with a focus on skill acquisition and the obtaining of new knowledge. Furthermore, learning goals take attention away from the final goal itself, and instead, place emphasis on the process of acquiring new strategies and knowledge.

When comparing the two goal types, Seijts and Latham (2005) conclude by stating that both types are important. It is suggested that learning goals should be implemented to let individuals reach a point where they can successfully and effectively set performance goals, thereby avoiding the potential downfall of setting performance goals while unprepared. Learning goals therefore increase an individual's level of knowledge, while performance goals motivate the individual to implement that knowledge (Seijts & Latham 2005).

2.2.3 Goal Setting for Health Related Change in Children

Goal setting can serve as a facilitator of behaviour change, specifically with regards to physical activity and nutrition (Shilts et al., 2004). Moreover, the authors argue that specific goals can provide a useful strategy for the implementation of healthier behaviors. This opinion is shared by Seijts and Latham (2005), who, when describing the benefits of performance goals, state that they can be implemented for individuals who are attempting to self-manage their health behaviours. It is explained that individuals with specific and challenging goals were more likely to achieve their goals, as compared to individuals who had set do-your-best type goals (Bandura & Simon, 1977, as cited in Seijts & Latham, 2005). Goal setting research regarding children indicates a similar trend. Coates et al. (1981) found that children who set goals, with regards to changing eating habits, made significant improvements as compared to control students. Additionally, despite the physical activity of the children improving only minimally, the authors state that this was due to the type of

physical activity which was suggested, as opposed to the goal implementation method. The following subsections will explore individual case studies where goal setting was used in order to promote healthy behaviours in children. This was done on a case-by-case basis, in order to extract detailed information from each example which can be used in later stages of the project.

Case Study 1: Peer Modelling and Rewards

One case study is that of research by Horne et al. (2009), in which the authors implemented peer modelling and rewards in order to encourage an increase in physical activity amongst children. The work done within their study builds upon that of the Food Dude Programme (Horne et al., 2004; Lowe et al., 2004, as cited in Horne et al., 2009) which encouraged healthy behaviours through peer-modelling, by showing children videos of fictional characters eating healthy, and rewarding the children with pencils and stickers if they would do the same. Both this programme, and the study by Horne et al. (2009), implemented peer-modelling due to evidence showing that children and adolescents can be effectively influenced towards activities by significant individuals within their social environments. The authors mention a study by McKenzie et al. (1997, as cited in Horne et al., 2009), which found that, for instance, children can be effectively pushed towards an increase in activity, by prompts from fellow children. Horne et al. (2009) therefore took this method, and implemented the 'Fit n' Fun Dudes', a group of fictional children who were very physically active. Aside from this, the authors included rewards, based on literature suggesting that rewards can be an effective way to encourage physical activity. Two examples are provided, one encouraging activity by rewarding children with baseball tickets, and the other by rewarding children with additional TV time (Epstein et al., 1995; Goldfield et al., 2000, as cited in Horne et al., 2009). Furthermore, the authors explained that literature showed the use of goals, in combination with rewards, leading to the most effective results (Cameron et al., 2001; Goldfield et al., 2000; Goldfield et al., 2006; Roemmich et al., 2004, as cited in Horne et al., 2009). This is where goal setting played a part within the intervention, despite the authors not explicitly referring to the theory.

The authors wanted to test the feasibility and the acceptability of this solution, as a school-based activity intervention. In order to monitor the progress of the children, the authors used pedometers, which enabled the setting and tracking of goals. The children were played songs, performed by the fictional characters, as well as sent letters from them, which explained the reward system of the study. Children were told that upon achieving their daily step target, which increased with every day, they would receive a reward. This was done for the first two weeks of the study, in the intervention phase. For the following 12 weeks, the children continued the pedometer use, however, they no longer received rewards. Instead, the fictional characters communicated with them occasionally through letters and an eventual certificate of completing the programme. A follow up study was

performed in the two weeks after this phase, to evaluate the long-term impact of the intervention.

The study tested the intervention with 38 children (15 boys, 23 girls), and a control group of 53 children (29 boys, 24 girls). The age range of the children was 9 to 11. The results of the study found that during the intervention, a significant increase in steps was observed, 35% for boys, and 21% for girls. However, during the followup, while the girls maintained an increase of 26%, the boys did not. Additionally, throughout the study, it was found that girls reported their performance more frequently. On the other hand, it was found that boys were more active towards the start, with the authors speculating that perhaps they reached their performance 'ceiling', which was then difficult to maintain. Additionally, a performance increase was observed within the control group, which the authors believe may be caused by seasonal differences which affect physical activity, as the study began in winter and ended in spring. Nevertheless, the increase in performance found in the girls from the experimental group, as compared to girls from the control group, indicates that the intervention worked. The results of the boys during the intervention phase also imply that the study worked. Two observations are made regarding areas for improvement. One of these is the long-term effectiveness of the solution, particularly for boys, and the other focuses on practical issues with the pedometer. Children lost, forgot, and accidentally reset their devices, leading to lost data. Additionally, activities such as cycling and swimming were not tracked accurately.

Case Study 2: Collaborative Goal Setting

A study by Costa et al. (2017) investigated collaborative goal setting with children, parents, and teachers. The study included 38 children, with ages ranging from 5 to 10 years old. The children within the study had difficulties in performing everyday tasks, and required therapy. The authors believe that identifying the priorities of these children, alongside the reasoning behind their choices, is essential for effective therapeutic goal setting. They also highlight that the focus in prior research was placed on goal setting with the parents or therapists of the children, not the children themselves. The purpose of the study was to identify: the goals set by the children, determine their reasons for setting the goals, and to compare these goals to those set by the children's parents and therapists.

Collaborative goal setting was implemented within this study, with the authors describing it as one of the best practices within contemporary healthcare (Brewer et al., 2014; Holliday et al., 2007; Pollock et al., 2014, as cited in Costa et al., 2017). The authors state that research has shown this method to result in increased motivation and an improved identification with the set goals, ultimately leading to better outcomes (Brewer et al., 2014; Locke & Latham, 2002; Wressle et al., 2002, as cited in Costa et al., 2017). Furthermore, the authors state that children can be heavily influenced by pressure from surrounding adults, but also their peers, leading to the selection of goals which would align with those pressures.

The results of this study identified a number of interesting findings. Three major categories of reasons behind children's goals were found: *social motives*, *independence*, and *ease, competence, and joy* when engaging in activities. According to the authors, this emphasised the importance of participation and self-efficacy for children. The study proved that children above the age of five were capable of expressing themselves and their needs, and translating these into well-defined and specific goals. The authors found that the participants defined their wishes and concerns clearly, and that they depicted an understanding of their own areas of weakness, as well as, the significance of making improvements in such areas. Furthermore, all of the children declared that they were ready to pursue the goals which they helped identify, with the authors considering this an indication of goal setting theory working.

Case Study 3: Pedometers and Encouragement

Chase et al. (2018) investigated the impact of pedometers, goal setting, and encouragement, on physical activity during physical education in a school. The goal of this study was to evaluate the effectiveness of this intervention. The study consisted of 200 participants, 94 of which belonged to the control group, and 106 belonged to the intervention group. The children's ages ranged from eight to ten years old. The authors identified a need for research regarding the impact of goal setting, combined with that of pedometers, on physical education classes, suggesting that, if proven effective, this could be a cheap and easy way to encourage such behaviour change.

The reason for the implementation of a pedometer was due to its potential for increasing physical activity and improving one's overall health (Bravata et al., 2007; Kang et al., 2009, as cited in Chase et al., 2018). The authors implemented goals, with regards to physical activity, based on prior success with regards to increasing children's step counts, found in literature (Burns et al., 2017; Wilson et al., 2017, as cited in Chase et al., 2018).

The study was performed during eight physical education classes, where children wore the provided pedometers. The children belonging to the intervention group wore these devices, had step goals, and were provided with verbal encouragement as well as sign reminders, placed around the room reminding them of their step targets. The results indicated that the intervention group saw an increase in performance of 350 steps, translating to a 20% improvement over the control group. The authors conclude that this method, combining a pedometer, goal setting, and encouragement, is an effective and cheap way of increasing the physical activity of children in physical education classes. Furthermore, Chase et al. (2018) expand on the potential benefits of this solution, as the extra steps may translate into other positive outcomes such as overall improved health (Brusseu et al., 2016; Burns et al., 2017, as cited in Chase et al., 2018), or improved classroom behaviour (Burns et al., 2016, as cited in Chase et al., 2018). In their reflections, the authors mention that they intentionally

avoided the implementation of rewards, as they may lower childrens' intrinsic motivation, reducing the long term impact of the solution (Ryan & Deci, 2000, as cited in Chase et al., 2018). Furthermore, with regards to limitations, the lack of a follow up, testing the long term impact of the study, as well as the lack of testing of the individual elements of the study, namely the goals, encouragement, and pedometers, were both mentioned as limitations.

2.3 Gamification

This section uses parts from the Research Topics report done by the researcher (Jarosinski, 2021).

2.3.1 What is a Game?

A book by Avedon (1971, as cited in Stenros, 2015), provides a list of seven common elements of which a game consists. These include: (1) *purpose*, (2) *procedures for action*, (3) *rules governing action*, (4) *number of required players*, (5) *roles of participants*, (6) *participant interaction patterns*, (7) *results or pay-off*. It is clarified however, that this is not intended as a definition of a game, but rather as a framework of elements. Suits (1978, 41, as cited in Stenros, 2015) provides a similar explanation of what a game consists of, summarizing it by stating that "Playing a game is the voluntary attempt to overcome unnecessary obstacles." A definition by Maroney, (2001, p. 1) is "a game is a form of play with goals and structure."

2.3.2 Gamification

Gamification is a process which aims to enhance existing services by invoking game-like experiences, with the goal of supporting individual's value creation (Huotari & Hamari, 2012). Deterding et al. (2011, p. 1) define it as "the use of game design elements in non-game contexts." Stenros (2015) makes an observation with regards to this definition, highlighting how it situates gamification in relation to games, as compared to play, due to it being rule-bound and goal-oriented. It is a trending topic with regards to supporting user engagement and positive service use behaviours (Hamari et al., 2014; Huotari & Hamari, 2012; Nacke & Deterding, 2017). It can increase social interaction, user activity, or the productivity and quality of actions (Hamari, 2013, as cited in Hamari et al., 2014). The role of gamification is to invoke psychological experiences similar to those evoked through games (Huotari & Hamari, 2012), by adapting game elements to non-play-related contexts (Stenros, 2015). Stenros (2015) highlights that gamification does not refer to using whole games for goal-oriented purposes, but rather, using design insights and game elements for that purpose. With regards to this, however, he emphasizes the importance of understanding the core concept of game and play, which gamification builds upon, prior to attempting to implement elements of these activities.

Nacke and Deterding (2017), discuss the state of gamification research. The authors explain that frameworks and industry publications have dominated the field of gamification design, pointing out that oftentimes these papers are unvalidated, and not grounded in game design or game research (Deterding, 2015a, as cited in Nacke and Deterding, 2017). They highlight the need for systematic research in the field, and explain that currently there are a number of different approaches and understandings of gamification. The authors also explain the progress of research within the field, starting with primarily theoretical literature, such as frameworks and definitions, technical papers, and user studies of gamified systems. However, at the time of writing, the authors identified a shift into more specialized research, looking into individual design elements related to gamification. The authors note a change in research, from literature asking “what?” and “why?” questions, to “how?” and “when?” They explain that, at first, people were asking if gamification works, and found out that it does (Seaborn & Fels, 2015, as cited in Nacke and Deterding, 2017). In their review paper, Hamari et al. (2014) reached the same conclusion, having analysed 24 empirical studies, and concluded that in the majority of the studies, gamification worked and produced positive effects. Having established such a foundation, the research space has since matured, with new research focusing on more specific aspects of the topic (Nacke & Deterding, 2017).

Hamari et al. (2014) provide three main parts of which gamification consists: (1) *the implemented motivational affordances*, (2) *the psychological outcomes*, and (3) *the behavioural outcomes*. Based on the analysis of 24 empirical studies, the authors provide a list of 10 motivational affordances which they came across within literature. These categories include: *points, leaderboards, achievements/badges, levels, story/theme, clear goals, feedback, rewards, progress, and challenge*. The motivational affordances identified by the authors correlate with the trinity of gamification design elements, described by Webach and Hunter (2012, as cited in Nacke & Deterding, 2017): *points, levels, and leaderboards*. Nacke and Deterding (2017) explain that, according to the often-used theory of self-determination, the three elements may serve as informational feedback for users, motivating them intrinsically. This hypothesis was tested by Mekler et al. (2017) who found that, while the quantity of tasks performed did increase, effects on intrinsic motivation, task quality, or need satisfaction, were not observed. The authors suggest that perhaps these affordances served as extrinsic incentives instead.

Rapp (2017) provides nine recommendations, identified within the video game world and supported by literature, which can be used when designing interactive gamified systems. These recommendations aim to capture what gives games a long-lasting appeal (Nacke & Deterding, 2017; Rapp, 2017). Rapp’s nine recommendations include: (1a) *identification and empathy*: provide users with an image of them that they can recognize and identify with; (1b) *past and future selves*: depict the user’s past and future, in order for them to reflect on, and encourage, behaviour change; (2) *rewards*: provide users with meaningful rewards; (3)

social presence: allow users to be seen by others, and be motivated by the pressure caused by that; (4) *self-organization*: give users the possibility to freely find and organize groups that may motivate and encourage them to make progress; (5a) *cooperation and friendship*: provide users with the possibility to join groups and include elements which require group work, and all of the individuals of which the group consists; (5b) *competition*: enable competition between groups, however, be careful not to promote aggression; (6a) *freedom*: create the feeling of freedom, while still implementing constraints; (6b) *journey*: provide different types of rewards and persuasive strategies at different times, supporting user behaviour change.

Korhonen et al. (2009) provide a framework of playful user experiences, aiming to categorize the possible experiences that users may have while playing. The goal of the implementation of such a framework is to obtain an improved understanding of the role of playfulness in overall user experience. The authors claim that aspects such as 'pleasure' and 'fun' are too vague when attempting to define the non-utilitarian qualities of a product, therefore making it difficult to implement such features in design. They also add that users have vastly different perceptions of what they find fun or pleasurable, making categorization using these terms even more difficult. This is the reasoning behind the proposal of a new categorization framework of playful experiences. This new framework is based on that of Costello and Edmonds (2007, as cited in Korhonen et al., 2009), however, it expands on it by adding new categories and changing some of the existing ones. The developed framework, proposed by Korhonen et al. (2009), named the Playful Experience framework (PLEX), includes the following categories: *captivation, challenge, completion, competition, control, discovery, exploration, eroticism, expression, fantasy, fellowship, nurture, relaxation, sadism, sensation, simulation, subversion, suffering, and thrill*. Lucero and Arrasvuori (2010) expand on this framework, by designing and evaluating PLEX Cards. The purpose of these cards is to communicate the various PLEX categories, and to aid in designing for playfulness. The findings of the evaluation indicate that these cards are an effective source of inspiration and can be used for efficient brainstorming.

The context of gamification is the activity or service to which gamification is being applied (Hamari et al., 2014). A common example of an application, mentioned by Nacke and Deterding (2017) is that of making repetitive tasks more engaging. Within the studies analysed by Hamari et al. (2014), learning and education were identified as the most common contexts. This finding is confirmed by Nacke and Deterding (2017), who mention education as a context which was heavily focused upon in early gamification literature. Hamari et al. (2014) state that all of the studies discussing learning and education found gamification to be mostly beneficial, particularly with regards to engagement and motivation. The contexts mentioned by the authors include: commerce, education/learning, health/exercise, intra-organizational systems, sharing, sustainable consumption, work, innovation/ideation, and data gathering. This indicates that the contexts for implementing

gamification can vary rather broadly. Nacke and Deterding warn, however, that the effects, and level of success, of gamifying different contexts may vary (Deterding, 2014a; Kim, 2012; Mollick & Rothbard, 2014; Webb, 2013, as cited in Nacke & Deterding, 2017). Involuntary tasks are mentioned as an example of a context which may struggle with gamification. Another example is a study by Fitz-Walter et al. (2017), which explored the use of gamification for enhancing the experience of new drivers, learning how to drive, however, the authors found that while this did make the experience more enjoyable and motivating, it did not lead to significant behaviour change. Nacke and Deterding (2017) use this as an example illustrating that gamification may not be applicable in all contexts. They identify a need to systematically explore the use of gamification in different contexts, in order to understand the best practices for them.

While literature suggests that gamification can be beneficial, drawbacks and limitations of the method are also discussed. From a theoretical perspective, Stenros (2015) identifies the risk of gamification, namely that it may encourage an attitude disregarding non-useful game and play activities as frivolous. He explains that while implementing games for increasing motivation and performance can be a valuable goal, one should be careful with their attitude while doing so. Stenros also raises the issue of gamification-related literature often basing its claims on an assumption that games and play are intrinsically motivating. He brings forth an example of a paper by Ellis (1973, as cited in Stenros, 2015) which already at the time of writing discussed this issue, highlighting the fact that it is a long-present problem. A different risk, discussed in several papers, is that of the results of gamification relying on the novelty effect, and thereby not being long-term (Farzan et al., 2008; Farzan et al., 2008; Hamari, 2013, as cited in Hamari et al., 2014). Nevertheless, it also appears that removing gamification in such instances can also have a negative effect, as users may be upset about losing progress (Hamari et al., 2014).

Hamari et al. (2014) also discuss potential negative outcomes of gamification, such as the effects of increased competition (Hakulinen et al., 2013, as cited in Hamari et al., 2014), difficulties with evaluating tasks (Dominguez et al., 2013, as cited in Hamari et al., 2014), and the design features themselves (Dominguez et al., 2013; Dong et al., 2012, as cited in Hamari et al., 2014). Hamari et al. (2014) conclude by identifying two primary confounding factors, with regards to the implementation of gamification, within existing literature. These include: the role which the gamified context plays, and the qualities of the user. An additional critique of gamification is provided by Bogost (2014). The author explains how the concept is often misused, particularly by marketers and consultants who wish to exploit it for their own benefit, caring little for the effectiveness of the implementation. He believes that the nature of gamification makes it easy for individuals to apply it to anything, recycling the same solutions, while benefiting from the ambiguity of the concept. He concludes by suggesting that it is not the concept which is at fault, nor is its purpose, but rather the way in which it is oftentimes being used.

Technological developments, alongside new literature mean that gamification is evolving. Nacke and Deterding (2017) suggest that a key enabler of this development is the presence of computing technology within society, such as smartphones, wearables, and ubiquitous sensors. The authors also note the significance of the societal changes, such as the growing presence of digital games, going as far as to state that there is a “gamer generation.” It is the belief of the authors that the cultural, economic, political and technical forces combined have created a need and potential for the improving of user experiences and engagement, which can be accomplished through gamification (Deterding, 2015, as cited in Nacke and Deterding, 2017).

2.3.3 Importance of Play in Games

Intrinsic Motivation

An alternative to the concept of gamification is that of playification. Márquez Segura et al. (2016) explain that it can be considered either an extension, or a replacement, of gamification. Nicholson (2015) believes that by focusing on fun and engagement, the focus can be shifted away from external rewards, which are a central element of many gamification systems, towards intrinsic motivation. This shift towards intrinsic motivation within the field of gamification, is also noted by Márquez Segura et al. (2016). Another aspect of playification, emphasised by Nicholson (2015), is that of play being optional (Callois, 2001, as cited in Nicholson, 2015). He states that if one is forced to engage with a game, then it can no longer be considered a play experience. It is therefore of great importance to create an experience which users actively wish to use, and come back to, even though this may be difficult to accomplish in some contexts. The author proposes the implementation of exploration as a means to soften this requirement, as it can allow users to decide what they wish to do and interact with. A science museum is mentioned as an example (Nicholson, 2012b, as cited in Nicholson, 2015), which does not offer any external rewards, but rather encourages free exploration and interaction.

Meaningful Gamification

Nicholson (2015) argues that gamification should adopt an approach that promotes long-term behaviour change. For this reason, designers should avoid implementing reward-based elements, since they may negatively influence intrinsic motivation, and rather focus on a number of elements supporting meaningful gamification. These elements can be summarized as the RECIPE approach, including: *Reflection, Engagement, Choice, Information, Play* and *Exposition*. These concepts are further explained in this section.

Reflection in this context refers to the creation of situations where the user can take a moment to reflect and consider the experience. The goal is for the player to draw parallels and create connections between the events in the gamified experience to their real experiences, as this can play a significant role in the user finding meaning of their actions

(Rodgers, 2002, as cited in Nicholson, 2015). Furthermore, Nicholson (2015) explains that group reflection could be of additional value, as it would not limit reflection to the thoughts of one person, but rather the thoughts and feelings of a collective group, resulting in deepened insights. He proposes three elements of which reflection in a gamified system can consist of. The first of these is the *description*, where the user is encouraged to discuss and recall what the activity consisted of. The next step is the *analysis*, where the user will think about what they did, and create connections with their real lives. The third and final component is that of *application*. Here, the user is encouraged to take their experience, and apply it to their real life. Combined, Nicholson (2015) believes that this can lead to an experience where the user takes what they have done, critically reflects on it, and implements it. For this to be successful, however, it is of importance for the user to shift their mindset from 'doing' to 'reflecting' (Nicholson, 2012c, as cited in Nicholson, 2015). A way, discussed by the author, of doing this is by changing the in-game situation, by having the user report to a character, or by breaking the fourth wall and having the user interact with the game maker.

The second element of meaningful gamification, namely *engagement*, can come in several forms (Nicholson, 2015). The author states that it can refer to social engagement, by interacting with others in a meaningful way, or the use of an engaging gameplay experience. He describes an engaging experience as one which increases in difficulty over time, as the user's abilities increase, keeping the experience interesting. The author proposes a way in which these two interpretations of engagement can come together, namely by selecting the right time in which the user is exposed to others. This can, for instance, occur when the user is comfortable with the gamified experience, and feels confident enough to interact with others. The author also differentiates between two types of player engagement. The first of these is *social engagement*, where the users are encouraged to interact with each other through things such as chats or discussion boards. *Engagement through game mechanisms*, on the other hand, refers to things such as leaderboards, challenges, shared goals, or other game elements which enable interaction. With regards to this, however, he encourages designers to consider whether they want their users to cooperate, compete, or to do both. Competitive elements can work well in environments which are competitive by default, however, it can discourage individuals in other contexts. Cooperative elements, on the other hand, can encourage users to introduce the gamified experience to people they know, and to then work together towards shared goals.

The third element of meaningful gamification, described by Nicholson (2015), is *choice*. This refers to users being able to decide how they wish to interact with the gamified system, by making meaningful decisions, which can then lead to an improved perception of the experience, as well as oneself. This approach is based on the Self Determination Theory approach (Deci & Ryan, 2004, as cited in Nicholson, 2015). As described by the author, choice relates to play based gamification, or playification, as freedom to do what one

decides is a significant part of it. He states that a way of incorporating it into gamified experiences is through allowing individuals to select which activities they wish to pursue, however, one should be careful as to not overwhelm users with choices.

Information, being the fourth element described by Nicholson (2015), refers to giving users insight into the gamified system regarding the “why” and the “how”. By providing users with information, they can develop a sense of mastery in the topic, leading to a positive experience (Deci & Ryan, 2004, as cited in Nicholson, 2015). Furthermore, information can help in strengthening the link between the gamified experience and the real world, adding more depth to the experience. In comparison, if the user is given no information, and simply rewarded for some activities, they find out that these are the activities that the designers considered to be important, as opposed to finding out why what they are doing is of significance. The author discusses some ways in which information can be conveyed to the user, such as the graphical user interface, non-player characters, or through the game mechanics. For instance, these mechanics can either provide information to the user, or they can immerse the user in an experience which is representative of the real world. The author also states that it is of significance to present information in a variety of ways in order to ensure that different types of learners are not excluded.

The fifth element of meaningful gamification is *play* (Nicholson, 2015). This describes an activity which someone does freely and voluntarily. Here, players should be able to create their own constraints which they then abide by, or change, if they desire. The entire premise of this element relies on the players finding the gamified experience fun, removing the need for external rewards. The author discusses aspects such as exploration and freedom, which can enhance the element of play. This element, alongside the shift away from extrinsic motivators, ties Nicholson’s (2015) approach to playification.

Exposition is the sixth and final element described by Nicholson (2015). Through this, the author refers to the addition of a narrative aspect to the gamified experience. He identifies two parts of which exposition consists: the development of the narrative element in a meaningful way, and the way in which the narrative element is presented to the player. The author also references Simons (2007), who points out the importance of finding a balance between having a strong narrative and giving the player the feeling of control. Nicholson (2015), discusses the value of exposition in allowing users to create connections with their real experiences. This can be done either through the mirroring of the real world, or through the use of an analogy. A danger of the exposition element, however, is the risk of it not having a clear connection to the real world, making it difficult for individuals to transfer their thoughts and findings from the gamified experience to their lives. The author suggests an approach to the implementation of exposition, which can be effective, namely, the ability for the user to create their own story.

2.3.4 Characters in Games

The use of characters in games is widespread. They give players the ability to interact with a game world, and to interact with others. They can be seen as a mediated form of self representation of the player, with the value of a character being a significant factor in the gameplay experience of a player, and the overall success of a game (Livingston et al., 2014). Some players can become very attached to their in-game characters, feeling guilt if a character is neglected (Birk et al., 2016). However, as explained by Livingston et al. (2014), characters can also provide value to players in other ways. Ten types of value that characters provide were identified by the authors: (1) *utility*, (2) *investment*, (3) *communication*, (4) *memory*, (5) *enjoyment*, (6) *representation of relationships*, (7) *new experience*, (8) *creativity*, (9) *sociability*, and (10) *self-expression*. *Utility* refers to some characters' value stemming from what they are able to accomplish for the player. *Investment* explains that the value of some characters comes from them representing the achievements, effort, or time investment of a player. *Communication* refers to what the look of the character communicates to the player's social group. *Memory* is the value of the character being a collection of the player's memories. *Enjoyment* refers to characters being fun to play with. *Representation of relationships* refers to the value of some characters being based on the fact that they represent relationships with other groups or players. *New experience* refers to some characters enabling new experiences for the player. *Creativity* is linked to the value of players being able to create visually appealing character designs. *Sociability* is the value of allowing players to interact with their friends. Finally, *self-expression* refers to characters enabling the player to express their personal characteristics or beliefs.

Creating an avatar with which the player identifies leads to an increase in the imagined enjoyment of playing a game with the character (Trepte et al., 2010, as cited in Birk et al., 2016). Identification can be defined as the extent to which people empathize with a character, like a character, or see them as similar to themselves (Cohen, 2001; Looy et al., 2012, as cited in Birk et al., 2016). Within the context of games, avatar identification can allow the player to become one with their character (Birk et al., 2016). Three forms of avatar identification are described by the authors. The first of these is *wishful identification*, where there are similarities between the characteristics of the character, and the player's ideal characteristics. Such identification can lead to increased immersion, intrinsic motivation, and positive affect. Within games focusing on exercising, Jin (2009) found that players who created avatars based on their ideal self, implementing wishful identification, reported higher levels of game interactivity. A second type of identification is *similarity identification*. Here, avatars are a representation of who the player actually is. This has been found to increase identification. Jin (2009) however, states that in exercise-based games, participants who created their avatars based on their actual selves, implementing similarity identification, experienced lower game interactivity when compared to wishful identification. The third type is *embodied identification*, where the identification is based on the similarity between the

player's avatar, and their idea of who they are while playing the game. Birk et al. (2016) found that *similarity identification*, *wishful identification*, and *embodied identification* increase immersion, autonomy, enjoyment, invested effort, and positive affect during interaction with a gamified system. Furthermore, increased identification resulted in motivated behaviour. Birk et al. (2016) suggest that the identification type should depend on the aim of the design. The authors indicate that in a persuasive game, which has the purpose of assisting players in reaching their goals, wishful identification may be appropriate.

Three ways of facilitating identification, based on existing literature, were found by Birk et al. (2016). These include: *avatar customization*, *narrative element*, and *naming a character*. With regards to avatar creation, the authors highlight that this process can be very context dependent, with players often matching the looks of the character to the world and narrative of the game. The impact of the avatar's appearance has been highlighted by Peña et al. (2016). The authors state that manipulating the physical attributes of avatars has reliably influenced the physical activity levels of their participants. By playing as an overweight character, or when playing against an overweight character, the authors found that participants would have lower levels. The authors therefore suggest that when designing avatars for a serious game focused on physical activity, it's important not to portray the player's avatar as if they are at a physical disadvantage when compared to others.

Birk et al. (2016) connect avatar identification to intrinsic motivation, proposing that identifying with a character in a game may increase the intrinsic motivation of a player. Intrinsic motivation refers to people doing things due to the satisfaction derived from doing the action (Birk et al., 2016). It poses benefits such as people being more willing to invest more time and effort into a task, and ultimately derive more enjoyment from it (Deci & Ryan, 2000, as cited in Birk et al., 2016). Deci and Ryan (2000) emphasize the importance of autonomy for intrinsic motivation. The results of Birk et al. (2016) suggest that identifying with an avatar could lead to a longer time investment, as well as a greater overall game enjoyment. The authors therefore recommend the use of avatars for increasing identification in serious games.

The use of an avatar with which the player identifies is recommended by Birk et al. (2016), as it could be applied to new contexts, such as serious games, where this enjoyment could be utilized. The authors explore some possible drawbacks of using characters in new contexts however. These include: potential issues with copyright and intellectual property, a mismatch between the character and the environment in which they are to be used, users being unfamiliar with character identification, and finally, that the benefits of character customization and avatar identification in lighter, more casual games, oftentimes used for serious purposes, has not yet been extensively explored.

2.3.5 Gamification Using Goal Setting for Health-Related Behaviour Change in Children

This section of the chapter will explore cases of goal setting being used in collaboration with gamification, for the encouragement of healthy behaviour in children. Each study is explained in detail within its own subsection.

Case Study 1: Narrative-Driven Encouragement

Murnane et al. (2020) describe a study focused around a smartphone application, WholsZuki, which aims to visualize physical activity and goals to the users, as chapters of a quest. The progress made by the user is mirrored by the progress of their in-game character. The focus of the paper is on physical activity, and how technology may be used to assist in developing healthier behaviours. The authors highlight the potential of technology, particularly developments in smartphone and wearable technology, in helping with this process. The effectiveness, scalability and low costs are mentioned as the primary contributing factors towards this. However, it is pointed out that a monitoring strategy is implemented by most of the applications offered today, focusing on the quantitative display of data. This approach is considered to be less effective (Hinyard & Kreuter, 2007; King et al., 2016, as cited in Murnane et al., 2020), and can make it difficult for users to interpret the data (Daskalova et al., 2017; Lupton, 2013, as cited in Murnane et al., 2020). Within this study, the authors instead focus on the implementation of a qualitative approach, using a narrative to convey a story to the user.

The reasoning behind implementing storytelling is based on research showing its effectiveness in promoting health-related behavior change. Users find it to be memorable and more personal (Hinyard & Kreuter, 2007; King et al., 2016, as cited in Murnane et al., 2020). Furthermore, narratives allow for an improved self-reflection (Busselle & Bilandzic, 2008; Cohen & Sherman, 2014, as cited in Murnane et al., 2020), encouraging engagement, and curiosity during this process. The authors combined this method with that of ambiently displaying the narrative via the user's smartphone wallpaper. They believe that due to the number of times that individuals check their phone on a daily basis, this may serve as a form of subconscious nudging. An additional method implemented within this design is that of goal-setting.

When developing the application, the authors went through an iterative, user-centered design process. Through the user-centered process the authors were able to obtain feedback, while also learning about fundamental user expectations regarding the concept. The design enables both manual and automatic data collection, while also allowing users to have control over their personal data. Two types of data entry are possible, with regards to tracking activity: duration, and the number of times the activity was performed. Throughout the day, the application reveals to the user their progress in the narrative, and every week, a new, visually unique, chapter is unlocked. All of the chapters are interconnected via one

plot. During the development of the narrative itself, the authors were in contact with experts in the field, adding features such as framing the story as a mission, in order to establish a more powerful connection with the reader (Slater & Rouner, 2002, as cited in Murnane et al., 2020). The goal of the narrative is to make the user feel attached to the character within the story. The authors also describe the implementation of characterization in order to evoke feelings of empathy and emotional stimulation to enhance the motivation and immersion (Busselle & Bilandzic, 2009; Green & Brock, 2000; Murphy et al., 2011; Oatley, 2002, as cited in Murnane et al., 2020), alongside the addition of an antagonist. The narrative was user tested prior to the implementation of the application. The physical activities of the user are depicted in the visuals, and color-coded to assist in identifying the type of activity. Furthermore, an additional visualisation shows to the user the stage of the chapter that they are in, serving as a form of a short-term goal, in the pursuit of a long-term one.

A field trial was performed in order to evaluate the work of the authors, however, it did not focus on evaluating long-term physical behaviour change, but rather, the feasibility of the solution. An emphasis was placed on descriptive findings regarding user experiences. Some participants were given a single-chapter version of the application, while others were given a multi-chapter version. The findings of the paper indicated that multi-chapter users outperformed single-chapter performances in all 3 weeks. Users found the ambient visuals to be motivating, and for the automatic input process to be much simpler as compared to the manual. With regards to psychological changes, the multi-chapter group indicated a larger progress in terms of behaviour change. The multi-chapter version was also found to be significantly more visually appealing. Furthermore, the authors identified the significance of coherence within the narrative, regarding both internal, interface and aesthetic oriented, and external, activity and progress related, elements. In terms of future work, a longitudinal study is described as necessary by the authors, alongside the use of other, perhaps more complex, narrative elements, customized towards specific target groups and contexts. An increased level of interaction with the character is also mentioned as a future development.

Case Study 2: Immersive Goal Setting

Simons et al. (2013) describe a study focused on a serious video game, named “Escape from Diab”, which is designed in order to lower risks of obesity in children. The game implements goal setting, goal evaluation, problem solving, skill development, and aspects of self determination theory. The authors describe goal setting as a two phase process: goal intentions, which define the goal, and implementation intentions, which define the when, where, and how. They also highlight the significance of problem solving in overcoming challenges when striving to reach a goal. “Escape from Diab” aims to promote the development of intrinsic motivation through targeting the three needs which drive behaviour, based on self determination theory: *competence*, *autonomy*, and *relatedness*. The study included 103 children in the intervention group, and 50 children in the control group. The ages of the children ranged from 10 to 12. The intervention group played “Escape from

Diab”, alongside a second game “Nanoswarm”, which implemented the same behaviour change model.

The game, which is described as immersive, had the children set physical activity and diet related goals. The goals of the children were then challenged in the game via a temptation, and successful goal completion resulted in the displaying of a motivational message. The primary outcomes of this study were the findings regarding what goals, topics, barriers, and solutions were of importance to the children. With regards to diet, the main values indicated were getting good grades and being fit. As for physical activity, the primary values were: not missing school, being a healthy weight, and having the energy to do homework. The authors also note an increase in fruit and vegetable consumption of the children, validating the design.

Case Study 3: Groups, Goals, and Rewards

A study by Garde et al. (2015) explored the impact of the “MobileKids Monster Manor” app as a way to encourage physical activity in children. The target group of this study were children ranging from 8 to 13 years old. The premise of the app is based on the observation that youth are progressively more interested in sedentary activities such as social media, television, or video games. The authors therefore see an opportunity in using these forms of entertainment as a way to encourage healthy behaviours. The solution which they propose implements the concept of exergaming, specifically applied to mobile phones, as they are not constrained to a specific location. The “MobileKids Monster Manor” app was therefore developed, with insight from children, in order to tackle unhealthy behaviours. This app was designed to work together with a physical activity tracker connected to the smartphone.

Within the game, children would be rewarded for real-world physical activities by receiving in-game currency, which could then be traded into game time. Additionally, the progress of users was shared between them, encouraging competition and peer support. The children would compete as teams, with the team rankings being shared, alongside individual scores. The premise of the game was based on a monster theme, where children had the goal of setting the monsters free. As children completed activities, they would be rewarded with various items. The authors highlighted some of the elements which were incorporated into the game for motivational purposes, such as challenge, curiosity, choice, fantasy, and structural features. Children were also given the possibility to send each other encouraging messages to motivate their team members. Goal setting was not explicitly mentioned by the authors, however, goals were used in the game for players to track their progress, and the progress of their teams. The activity tracker in particular was linked to goal setting, as users set their own activity goals, and the device alerted them of their progress and whether or not they completed the task.

Garde et al. (2015) emphasised the importance of integrating the input of children during the design phase, as it can help in finding existing issues and areas for improvement (Flicker et al., 2008, as cited in Garde et al., 2015), and explained how they integrated youth ambassadors from an initiative called KidsCan. When evaluating the finished design, a study was performed with a 'game' group and a 'feedback' group. For the first week, a baseline study was performed using the activity tracker. After the initial week, the 'game' group received smartphones with the game installed, able to track activity and steps, while the 'feedback' group received access to a web-based activity tracking monitor, which would provide them with quantitative information regarding their activity. After completing the two weeks, the children from the 'game' group answered a survey. The study was performed with 54 children, with the primary goal of comparing the results of the groups. The second goal of the study was to analyse the level of enjoyment of children using the app. The findings of this study indicate that the 'game' group saw an average increase in performance of 1191 steps and 25 active minutes, while the 'feedback' group saw an average improvement of 796 steps and 6 more active minutes per day. Children enjoyed the requirement of being active in order to obtain points, and 85% of them liked the ability to compare their progress with others, and to send each other messages. Additionally, the authors discovered reasons for why some children did not enjoy using the app, such as misunderstanding instructions.

The authors conclude that overall the game had a positive effect on children's activity. They also concur that the quantitative feedback approach also leads to some benefits, however, these were smaller. They speculate that this could reflect the need for gamified elements which make the experience more fun. With regards to limitations, the authors mention other studies in which children lost interest in such games within a short period of time (Lin et al., 2006), and describe this as something which needs to be explored further. Furthermore, limitations of using physical activity trackers were discussed, mentioning that some children stopped wearing them, or did not wear them for long enough. It is also impossible to know who is wearing the tracker.

2.4 State of the Art in Literature

This section uses parts from the Research Topics report done by the researcher (Jarosinski, 2021).

Literature exploring apps for encouraging physical health in children exists. One such example is a paper by Schoeppe et al. (2017) where the authors evaluated apps which aimed to improve the diet and physical activity in children and adolescents. Here, the authors identified the lack of research exploring the content and quality of existing apps targeting children. The apps within the review were included based on a number of criteria such as the value of the user ratings (4+), as well as the quantity of such ratings (20+).

These apps were then tested by the researchers. Out of the 25 apps investigated by the authors, 13 were categorized as games, which included sub-categories such as serious games and exergames. 17 of the apps included educational information, 15 had social networking features, 17 included rewards, and 21 had various elements of gamification. With regards to the behaviour change techniques implemented within the apps, the most common was 'providing instructions' (76%), followed closely by 'providing general encouragement' (72%), and 'providing rewards' (68%). The technique of 'prompting specific goal setting' was present in 32% of the apps.

The general findings of the paper by Schoeppe et al. (2017) included the observation that fewer apps targeting children exist, as compared to those targeting adults. Furthermore, the authors pointed out the difference in the behaviour change techniques used within these apps, targeting children, as compared to the findings from literature which explored the techniques which were used in adult-oriented apps. While instructions, encouragement, rewards, and feedback were the most present features in the children-oriented apps, literature indicates that goal setting, self monitoring, and performance feedback were the most present in apps focused on adults (Bardus et al., 2016; Lyons et al., 2014; Middelweerd et al., 2014, as cited in Schoeppe et al., 2017). An additional remark by the authors is the comparison of the behaviour change techniques used within the apps for children, to the behaviour change techniques identified in literature, which are considered to be the most effective in children. These techniques include social support, social modelling, consequences for behaviour, social approval, self-monitoring, and the formation of intentions (Brannon & Cushing, 2015, as cited in Schoeppe et al., 2017). The authors point out how these differ from those found in the apps, suggesting a need for more research-based app development.

Schoeppe et al. (2017) conclude their app review paper by providing a list of recommendations for developing an app. These include: pilot test existing apps, incorporate literature-based behaviour change techniques, and test which combinations are the most appealing, focus on specific child groups, provide children with information and advice, compare the use of apps to the combination of both apps and wearables, analyse usage data, find and implement elements which encourage long-term use, and to base the design on a collaboration between behaviour change experts and the app developers. Moreover, it is worth noting that the paper by Schoeppe et al. was published in 2017, and the app space may have seen some developments since then. Nevertheless, the general findings of the papers can be considered for inspiration and guidance.

3 PROJECT METHODOLOGY

The method which was implemented in this project was that of design thinking. Design thinking refers to a creative problem-solving approach (Luchs, 2015). It is a five stage process (Wolniak, 2017), depicted in figure 1, and explained in this section.

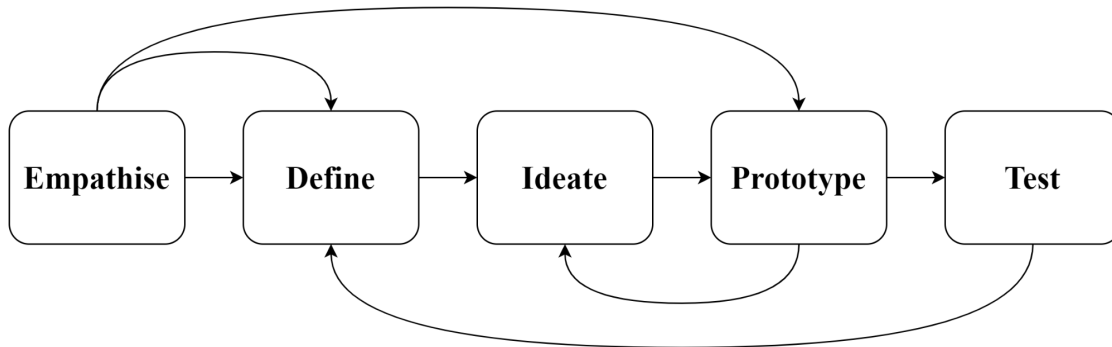


Figure 1. Diagram showing the five stages of the design thinking process.

The *empathising* stage is used in order for the researcher to understand the characteristics of the audience that they are designing for (Wolniak, 2017). This is typically done through data gathering methods such as interviews or observations. The goal is to build empathy for the audience that the researcher is designing for (Rauth et al., 2010). The *defining* stage's purpose is to create a narrow problem statement which will guide the ideation phase (Rauth et al., 2010). During this phase, the researcher identifies user needs and creates a design brief which summarizes them (Wolniak, 2017). The third stage is *ideation*, with the focus being placed on idea generation (Rauth et al., 2010). At this stage, the researcher can use tools such as brainstorming in order to generate creative ideas for potential solutions (Rauth et al., 2010; Wolniak, 2017). This stage is concluded with the researcher selecting the most promising idea, leading to a development of a prototype based on this idea (Wolniak, 2017). The *prototyping* stage revolves around creating one or more prototypes for the sake of testing a design concept, providing a solution with regards to which users can give feedback. The purpose of creating a prototype is to test specific elements of a solution (Wolniak, 2017). The final stage of the design thinking process is *testing*. Here, the researcher evaluates the prototype through performing user tests (Rauth et al., 2010; Wolniak, 2017). The aim is to evaluate the proposed solution in a real environment, by real users (Wolniak, 2017).

A variation on the design thinking method was implemented in this project. Rather than performing interviews and observations, the *empathising* stage was executed through researching literature. This was done partially due to the difficulty of reaching the target group, namely children who pose both practical and ethical challenges in research, but also due to the availability of research on the subject. Through this process, the relevant topics were explored, including ones exploring user needs. Based on this research, the *define* stage could be executed, with the researcher identifying a narrow problem statement. This was then followed by the *ideation* phase, during which a final concept was developed. Finally, a *prototype* of this concept was developed, and *tested*.

In the following chapters, the different phases are detailed as follows: *Empathise & Define* (Chapter 4), *Ideate* (Chapter 5), *Prototype* (Chapter 6) and *Test* (Chapter 7).

4 EMPATHISE & DEFINE

The purpose of this phase was to obtain an understanding of the key concepts (goal setting and gamification) and to identify ways in which these could be implemented to support childrens' goal setting. Following this, the aim was to understand the users' problems and needs. This was achieved by first conducting a literature review exploring the current recommendations for supporting children in their goal setting journey (Chapter 2), investigating existing physical activity apps for children (4.1) and attempting to identify and bridge the gap between research and practice (4.2). These empathising activities then led to the definition of the problem statement (4.3).

4.1 Investigating Existing Apps

This section uses parts from the Research Topics report done by the researcher (Jarosinski, 2021).

4.1.1 Selection Criteria

A part of the design process involved investigating existing apps within the design space, as recommended by Schoeppe et al. (2017). A total of five applications were looked at. When selecting the apps to review, online research was performed to find relevant options. Apps from the Google Play Store¹, as well as the Apple App Store² were considered, as these are the two most popular operating systems in consumer smartphone devices. It was not possible to use the search systems of these stores to search for game elements or keywords, therefore it was not possible to find terms such as 'goal setting', 'goals' or 'physical health', as these provided very literal results with apps with those keywords in the names. An additional reason for this was the overwhelming quantity of apps which are present on these stores, with many duplicates or very similar interpretations of the same concepts. Combined, this made searching for apps difficult. Instead, it was therefore decided that an online search would be performed, browsing various lists and performing manual searches through the app stores.

These apps were selected based on a number of criteria:

- (1) *The app uses gamification to encourage physical activity*
- (2) *The app requires physical activity*
- (3) *The app was still active at the time of the investigation*
- (4) *The app was offered on either of the two major app stores*
- (5) *The app had positive reviews (4+ on at least one of the two stores)*

¹ <https://play.google.com/>

² <https://www.apple.com/app-store/>

4.1.2 Analysis of the Selected Applications

The five apps which were investigated were: NFL Play 60, Zombies, Run!, The Walk, Hops - Journey of Tree Spirit, and Walkr. A detailed overview of the apps, including the reasoning behind the individual app selection, can be found in Appendix A. These apps were analysed based on recommendations from literature, and compared. This could assist in future stages of the design process, by simplifying the process of searching for inspiration and apps which implemented the same features which may be integrated. While this was not a quantitative analysis, and the number of apps was limited to five, meaning that it was not statistically significant as a representation of the available apps, this overview did discuss a variety of apps which were well rated, and popular. Considering and analysing these apps was a useful qualitative tool for determining how theory-based elements were implemented at this point in time.

Analysis Step 1 - Defining a Good Goal (Shilts et al., 2004)

With regards to goal setting, the apps were analysed based on the Shilts et al. (2004) model of defining a good goal. However, it was found that the use of the 'difficulty' was challenging, as whether a goal was difficult or not was highly based on the individual interacting with the app. It was therefore of more use to consider what influence the user had on the goals which could be set, as this could define the level of difficulty. Additionally, the in-app goals were categorized into either performance or learning goals. This would provide an overview of the goals which were set within the apps. The results of these comparisons can be found in table 1.

Table 1.

A table comparing the apps based on goal setting elements.

	NFL Play 60	Zombies, Run!	The Walk	Hops	Walkr
Difficulty	-	-	-	-	-
Specificity	✓	✓	✓	✓	✓
Proximity	✓	✓	✓	✓	✓
Feedback	✓	✓	✓	✓	✓
Rewards	✓	✓	✓	✓	✓
Performance goals	✓	✓	✓	✓	✓
Learning goals	×	×	×	×	×

Based on the results found in table 1, it became evident that the five apps shared many similarities with regards to goals. Specificity, proximity, feedback, and rewards were present in all of the apps, to some extent. Based on this evaluation, these features appeared to be standard in apps which encourage physical behaviour change through gamification and goal setting. With regards to the two types of goals, performance goals were noted in all of the apps. Learning goals were not present within these apps.

Analysis Step 2 - Meaningful Gamification (Nicholson, 2015)

When considering the elements which could lead to meaningful gamification, as described by Nicholson (2015), one can notice some similarities and differences. The results of this comparison can be seen in table 2.

Table 2

Table showing the comparison between the apps based on the RECIPE model (Nicholson, 2015).

	NFL Play 60	Zombies, Run!	The Walk	Hops	Walkr
Reflection	×	×	×	×	×
Engagement	✓	✓	✓	✓	✓
Choice	✓	✓	✓	✓	✓
Information	×	✓	×	×	×
Play	×	✓	✓	✓	✓
Exposition	×	✓	✓	✓	✓

As shown in the table, reflection was not featured in any of the apps as none of them allowed users to link their experiences to other interests which could enrich the learning experience (Nicholson 2015). Engagement, on the other hand, was present in all five of the apps. This was primarily done through the creation of an engaging gameplay experience (Nicholson, 2015). All of the apps featured choice to a certain degree, whether it was the ability to select activities, goals, or to customize various elements. Information, referring to providing users with knowledge relating to the outside world, was only present in “Zombies, Run!” In this app, users were able to practice for real world activities, like running marathons, which included relevant information. Play was a difficult criteria to evaluate. An important aspect of play is the freedom element (Nicholson, 2015), yet all of the apps required users to follow specific rules and steps in order to progress. Nevertheless, the four apps which provided users with flexibility, with regards to their physical activities which would be rewarded in-game, were categorized as ones which included play. Exposition, focusing on the narrative element (Nicholson, 2015), was present in the majority of the apps.

Analysis Step 3 - Enriching Gamified Experiences (Rapp, 2017)

The third comparison was done based on the nine recommendations of Rapp (2017), focusing on enriching gamified experiences. The results of this comparison can be seen in table 3.

Table 3

Table showing the comparison of the apps based on Rapp's (2017) recommendations.

	NFL Play 60	Zombies, Run!	The Walk	Hops	Walkr
Identification and empathy	✓	✓	✓	✓	✓
Past and future selves	✓	✓	✓	×	✓
Rewards	✓	✓	✓	✓	✓
Social presence	×	✓	×	×	×
Self-organization	×	×	×	×	×
Cooperation and friendship	×	×	×	×	×
Competition	×	✓	×	×	×
Freedom	✓	✓	✓	✓	✓
Journey	×	✓	✓	✓	✓

The goal of the recommendations by Rapp (2017) was to provide designers with elements which could make their designs more interesting in the long-term. This comparison evaluated whether or not the analysed apps included these elements. Identification and empathy were present in all of the apps, either through identifying with a character, or a different entity such as a spaceship. The ability to see one's past and future was present in all apps but one. Rewards were identified in all apps. Social presence, on the other hand, was only noted in "Zombies, Run!", where online leaderboards exist and users could compare their scores with others. Self-organization was not identified in any of the apps, and neither was cooperation and friendship. Competition was only observed in "Zombies, Run!" Freedom was present in all of the apps, to various degrees. Journey was included in all apps aside from "NFL Play 60", where users selected one activity at a time with no progress, aside from levels and points.

Analysis Step 4 - PLEX Framework (Korhonen et al., 2009)

The fourth comparison considered the playful experiences that users may have, based on the PLEX framework (Korhonen et al., 2009). The results can be seen in table 4.

Table 4

Table showing the comparison of the apps based on the PLEX framework (Korhonen et al., 2009).

	NFL Play 60	Zombies, Run!	The Walk	Hops	Walkr
Captivation	×	✓	✓	×	×
Challenge	✓	✓	✓	✓	✓
Completion	✓	✓	✓	✓	✓
Competition	×	✓	×	×	×
Control	×	✓	✓	✓	✓
Discovery	×	✓	✓	✓	✓
Exploration	×	✓	✓	✓	✓
Eroticism	×	×	×	×	×
Expression	✓	×	×	×	×
Fantasy	×	✓	✓	✓	✓
Fellowship	×	×	×	×	×
Nurture	✓	✓	×	✓	✓
Relaxation	×	×	×	✓	✓
Sadism	×	×	×	×	×
Sensation	✓	✓	✓	✓	✓
Simulation	×	✓	✓	×	×
Subversion	×	×	×	×	×
Suffering	×	✓	✓	×	×
Thrill	×	✓	✓	×	×

This comparison provided a detailed overview of possible experiences which users may have had when using the apps. Experiences are subjective, and therefore this evaluation was based on the authors' own reflections, and imagination of what other users may have experienced. Challenge, completion, and sensation were featured in all of the apps. Eroticism, fellowship, sadism, and subversion were not present in any of the apps. The two strongly narrative driven apps, namely "Zombies, Run!" and "The Walk" featured many similar elements such as captivation, suffering, thrill, and simulation, which were only present in these two apps. The majority of apps included control, discovery, exploration, fantasy, and nurture. An interesting conclusion can be made when summarizing the number of PLEX elements which were identified per app: "NFL Play 60" - 5, "Zombies, Run!" - 13, "The Walk" - 11, "Hops" - 9, and "Walkr" - 9. Based on this, one could conclude that "Zombies, Run!" featured the biggest variety of experiences.

4.2 Bridging the Gap Between Literature and Current Solutions

This section uses parts from the Research Topics report done by the researcher (Jarosinski, 2021).

In this section, the core findings from the literature review, as well as the analysis of contemporary physical activity apps will be discussed, in order to identify the current gap between literature and practice, and create a foundation for defining the problem space.

4.2.1 Literature Discussion

During the literature review, several key insights emerged from scientific authors in the field of goal setting theory and gamification. In this section, these core takeaways from the literature research will be discussed.

Goal Setting for Children

Based on research, goal setting has been shown to be a powerful tool for supporting behaviour change, with examples showing it working with children, and with regards to physical activity encouragement (Costa et al., 2017; Chase et al., 2018; Horne et al., 2009; Shilts et al., 2004). Shilts et al. (2004) have identified three goal properties which make a good goal: *difficulty*, *specificity*, and *proximity*. It was concluded that goals should be difficult but attainable (Locke & Latham, 1990, as cited in Shilts et al., 2004). Goal specificity was also found to consistently contribute to goal effectiveness (Bandura & Simon, 1977, as cited in Shilts et al., 2004; Locke & Latham, 2019; Locke et al., 1981). Proximal goals were found to be the most effective (Shilts et al., 2004), although distal goals may also be considered, but only if broken down (Latham & Locke, 2007, as cited in Locke & Latham, 2019). However, during research it was also found that collaborating with, or giving power to, the users, in this case children, could also be of great benefit when developing goals.

This could lead to many positives, such as increased motivation, but also more personalised goals which could be more easily achieved (Costa et al., 2017; Shilts et al., 2004; Vroland-Nordstrand et al., 2016). Based on this, it could be concluded that allowing children to customize their goals could be of great benefit. The author therefore suggests the addition of a fourth component to the qualities of a good goal, namely *customization*.

A combination of both learning and performance goals appeared to be the most beneficial approach, as this would both teach the children the necessary strategies and knowledge, but also have them implement it (Seijts & Latham, 2005). Finally, while literature did not clearly indicate if this was a superior option, group goal setting should be considered for this project as an option, as it could lead to superior results (Shilts et al., 2004).

Two additional but important components for effective goal setting, identified by Shilts et al. (2004), were *feedback* and *rewards*. Feedback, as explained by Locke and Latham (2019), is essential for goals, as it allows individuals to track their progress. The authors propose that goals and feedback work best together. Rewards, on the other hand, were also found to be of importance, and can be classified as either internal or external (Locke & Latham, 1990, as cited in Shilts et al., 2004). A number of different ways to set goals were found, however, none were identified as superior (Shilts et al., 2004). The types of goals which appeared to be fitting for this project were *self-set*, *participatory/collaborative* and *guided*. *Group-set* goals could also be considered.

An interesting topic with regards to goal setting, specifically for children, was that of the age group for which one is designing. Throughout this review, the age group of 12 to 14 was considered. Studies including younger and older children were also reviewed. An important factor which was discovered was to consider the diverse range of users, with very different perspectives, wants, and needs, which fall under this age group. Shilts et al. (2004), for example, stated that for children under the age of 12, group goal setting should be considered. This was further supported by Lytle and Achterberg (1995, as cited in Shilts et al., 2004), who highlighted that it is between the ages of 12 and 14 that children begin to understand more abstract concepts such as causality. While other research, such as that by Vroland-Nordstrand et al. (2016), suggests that much younger children can identify and set goals, these findings do indicate a topic worth investigating further, namely, whether the age group which was specified is too different.

Gamification

With regards to gamification, despite it being a slightly vague discipline (Nacke & Deterding, 2017), it showed great promise as a useful approach for this research. Due to the existence of a number of frameworks and guidelines for gamification, it is necessary to identify the experience which one wants to design for, and to select the appropriate game design elements. It can be said, however, that it is worth going beyond the trinity of game

elements, namely: *points*, *levels*, and *leaderboards* (Webach & Hunter, 2012, as cited in Nacke & Deterding, 2017). Three approaches in particular were considered to be of particular interest and promise. The first of these were the recommendations provided by Rapp (2017), which were grounded in experiences from the video game world, and supported by literature. Here, the author emphasised elements of games which made them lasting in the long-term, a feature of great significance, given the limitation of many gamified solutions not being effective after the novelty effect disappears (Farzan et al., 2008; Farzan et al., 2008; Hamari, 2013, as cited in Hamari et al., 2014). The second interesting tool was the PLEX framework introduced by Korhonen et al. (2009), which created a broad categorization of playful experiences which users may have while interacting with gamified designs. The third note-worthy approach was that by Nicholson (2015), which introduced the RECIPE approach of meaningful gamification elements. This included: *reflection*, *engagement*, *choice*, *information*, *play*, and *exposition*. *Reflection* and *information* were identified as being of particular importance for this project, as these qualities tie what is being done in the game to real life, something of significance when striving for behaviour change. *Choice* was also considered to be an element of significance, and supported the proposed customization-based approach to goal setting explained earlier.

An approach which was explored, with regards to enriching the gamified experience beyond points, levels, and leaderboards, was the inclusion of a character. Ten ways in which characters can provide value to the player were identified: (1) *utility*, (2) *investment*, (3) *communication*, (4) *memory*, (5) *enjoyment*, (6) *representation of relationships*, (7) *new experience*, (8) *creativity*, (9) *sociability*, and (10) *self-expression* (Livingston et al., 2014). It was found that through creating a character, with which the player identified, the imagined enjoyment of playing a game could also increase (Trepte et al., 2010, as cited in Birk et al., 2016). Identification, in itself, was found to be an important element, with three key types of identification being described: *wishful identification*, *similarity identification*, and *embodied identification*. All of the types were found to increase enjoyment, invested effort, positive affect, autonomy and immersion (Birk et al., 2016). This, in turn, can lead to an increased level of motivated behaviour. The type of identification should be chosen based on the type of experience which one is designing. Identification can be facilitated in different ways: *avatar customization*, *narrative element*, and *naming a character* (Birk et al., 2016). These elements should therefore be considered in the designing of the solution. Encouraging identification is of particular importance, due to its link to intrinsic motivation, with Birk et al. (2016) proposing that it can have a positive influence. Through identifying with their character, individuals may be willing to invest more time into a task, as well as effort, and may ultimately enjoy the experience more (Deci & Ryan, 2000, as cited in Birk et al., 2016). The concept of identification also has strong ties to the model provided by Rapp (2017), emphasizing the importance of identification and empathy. Furthermore, through its positive effect on intrinsic motivation, the creation of characters supports meaningful gamification,

as proposed by Nicholson (2015), and strays away from extrinsic motivation, based exclusively on elements such as points and rewards.

Additionally, with regards to gamification as a whole, Nacke and Deterding (2017) found that there is a need to systematically investigate the impact of gamification on various contexts, to develop the field further. This indicated that there is a promising research space for this project to contribute towards, through the implementation of a specific gamified approach, in the context of goal setting for children.

4.2.2 Discussion of Existing Apps

When reviewing contemporary physical activity applications, based on elements mentioned in scientific literature, several strengths, as well as weaknesses of the existing solutions were identified. Through this, potential areas to focus on in this project emerged.

Goal Setting

With regards to goal setting, and the three qualities of a good goal (Shilts et al., 2004), it was found that all of the analysed apps included goal *specificity* and *proximity*. Goal *difficulty* was hard to evaluate, as this was very dependent on the user. *Feedback* and *rewards* were also found in all of the apps. Performance goals were also present in all of the apps, while none of them implemented learning goals. What these findings indicate is that the core three components of good goals, alongside features such as feedback and reward, are essential in this type of app. While goal difficulty was not confirmed, it is something that should be pursued in the design of this solution. Performance goals appear to be a natural component, however, if possible, one should also try and add learning goals.

Gamification

With regards to gamification, the first framework which was used to evaluate the apps was the RECIPE model by Nicholson (2015). Here, it was found that while *engagement* and *choice* were present in all of the apps, none of them included *reflection*, and only one included *information*. Four out of five apps had both *play* and *exposition*. Based on the evaluation of existing apps, it was identified that none of them included opportunities for reflection, nor did the majority provide information supporting the in-app actions with implications for the real world. Both of these appear to be areas which need to be addressed in future designs. Particularly the missing aspect of information is interesting, as this appears to be supported by the lack of learning goals, identified earlier. Engagement, choice, play, and exposition were found to be quite common features, and appear to be a natural fit for an app like this.

With regards to Rapp's (2017) model of recommendations for gamified experiences, it was found that all of the apps featured *identification and empathy*, *freedom*, and *rewards*. *Past and future selves*, alongside *journey* were found in the majority of apps. The various social

components were not present in the apps, with only one except having *social presence* and *competition*. Through this analysis it was concluded that it is important to include identification, a way to track progress, rewards, freedom, and journey. It also highlighted the lack of social elements in similar apps, portraying a potential gap in the design space.

The third evaluation was performed using the PLEX framework of Korhonen et al. (2009). Through this, the various playful experiences that players could have in the apps were identified. The most common experiences were: *challenge*, *completion*, *control*, *discovery*, *exploration*, *fantasy*, *nurture*, and *sensation*. A notable lacking experience was that of *expression* as it can be an important component of identification.

Meaningful Gamification

During the process of finding the apps, a criticism of gamification was identified. Bogost (2014) made an argument that gamification can be, and frequently is, abused as a marketing tool, with individuals applying the same design onto every context. The author argued that this was due to the vague nature of the concept, which meant that people could apply it everywhere. This was confirmed when looking for existing apps online to evaluate. An enormous selection of nearly identical apps, all claiming to implement gamification for making exercise and physical activity, was found. Upon evaluating these results further, most of the designs were restricted to including very basic gamified features, indicating a lack of depth.

Based on these insights, the problem space could be defined in the following section.

4.3 Defining the Problem Space

This section uses parts from the Research Topics report done by the researcher (Jarosinski, 2021).

Children are exposed to increasingly high risks of obesity and physical inactivity (Takken & Jong, 2018; WHO, 2020). Gamification and goal setting appear to be good approaches to tackling this problem, however, apps which currently try to accomplish this goal fall short with regards to connecting to literature (Schoeppe et al., 2017). The investigation into literature, as well as exploration of existing apps, has shown that there is promise in combining the two methods into one cohesive solution, which can benefit the target group. This belief is emphasised by the parallels and links which the two approaches have in literature, with many projects overlapping, either explicitly or implicitly. In this section, the scope for the ideation will be defined.

With regards to goal setting, the four qualities that make a good goal should be implemented. These include: *difficulty*, *proximity*, *specificity*, and *customization*.

Performance goals will be implemented, with *learning goals* being a potential addition. Both *feedback* and *rewards* should be implemented, while keeping in mind that a focus on intrinsic motivation could be beneficial. A variety of goal setting methods may be considered: *self-set*, *participatory/collaborative*, *guided*, and *group-set*.

In terms of gamification, it is important to try and go beyond *points*, *levels* and *leaderboards*. A number of recommendations and suggestions are proposed by the frameworks of Nicholson (2015), Rapp (2017), and Korhonen et al. (2009). For this purpose, among others, the use of *characters* should be considered. With regards to characters, identification is of importance, which can be strengthened through customization.

Some prerequisites existed from the initial proposal for this project. One of these was the project being oriented around an app. Initially, this was limited to a mobile phone app, however, due to this project focusing more on the theory and concept, a computer app was also considered as a viable solution, particularly if it would make the design and evaluation easier. An additional prerequisite was the focus on children. The age group was not specified, however, the age group of 12-14 was ultimately decided upon.

In the next chapter, newly designed problem space was used to guide the ideation process.

5 IDEATE

5.1 Initial Ideas

During the ideation phase, the goal was to develop potential solutions that would address the identified gap between literature and current physical activity apps in the market, as discussed in Chapter 4. In order to do so, several methods of diverging the solution space were used, such as brainstorming and brainwriting. In this chapter, the steps taken to reach the final concept are described.

5.1.1 Exploratory Brainstorming

At the early stages of the ideation phase, exploratory brainstorming was deployed, to extrapolate findings from literature research regarding gamification and goal-setting theory, into the context of physical activity apps for children. This stage was done with little judgement of the quality of the ideas, but rather to generate several possible solutions that could inspire further thinking. The brainstorming was done primarily by the main researcher, and occurred over several sessions, with ideas being iterated and developed based on conversing with the project supervisors. The process of this brainstorming was to first identify various elements which could be considered or implemented within a potential solution, and to then write relevant ideas or solutions, based either on literature, additional research, or personal experiences of the researcher, related to these elements. These were then linked to the original element in a mind-map format. Therefore, through this brainstorming, a number of key considerations were identified, alongside possible solutions, approaches, and things to consider. The full depiction of the findings of this brainstorm can be seen in Appendix B, meanwhile a summary is presented in table 5. Here, the key elements are presented in italics, with the connected, most promising sub-ideas and solutions being mentioned afterwards.

Table 5

Table depicting ideas from the initial brainstorm.

Possible features	Goal Setting Theory	Gamification
Context of use - to be used during children's free time.	x	x
Types of physical activity - cover a broad range of types of activities.		x
Tracking - the solution would use different tracking methods to enable users to be free in the activities that they do.	x	x
Characters: <i>Archetypes</i> - children are able to choose a specific 'type' of character that they relate to (e.g. wizard, knight). Different classes would play different roles. <i>Customized characters</i> - allow users to customize their characters to their liking.		x
Group formation - allow children to form groups with others, either strangers met online, or friends.		x
Narrative - Incorporate rich narrative elements, encouraging children to be active while telling a story.		x
Learning goals - children are encouraged to set learning goals, alongside performance goals.	x	
Re-design goal-setting process - Children are guided through the goal-setting process in a creative way.	x	x
Skill tree - Children are encouraged to develop different aspects of their physical activity skills.	x	x

These early ideas inspired the concept for a physical activity app for children, explained in the next section. In this phase, the concept of using a skill tree was born. This is a popular game design element which allows players to track the in-game ability progression of their characters.

5.1.2 Concept 1 - Collaborative Goal Setting for Children

Based on the exploratory brainstorm, a concept for a fully fledged mobile app was imagined. The visualization of this concept can be seen in figure 2. This idea incorporated a number of aspects grounded in both gamification and goal setting theory, but also elements extracted from the prior brainstorm sessions. The core premise was to make childrens' goal-setting process for physical activity more engaging, integrating it into a game-like app.

The app would be oriented around a survival-genre game where players would team up with others to work towards developing their base. In order to do so, the players would have to gather resources. The teams would consist of different characters, capable of accomplishing different tasks and with access to different skills. In order to gather resources, the team members would have to go outside in real life and perform activities. For instance, players would have to visit specific locations to upgrade items, heal their characters, or craft new objects. Learning goals would be implemented and would unlock new locations. Reflection on progress would be encouraged through weekly summaries which would inform the users about their activity progress. Play and intrinsically motivated gamification, qualities encouraged in gamification-related literature, would be promoted through the implementation of a 'training grounds' feature, conceptualized by the researcher. This involved users selecting a real world location, and being able to perform any type of physical activity in that location. Being active within the specified location would translate to the character becoming stronger, which in turn could lead to benefits such as being able to gather more resources when doing so. Users would be able to track the progress of their characters using a skill tree. The app would be able to suggest various activities to the user, incorporating learning goals.

Gamification would be incorporated in this idea through the implementation of a large number of game-like elements such as: narrative, character types, teams, exploration, and survival. The narrative element is encouraged by several authors such as Hamari et al. (2014), Rapp (2017), and Nicholson (2015), as it may lead to increased motivation and attachment to the experience. The use of character types was based on the recommendations of Livingston et al. (2014) and Birk et al. (2016), who suggested benefits such as increased identification, motivation, and imagined enjoyment of interacting with a gamified experience. The team element was largely inspired by the recommendations of Rapp (2017), who highlighted the value of social presence, self-organization, cooperation and friendship, and competition in designing interactive gamified systems. Additionally, this element was supported by the idea of implementing group goal setting (Shilts et al., 2004), as well as on the experiences of the researcher, namely having played team-based games and acknowledging the various benefits of doing so, such as teamwork, a competitive drive, and others. The idea of exploration was inspired by the advice of Korhonen et al. (2009) who mentioned it as one of the potential experiences that an individual may have when interacting with a gamified design. The survival element was selected as the genre of the game, something which Hamari et al. (2014) highlighted as an important category of potential motivational affordances of gamified systems. Goal setting, on the other hand, would be implemented through the users being able to specify which activities they would want to perform. This would involve both performance and learning goals. Furthermore, collaborative goal setting would be integrated, allowing children to create goals for their teams.



Figure 2. Diagram depicting the idea visualization of Concept 1.

Although this concept was exciting, it became rather broad, and expanded beyond the scope of this project, with a large part of it revolving around game-design. Moreover, research showed that gamification is already a proven concept, and instead it may be more valuable, for the research space, to explore a specific implementation and relationship of gamification with another concept or feature (Nacke & Deterding, 2017). For this, a few key themes were identified based on the original idea, that felt novel and promising, to be expanded on further. These were the aspects of characters and character development, skill-trees, as well as a customized goal-setting progress. A new idea was then developed based on these concepts.

5.1.3 Concept 2 - Characters, Skill Trees, and Goals

Following the first concept, a new idea was generated. This idea was based on the implementation of gamification, characters and character customization, skill trees, and a customization-oriented approach to setting appropriate goals. In order to ideate on the new concept, a brainwriting session (e.g. Litcanu et al., 2015) was hosted together with another researcher in the field of interaction design. This method is an alternative to brainstorming, and is a group creativity technique where participants write down ideas, and pass them on to other participants, building upon each others' concepts, during a predetermined amount of time. It was selected due to it simulating the creative process, and being a rather efficient way to generate ideas (Litcanu et al., 2015). The goal of this session was to explore how the identified themes (gamification, characters, character customization, skill trees, and an innovative approach to goal setting) could be integrated into a novel design of a physical activity app for children, aged 12 to 14.

The brainwriting session was divided into four sections: (1) *User Experience (UX), Game Concept & Story*, (2) *Character Customization*, (3) *Skill Tree*, and (4) *Appropriate Goals*. Each of these sections aimed to explore an aspect of the new concept, generating new ideas, and building on existing ones. Each section will be briefly summarized, meanwhile a full depiction of the outcomes can be seen in Appendix C.

User Experience (UX), Game Concept & Story

The section of *UX, Game Concept & Story* covered a number of topics. With regards to *UX*, it was decided that the app should be child oriented, not very fitness-app-like, friendly, informative, and inspired by what was popular with children. The design in itself should be minimal and clean. With regards to the *game* aspect, one of the key takeaways was that characters should have strengths or abilities, which would benefit them in some way within the game. Through developing these skills and abilities, the character would experience various benefits, however, it was also highlighted that the player should feel as if they were also experiencing some advantages. This topic was then linked to the idea of a skill tree, which would depict the progress, with regards to skills and abilities, of the characters and players. The topic of goal rewards was expanded upon, with the idea of specific goals being rewarded with specific points. For instance, going to a sports store in real life could reward the character's intelligence points within the game. In more general terms, with regards to the game itself, the idea of it being a two dimensional adventure game was developed. It was also decided that the app should appeal to both genders, and that the game aspect should not take away from the physical activity. With regards to the *story*, different themes were considered. These included games of the following genres: role playing, fantasy, team-oriented, and battling monsters.

Character Customization

With regards to *Character Customization*, the first topic which was explored was the theme of the characters. Different options were considered, such as realistic depictions, cartoon-like characters, and automatically generated characters based on use photos. It was emphasized, however, that regardless of the type of character, they should provide value to the user. It was ultimately decided that the player should be able to customize their characters to their own liking, however, the question arose of whether or not they should be instructed on how to do this, with regards to the different ways in which a player may identify with a character (Birk et al., 2016). Wishful identification was explored as a solution, however, it was decided that perhaps this did not need to be made explicit to the user, and that rather, they should be able to decide in which way they wish to create their own character. The idea of personality customization was considered, inspired by Birk et al. (2016), in which players would be able to assign points to various personality traits of their characters. This would be done to encourage a deeper level of character customization, with the aim of developing a deeper identification. With regards to characters, two alternative concepts were developed. The first option was based on having character types, as described in Concept 1. These character types could already be linked to goals or specific skills which would be unique to them. The second approach was to allow users to customize their characters from scratch, with no prior categorization of their characters. This would involve implementing a fully customizable character where the user would be able to change things such as hair, skin color, facial features, body shape, and clothing.

Skill Tree

Several ways in which to integrate the skill tree concept into the application were considered, to allow users to see their progress, which could be reflected on their character. One concept was to also visualize future states of the character, as a way to both motivate and inspire the player. This could show users where they are now, and where they could be if they completed the goals, serving as a tool for reflection. The skill tree could also feature abilities which users would unlock upon reaching a certain threshold, with options such as unlockable aesthetics being considered as additional rewards. The concept of knowledge points was also developed as a means to encourage learning goals, and the obtaining of knowledge. Users would be able to complete reflection activities, answer questions, or find out about physical activities in order to obtain these points. An additional concept which was explored was that of rewarding users for the branch of the skill tree which they developed the most. For instance, if a user developed speed the most, they could receive golden shoes. With regards to the information which would be depicted within the skill tree, the chosen idea was to use high level categories such as: *speed*, *endurance*, *strength*, and *intelligence*. These would then be linked to relevant physical activities. The way in which points were obtained and distributed had two alternatives. The first of these was that every goal completion would allow the user to distribute their obtained points among the

branches, versus the second idea that the points obtained go only to the relevant branch of the skill tree.

Appropriate Goals

The final section was that of the *Appropriate Goals*. An idea was generated which suggested that users would be able to select what their character wanted to improve in, on a high level. For instance, a user could say “[Character] wants to become stronger”. Based on their choice, as well as skill level, a number of goals would be suggested to the user. The completion of these goals would contribute to the skill tree progress, with each activity category contributing to a different branch. With regards to the goals themselves, the various components of effective goal setting were considered. It was decided that short term and specific goals were implemented in existing solutions, meanwhile customized and difficult goals were not. Based on this, the idea was developed of involving children in the customization of their goals. However, it was also decided that the goals should not be completely up to the users, as they may not be capable of assigning good goals for themselves. It was therefore decided that semi-customizable goals should be implemented. This could be done in one of two ways, either through the child selecting a goal difficulty, or through entering a quantity, into a goal preset. Additional elements which were developed were: the idea of activities being goals, such as football, and that of the way in which goals are formulated. This presented two alternatives. The first suggested that goals were set for the characters, but completed by the users, using the character as a goal setting proxy, versus, the goals being set for the users themselves, with the character mimicking their progress.

Based on this brainwriting activity, and the concepts which were developed, the final concept was generated. This was described in the following section.

5.2 Final Concept: Active Quest

Based on the previous ideation, a number of potential features for an app were identified, and a final concept was developed. This concept was centered around several core features: *character creation*, a *skill tree*, and *goal setting*. The idea was to combine these elements into one design, presenting a potential solution for a gamified goal setting approach in the form of an app titled ‘Active Quest’. The narrative theme (Hamari et al., 2014; Nicholson, 2015) which was ideated for this game concept was that of it being set in a medieval world, with the character designs being based on knights, squires, and other related entities. This decision was made due to the theme being quite common among video games, making it more accessible to potential users, and making it easier to find appropriate assets which could be used to develop the prototype.

With regards to *character creation* (Birk et al., 2016), it was decided that this should follow an unrealistic theme, both due to aesthetic reasons, as well as technical simplicity. These characters should be freely customizable by the user, to their liking. No character types would be implemented, but rather, the user would be able to create their own character from the ground up. It was important that the user would identify with their character, however, no form of identification was to be forced upon them.

In terms of the *skill tree*, this should be implemented as a way to visualize feedback upon goal completion, and to allow users to track their own, and their character's, journey. Visualising progress is recognised as one of the main motivational affordances enabled by gamification (Hamari et al., 2014). Additionally, progression and feedback are essential for effective goal setting (Locke & Latham, 2019). Moreover, rewards can positively contribute to goal setting (Locke & Latham, 1990, as cited in Shilts et al., 2004). Completing relevant physical activities would reward the user with points being added to the corresponding branches of the skill tree. The amount of points would be determined by the goal difficulty.

Finally, with regards to *goal setting*, the concept would be centered around the goal components identified in research. Goals would be short term, specific, difficult yet attainable (Shilts et al., 2004), and customizable. The customization of the goals would be implemented through the users being able to answer questions about what they wished to accomplish, and the difficulty level which they would want to work with. It was of significance, however, that the users would be given a way to understand the difficulty of the goals, as too difficult and too easy goals may have detrimental consequences. The app would focus on performance goals, and only a specific branch of the skill tree, for the sake of keeping the test results comparable and more easily analysable.

The concept for the app flow which was developed began with the main menu, where the user would be introduced to the setting of the game. This would be followed by the character customization screen, where they would be able to tweak the appearance of their character to their liking. The user would then be introduced to the concept of the skill tree, showing some of the possible branches and activities. Following this, the goal setting would take place via a three-step process, inspired by the flow of Niess and Woźniak (2018), beginning with a high level goal, progressing onto a qualitative goal, and finishing with a quantitative, specific goal selection.

The final design was explained in detail in the following chapter.

6 PROTOTYPE

This chapter will explore the creation of the prototype, including technical details, as well as the final design, and summarized walkthrough. The decision was made not to build a full app, but rather, to focus on the core, research-based elements of the design, and the relationships between them, for the purpose of evaluation. Furthermore, while the ultimate goal would be to have this app accessible on smartphones, for the sake of prototyping and testing, a computer-based approach was selected. This would make both the process of developing the prototype, as well as sharing the prototype with test participants, easier.

6.1 Technical Process

The prototype was created using Unity³, a game development platform. This was chosen due to its relative ease of use, and the ability to seamlessly integrate interactive user interface elements. This was of particular importance since the design would use buttons as its primary interaction method. The prototype consisted of two Unity scenes, one for the main menu, one for the remaining interaction. The various buttons, overlays, explanatory texts, and pop-ups were animated using the 'Animation' window when necessary. Meanwhile, the appearing and disappearing of the various on-screen elements was programmed in a custom script, ensuring that when a button was pressed, the appropriate objects would disappear, and the correct objects would appear. An additional functionality was added to the prototype's buttons, making them unclickable until the on-screen speech bubbles disappeared. This was implemented to ensure that the participants would not simply skip through the interaction without reading any of the informative elements. The prototype primarily used custom made elements, however, the character creation asset was imported, as described in section 6.1.1, the background image was found online from a royalty free source⁴, and the running animation used to visualize the explanation was also taken from a website offering royalty free videos⁵.

After the prototype build (the functioning prototype) was exported, an installer file was created to simplify the installation process for the participants. This was done using Inno Setup⁶ and made it so that the players would be able to download one file, as compared to a folder with a number of files. It was of importance to make this process easy for the participants, as their level of technological know-how was unknown to the researcher.

³ <https://unity.com/>

⁴ <https://www.freepik.com/>

⁵ <https://www.pexels.com/>

⁶ <https://jrsoftware.org/isdl.php>

6.1.1 Character Creator 2D

The paid asset 'Character Creator 2D'⁷ was bought from the Unity Asset Store⁸ and used for the character creation functionality. Through buying the asset, the right to use it for both commercial and non-commercial projects was obtained. This included the right to modify the asset within Unity for the purposes of the project. This asset allowed for the creation of visually appealing, two-dimensional characters, with a large number of customization options, including: body part selection, body slider adjustments, clothing options, and color selection for practically every component. Additionally, the theme of the creator was fitting with the theme of the game, namely a medieval-like fantasy world. Furthermore, the asset came with a ready interface for the creation and customization of characters, meaning that the remainder of the prototype could be built around it, rather than starting from scratch.

The asset was modified in order to better suit the prototype, by removing elements which could overwhelm or confuse the participants interacting with the design (e.g. the ability to save and export characters, as well as character customization functionalities that were deemed unnecessary, as described in section 6.2). This modification was primarily executed by hiding unwanted Unity objects which were included in the example scene of the asset.

6.2 User Interaction Flow

In this section, the design flow of the prototype is described. A simplified flow of the interaction steps can be seen below in figure 3. In the following sections, the main components of the application are explained in greater detail. A full depiction of the flow can be found in Appendix D.

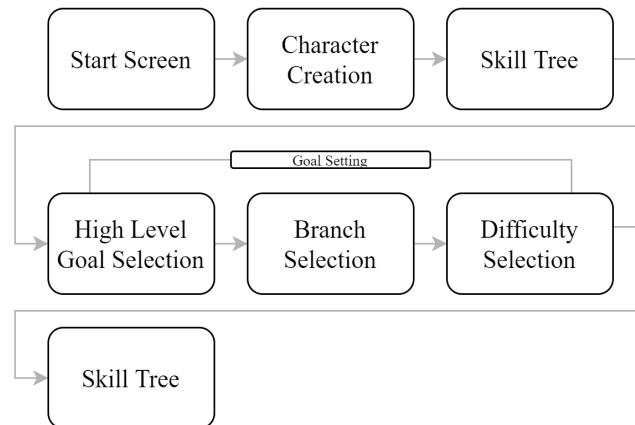


Figure 3. Diagram showing the flow of Active Quest.

⁷ <https://assetstore.unity.com/packages/2d/characters/character-creator-2d-111398>

⁸ <https://assetstore.unity.com/>

The chosen interaction flow was based on iterative development, based on discussions with the project supervisors, and the researcher's experience interacting with the work-in-progress versions of the prototype. It was decided that the start screen would introduce the app, providing participants with a brief explanation of what to expect. The step following this was the character creation. It was important for this to occur early on, as it was of significance that users understood the context of for who, and why, they were setting goals and trying to improve. Furthermore, by being introduced to, and creating a character early on, the benefits of the use of characters would come into play early on into the experience. Following this, the participant was introduced to the skill tree. It was important that users understood how this feature worked so that they would be able to better understand the goal setting process, and the impact of completing goals on the skill tree. This element was followed by a goal setting process divided into three steps, including: (1) *High Level Goal Selection*, (2) *Branch Selection*, and (3) *Difficulty Selection* (see further reading in 6.2.4). Finally, the last part of the app experience would be the user seeing the skill tree once again, this time seeing how the skill tree has changed based on the goal, and the goal difficulty, which the user has selected.

6.2.1 Start Screen

Upon starting the application, the user is welcomed by a starting screen (shown in figure 4), immediately placing them in a fantasy environment. A pop up was implemented to briefly introduce the context and narrative of the application, as well as the core concept behind the idea, namely creating a fantasy character, alongside whom the player would improve.

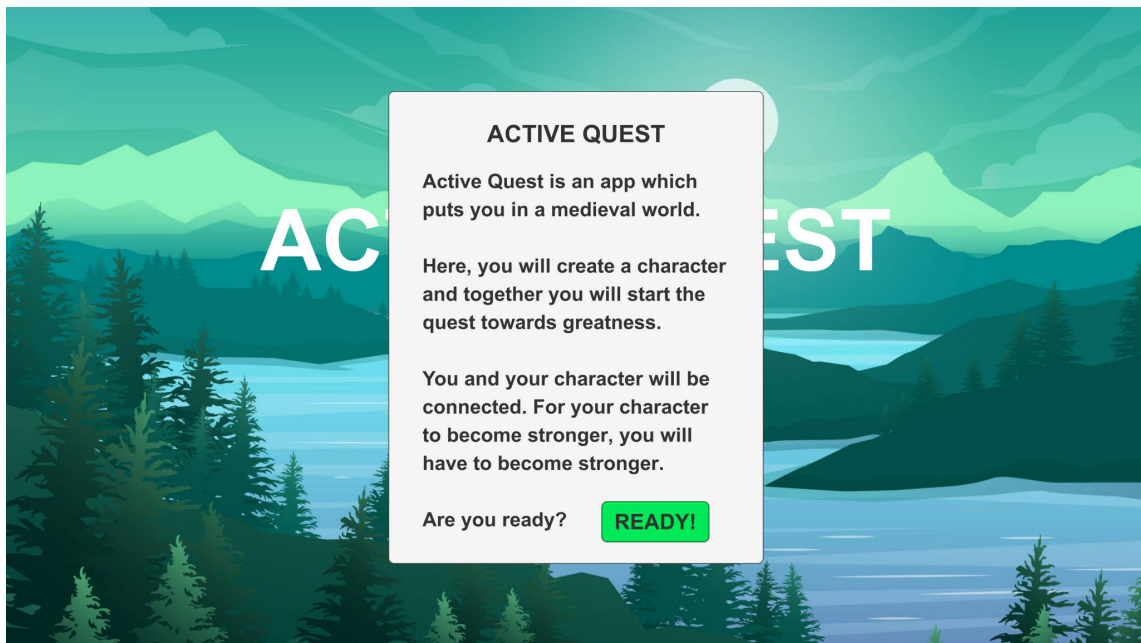


Figure 4. Screenshot showing the main menu of the prototype with an explanatory pop up.

6.2.2 Character Customization

Next, the user was introduced to the character creation screen (see figure 5). As found in the Background (Chapter 2), characters, and more specifically customized characters, can provide great value to users (Livingston et al., 2014). Therefore, the user was given a considerable amount of freedom to customize multiple parameters, including: hair, eyes, body shape, clothes, armor, and even emotions.

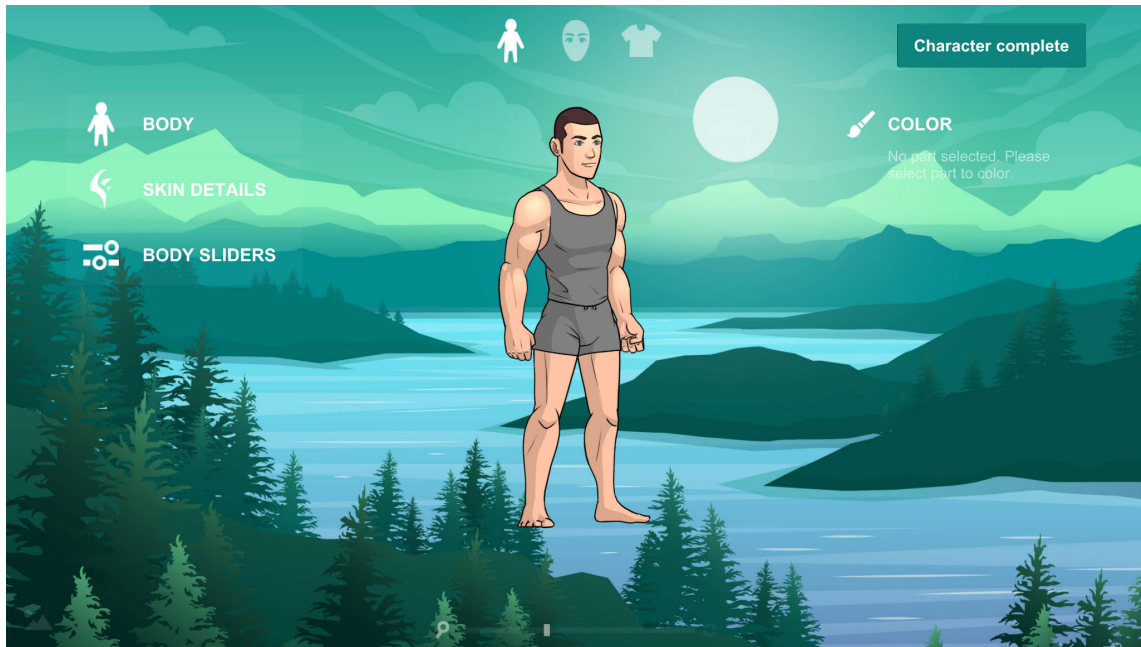


Figure 5. Screenshot showing the character customization part of the prototype.

This scene was created by using the Character Creator 2D asset described in the technical process section of this document. The top of the screen allowed the user to select which part they wished to focus on: body, head, or clothing respectively. The body customization screen allowed for the changing of the character's gender, skin color, skin details, such as tattoos, as well as their color, and the tweaking of body sliders. Body sliders allowed the user to change the size of various body parts, e.g. the length or width of the upper leg, or bicep. Through these customization options, users were able to create the character body that they wanted. Some changes were made to the default customization options provided by the Character Creator 2D asset however. One of these was limiting the range of the body sliders to prevent users from creating caricature-like characters with extreme characteristics, such as a very large body with a very small head. Another change made by the researcher was to remove the random functionality from the entire character customization screen. This would have allowed users to randomize any of the various elements which they could choose from. This was done in order to encourage participants to make more conscious design choices with regards to their characters.

The second screen was focused on head customization. Here the user was able to select from a broad range of hair styles, facial hair, eyebrows, eyes, nose types, mouths, and ears. For elements such as hair, facial hair, eyebrows, eyes, and mouth, the user was able to change the color.

The third screen was the clothing selection. Here, users could give their characters a helmet, upper armor, pants, skirts, gloves, boots, and capes. Each clothing option came with the capability of changing its colors. In many instances, up to three colors could be chosen per individual clothing item, affecting different parts of the clothing piece.

The original asset included a weapons selection screen as a fourth component of the character customization, however, it was deemed by the researcher that this was not highly relevant for the purposes of this prototype, and as such, it would be of more value for the users to focus on the remaining customization options. An additional reason behind this choice was that being able to choose weapons would suggest that fighting or combat would be a part of the app, which could impact the users' decisions.

6.2.3 Skill Tree

The next part of the design was the skill tree screen (see figure 6). This was added in order to provide users with a way to visualize and track their goal progress. The skill tree broke down a concept, such as mobility, into different components, encouraging the participant to work on all of them. In this screen, the user could still view their character, while also being introduced to the skill tree component of the prototype. The character informed the user, through text written in speech bubbles, that this was the skill tree, and that he or she would now explain it to them. The skill tree itself depicted the *mobility* skill of the character, with three branches coming out of it: *speed*, *distance*, and *stamina*. Each of these branches had a number of rectangles next to them, some grey, some white. White rectangles indicated how many points the character had in each branch, meanwhile grey rectangles indicated how many points the character could have. The *mobility* skill would not be the only skill that the character would be able to work on in the hypothetical app, however, for the sake of the prototype, it was decided that only this skill would be focused upon. This was done both for the sake of speeding up the development process, but also to make the analysis of the study participants' choices more comparable.

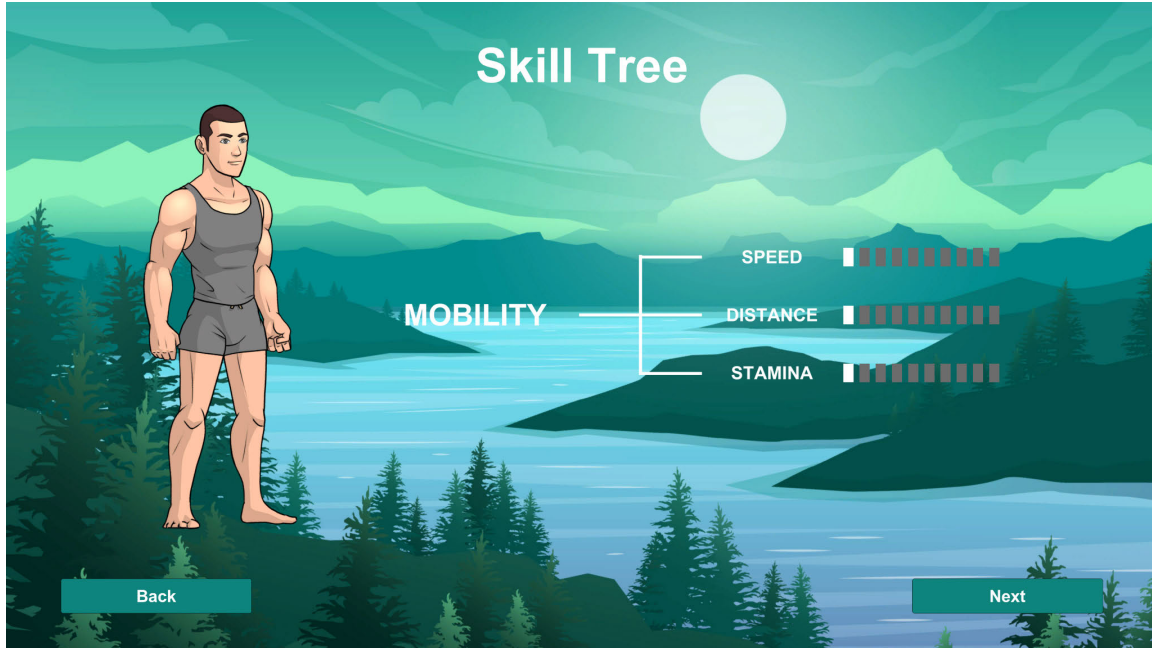


Figure 6. Screenshot showing the skill tree screen of the prototype.

In order to explain the concept of the skill tree, a pop up was implemented. This can be seen in figure 7. This pop up used text on the bottom of the screen, representing the speech bubble of the character. This explained to the user that the skill tree is used to represent progress in different abilities, and that through being active the user can make the character stronger. The wording of these explanations was chosen carefully to emphasize that this was the skill tree of both the character, and the user, highlighting the fact that it is representative of both of their progress. The text then explained that if, for instance, the user chose to work on speed, the skill tree would progress in that branch. A video of a person running was then shown in the pop up, showcasing to the user the completion of a goal. After the video, the text continued to explain that points would then appear in the skill tree in the appropriate branch, in this case speed. Several of the rectangles then changed color from grey to white to showcase the obtaining of points.

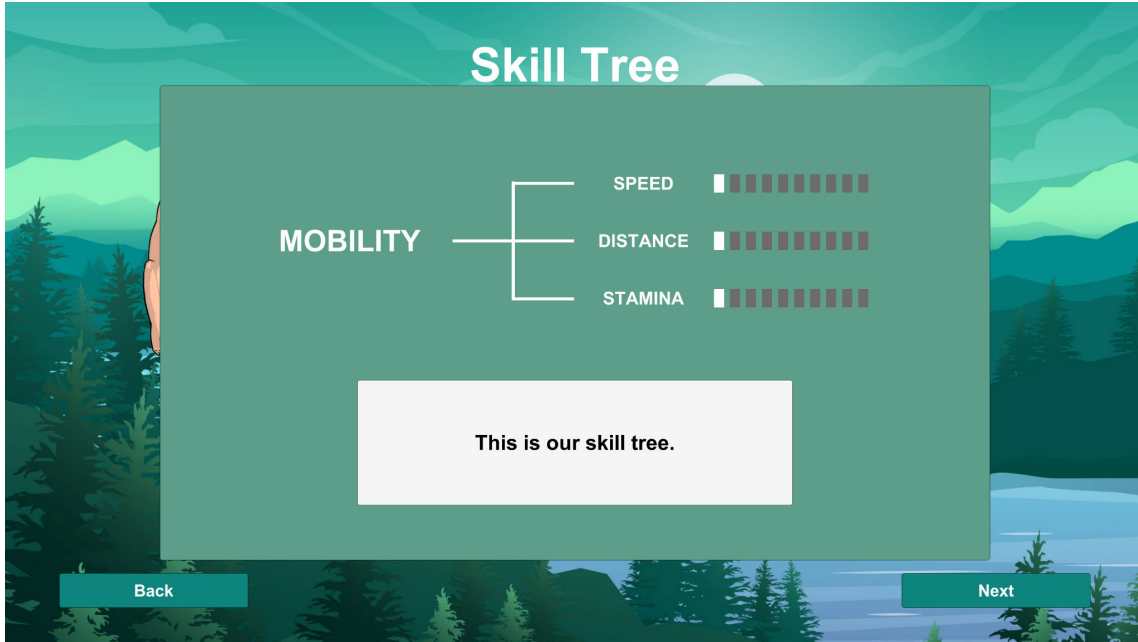


Figure 7. Screenshot showing the skill tree screen of the prototype with an explanatory pop up.

6.2.4 Goal Setting Process

The goal setting process was broken down into three elements: the *high level activity choice*, the *branch selection*, and the *difficulty selection*. This can be seen in figure 8. This flow was inspired by that of Niess and Woźniak (2018), following the structure of high level, qualitative, and quantitative goal selection. The aim of this approach was to encourage goal customization, something which was identified as a core requirement for childrens’ goal setting (Costa et al., 2017; Shilts et al., 2004; Vroland-Nordstrand et al., 2016), as well as thoughtful goal setting, through breaking the process down into segments. Furthermore, additional information was presented to the users, in the form of depicting the contributions of each goal, both to the user and the character, as well as the goal difficulty.

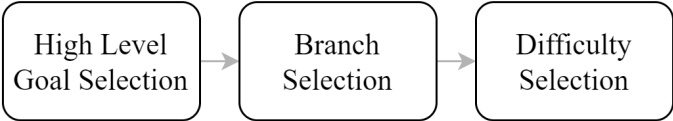


Figure 8. Diagram depicting the three-part goal setting process.

The first goal setting component was the *high level goal selection*. The concept of this part was to encourage the user to consider which activity they would enjoy working on, or which activity they feel like they need to work on the most. For the sake of the prototype, the three activities were: *walking*, *running*, and *biking*. These were selected for the sake of keeping the prototype simple, and limiting the options to quite common activities, to ensure that

participants during the study would be able to relate to at least one of the activity types. The character explained to the user that they should think about how they want to develop the mobility skill. The character encouraged the user to consider which of the activities they enjoy, or alternatively, which ones would they like to improve in. The user was then able to select one of the activity types. This screen can be seen in figure 9.

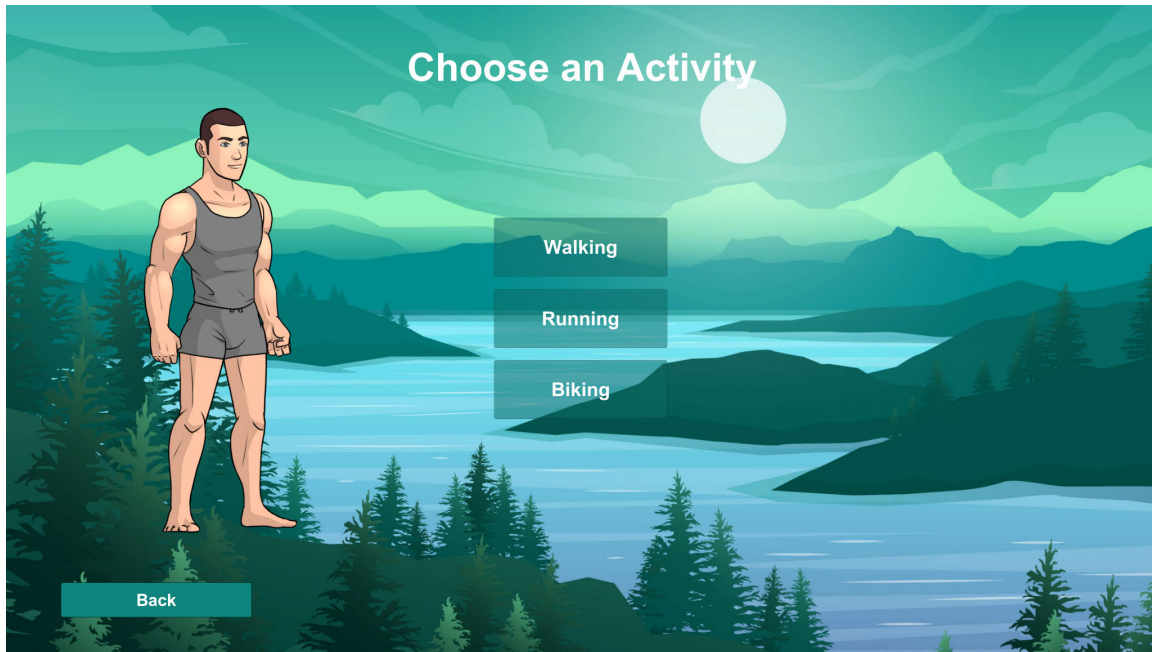


Figure 9. Screenshot showing the high level activity selection screen of the prototype.

The next component of the goal setting process was the *branch selection* screen. This can be seen in Figure 10. This was inspired by the second section of the model proposed by Niess and Woźniak (2018), namely the qualitative goal. Here, the user was encouraged to consider how they wished to improve with regards to the specific activity which they chose. The options included wanting to walk/run/bike: *faster*, *longer*, and *more often*. These selections contributed to the *speed*, *distance*, and *stamina* branches of the skill tree respectively. During this stage the character explained to the user that it was time to decide how they would like to improve in the chosen activity type. The name of the corresponding skill tree branch was included on the right of each option, to make it easier for the user to understand what the selected option would contribute to.

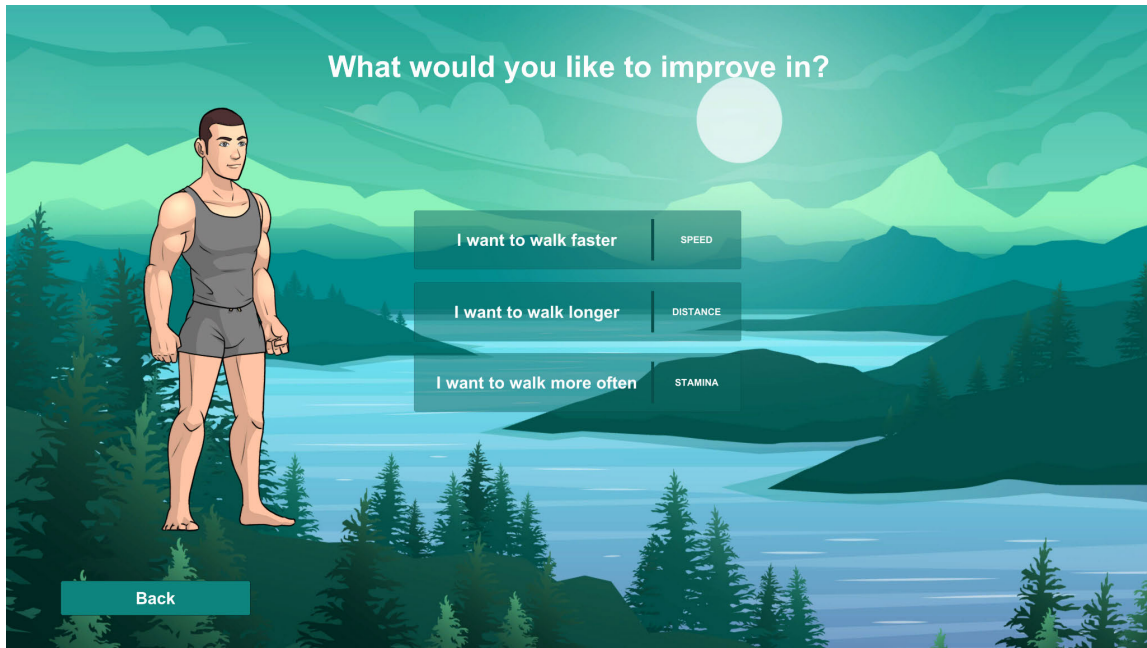


Figure 10. Screenshot showing the branch selection screen of the prototype.

The third and final segment of the goal setting process was the *difficulty selection* screen. Here, the user could select from a list of three specific goals, varying in difficulty. This section was inspired by the quantitative goal component of the model proposed by Niess and Woźniak (2018). Having selected the high level activity, the qualitative goal, it was now time for the user to select a specific, quantitative goal. This would make the goal specific, fulfilling one of the core four components of good goal setting practices. The reason for implementing difficulties, as compared to one goal, was to allow the user to choose a goal which better matched them personally. Furthermore, through incorporating difficulties, the idea was to encourage users to reflect on goal difficulties by considering the fact that difficult goals were more challenging, but also more rewarding, meanwhile easy goals were less rewarding, but also less challenging. Each goal included a title stating what difficulty it was, how many points the skill tree would develop upon goal completion, and the level of fatigue which would be caused by completing the goal. The fatigue indication was added as a means to encourage the user to reflect on how challenging the goal would be for them to complete in real life, to support further reflection during goal setting.

The various goal difficulties changed depending on the type of activity, and the branch which was selected. An example of the goals which were proposed to the users who chose biking can be seen in table 6. For the other activity types, the values were adjusted, however the formulation and goals remind the same. The values used for the goal difficulty were based on assumptions of the researcher, based on the speeds and distances that an adult is capable of, adjusted to be easier due to the child target audience. It was decided that basing these values on assumptions which were at least somewhat representative of

what would be easy, medium, and hard for children, would be enough for the purposes of the user test which would be performed as a part of this project. If the solution was to be fully developed, a benchmarking process would most likely have to be implemented in order to adjust the goal difficulty towards individual children.

Table 6

Table showing the possible goals for a user that selected biking as their activity.

	Easy	Medium	Hard
Speed	I will bike 3km in 22 minutes	I will bike 3km in 17 minutes	I will bike 3km in 13 minutes
Distance	I will bike for 10 minutes	I will bike for 20 minutes	I will bike for 30 minutes
Stamina	I will bike 1 time this week	I will bike 2 times this week	I will bike 3 times this week

On this screen (shown in figure 11) the character explained to the user that it was time to pick a goal, and that each difficulty would affect both them and the user differently. The character explained the three difficulties and that each goal also showed the amount of points which would be gained for the corresponding branch of the skill tree. The easy goal would give one point, the medium would give two, and the hard would give three. These values were chosen to encourage the completion of more difficult goals, by rewarding them with more points, while still making the easier goals worthwhile. It was of significance not to pressure children into completing goals which they were not capable of, simply to obtain more points. Finally, the character explained that each goal also had a depicted fatigue level, which showed how tired the user could expect to be, upon completing the goal. The character emphasized that choosing a difficult goal would be the most rewarding, however it would also be the most challenging to complete. The user was therefore encouraged by the character to consider if they prefer an easy goal with less points, or a difficult one with more points.

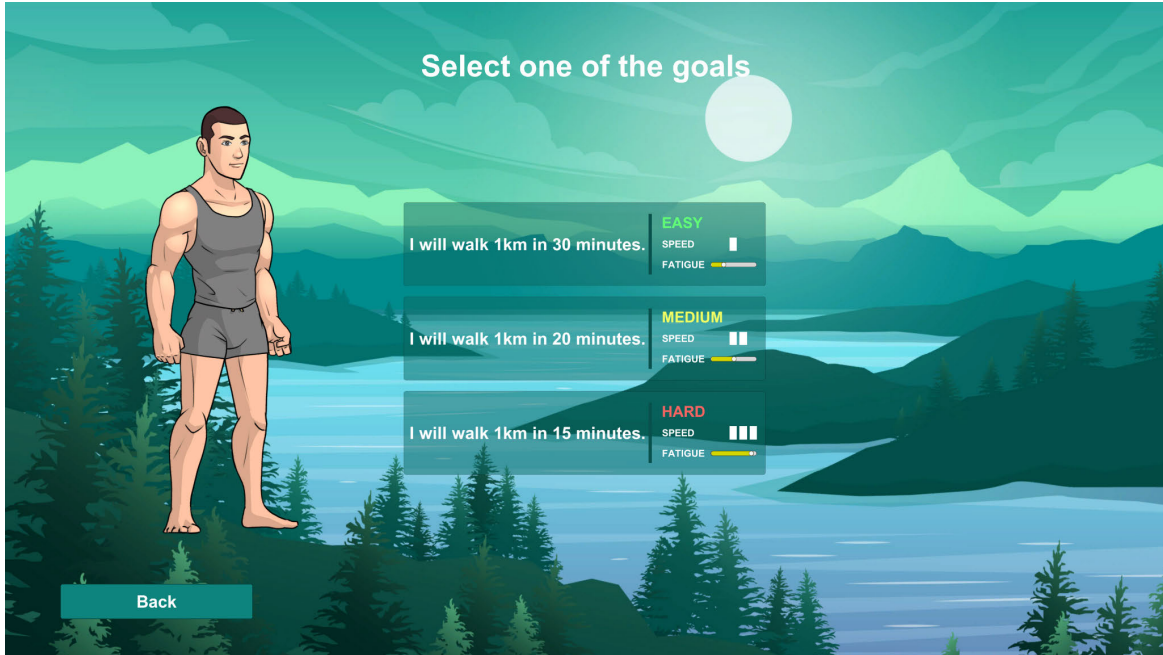


Figure 11. Screenshot showing the difficulty choosing screen of the prototype.

6.2.5 Goal Completion

Upon selecting a goal, the user was told by the character that for the sake of the study they would not need to complete the goal, and that instead, the goal completion would be simulated. The screen then faded to black, showing a text saying “The goal is being completed...”. Following this, the character reappeared, and explained to the user that it was time to take a look at the skill tree again. This can be seen in figure 12. Here the user was able to see that they have received points in the branch which they selected during the goal process. The number of points gained depended on the chosen difficulty. The idea of this section was to allow the user to, at least to some degree, experience what it would be like to complete a goal, and what this would mean for their character. With the skill tree being shown to the user for the second time, the character explained that, based on their goal selection, the skill tree has developed in the appropriate branch. The user is then congratulated by the character, and can press next. The screen then fades to black, telling the user that it was now time to answer some questions. This concluded the prototype interaction, and introduced the question phase of the test.

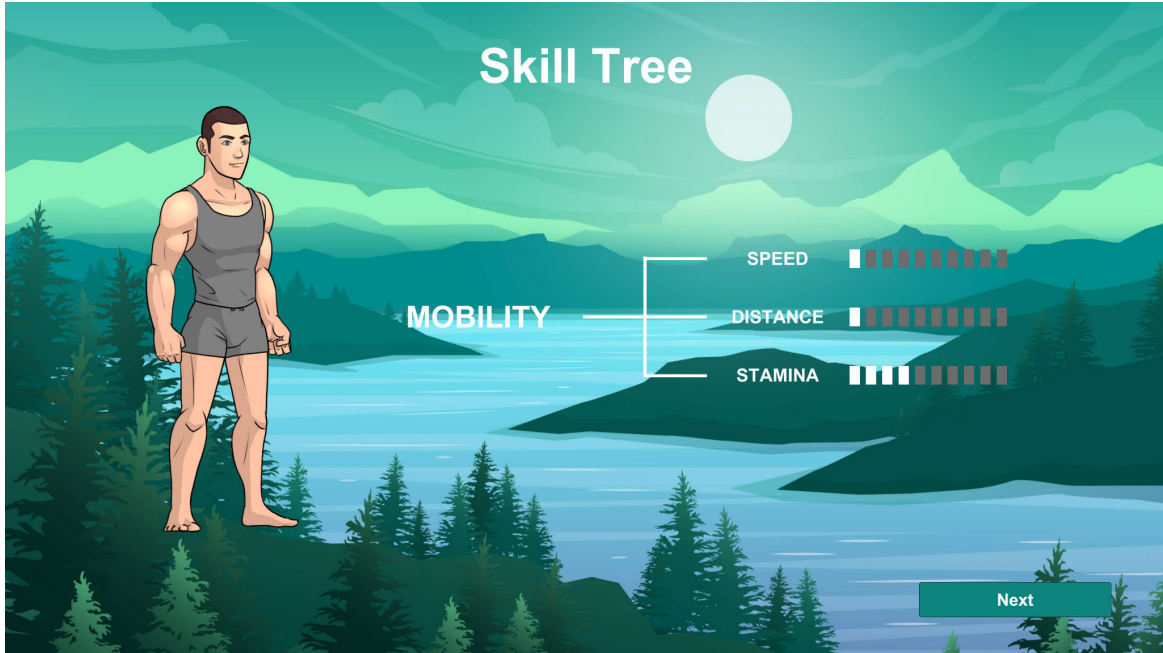


Figure 12. Screenshot showing the skill tree screen following the goal completion simulation.

6.3 Conclusion

In conclusion, through an iterative process of working on the prototype and receiving feedback from the researchers' supervisors and fellow designers, a prototype was designed and created, implementing the final concept, described in section 5.2. This prototype was then ready to be tested with participants belonging to the target group, namely children aged 12 to 14. This testing procedure was explained in the following chapter.

7 TEST

Following the development of the digital prototype which aimed to improve the goal setting process for children, by leveraging gamification (as described in Chapter 6), a user test was planned and conducted, together with members of the target group. The study involved users interacting with a prototype of the design, and answering semi-structured interview questions about it. This chapter describes the goal of the study (7.1), the applied method (7.2), the procedure (7.3), and the results (7.4).

7.1 Study Goal

The primary goal of the study was to obtain an understanding of the opinions, thoughts, and reflections of the target user group, namely children aged 12-14, surrounding the proposed design. Through this, the aim was to explore the way children perceived the character and character creation component, the skill tree, the goal setting process, and the overall app concept. These findings could then be compared and connected to the literature which was investigated in the background research of this project.

A number of research questions was created for the study, which fell under 6 different categories: (1) *understanding children's goal setting practices*, (2) *characters & character customization*, (3) *skill tree*, (4) *goal setting process*, (5) *link between character and goals*, and (6) *prototype evaluation & usability*.

The purpose of the questions in the *understanding children's goal setting practices* category was to see how children approach goal setting currently, and to find out in what ways they are active. The research questions which were addressed in this section were:

1-A: How do children currently approach goal setting?

1-B: Do children have experience with activity-oriented apps and games?

The *characters & character customization* category was to explore how children felt about the character customization feature, and to investigate the influence of customization on the connection between the player and their character. The research questions which were therefore addressed were:

2-A: What is the influence of customization on connecting with a character?

2-B: How do children feel about the character customization feature?

The third category considered the *skill tree*. Here, the aim was to explore how the skill impacted the goal setting process, and the way in which children interpreted the skill tree element. The questions which were addressed in this category were:

3-A: How does the skill tree influence the goal setting process?

3-B: How do children interpret the skill tree element, with regards to goal setting?

The next category focused on the *goal setting process*. Here, the aim was to find out what children thought about this approach towards goal setting, and to investigate the reasoning behind the decisions which they made during the process. The questions which were investigated were:

4-A: What do children think about this approach towards goal setting?

4-B: What are the reasons behind the choices of the children during the goal setting process?

The aim of the fifth category, the *link between character and goals*, was to find out the way in which children perceived their relationship with the character, and to see in what way the character influenced the goal setting process. The questions which were asked were:

5-A: How do children interpret their relationship with the character?

5-B: What is the influence of the character on the goal setting process?

The last category of questions was focused on *prototype evaluation & usability*. The aim was to explore the general thoughts that children had about the proposed system, find out what they liked, and what they did not like. The question which was investigated was:

6-A: What did the children think of the prototype?

7.2 Method

The format which was chosen for the study was that of an evaluation test, where the participants were asked to interact with the prototype, and questions were asked via a semi-structured interview. During the interaction users were asked to follow a think aloud protocol. However, due to the target group consisting of children aged 12 to 14, a slight variation to this protocol was implemented, with the researcher responding in a neutral manner to the statements of the participants, as children (particularly younger children) may struggle with the concept of talking to no one, and such an approach is recommended (Barendregt & Bekker, 2003). The semi-structured interview was chosen as the data collection method primarily due to it allowing for the use of follow-up questions (Baxter et

al., 2015) if something remained unclear to the participants, or if something interesting was brought up during the reply. The complete protocol for the session, including the list of questions which guided the semi-structured interview, can be found in Appendix E.

7.2.1 Participants

The requirements for recruiting participants were that the users were between 12-14 years of age, were able to communicate in English, and had access to a Windows computer, as that was the operating software for which the prototype was designed.

Due to the exploratory nature of the study, with the focus being placed on obtaining feedback and initial input from users based on a short-term study, the number of required participants was limited. The initial goal was to recruit six to ten participants, however, the final study was done with five participants. The participants were recruited through social connections of the primary researcher. This was deemed as the suitable approach due to the relatively low number of participants required. The participants were first shown a pamphlet, briefly explaining the goal of the overall project, and the study itself. This can be seen in figure 13.



Figure 13. Image showing the pamphlet which was shared with participants in order to give them an initial understanding of the project and study.

The five participants which were recruited were all male, three of which were 14 years old, one of which was 13, and one participant was 12 years old. All of the participants spoke English, with one participant having a family member present during the session as an entity in the video call, in case of any language barriers.

7.2.2 Materials

The sessions were held individually, and online. The online aspect was partly due to the ongoing COVID-19 pandemic, which made face-to-face interaction more difficult, but also due to the fact that it allowed for the broadening of the search for participants to ones who may be in other cities, or even countries. Each session took approximately one hour, and was executed using video calling software. The software which was selected for this purpose was Google Meet, due to it not requiring the user to download a new software, its recording capabilities, and its ease of use. It was also of importance that the users could share their screens, as to allow for the researcher to observe what they are doing. Prior to each session, the participants were sent the required installation files for the prototype, and were asked to install them onto their computers. Assistance was offered both for the installation as well as the uninstallation process.

During the study sessions, the participants were asked to have their video cameras on, and to share their screens so that the researcher could observe their interactions with the prototype. These recordings included the audio of the session, the videos of the participants, and their screens.

7.2.3 Ethics and Consent

Prior to performing the study, it was of importance to ensure that the study met the ethical requirements which one must consider. This was of particular importance for this project due to the fact that the target group consisted of children, who not only may be more vulnerable to any ethical challenges, but also cannot fully consent to participating in a study. Due to this, an ethical form was submitted to the Ethics Committee at the University of Twente in order to evaluate the ethics-related decisions which were made - the reference number which was given for this project was RP 2021-207. Furthermore, a detailed information brochure, as well as a consent form, was shared with the participants and their legal representatives. The consent forms were to be signed by the representatives, but also by the participants themselves.

Following the guidelines provided by the Ethics Committee of the University of Twente, appropriate measures were taken with regards to processing the personal data of participants. The research, and the ways in which personal data would be collected and processed, were registered using the university's platform⁹.

⁹ <https://www.utwente.nl/privacy/>

7.2.4 Pilot Test

Having a functioning prototype and the first draft of the protocol, a pilot test was carried out in order to evaluate any obvious faults in the design which could negatively affect the test, but also to try the questions in practice, in order to see if they cover the desired topics, and lead to fruitful results. This pilot test was performed with an adult design researcher, to obtain feedback. The results of this pilot test led to the addition of new questions in the protocol, and the tweaking of some elements in the prototype.

7.2.5 Analysis

Following the tests, the data which was obtained was in the form of interview transcripts from the sessions, alongside video recording of the users' interactions. In order to process this data, affinity diagramming was implemented, as recommended by Baxter et al. (2015). The authors suggest this method for analysing semi-structured interview data, and explain that it is focused on grouping similar findings together to identify themes and trends in the data. The process which was followed in order to analyse the data will be explained below.

The first step of the analysis process was to transcribe the five sessions into text documents. A verbatim transcript approach (Baxter et al., 2015) was chosen. This step was followed by the researcher reading through the transcripts, and annotating significant takeaways and pieces of information from the participant responses. These points were summarized into smaller, more easily processable statements. The wording of these summaries remained similar to the wording of the participants.

The summarized points were transferred to an online platform, Mural¹⁰, which allows for the use of virtual sticky-note-like tools. Each research insight received its own sticky note, as suggested by Baxter et al. (2015), and the sticky-notes were color coded between the different participants. This was done in order to be able to distinguish between the participants after the notes were mixed together, and sorted into themes, allowing for the researcher to see how many participants contributed towards the individual themes. Following this, the notes were grouped based on the emerging themes. This resulted in the creation of 25 higher level themes. Having done this, the notes within the higher level themes, such as the theme "General app positives", were divided into smaller subcategories, such as "The app is motivating", which contained all the notes from within the "General app positives", which matched the sub-theme. A total of 71 sub-themes were identified. The researcher then looked through all of the categories, ensuring that no note was out of place, while at the same time removing some duplicates of the same point being made by the same participant.

¹⁰ <https://www.mural.co/>

Having divided the key findings into categories and subcategories, the research questions of the study were placed within the digital work environment, and the categories, including the notes, were placed underneath the question which they answered. The resulting affinity diagram, split into multiple parts due to visual size constraints, can be seen in Appendix F.

7.3 Procedure

Five participants took part in the study, with each session taking approximately 45 minutes. Each session began with a brief introduction, during which the researcher introduced himself, participants were informed about the context of the study, the value of their input, and the session itself. Children were told that the purpose of the session was to test an early version of an activity app for children, and that they would interact with a prototype of the app, and then answer some questions about it, and their activity related behaviours. The participant was then told that the recording would begin. Following this, the participants were once again asked about their willingness to participate in the study. Lastly, the think aloud protocol was introduced and explained to the participants. This was expanded upon, with the researcher informing the children that nothing they say could be wrong, as both positive and negative feedback would be of great use.

Following the introduction, the first part of the semi-structured interview took place. Here, the goal was to obtain an understanding of childrens' current practices in goal setting. Children were asked about whether or not they do any sports, and if they have any goals for these activities. Following this, the children were asked about the way in which they would approach a hypothetical goal for said activity, provided by the researcher, to see how they would approach goals prior to interacting with the system. The participants were also asked about any apps or games that they may use, or have used, which require physical activity.

The next section of the study introduced the game, Active Quest. Participants were told that it is set in a medieval world, and is centered around creating a character, and then trying to make them stronger through being active themselves. Children were also told that the app also aims to help them set goals for themselves. The participants were then asked to share their screens and to open the app on their computer. They were then told that from then on they could interact with the prototype as they wished, that the character would tell them what to do, and that they could ask the researcher, if they had any questions.

The following step had participants interacting with the prototype. They were told that the first step would involve creating a character, and that they could spend up to 15 minutes on this process. This time limit was inspired by Birk et al. (2016), where the designers gave their participants a minimum amount of time to create their character. For the sake of this study however, a time limit, rather than a time minimum was implemented. This time limit was enforced by the researcher and was not a part of the prototype design. Beyond this

point, the users interacted with the app, until they reached the final screen. They were then told to leave that screen on, and that it was time for some questions.

Following the interaction, the main part of the semi-structured interview (questions can be found in Appendix E) took place. This was divided into five different sections. The first section asked the participants about the character creation. They were asked about their thoughts on the process, and about the decisions they made surrounding the character creation. The children were then asked to click on the on-screen text, which revealed a hidden evaluation screen which featured sliders. These were used by the participants to provide further information about their thoughts on the characters and the creation process. Following this, the participants were asked to explain their slider decisions.

The next section was focused on the skill tree. Participants began by pressing the 'next' button to reveal the skill tree on their screen. They were then asked about their interpretation of the skill tree, and the impact that the skill tree had on them.

The third section targeted the goal setting process. Participants were once again asked to press 'next', opening a screen which displayed screenshots of the three stages of the goal setting process. They were then asked to explain their choice at every stage. The children were then asked to explain if they liked this way of setting goals. Next, the children opened the following screen, revealing more sliders for them to use to evaluate the goal setting. This explored topics such as goal difficulty, but also whether they thought about themselves or the character more while setting goals. They were once again asked to explain their choices and provide additional insights regarding the goal setting.

The fourth section was brief, and asked children to think back to the scenario which was presented at the start regarding their own activity and setting goals for themselves. They were asked to consider if they would set goals differently having experienced the app.

The last section was focused on the prototype usability evaluation, asking children to share their thoughts about the app in general. Among other things, the researcher asked about whether or not the children would show this app to their friends, and about the childrens' thoughts on missing or confusing features.

The sessions ended with a debriefing of the participants. It was explained how the speed of progress within the game is not representative of the speed of progress in real life, as that is slower, and that it takes consistent goal setting and execution to observe results. Additionally, it was explained that the tips given during the interaction with the prototype should not be taken as actual advice, as that was not the main aspect of this study. The participants were then thanked for their participation, and asked if they had any remaining comments or questions.

7.4 Findings

As stated in the previous section, the affinity diagram (as depicted in Appendix F) was divided into different parts, based on the research questions which the study aimed to investigate. These questions fell under different categories: (1) *understanding children's goal setting practices*, (2) *characters & character customization*, (3) *skill tree*, (4) *goal setting process*, (5) *link between character and goals*, and (6) *prototype evaluation & usability*. This section will describe the findings of the study through answering the research questions based on the findings, divided by the aforementioned categories.

7.4.1 Understanding Childrens' Goal Setting Practices

This category investigated children's current goal setting practices, and aimed to answer the research questions 1-A and 1-B.

1-A: How do children currently approach goal setting?

When asked about the types of activity that the participants partake in, all of the participants described participating in at least one physical activity. The activities were: karate, football, basketball, badminton, and boxing. It was found that all of the children understood the concept of a goal enough to be able to answer when asked if they had any with regards to their activity. The ways that the children would set goals for themselves with regards to these activities included: simply practicing more often, looking for guides online, and analysing one's mistakes to see how they can improve.

1-B: Do children have experience with activity-oriented apps and games?

With regards to experience with other activity-oriented apps or games, three out of five participants stated that they had such experience. These other apps and games included virtual reality, the Wii console, and Pokemon GO. All of the mentioned apps or games were gamified ways of motivating physical activity.

7.4.2 Characters & Character Customization

The focus of this category was to explore the thoughts of children about the character and character customization, answering research questions 2-A and 2-B.

2-A: What is the influence of customization on connecting with a character?

With regards to the influence of customization on the connection with the character, five, overlapping main themes were found: (1) *I connected to my character through customization*, (2) *I care about my character*, (3) *the character is a reflection of me*, (4) *I need to care to improve*, and (5) *I connect to characters in games*. It was found that a majority of participants felt connected to their characters through being able to customize them. Children expressed that through creating a character you connect with it, you feel bonded,

and that the character becomes unique and your own. The children also highlighted that this connection made them feel attached to the game, with P1 saying that when you make a character “*you kinda get attached to the character, you want the character to improve, and you want yourself to improve*”. The connection with the character was emphasised by opinions such as the character being a reflection of the child in the game, “*I’m them in the game universe, and being me is kind of cool*” (P5). Children stated that they liked their character, with one going as far as to say that “*I think you have to care about the character if you want to push a skill*”, emphasising the importance of the connection between the player and the character. The reason for why children customized their character in a certain way was either (1) *being inspired by something* (e.g. a game character or real life person), or (2) *for aesthetic reasons* (e.g. colors, design, or character traits).

2-B: How do children feel about the character customization feature?

In terms of the evaluation of the customization feature, it was very well received by all five participants. One participant, P4, stated that “*This is the best character creation that I’ve seen in any game*”. Furthermore, four out of five participants stated that creating the character was the most memorable part of the app. Five themes emerged from the various elements that the children liked about the character customization, being (1) *I like the amount of customization options*, (2) *I like the visual design*, and (3) *I like the color options*. Moreover, one participant liked that the design of the character gave an indication of the narrative of the game, as well as its aesthetic, while another liked making the character as a creative activity. Only a few negative points of feedback were raised, mainly pointing out the limitations of the customization features such as some visual errors, the character looking too old, and asking for some more fantasy clothing options.

7.4.3 Skill Tree

The skill tree was an important part of the app, visualising the progress of both the character and the player. It was therefore of importance to understand both the influence of the skill tree on the goals that the participants set, as well as the participants actual understanding of this design element. These topics were addressed through research question 3-A and 3-B.

3-A: How does the skill tree influence the goal setting process?

With regards to the impact of the skill tree, four main themes were identified: (1) *Seeing progress is rewarding*, (2) *the skill tree impacts decision making*, (3) *it encourages setting follow-up goals*, and (4) *wanting to fill all branches*. All five of the participants stated that seeing progress on the skill tree felt good, and made them feel as if they achieved something. Children stated that what contributed to this feeling was the awareness that they developed a real-life skill, and that seeing the progress would motivate them to keep improving. Four of the five children stated that the skill tree had, or would have, an impact

on the decisions which they made, or would make, with regards to their goals. What contributed to this impact was the fact that children wanted to fill all the branches of the skill tree, with three of them saying that if a branch was falling behind, or if there was only one branch missing, they would feel motivated to fill it as well. This meant that children felt that if one of the branches was falling behind, representing a category of goals, they would feel motivated to work on it, and thereby develop in that goal category. Lastly, two of the participants also explained that the skill tree filling up as they progress would push them to set new and harder goals to keep progressing. This was due to them wanting to improve both themselves and their characters, but also to complete the skill tree, and feel accomplished for doing so.

3-B: How do children interpret the skill tree element, with regards to goal setting?

All of the participants demonstrated a clear comprehension of the purpose behind the skill tree feature, whether they had previous experiences with skill trees or not. Three primary themes were identified within the answers of the children: (1) *I have experience / understanding of the skill tree*, (2) *the tree represents my progress*, and (3) *the tree represents my character's progress*. Moreover, although some children had seen skill trees before, they stated that they have not seen one where they have to move and be active themselves. The participants shared an understanding of the skill tree depicting their progress: by playing the game, they would 'fill up' the branches, and the amount that is 'filled up' is affected by the goal difficulty. The participants found this to be a good way to track how you are improving, and to monitor their progress in individual skills as they would progress through the game. While understanding that the tree is a way to monitor their own progress, the children also understood that it represents the progress of their characters. Participants explained that it is a way to track their character's experience, their level, and their skills. According to one participant, filling the skill tree was the goal of the game, and two participants explained that if you play the game often, you will progress faster.

7.4.4 Goal Setting Process

This category explored the opinions of the participants on the goal setting process implemented in the app. Two research questions were addressed, namely 4-A and 4-B.

4-A: What do children think about this approach towards goal setting?

With regards to the children's thoughts about the goal setting process, three main feedback categories were identified. These included the pros of the approach, areas for improvement, and the users' feelings regarding goal completion. Within the pros, five themes were found: (1) *it makes goal setting easier*, (2) *it challenges the participants*, (3) *the users' like this approach of goal setting*, (4) *participants' like the customization of goals*, and (5) *other benefits of the approach*. Children indicated that they enjoyed this way of setting goals, describing it as a nice experience, and that their friends would also like this way of setting

goals. Participants stated that setting goals this way was easier, and that it would make executing them in real life more achievable, by implementing this in a fun and accessible way, as compared to other approaches to setting goals for oneself, which children described as more serious and intimidating. P2 explained: *"I think it is much easier to set goals with this game. When you do it really intensely and seriously you don't really do it, but if you use the game, it goes way faster and looks really nice. You finish faster and can move on a lot easier. You set more goals, too. You also think about really doing it and know that you set goals correctly."* Two participants emphasised that the three step approach, which progressively narrows down onto a final goal, would challenge them to set goals for themselves, and that it would push them to improve.

Children also highlighted the significance of the goals being personalized to them, explaining that it was of importance to them. When asked about their thoughts on the goal customization, P5 gave an example of wanting to work on their speed, explaining that if they would not be able to choose the goal they wanted, they would never be able to beat their friends in races. Through this the participant explained the value that goal customization has for them. When asked about their thoughts on the ability to personalize their goals, P4 explained *"Yeah, I think that was really good."* Other benefits of this approach, as mentioned by the participants, included: increased commitment to goals, the experience being reminiscent of completing quests in games, being encouraged to set more goals, an overall improved and less serious experience of setting goals, and the fact that when one decides to set a goal, they will most likely try to complete it. P2 stated *"You also think about really doing it and know that you set goals correctly"*, explaining that this approach makes you think about your goals, and ensures that you set them correctly. With regards to goal completion, users stated that if they actually were to use the app, it would feel good to complete a goal, as they would feel rewarded. Additionally, children emphasised that completing a goal this way would make them feel proud of their accomplishments.

In terms of areas for improvement, for the goal setting process, some comments were made. Two participants stated that a bigger variety of goals, in terms of activities to choose from, would be appreciated, as well as the ability to personalize the goal difficulty to oneself. This was expanded upon by one of the participants, P4, who explained that what may be difficult to one child, may be easy to another.

4-B: What are the reasons behind the choices of the children during the goal setting process?

When discussing the findings focusing on the reasons behind childrens' choices during the goal setting process, this can be divided into three sections: *high level goal selection, branch choice and difficulty choice.*

- (1) *High level goal selection.* When deciding on the ‘high level activity’, users could choose between *biking, walking, and running*. A majority of the children stated that they chose an activity they *wanted to improve on in real life*. Two users explained that they were already good at two out of the three activities, and therefore chose the one which they were not good at. Moreover, some children chose the activity because it was similar to another activity they enjoy, it looked easy, based on recent activity, or other factors such as an upcoming school tournament, and being able to run with one’s pet.
- (2) *Branch choice.* For the next step of the goal setting process, children could choose between different ‘branches’ in the skill tree, i.e. *speed, distance and stamina*. All five participants stated that they anchored the choice in something they felt like they *wanted to improve on in real life*. One participant explained that they chose stamina because they often became tired when playing badminton, while another chose speed to be able to keep up with their father when running together. One participant explained that they wanted to improve on all aspects of the skill tree.
- (3) *Difficulty choice.* The last step of the goal setting process allowed the participant to select the difficulty of their goal. A majority of the participants chose medium difficulty, describing reasons such as *not wanting the goal to be too hard or easy* to complete in real life. One participant chose medium because that is what they were used to doing when playing games, with the plan to increase or lower the difficulty the following time, depending on how they experienced the difficulty level. Another participant explained that they did not want to have to wait too long before doing another activity, so they chose a medium to not become too exhausted. One participant chose easy, explaining that they wanted to *start off easy, and then progress upwards in difficulty*. One participant chose hard, stating that they liked a challenge. Thus, a majority of participants chose their difficulty level based on their skill level in real life, while two players mentioned other strategic reasons (so that they can allow for room to improve, and using the medium skill level as a bench-marking test when starting a game).

7.4.5 Link Between Character and Goals

The focus of this category was to investigate the relationship between the user-made character, and the goal setting. The two questions which were addressed were 5-A and 5-B.

5-A: How do children interpret their relationship with the character?

In terms of describing their relationship with the character, the children described it as one where they progress along with the character. Two main themes were identified: (1) *I become stronger with the character*, and (2) *the character is motivating*. Children explained the relationship as one where when the character becomes stronger, they become stronger. They highlighted that the character grows with you, and that it is fun to see you and your

character developing together. A majority of the children also explained that the character developing along with them would be motivating. P4 stated that *“It just makes me feel better if I do something, and I gain more than just one thing from it. Just makes me feel better in more ways.”* This statement explains how by adding another benefit to being active, namely progressing the character, they would feel better about said activity. Additional remarks of the children highlighted that the character would be a good way to track their real life progress, and that the character is there as a tool for them to improve themselves.

5-B: What is the influence of the character on the goal setting process?

With reference to the influence of the character on the goal setting process, the majority of children indicated that they thought about themselves more, as compared to the character, when setting goals. On the other hand, one child stated that they thought a lot about the character while setting the goal, while another explained that if they were to play the game a lot, they would think about the character more. The former specified that they see themselves as the character, and therefore it could be said that they thought about both equally. A third child explained that while they thought about themselves more, the character had a big impact in their selection of the difficulty, as they wanted their character to improve as efficiently as possible. In terms of evaluating the impact of the goals on their characters, childrens' evaluations matched their chosen difficulty levels, i.e. easy goals will not impact the character very much, while a hard goal would impact them a lot.

7.4.6 Prototype Evaluation & Usability

The answers of children with regards to the concept and app as a whole, can be divided into three major segments: pros, cons, and areas of confusion. These answer the research question 6-A.

6-A: What did the children think of the prototype?

All of the children reacted positively to the concept. P2 stated that *“I think it is a very good app and can help a lot of people”*. The idea of combining a game with exercise was appreciated by the majority of children. P4 explained *“I really like it because the game pushes you to do something in real life, and not just on your computer”* and P2 stated that *“I think it's a good game because you're not sitting down there, just playing it all day, you actually train your own body”*. With regards to the purpose of the game, P2 also explained that *“the main meaning of the game [is] to chase your goals and to get to your goals”*. The motivational aspect of the game was also highlighted by most of the children, with them explaining that it motivates you to work on yourself, and that the app would push them to improve more. Similarly, children explained that this app would help them become more active, and feel good about being active. The novelty of the concept was also highlighted by the children with P3 expressing that *“I didn't really see a system like that in another game”*

and P2 saying that *“you can remember [the app] pretty easily because it's not like every other game”*. P2 expanded on this by explaining that *“you can improve your character in many games, but not if you actually do something in real life, that's new for me”*. Additionally, P3, emphasised that *“I could do what I want”*, explaining that they felt like they could do what they wanted in the app.

Other positive aspects of the app, as mentioned by the children, included the design of the app being good, referring to both the aesthetics, as well as interface, and the game being fun. Two participants explained that they would not change anything in the app, with P2 saying that *“I think every game is different, so [...] you can't say something is missing if it's just the game”*. A majority of the participants said that they would use the app again, and that they would tell their friends to play this game if they wanted to improve on their own activity levels.

In terms of areas for improvement, a number of elements were identified. The first of these was the fact that some children stated that they could not fully evaluate the app without having the full version of the app, and without being able to actually execute the goals themselves. With regards to feeling connected to their character, P1, for example, stated that *“I guess it's a little bit hard to say, without actually experiencing it”*. P4 also shared an opinion that *“I didn't really do [the goal], so I can only judge [so] much about it”*. Some children also made some remarks regarding some game design aspects. One participant, for instance, stated that the background in the game could be more interesting, while another wished that the speech-bubbles in the game were skippable. Remarks were also made about the interface, with some buttons being out of place, and about the graphics, or visual element, of the game. P1 explained that *“I think some of my friends would prefer to play like, more of a realistic game”*. Following the theme of friend opinions, some children said that their friends may not like the game, either because they are not interested in games other than big releases, or because they simply do not like to be active. P2 explained that *“Some of them might not like it. Maybe because they just don't like to move in general, even if this game is included”*.

8 DISCUSSION

This chapter discusses the main research question and sub-questions (8.1), suggests implications for designers (8.2), addresses the limitations of the research (8.3) and makes recommendations for future work (8.3).

8.1 Addressing the Research Questions

This research provides an example of how a gamified approach can be used to support children through the physical activity goal setting process. Based on scientific research, a prototype was designed and tested with users of the target group. The goal of the discussion was to answer the main research question “How can a gamified approach be used to support children through the physical activity goal setting process?”, while connecting the findings of this project to literature. In order to do this, the sub-questions of the report were explored. Each question will be covered in the following sections.

8.1.1 Components of Good Goal Setting for Children

What components are important to helping children, aged 12-14, set appropriate physical activity goals? (SQ1)

Through literature research, it was concluded that four main components of a goal should be considered for goal setting to be effective. The goal should be *difficult but attainable*, *short term*, *specific* (Shilts et al., 2004), and *customized* (Costa et al., 2017; Shilts et al., 2004; Vroland-Nordstrand et al., 2016). Particularly when setting goals for and with children, their contribution in the setting process may lead to improved results (Chase et al., 2018; Costa et al., 2017). These components of effective goals are therefore of great significance when designing a solution which implements goal setting as a behaviour change method. The use of *feedback* and *rewards* is also recommended (Locke & Latham, 1990, as cited in Shilts et al., 2004; Locke & Latham, 2019). When considering the types of goals which are set, both learning and performance goals combined appear to be the most beneficial (Seijts & Latham, 2005). In terms of the process of setting goals, for the purpose of this project, *self-set*, *participatory/collaborative*, and *guided* goals were relevant for consideration. It was also of significance to consider the age of the participants, due to their varying ages and maturity levels, which could impact their relationship with goals and goal setting (Lytle & Achterberg, 1995, as cited in Shilts et al., 2004; Shilts et al., 2004; Vroland-Nordstrand et al., 2016).

8.1.2 The Role of Gamification in Physical Activity Interventions for Children

What is the role of gamification in physical activity interventions for children? (SQ2)

The concept of gamification was defined as the use of game elements, in non-game contexts (Deterding et al., 2011; Huotari & Hamari, 2012). Three approaches towards gamification were found. The first of these were the recommendations made by Rapp (2017) for making a long-lasting gamified system. The second approach was that by Korhonen et al. (2009), exploring the variety of experiences which users may have while using a gamified system. Finally, the RECIPE approach of Nicholson (2015) was found, providing important guidelines for designing meaningful gamified experiences. Character creation was also identified as an approach towards enriching the gamified experience, providing a variety of types of value for the user (Livingston et al., 2014). Through creating and playing as a character, users could increase identification, which in turn could increase the overall enjoyment, effort, positive affect, and immersion of the users (Birk et al., 2016). Furthermore, characters were found to be meaningful ways to support intrinsic motivation (Birk et al., 2016), and therefore may support creating meaningful gamified experiences, as proposed by Nicholson (2015).

8.1.3 Childrens' Experiences with Goal Setting and Physical Activity Apps

How do children currently approach goal setting? (1-A) & Do children have experience with activity-oriented apps and games? (1-B)

This research question, along with the following questions, was answered by conducting a semi-structured interview with children aged 12-14 during the user test. When investigating children's current approach to goal setting, it was found that all of the participants had a level of understanding of what a goal was, and they were able to describe ways in which they would address pursuing a goal in an activity of their liking. It was also found that a majority of the children had experience with apps or games that required physical activity.

8.1.4 Character Customization & Identifying with the Character

What is the influence of customization on connecting with a character? (2-A)

Research indicates that character customization can lead to an increased identification with a character (Birk et al., 2016; Trepte et al., 2010, as cited in Birk et al., 2016). This claim was supported by the findings of this project, with participants explaining that they felt connected to their characters, and that through being able to create them, they felt bonded, and the character became their own. Furthermore, it was emphasized that this link made them feel more connected to the game overall, matching the findings of Livingston et al. (2014), who explain that the character-player relationship is crucial to the success of a game. This was further highlighted in the study, with four out of five participants describing

the character creation element as the most memorable aspect of the experience. The concept of the character being a reflection of the player was also expressed by participants, supporting the opinions found in literature that characters can serve as a mediated form of self representation (Livingston et al., 2014) and that identifying with a character can allow the player to become one with the character that they created (Trepte et al., 2010, as cited in Birk et al., 2016).

With regards to the reasoning behind their customization, children explained that they were either inspired by something, such as a real life person, or game character, or designed their characters based on aesthetic reasons. This reasoning would suggest that children customized for embodied identification, meaning that they created their characters based on their ideas of who they were while playing the game, as compared to wishful identification, which was suggested in literature for persuasive, goal oriented games (Birk et al., 2016). In summary, through customizing their characters, children felt more connected to their characters, but also to the game as a whole.

How do children feel about the character customization feature? (2-B)

Children considered the character customization process to be very impressive, highlighting the amount of customization options, liking the visual design, and liking the amount of color options, as the main reasons. Based on this it was concluded that children enjoyed creating their characters, and the quantity of options for doing so. These findings were in line with the recommendations from literature to give users freedom (Rapp, 2017), expression (Korhonen et al., 2009), and choice (Nicholson, 2015), emphasizing that through providing users with the freedom of choice and expression, the overall gamified experience would be improved. Furthermore, through the character creation process, the creativity value of incorporating characters in a gamified experience (Livingston et al., 2014) was identified. Thus, this project provides an example of character customization being an appreciated feature for physical activity applications targeting children aged 12-14.

8.1.5 The Role of the Skill Tree in the Goal Setting Process

How does the skill tree influence the goal setting process? (3-A)

The skill tree was found to influence the goal setting process positively by allowing users to see their progress. This supported the claims of Locke and Latham (2019) and Shilts et al. (2004), regarding the importance of feedback during goal setting, as a way for users to track progress, and use this information to change their efforts and strategies. Participants also explained that the skill tree had impacted, or would impact, their goal setting decisions. The primary contributor to this impact was that children would want to fill all of the branches of the skill tree, and thereby would adapt their activity goals to accomplish this task. This meant that if one of the branches of the skill tree was falling behind, they would adapt their approach to work on the branch which was underdeveloped. Aside from this, children

explained that seeing progress on the skill tree was rewarding, and made them feel as if they accomplished something. This finding supported the suggestion found in literature, that the implementation of rewards, namely the progress in the skill tree, in combination with goal setting, would lead to the most effective results (Cameron et al., 2001; Goldfield et al., 2000; Goldfield et al., 2006; Roemmich et al., 2004, as cited in Horne et al., 2009). What strengthened this feeling, for the children, was the knowledge that they developed a real-life skill, depicted by the progress of the skill tree. Furthermore, children expressed that seeing this progress would be motivating, and would encourage them to set more goals. This further supported the significance of feedback (Locke & Latham, 2019; Shilts et al., 2004) in goal setting. Additionally, this observation was of particular interest as it contrasted findings in literature which suggested that adolescents' motivation for fitness is significantly lowered when using a physical activity tracker, going as far as to say that it demotivates them (Kerner & Goodyear, 2017). However, the proposed design would have to be tested in the long term in order to form a full conclusion about this. The inclusion of the skill tree, as a form of feedback, was therefore found to be a good way for users to track progress, be encouraged to complete goals, and be motivated by it for future goals.

How do children interpret the skill tree element, with regards to goal setting? (3-B)

Most of the children's understanding of the skill tree was based on prior experiences with similar features, while some participants said that, despite not having seen anything like it before, they immediately understood the way in which it functioned and what purpose it served. It was stated by the participants that this was a good way to track their improvement, as they could see their own developments with regards to the various types of activities. Children acknowledging this functionality indicated a successful implementation of a way for them to view their past and future selves, and their journey, two elements suggested by Rapp (2017) for giving gamified experiences a long lasting appeal. Furthermore, while the children expressed that the skill tree depicted the progress of their character, they understood that their real-life physical activity progress was mirrored in this development. This suggested that children understood how the character's skill tree progress translated from in-game progress, to their own real life experiences This was of significance, as it indicated the presence of both the information and reflection components of Nicholson's (2015) model for creating meaningful gamification. Through these two components, Nicholson highlighted the need for users to understand the impact of what they are doing within the gamified experience, on themselves in the real world. Through acknowledging that the skill tree not only represents the progress of the character, but also of themselves, this understanding appears to be present. It is of value to consider the possible implications of this relationship, as by making decisions based on what's best for the character, perhaps the user's needs would be deprioritised, and vice versa. Thus, there is support both in literature and from the primary research conducted in this project, for the utilization of skill trees to achieve meaningful gamification of the goal setting process.

8.1.6 Childrens' Evaluation of Proposed Goal Setting Approach

What do children think about this approach towards goal setting? (4-A)

Children stated that they enjoyed the implemented method of goal setting. They found the proposed approach to make setting goals easier, and completing goals more achievable. One of the reasons behind this was that children found the gamified approach to be less serious and intense, as compared to setting goals without it. Due to this, it was expressed that users could complete their goals faster, and move on more easily. Some participants also explained that this method would push them to set more goals for themselves and improve. These opinions supported the implementation of a gamified approach, through confirming the findings from literature that gamification can increase engagement, and motivation (Hamari et al., 2014). A parallel was drawn by one participant regarding the gamified implementation of goal setting, stating that setting and completing goals was reminiscent of completing quests within a game. It was also found that children thought that upon goal completion, they would feel good about themselves and rewarded. Furthermore, children expressed that they would feel proud of their accomplishments if they were to complete a goal. Children also emphasized the importance of goal customization, explaining that it would allow them to work on things which were important to them. This supported the claim made in this project, based on literature (Costa et al., 2017; Shilts et al., 2004; Vroland-Nordstrand et al., 2016), that customization is a significant factor for effective goal setting.

What are the reasons behind the choices of the children during the goal setting process? (4-B)

When selecting the high level activity (biking, walking, or running), the majority of users said that they chose based on what they wanted to improve on in real life. Additional reasons included: the activities being similar to other activities that the children enjoyed, the activity looking easy, and other factors like wanting to run with one's pet, or an upcoming tournament. These findings were of interest as they suggested that the approach encouraged children to develop their areas of weakness, as compared to wanting to do what they already thought was easy. Furthermore, this indicated that, while children were aware of the rewards of completing a goal, they did not select activities they were already good at to try and maximize the reward by completing goals more easily. This may suggest that the solution was successful in supporting childrens' exploration of various physical activities, and developing skills which they may not be already good at. Furthermore, it indicated that children were not only driven by extrinsic rewards, namely maximizing the points appearing in the skill tree, but rather, that they considered what would be best for them, suggesting a more intrinsically motivated approach.

During the branch selection phase (speed, distance, or stamina) where children decided the way in which they would improve the previously selected activity, all of the participants

expressed that they based this decision on what they wanted to improve on in real life, further supporting the findings from the previous step. Combined, these elements indicated that children reflected on their decisions, which was one of the major components for meaningful gamification proposed by Nicholson (2015). Furthermore, through being able to make decisions based on what they felt was significant, the successful implementation of choice, another key element of meaningful gamification (Nicholson, 2015) was proven. Thirdly, the incorporation of the exposition component, also proposed by Nicholson (2015), was also identified. As explained by the author, this could be done through having the experience mirror the real world and allow users to connect in-game decisions to their real experiences.

Finally, during the selection of the goal difficulty (easy, medium, or hard), the majority of participants selected the medium difficulty. One reason for this was children not wanting the goal to be too difficult or too easy. One participant explained this by stating that this was the way they approached games in general, starting off at a neutral point, and then adjusting difficulty based on their experience. An additional reason was that of a participant not wanting to be too exhausted by the goal, as they wished to complete another goal not too long after. One of the children selected the hard difficulty, explaining that they enjoyed a challenge, while another selected easy, stating that they wanted to start off easy, and then progress to more difficult levels. These findings suggested that children reflected on goal difficulty, and strategized accordingly. It was shown that displaying goal difficulty levels had an impact on the decision making of children, as they either based their decision on prior game experiences, which they could project onto the offered goal difficulties and decide accordingly, or personal preferences towards facing a challenge. Furthermore, one participant highlighted that the displayed fatigue level played a role in their decision making, as they did not want to be too tired after completing their goal. This indicated that this feature may be a viable approach towards encouraging children to reflect on goals and goal difficulties. Due to difficulty being one of the core elements of effective goal setting (Locke et al., 1981; Locke & Latham, 1990, as cited in Shilts et al., 2004; Locke & Latham, 2002), children being aware of this component, and planning their goals around it was a significant finding. Furthermore, through discussing the potential increase in difficulty over time, children revealed the incorporation of an engaging gameplay experience in the solution, described as one which increases in difficulty over time, and as an important attribute of a meaningful gamified experience (Nicholson, 2015).

8.1.7 The Relationship Between the Player, the Avatar & the Goal Setting Process

How do children interpret their relationship with the character? (5-A)

When explaining their relationship with the character, children emphasised the fact that they progressed alongside them, becoming stronger with their character. Through doing so,

users were given an image of themselves that they could identify with, as recommended by Rapp (2017), which, in turn, could lead to increased intrinsic motivation and positive affect towards the solution as a whole (Birk et al., 2016). This was confirmed, with the majority of participants explaining that seeing their character develop alongside them would be motivating. This suggested that the proposed solution managed to motivate players intrinsically, a feature significant for meaningful and lasting gamification (Nicholson, 2015), and something that activity trackers focusing on extrinsic motivators often fail to achieve (Deci et al., 1999). These findings also confirm the validity of using customized characters in serious games, as proposed by Birk et al. (2016). Furthermore, through investigating this, the use of characters in more casual games, a topic which has not yet been extensively explored (Birk et al., 2016), was evaluated.

What is the influence of the character on the goal setting process? (5-B)

During the goal setting process, children expressed that they thought about themselves more than the characters. One child stated that they thought equally about both, since they perceived themselves as the character. These findings corresponded positively to the recommendations made by Nicholson (2015), for the creation of meaningful gamified experiences. The two elements of information and reflection, highlight the importance of the users being aware of how the things which they did within the game, impact them in the real world. Through the participants expressing that, despite being aware of their relationship with their character, they thought about themselves more during the goal setting process, the effective implementation of these two elements can be confirmed. At the same time, while children thought about themselves during the process, they also thought about the characters quite a significant amount. One individual expressed that the character had a particularly big impact on their decisions, as they wanted their character to improve as efficiently as possible. These findings indicate that while they thought about themselves more, the characters did have a motivating impact on the goal setting process for the users. This, in turn, was in line with Birk et al.'s (2016) opinion that characters may increase motivation. Overall, what this suggested was that while children were thinking more about themselves during the goal setting process, the connection and identification with their characters that they experienced had a positive impact on motivation and could trigger future actions.

8.1.8 General Concept Evaluation

What did the children think of the prototype? (6-A)

When evaluating the overall concept and execution of the solution, all of the participants reacted positively. In particular, children responded well to the idea of combining a game with exercise. This finding was significant as it indicated that the use of gamification for the enrichment of the goal setting process for physical activity in children, was a valid approach. Through doing so, this context of use was shown to have promise, positively

fulfilling the recommendations of Nacke and Deterding (2017), who emphasized the need to systematically explore the implementation of gamification in a variety of contexts. Furthermore, the context of health/exercise, as mentioned by Hamari et al. (2014), was further explored through this project. A different positive aspect identified by one of the children was that of the solution giving them the ability to do what they wanted. This reflected the design giving users freedom (Rapp, 2017), control (Korhonen et al., 2009), and choice (Nicholson, 2015). Another key finding was that of children finding the game to be motivating, with regards to physical activity and setting goals. This aligned with the findings from literature that gamification can increase both engagement and motivation (Hamari et al., 2014). Furthermore, participants stated that this solution would not only make them more active, but also make them feel better about being more active. The concept was also evaluated as novel by the participants, with most stating that they have never seen anything like it before. This, in combination with the overall positive reaction to the solution, with most participants saying that they would use the app again, was used to conclude that the concept was appropriate for, and appreciated by, the target group. Additionally, the users describing the experience as fun, and stating that they would use it again, suggested that this was an experience which they actively wished to come back to and use, implying that they felt intrinsically motivated (Nicholson, 2015) to interact with it. This also highlighted the presence of play, one of the key methods for meaningful gamification (Nicholson, 2015), within the solution.

8.1.9 Answering the Main Research Question

How can a gamified approach be used to support children through the physical activity goal setting process? (RQ)

In the answers of the sub-research questions explored above, the final research question was progressively discussed and answered. It was found that a gamified approach, implemented through the use of characters, skill trees, and a game-inspired interface, could be effectively used in order to design a three-step goal setting process. It was found that children considered this method to be fun, engaging, and intrinsically motivating. This not only highlighted the successful implementation of gamification, but also emphasised the enrichment of the goal setting process, which may otherwise be considered to be dull and serious, as described by one of the participants. Participants appreciated the ability to work on goals which were personalized to them, and found the designed method to support this behaviour.

8.2 Implications for Designers

Based on the findings of this project, several implications for designers working on similar projects targeting children were formulated. These are summarized in this section.

8.2.1 Goal Customization

Through literature research and the design and testing of a digital prototype, it was found that customization is a key element for goal setting. Therefore, this can be considered as the fourth element for effective goal setting, adding to the three commonly accepted characteristics of good goals being *difficult*, *short-term*, and *specific* (Shilts et al., 2004). This is supported by findings from literature that emphasize the value of giving power to the users when setting goals (Costa et al., 2017; Shilts et al., 2004; Vroland-Nordstrand et al., 2016). When offering goal customization, however, it is of importance to find a balance between offering users freedom of choice, and making recommendations. Giving too much freedom to the users may result in subpar goal quality, particularly if they lack goal setting experience. On the other hand, not offering enough freedom leads to the lack of personalization, which removes the benefits of goal customization. The approach recommended by the author is to split the process into steps, in this case starting with a high level goal, followed by a more specific qualitative goal, concluding with a quantitative goal. This approach was inspired by the work of Niess and Woźniak (2018).

8.2.2 Characters and Goal Setting

The use of characters, as a game-inspired element, was found to be an effective way of supporting intrinsic motivation in goal setting, while making it more fun. Additionally, this design element can encourage children to consider their progress, based on the progress of their characters. The use of a character that children felt connected to was found to be a viable way to encourage them to set goals, but also to complete them, and set new ones. This was due to them wanting to develop their characters further. However, it is important that throughout the user's interaction with the design, they are aware of the real life implications (Nicholson, 2015) of the character's progress, and are able to reflect on this accordingly. In this project, it was found that children thought about themselves more than their characters when setting goals, showing that they were not solely driven by the in-game rewards, but also that they were reflecting on the real-world outcomes of their actions, identifying areas in which they wanted to improve.

8.2.3 Using Characters in Serious Games

Based on the findings of this research, the use of characters that users identify with in serious games is recommended. While this was suggested in literature, the implementation of this design feature in such games has not yet been extensively explored (Birk et al., 2016). It has been found that this led to increased intrinsic motivation, user enjoyment, and connection to the game as a whole. Various forms of value were also derived from the characters by the participants. Furthermore, it was found that creating a character during the short interaction with the prototype was enough for participants to feel connected to their characters, indicating that characters in serious games, which are often based on shorter interactions compared to traditional games, can be implemented effectively, and

potentially lead to comparable feelings of connection as traditional games. This, in turn, may allow for designers to reap the benefits of using characters, such as the ten types of value that they can provide (Livingston et al., 2014), an increased imagined enjoyment of playing a game with a customized character (Trepte et al., 2010, as cited in Birk et al., 2016), and increased motivation (Birk et al., 2016).

8.2.4 Using Skill Trees to Visualise Goal Progress

The implementation of skill trees proved to be an effective way to visualise the goal progress of users. As a feature, it was understood both by participants who had prior experience with similar elements, and those who did not. This tool is therefore recommended for other designers exploring gamified goal setting for physical activity applications. It was found that this approach offered benefits beyond traditional rewards, as it allowed users to monitor their progress, review their skills by proxy, using the skills of the character, and reflect on what they wanted to work on. Participants highlighted that the skill tree helped them understand that they developed a real-life skill, which made the reward of seeing the skill tree fill up with points even more gratifying. It was also found that the skill tree had the ability to influence goal selection, with children explaining that if a goal was falling behind, they would likely want to work on it. Through this, the potential for skill trees to encourage the exploration of different activities was also found.

8.3 Limitations

8.3.1 Limitations of the Design

One of the key limitations which was found was the inability of participants to fully evaluate the concept without actually completing the goal which they selected. When asked about how they felt upon seeing the skill tree fill out, post goal completion, children had to rely on their imagination and assumptions to provide feedback. Their thoughts and reflections on the process would be more accurate if they had completed the selected goals, and then experienced how the app would react to this. Moreover, since the participants were informed before the user test about the nature of the activities, which excluded performing any physical activity, it cannot be confirmed if the goals which they chose would be the same goals as if they had to actually complete them. It's worth considering that children may have chosen more difficult goals to receive more points, even if in practice they would not have done this.

With regards to goal setting, the proposed design did not implement learning goals. A combination of both learning and performance goals is recommended in literature (Seijts & Latham, 2005), and would enrich the goal effectiveness of this approach.

One limitation of the design stemmed from the character creation feature, developed by adapting the purchased Character Creator 2D game asset. Changing the default character was found to be a difficult task without causing technical difficulties and therefore it was not edited for the sake of keeping the prototype functional. Due to this, however, the default character was a muscular caucasian male. In future iterations, this should be changed to promote a more diverse design.

While the solution did implement all six recommendations of Nicholson (2015) for meaningful gamification, it missed out on several suggestions by Rapp (2017) for designing interactive systems inspired by game-elements. While not all of these elements have to be incorporated into every design, it is worth reflecting on how the design could be improved. The primary missing aspect, which was emphasized by Rapp (2017) was that of social elements, including: *social presence*, *self-organization*, *cooperation and friendship*, and *competition*. Through the implementation of some, or all, of these elements, the solution could perhaps be improved.

8.3.2 Limitations of the User Study

Another limitation of the user study conducted in this research was the limited number of participants, with whom the prototype was evaluated. This was caused by the difficulty of reaching members of this target group. Through presenting the solution to more participants, a broader overview of opinions and feedback on the subject could have been obtained. The age distribution of the participants was also skewed towards older children, with three out of five being 14 years old, one being 13, and one child being 12. As expressed by Lytle and Achterberg (1995, as cited in Shilts et al., 2004), it is during this time that children begin to understand more complex concepts, such as that of causality. Due to this, it would have been of benefit to investigate the thoughts and opinions of a balanced range of ages. With regards to participants, an additional limitation was the fact that all of the participants were male. This was due to the limited access to members of the target group, and resulted in the exclusion of an important segment of the target population. The importance of including both male and female participants in studies such as this one, was emphasized by Horne et al. (2009), who found that in an intervention that implemented goal setting for healthy behaviour change, the results between male and female participants differed quite significantly during the study, and during a follow up study which was performed. Furthermore, the authors found that female participants reported their performance more frequently, further proving that both genders should be included to obtain a variety of useful perspectives. Thus, by recruiting a larger sample size, with a more heterogeneous population, the generalizability of the results could have been increased.

8.3.3 Limitations of the Project Scope

Since this was conducted as a part of a Master Thesis for the Interaction Technology programme at the University of Twente, the project focused on translating insights from research into a proposed designed solution, that could support children in their goal setting process. However, evaluating the actual efficacy and efficiency in producing long-term behaviour change lied outside the scope of this project.

8.4 Future Work

8.4.1 Improvements to the Proposed Design

Some areas for improvement were highlighted by the users for future iterations of this design. With regards to the character creation process, a user expressed that they experienced some visual errors, while another user stated that their character looked too old. A participant also expressed that they wished there were more clothing options. In terms of the skill tree component, users were uncertain about what happened upon the tree being completely filled, this could be clarified better. One user also expressed that they wished the depiction of goal completion was more rewarding. In regard to the goal setting process, one user stated that a bigger variety of goals would be appreciated, as the existing ones did not include their favorite activities. One participant also expressed that they would like for the goal difficulty to be more personalizable. In terms of the design of the app, one participant said that the background visuals could be more interesting, and another explained that they wished that the speech bubbles were skippable. One of the children also stated that for some of their friends, the cartoon-like graphics may be discouraging, explaining that their friends prefer more realistic games. A potential issue presented by one of the users was also the fact that some individuals simply do not like to be active, and even if the approach is gamified and made fun, this may not encourage them enough to actually be active. One of the participants also expressed that they were slightly confused at the start of the interaction, due to a language barrier, with English not being their first language.

Beyond the suggestions for improvement indicated by the participants, various features were identified by the researcher. One of these would be the integration of a social component to the design. Through the addition of this, the design could leverage a variety of additional motivational affordances, such as: *social presence*, *self-organization*, *cooperation and friendship*, and potentially *competition* (Rapp, 2017). Through this, users would be exposed to a number of additional playful experiences such as *competition*, and *fellowship* (Korhonen et al., 2009). The group approach towards gamified goal setting was found to be effective by Garde et al. (2015), and group goal setting was recommended as a potential approach to effective goal setting with children by Shilts et al. (2004), further suggesting that this could be a valuable addition.

A different possible improvement would be the addition of a goal evaluation screen within the app design. This would provide users with the ability to reflect and review the goals which they have completed, encouraging them to think about which activities they enjoyed, and what level of difficulty is appropriate for them. This would support both the information and reflection aspects, suggested by Nicholson (2015). However, this element was intentionally excluded during the design of the prototype, as it did not make sense to ask users to evaluate a goal that they did not complete.

With regards to goal setting, the addition of learning goals is an element which could improve the overall quality of the proposed solution. Through the use of learning goals, children would be encouraged to acquire knowledge, which they could then implement through the use of, the already included, performance goals (Seijts & Latham, 2005). Furthermore, the presence of more options during goal setting would be of value to the users. This would allow children to select goals which were better suited to their personal preferences.

A benchmarking process is another element which could be added to this design. It was not included in this prototype, as children would not actually complete the physical activity goals, and therefore the personalized accuracy of the goals which they could choose from was not deemed to be of great significance. Nevertheless, through the inclusion of this feature, the app would be able to provide more fitted recommendations for the user's activity goals, as compared to the fixed values which were implemented in this prototype.

An additional element which could be added would be that of more branches being present in the skill tree. For the sake of simplicity, the prototype only focused on mobility, however, this excluded a range of other activities. If expanded, the skill tree could include elements such as a knowledge component, which, in turn, could be used to incorporate learning goals, and reward them with knowledge points, as suggested during the ideation phase.

A potential issue regarding this approach towards gamified goal setting was whether or not it would remain effective and interesting in the long term. This issue was brought up by one of the participants, stating that they were not sure if the app would remain entertaining over time. This finding correlated with limitations to gamified approaches found in literature, such as Horne et al. (2009) finding that their app depreciated in effectiveness over time, Lin et al. (2006) expressing that, in literature, they found children to lose interest in similar games, and the threat of gamification relying on the novelty effect (Hamari et al., 2014). However, this was neither proven or disproven, as children were not exposed to the solution for a prolonged period of time. This would have to be tested in future research. Worth considering, however, is whether or not the long term appeal would be an issue, as perhaps simply through using the app for a small period of time, children would be encouraged to

approach goal setting in a new and refined way, translating their new-found knowledge into real life actions. Once again, however, this would have to be investigated.

8.4.2 Recommendations for Long-Term Study

As a whole, this project indicated that the combination of goal setting with gamification, done through the use of a gamified interface, a skill tree, and customization of characters, is an effective approach not only for encouraging goal setting in children, but also for making the process more enjoyable, rewarding, and fun. Moving forwards, it would be of interest to determine the impact of this solution in a longer-term study, to investigate whether the positive findings of this paper last over time, and the suggested approach to goal setting has a positive impact on childrens' physical activity levels. For this purpose, however, the design would perhaps have to be expanded upon, through the 'completion' of the app, by adding a context in which the improved character and skill tree would play a role. This could, for instance, be a game where the character has to fight opponents, benefiting from improved strength, or a game where the goal is exploration and the gathering of resources, where additional stamina may help in carrying heavy items. It would also be of interest to determine the impact of the various goal difficulties on goal motivation, completion, and satisfaction.

9 CONCLUSION

In this project, the concepts of gamification and goal setting were utilized in the development of Active Quest, an app for children aged 12 to 14, which aimed to encourage the setting of appropriate physical activity goals. This app implemented custom characters, skill trees, a game-inspired interface, and a three step goal setting process, which worked together in providing a fun and engaging experience for the users. Children connected to the characters that they made, monitored their progress via the skill tree, and set goals based on what they wanted to improve on in real life.

This research contributed towards several fields. Firstly, the combination of research-based goal setting and gamification was implemented and tested, with the results indicating that this is a promising approach for future designers. Secondly, the use of characters and skill trees was designed and tested in the context of goal setting, with the findings suggesting that this is a viable approach to increase intrinsic motivation, enjoyment, connection to the game as a whole, and allowing users to monitor their progress in a way which encourages reflection. Furthermore, through the use of characters within this app, their implementation in a serious game was tested and proven to work.

The findings of this project suggest that the designed approach towards encouraging physical activity in children is viable, and should be considered by future designers. They show that using game-inspired elements which have not yet been extensively covered in literature, such as characters (Birk et al., 2016), can lead to positive outcomes, and perhaps should be explored further.

Future designers should continue exploring the use of gamified elements in non-game contexts, such as physical activity goal setting. The use of goals which are customized to the user should be considered, alongside methods to motivate and inspire the users intrinsically. For this purpose, the implementation of characters could be considered. It would also be of value to test similar solutions over a longer period of time, to investigate the long-term effects. However, when doing so, it is worth asking if such solutions need to be long lasting, or if instead, they serve a sufficient role by educating users on effective and fun goal setting, and that they can then be trusted to use this knowledge in the real world, unassisted.

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APPENDIX

Appendix A. Analysis of Commercially Available Apps

This section uses parts from the Research Topics report done by the researcher (Jarosinski, 2021).

A.1 Explanation

The purpose of exploring other designs within the same space is of significance in order to understand what is being done, and what gaps exist. The goal of the project for which this literature review is written is to consider ways in which an app which aims to improve the physical health of children can improve. More specifically, goal setting as well as gamification are of interest. Therefore, when looking into existing designs, it was decided that a focus would be placed on mobile apps which target physical health.

When identifying the apps to describe within this section, online research was performed to find relevant options. Apps from the Google Play Store¹¹, as well as the Apple App Store¹² were considered, as these are the two most popular operating systems in consumer smartphone devices. It was not possible to use the search systems of these stores to search for game elements or keywords, therefore it was not possible to find terms such as 'goal setting', 'goals' or 'physical health', as these provided very literal results with apps with those keywords in the names. An additional reason for this was the overwhelming quantity of apps which are present on these stores, with many duplicates or very similar interpretations of the same concepts. Combined, this made searching for apps difficult. Instead, it was therefore decided that an online search would be performed, browsing various lists and performing manual searches through the app stores. Through doing this, a number of apps were identified.

The criteria for selecting the apps were:

1. The app uses gamification to encourage physical activity
2. The app requires physical activity
3. The app is still active during the writing of this paper (12.2020 to 01.2021)
4. The app is offered on either of the two app stores
5. The app has positive reviews (4 + on at least one of the two stores)

Neither goal setting nor the target audience of children were considered a search criteria. The reason for excluding goal setting was the fact that it may not be immediately clear or

¹¹ <https://play.google.com/>

¹² <https://www.apple.com/app-store/>

explicitly specified if an app uses goal setting theory, and that the knowledge from apps which do not include it can still be translated into useful elements for the development of an app which does implement it. The reason for excluding children as a search criteria was that many child-specific apps targeted groups below the one in focus in this report, and the fact that many apps which can be used by children within the target group, are not explicitly advertised as such.

The process of evaluating the apps began with downloading them, and personally testing them out. This was done for all of the applications which were available on Android, due to technical limitations. The apps which are only present on the Apple app store were investigated through further online research, such as the reading of articles and the watching of videos. The manual testing of the apps included the testing of features, and the viewing of the tutorials which were provided. This served as a useful way of obtaining a holistic overview of what the apps offer, while restricting the time necessary to evaluate them.

A.2 NFL Play 60

There are several reasons behind the selection of this app for analysis. Firstly, the app rated 4.3 in the Google Play Store, based on 248 reviews, and 3.6 on the Apple App Store based on 72 reviews. Another reason for the selection of this app was the fact that it was developed by the American Heart Association, meaning that it was built by an organization which is an expert in the field of health. The following reason was that, upon an initial evaluation from reading the description, the app covered many of the relevant criteria such as goal setting, requiring physical activity, and even targeting children. The link to the NFL was also considered a benefit, as this was speculated to ensure a bigger outreach of the app, and to add another layer of gamification by employing this theme.

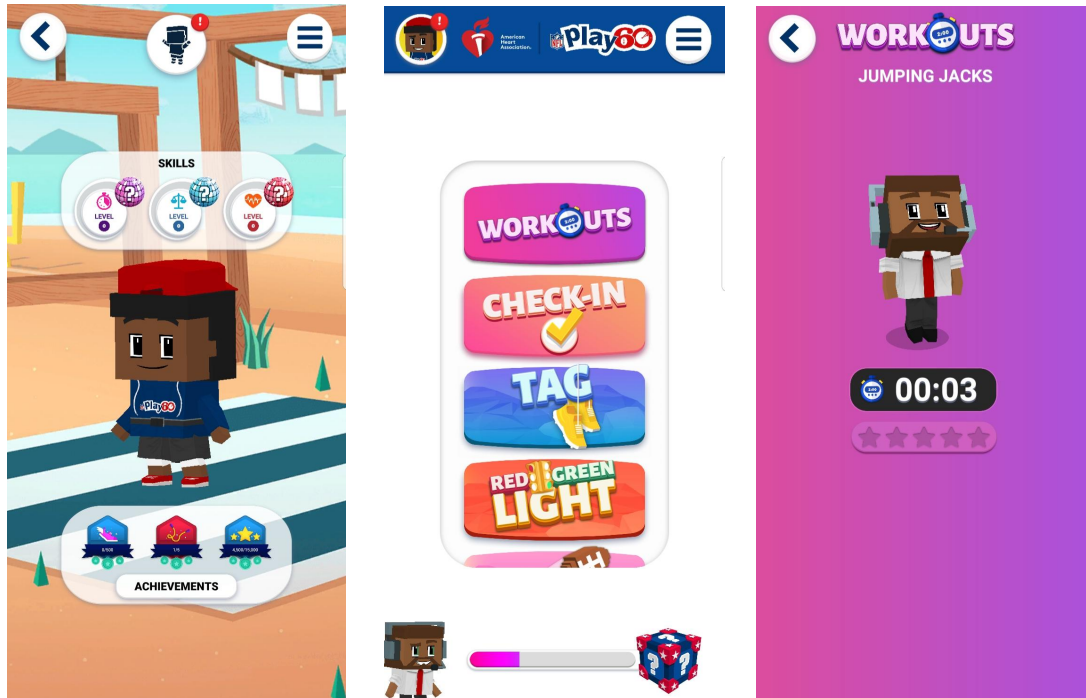


Figure A1. Screenshots showing the 'NFL Play 60' app.

This app was developed by the American Heart Association, and targets children ranging from 9 to 11 years old. The game follows the theme of the NFL (National Football League), where users can create their character, a 'fan', customizing his looks to match their personal preferences. The app is centered around 'play points' which the user can earn, filling up a bar, eventually leading to rewards such as new costumes for their character. 'Play points' are awarded for working out and being active. Users are encouraged to track their daily activity by checking in, resulting in a 'play point' multiplier. Additionally, users can earn points by playing games such as tag or catch. Furthermore, users can earn achievements by staying active, and develop 'skills' which in turn can unlock dances.

A variety of workouts is presented in the game such as: running in place, leg raises, push-ups, squats, and jumping jacks. Users can perform these workouts, which are accompanied by an animated character showing them what to do. The more time the user spends in a workout, the more points they obtain. The games, on the other hand, require the user to actually move their phone, in order to prove that they are performing the exercises. For instance, in 'red light, green light' users have to move around, shaking their phone, while the light is green, and stop moving completely when the light is red. In 'catch', users tap the screen on the phone in order to reposition their character to catch a ball, and then have to physically jump in order for their character to reach the ball. Finally, the 'tag' game requires the user to tilt their phone sideways when controlling their character.

The app motivates physical activity in a number of ways. Gamification is implemented in order to encourage exercise, through the use of a customizable character, levels, rewards, achievements, and play activities. Goal setting is not explicitly implemented within the app, nor is it possible for users to set goals for themselves. Nevertheless, levels, which require ‘play points’ could be interpreted as goals which the users strive towards.

A.3 Zombies, Run!

The primary reason behind the selection of this app was its popularity as well as positive rating. The app featured a 4.5 rating on the Google Play Store, based on 22,902 reviews, and a 4.5 rating on the Apple App Store, based on approximately 18,500 reviews. These are very positive reviews, which indicate a positive reception of the app. An additional reason was the unique approach of the app, in adding a narrative layer to real physical activities. Beyond this, the app met the preferred criteria of implementing goals, and required users to physically move. While this app did not target children specifically, it could be used by children.

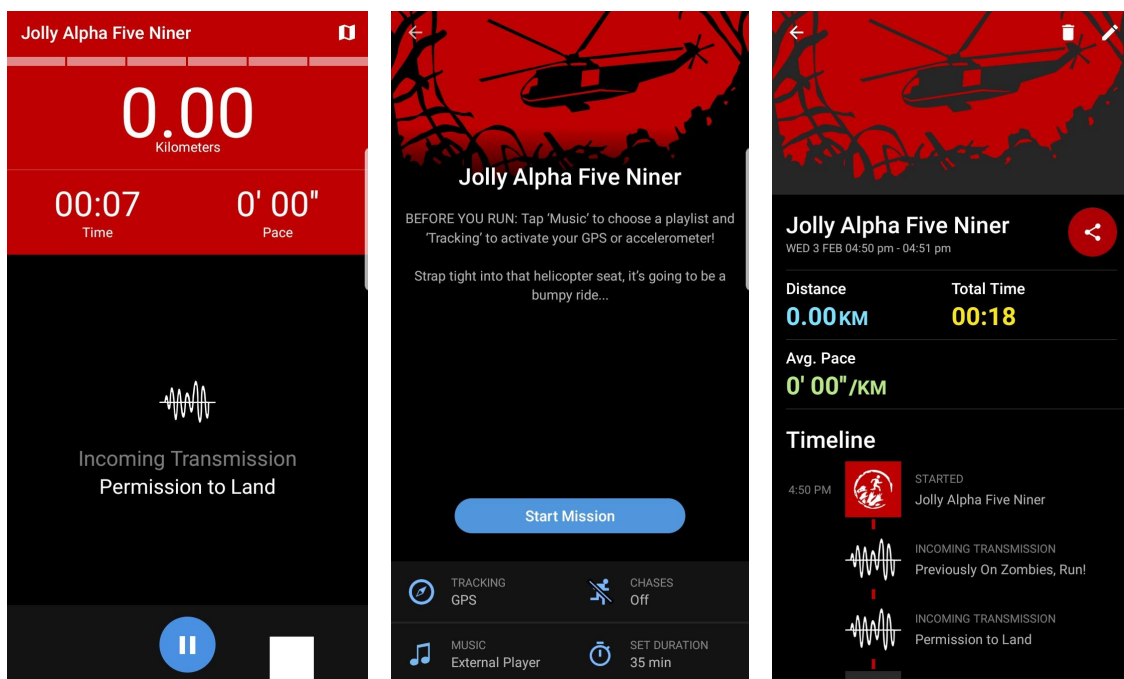


Figure A2. Screenshots showing the ‘Zombies, Run!’ app.

‘Zombies, Run!’ is an app which describes itself as an “ultra-immersive running game and audio adventure.” Each run that the user goes on is a unique mission, with its own narration, where the user is the hero. While running, the user hears a variety of audio. This ranges from the sounds of zombies chasing the user, to music, and narration. The goal of the game is to collect supplies in order to grow one’s base, while following an award-winning narrative.

The plot of the app is centered around a zombie apocalypse, where not many have survived. The user is a runner whose responsibilities include rescuing survivors, defending the base, and gathering supplies. The game can be played either by walking, jogging, or running in the real world. Users can select from a variety of options with regards to tracking, making it possible to use the app when running outdoors, indoors, or even when using tools such as rowing machines. The user can either enable or disable zombie chases, which add a high-pressure component to the experience, where at some point during the run they will hear zombies coming close, requiring them to speed up. The game is primarily audio based, with users listening to a narration of the story, the sounds of zombies, and their own selection of music during exercising. The app features 200 missions, each linked to its own exercise session.

The app encourages physical activity through the implementation of gamification. In particular, narrative is used as a tool to encourage users to exercise, in order to continue with the story. Additionally, elements such as suspense and tension are added, enhancing the user experience.

A.4 The Walk

This app was selected partially due to it being created by the same developers as “Zombies, Run!”, alongside it building upon the foundation of that app, and adding new, different elements. The app is rated 4 stars on the Google Play Store based on 288 reviews, and 4.4 on the Apple App Store based on 568 reviews. As an app it implements the narrative element to encourage physical activity, and allows users to track their goals and progress in an innovative way.

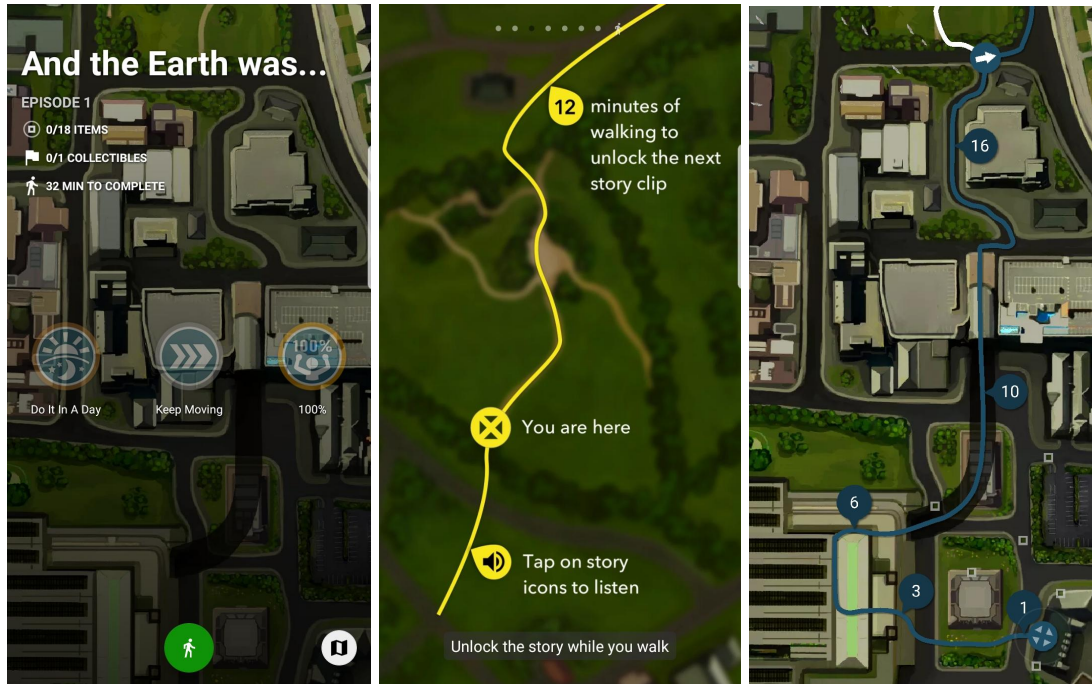


Figure A3. Screenshots showing the 'The Walk' app.

'The Walk' is an app created by the makers of 'Zombies, Run!' It was created in collaboration with the NHS and the Department of Health. The creators describe it as something beyond a pedometer, which transforms walking into an adventure, a challenge, and a journey. The app visualizes progress, showing the user for how much longer they need to walk in order to unlock the next chapter of the story. The app implements its own virtual map, which the user travels across by walking in real life. It rewards taking longer paths within the game, which correlate to walking more. Additionally, the game rewards behaviours such as completing whole episodes within a day, completing episodes without taking breaks, and completing the game in its entirety, including the side missions.

The plot of the game is that a bomb has exploded in Inverness station, and that the user is given a package which can save the world. By progressing through the game, the user advances the story, while collecting clues and useful bits of information which can be interacted with. Upon reaching specific checkpoints, the user listens to audio which adds to the story. Within 'The Walk', the game is played passively, with the user being able to put their phone in their pocket, ensuring that they are making progress, without the need to constantly check their device.

The game aims to entice the user to walk more through the use of narrative elements. Additionally, other gamification elements are implemented such as levels, rewards, and the ability to track one's progress. Furthermore, the app includes a degree of exploration, as the user can select more than one path to follow within the game. The game also implements

goal setting, although the user has to follow the goals set by the game itself, namely, walking distance challenges.

A.5 Hops - Journey of Tree Spirit

This app was included within this review due to it including a well-polished approach to gamification for healthy behaviour change, implementing many relevant aspects. For instance, goals and rewards are quite explicitly integrated within the app, alongside features such as the ability to track one's progress. This, combined with the positive rating of 4.5, based on 106 reviews, lead to this app being included.

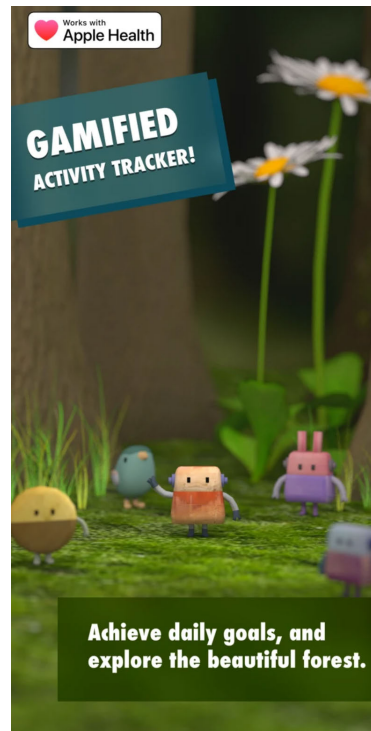
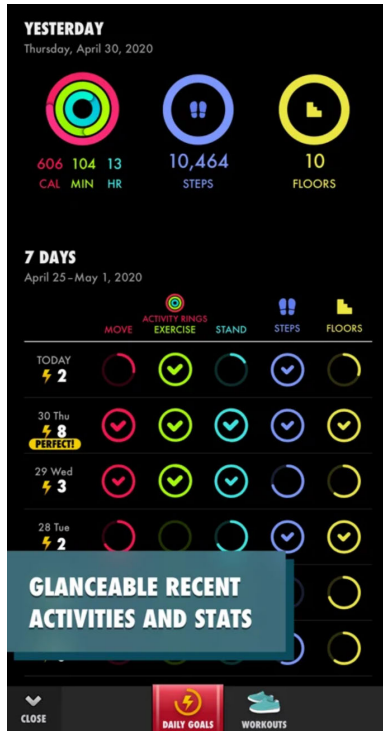


Figure A4. Screenshots showing the 'Hops' app. Images obtained from Apple App Store¹³.

¹³ <https://apps.apple.com/us/app/hops-journey-of-tree-spirit/id1433717138>

'Hops' is an activity tracker which implements gamification. The goal of the app is to motivate the user to increase their level of physical activity. Through physical activity, users gather 'energy' which can be used to explore the in-game world and to craft various items. Completing missions leads to additional rewards.

The main character of the game is Hops, who the user can explore the virtual forest with. Through achieving daily goals by walking, running, and exercising, the user gathers energy which can be used to travel. The user's steps lead to the gathering of various materials which can be used in order to craft in-game items. Furthermore, it is possible to change the look of Hops, and to unlock special effects, enhancing the experience. Through the completion of missions, such as walking a specified amount of steps it is possible to unlock friends for Hops. From an activity tracking perspective, the user can look at their exercise values in an overview page which tells them if they have reached their goals, alongside a history of the past days. An additional feature of this app is its compatibility with the Apple Watch. This allows users to make progress in the game even when they do not have their phone on them.

The way in which 'Hops' encourages physical activity is through a combination of gamified elements, and goals which the user can select. The user is encouraged to bond with the main character, Hops, customizing him based on their personal preference, and to explore the virtual world. Goals within this game are set, and therefore, the user has to select from an existing list.

A.6 Walkr

The primary reason for the selecting of this app was its implementation of many relevant design elements, such as goal setting, social features, and exploration, alongside its popularity. The app is received positively, with a 4.3 rating on the Google Play Store, based on 70,411 reviews, and 4.5 on the Apple App Store based on approximately 5,900 reviews. Additionally, the app features a uniquely well executed visual aesthetic, including well made animations and visualisations.

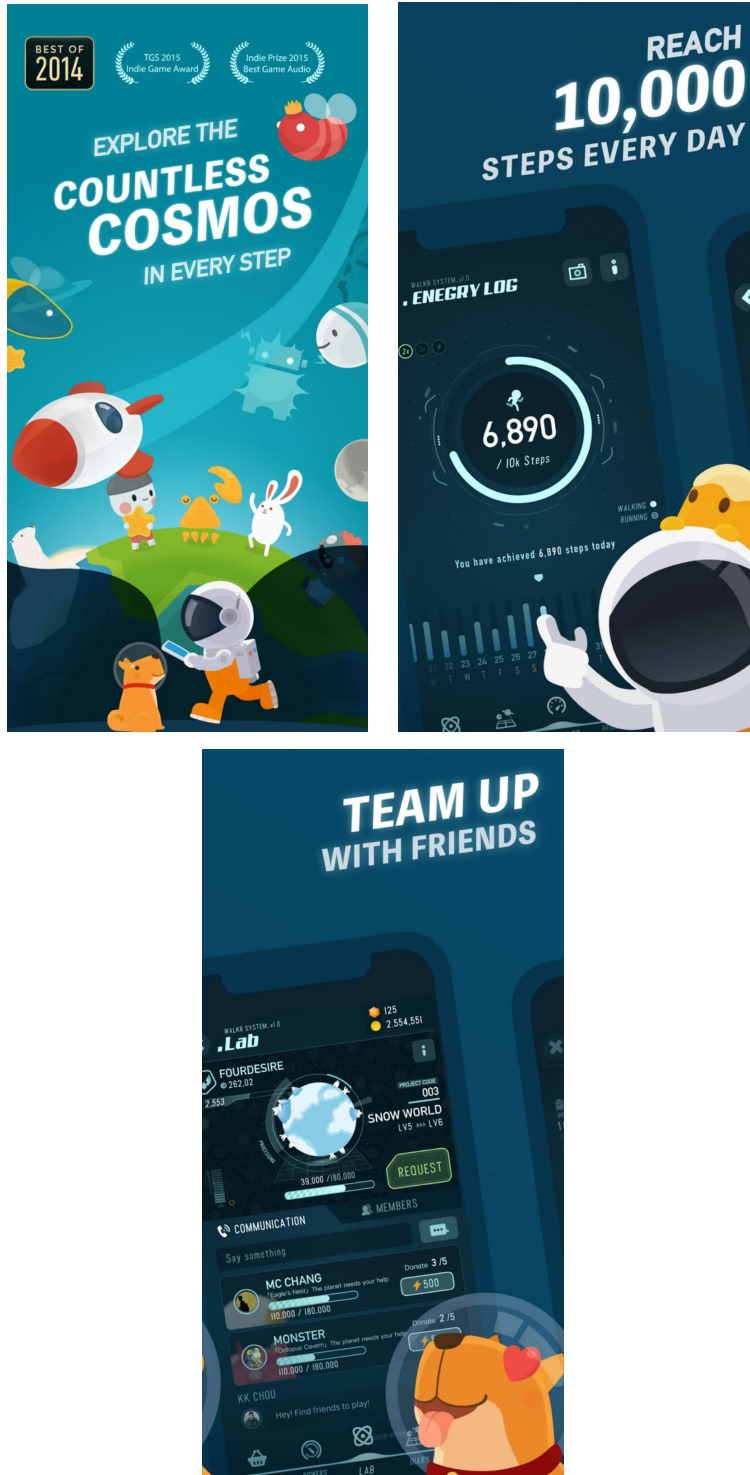


Figure A5. Screenshots showing the 'Walk' app. Images obtained from Apple App Store¹⁴.

¹⁴<https://apps.apple.com/us/app/walkr-a-gamified-fitness-app/id834805518>

This app presents a gamified fitness tracking experience. It uses the smartphone's pedometer in order to drive a galaxy-themed gamified experience. The primary goal of this app is to encourage the user to walk more, by converting the user's steps into fuel for the virtual spaceship. Additionally, the app presents the user with useful information such as calories burnt, but also with recommended activity goals. As the user progresses through the game, they collect planets as well as other, space-themed items.

The way in which this app encourages physical activity is through encouraging step-taking, with the purpose of exploring the in-app galaxy. As the user uses the app, they are prompted and encouraged to explore new planets, however, upon doing so, they are met with a timer. This timer can be reduced with fuel, which is built up by walking. Users are encouraged to reach daily goals, but also to work together with friends in order to obtain more fuel, while competing on leaderboards.

Appendix B. Exploratory Brainstorming

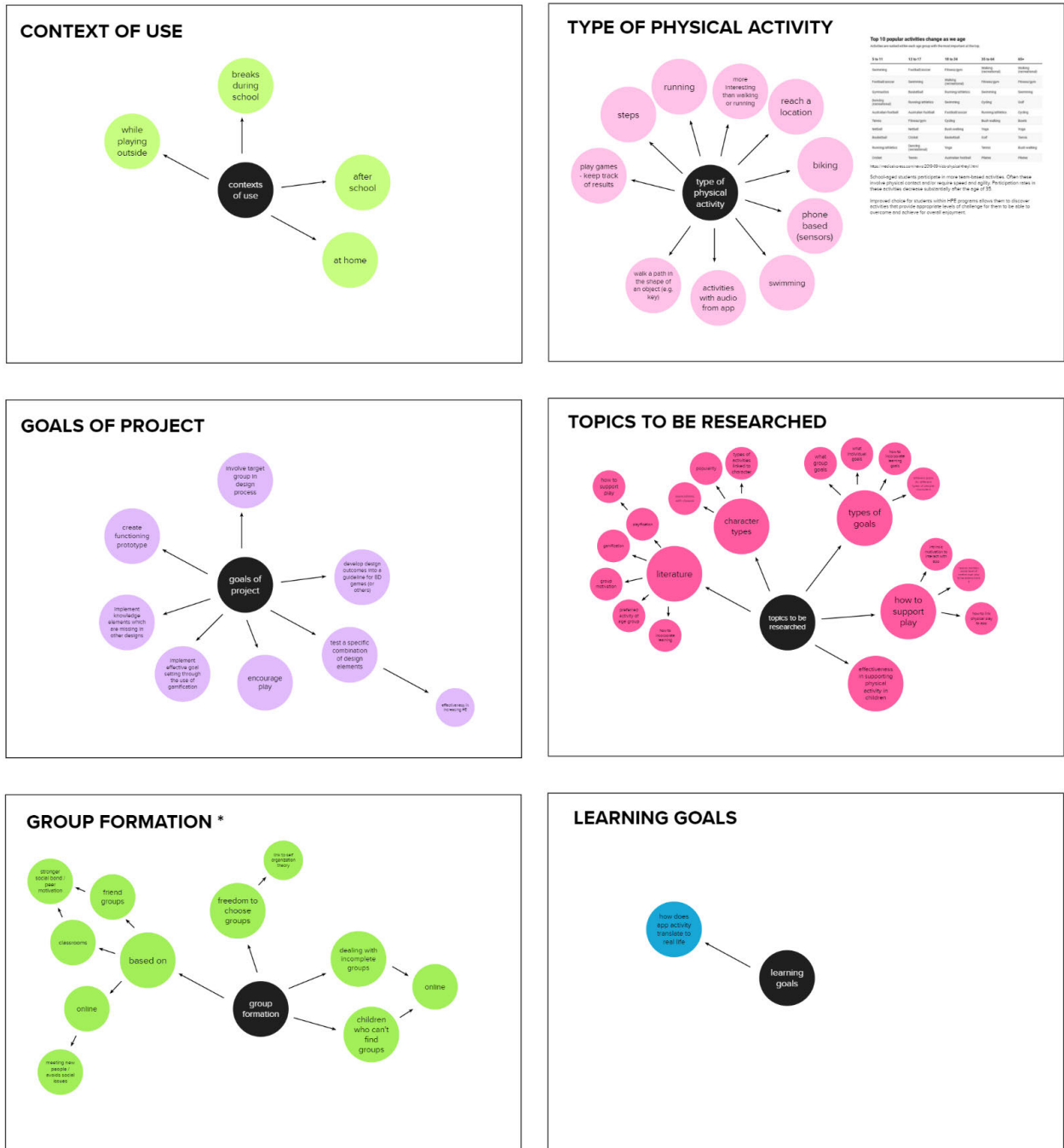


Figure B1. Screenshot showing the results of the exploratory brainstorming activity.

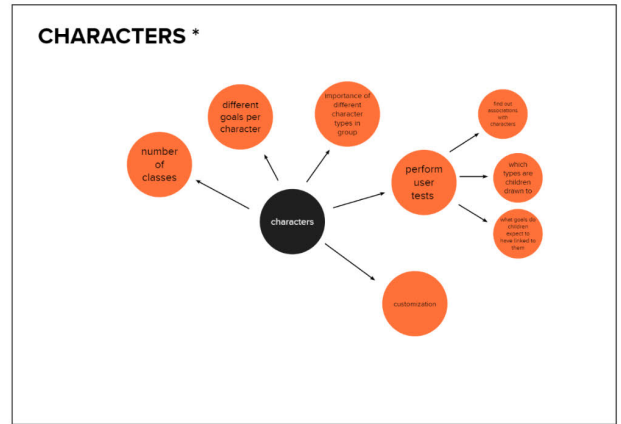
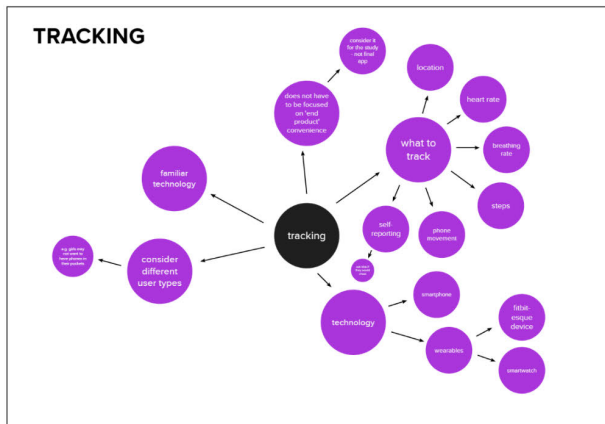
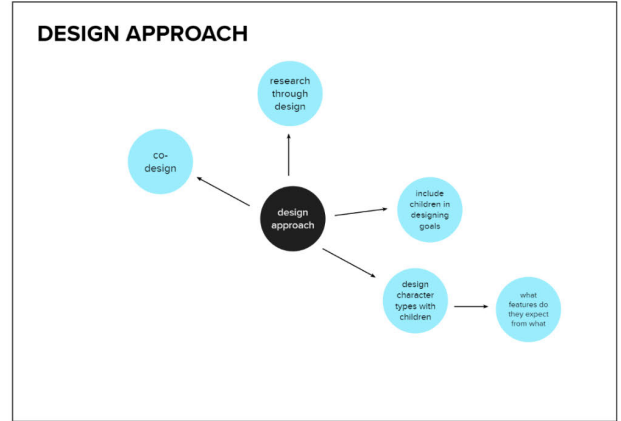
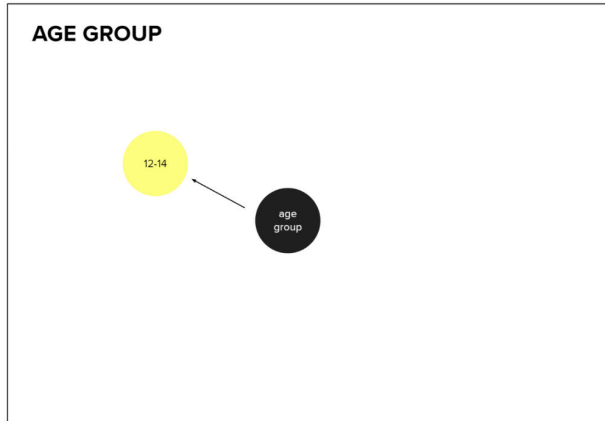


Figure B2. Screenshot showing the results of the exploratory brainstorming activity.

Appendix C: Brainwriting Session Outcome

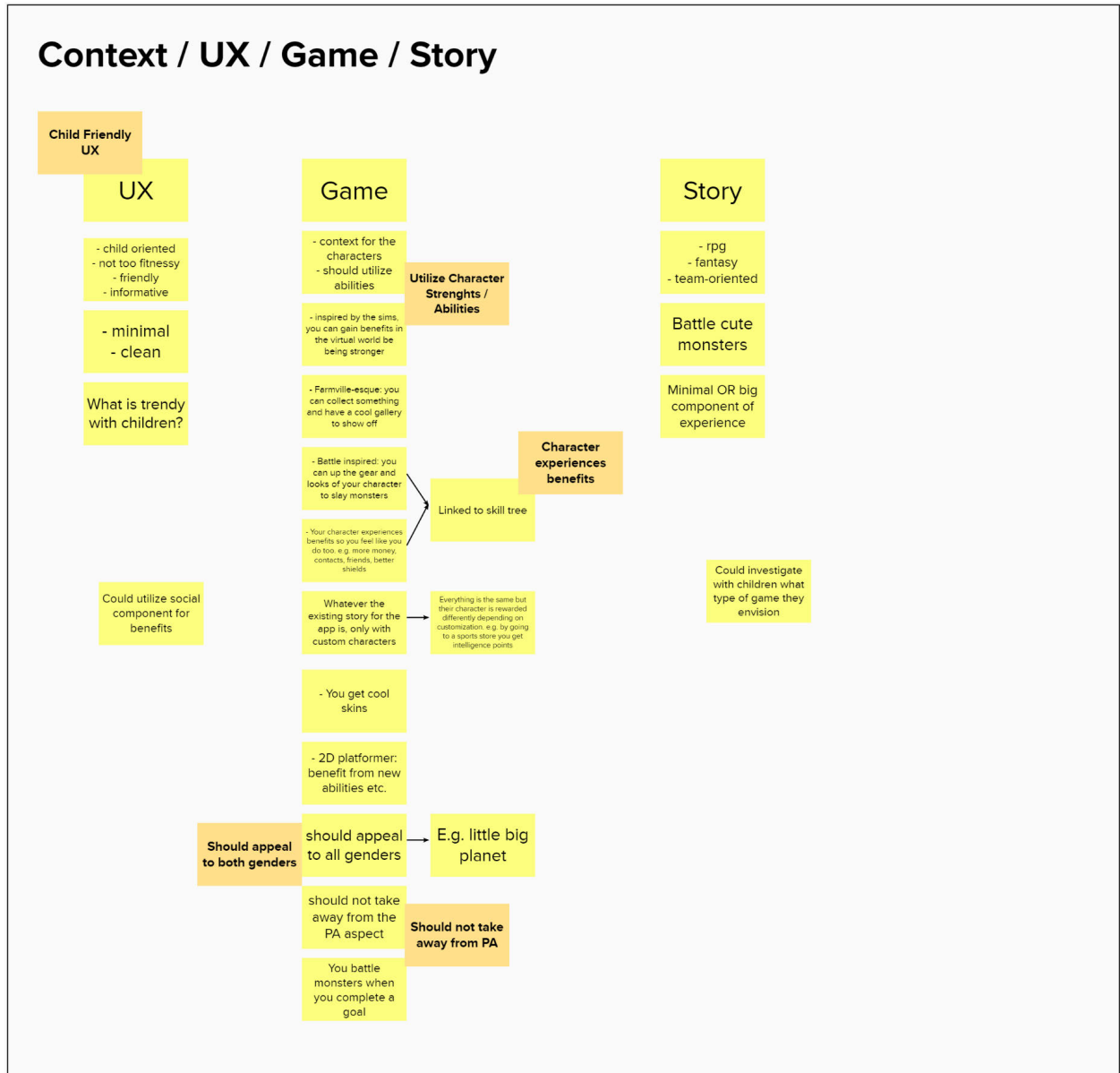


Figure C1. Screenshot showing the outcome of the brainwriting session.

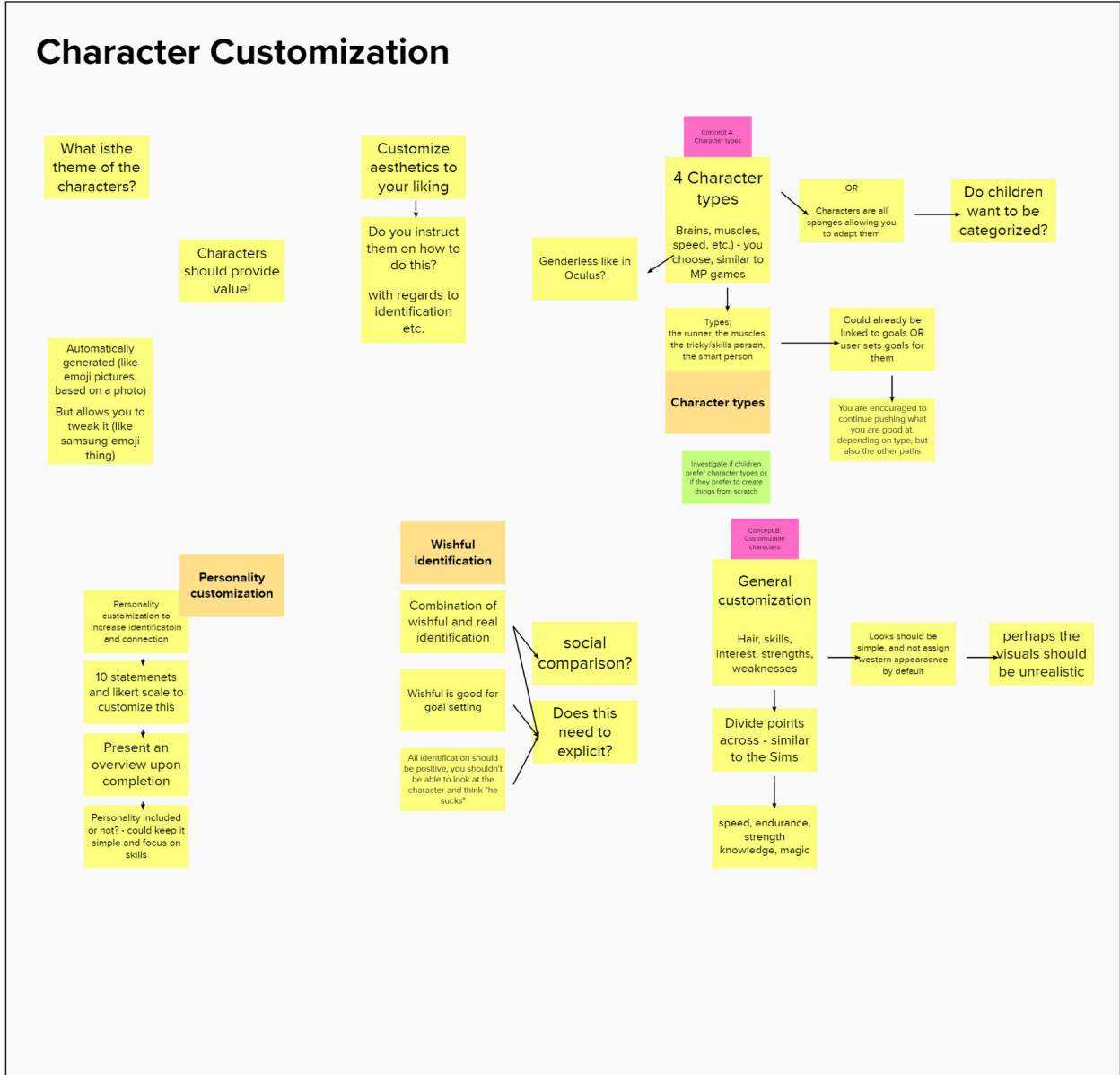


Figure C2. Screenshot showing the outcome of the brainwriting session.

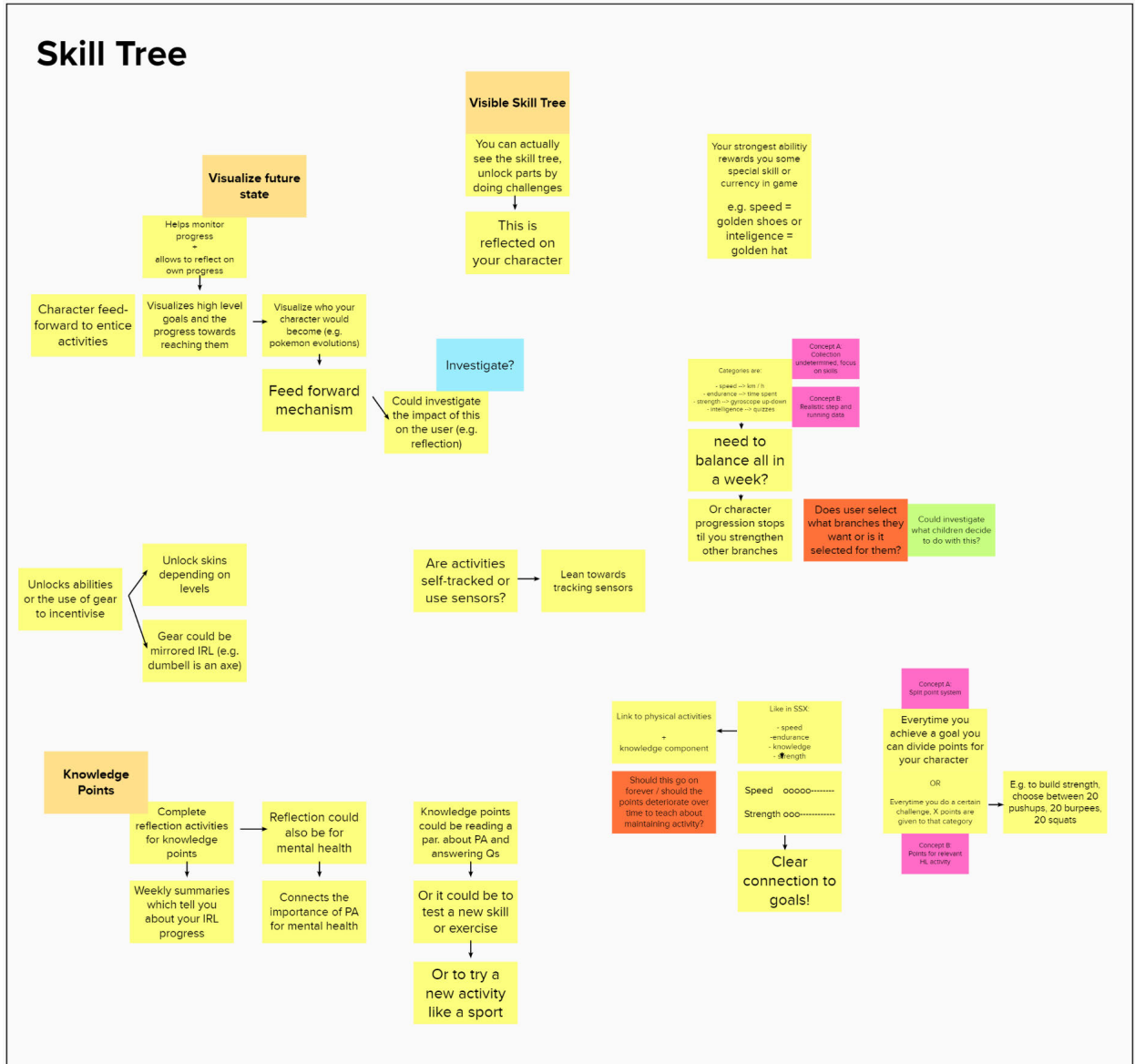


Figure C3. Screenshot showing the outcome of the brainwriting session.

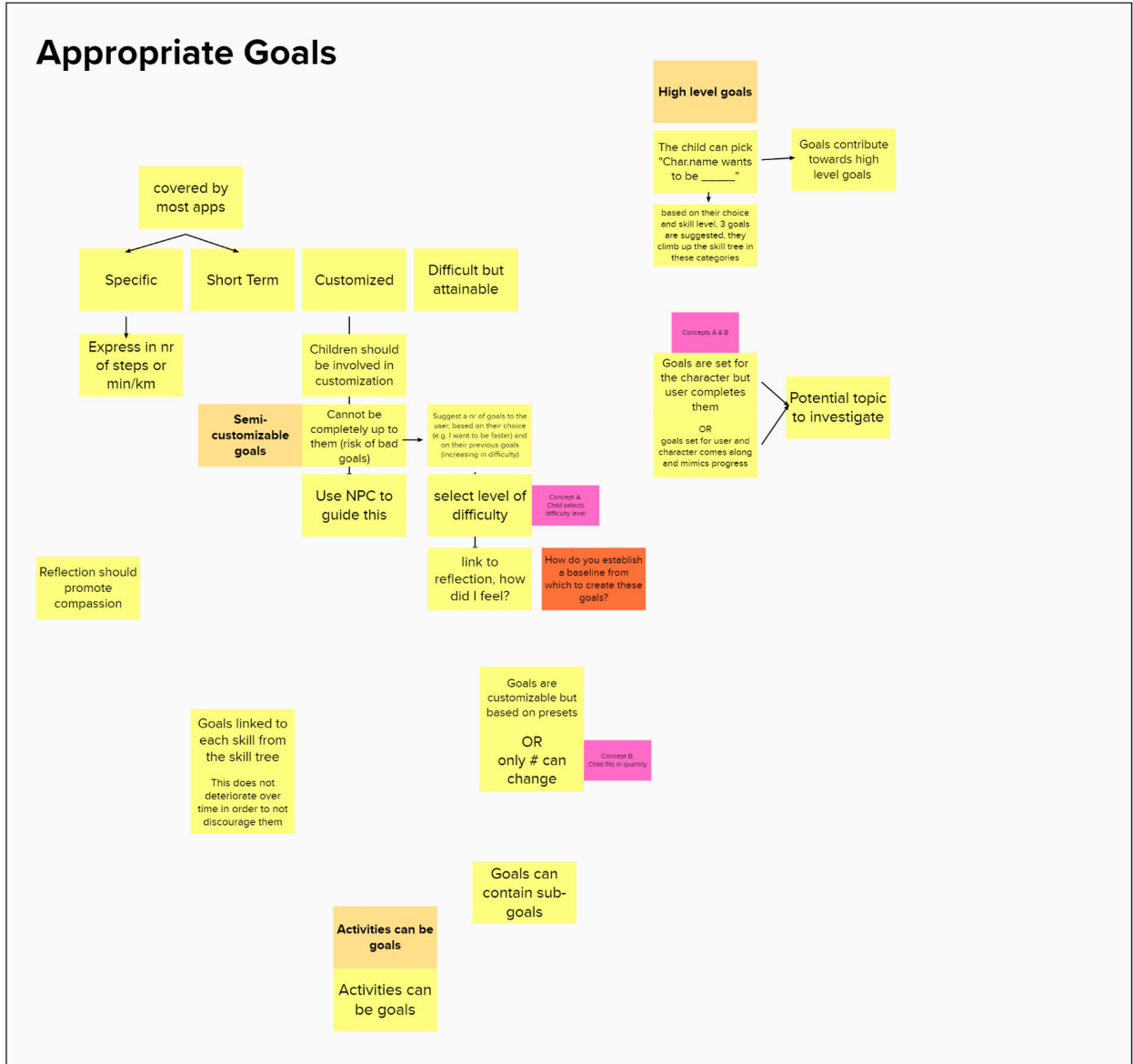


Figure C4. Screenshot showing the outcome of the brainwriting session.

Appendix D. Full App Flow

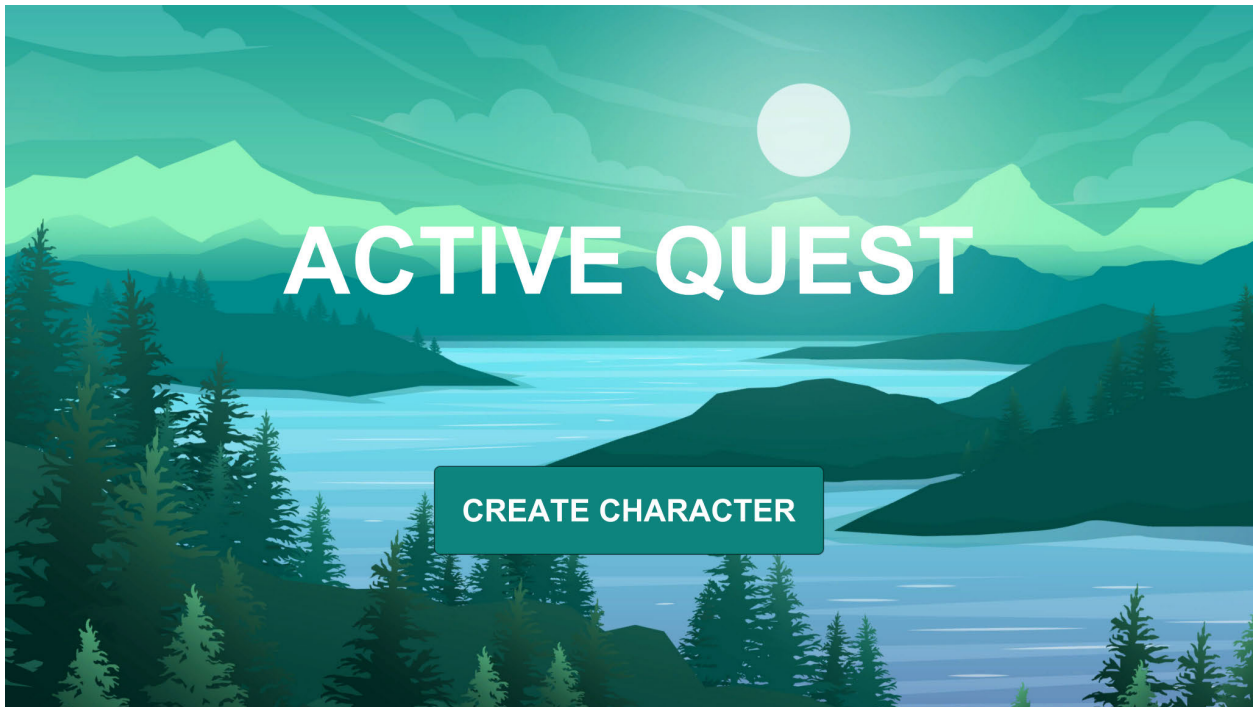


Figure D1. Screenshot of the main menu screen.

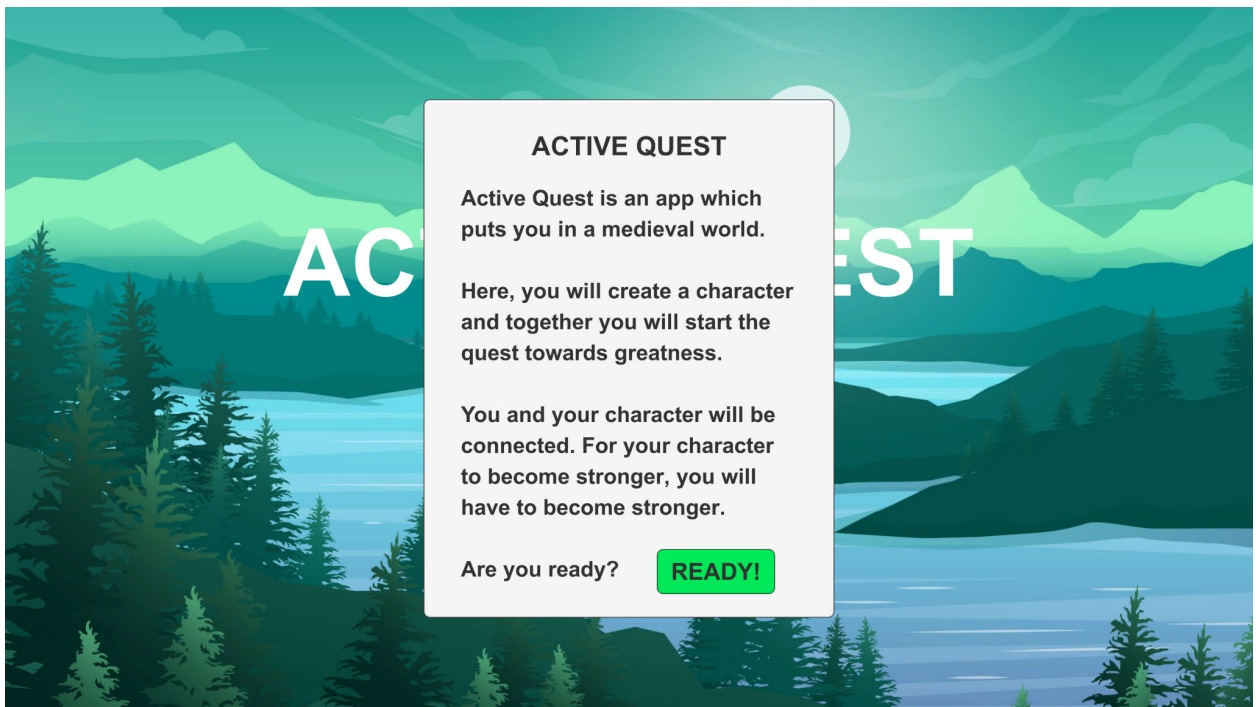


Figure D2. Screenshot of the main menu pop-up screen.

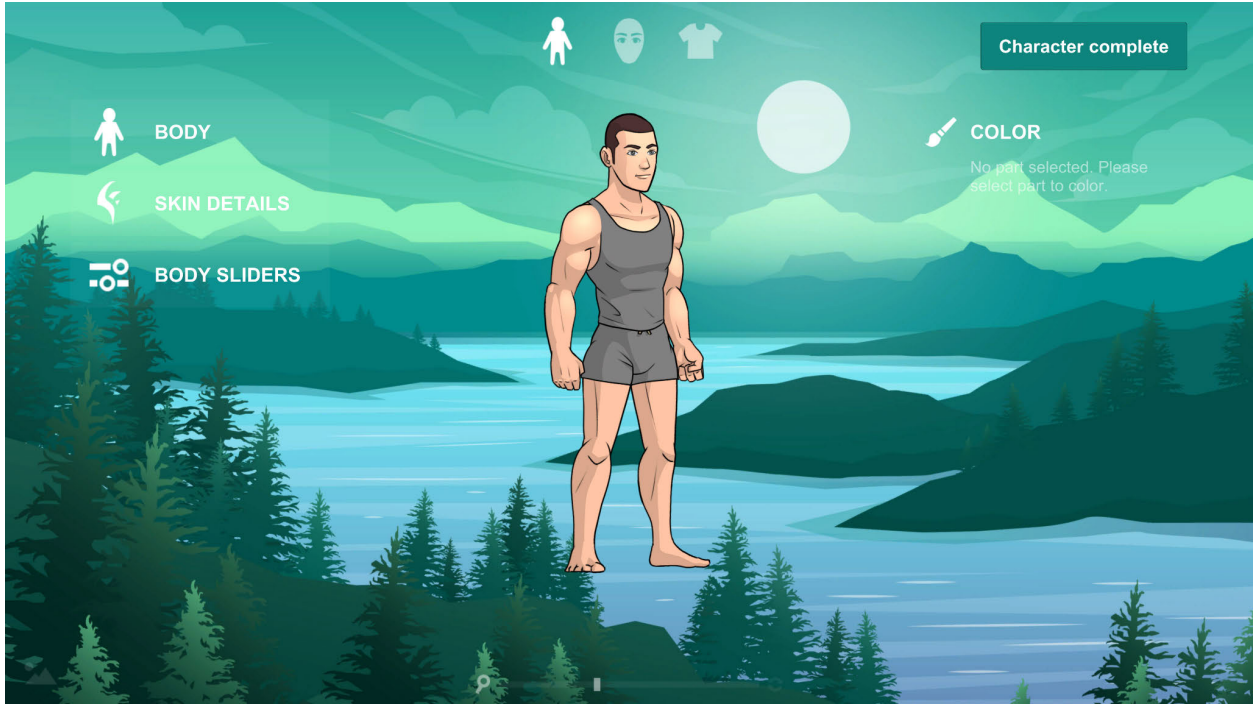


Figure D3. Screenshot of the body customization screen.

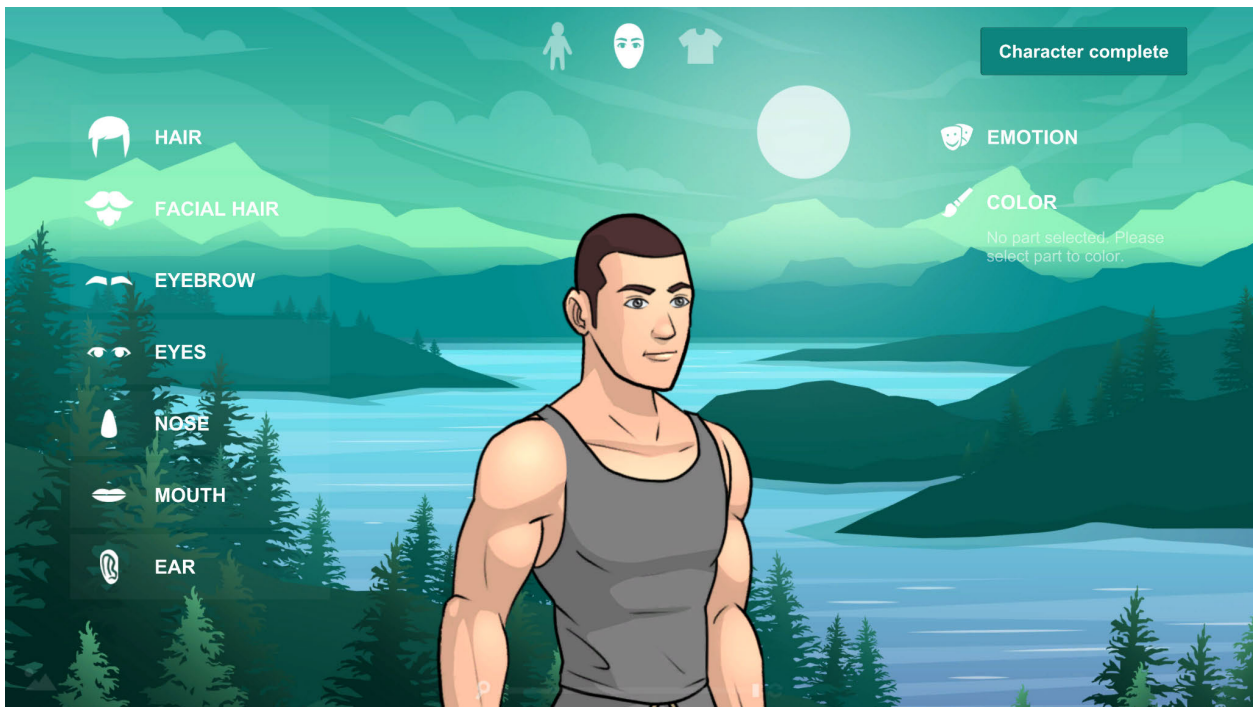


Figure D4. Screenshot of the face customization screen.



Figure D5. Screenshot of the clothing customization screen.

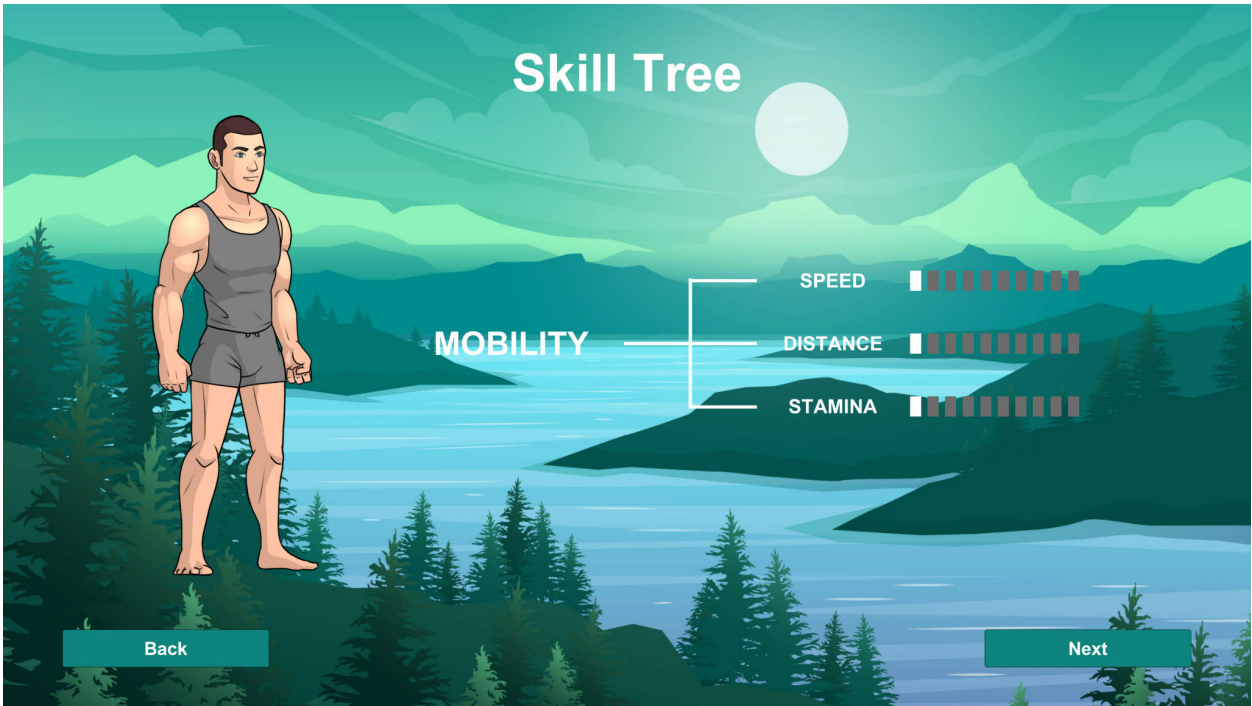


Figure D6. Screenshot of the skill tree screen.

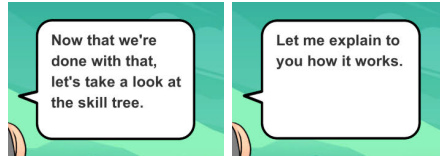


Figure D7. Screenshots of the speech-bubbles from the skill tree screen.

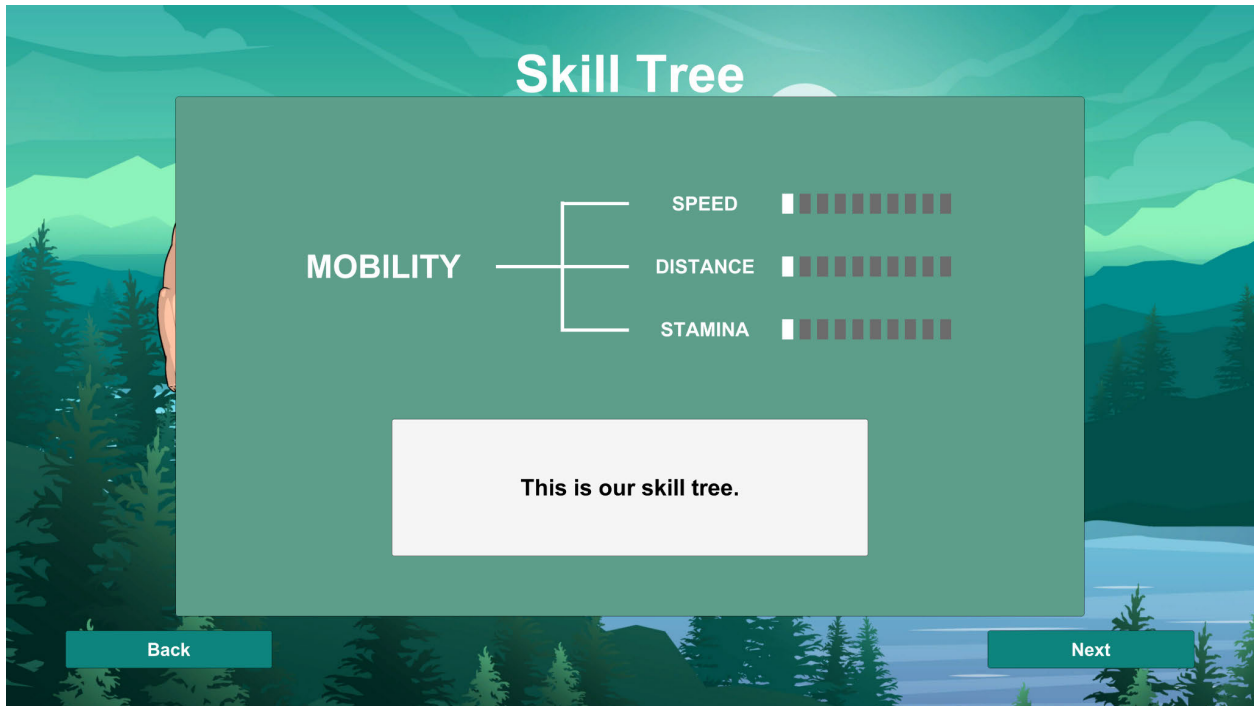


Figure D8. Screenshot of the skill tree pop-up explanation screen.



Figure D9. Screenshots of the speech-bubbles from the skill tree pop-up screen.

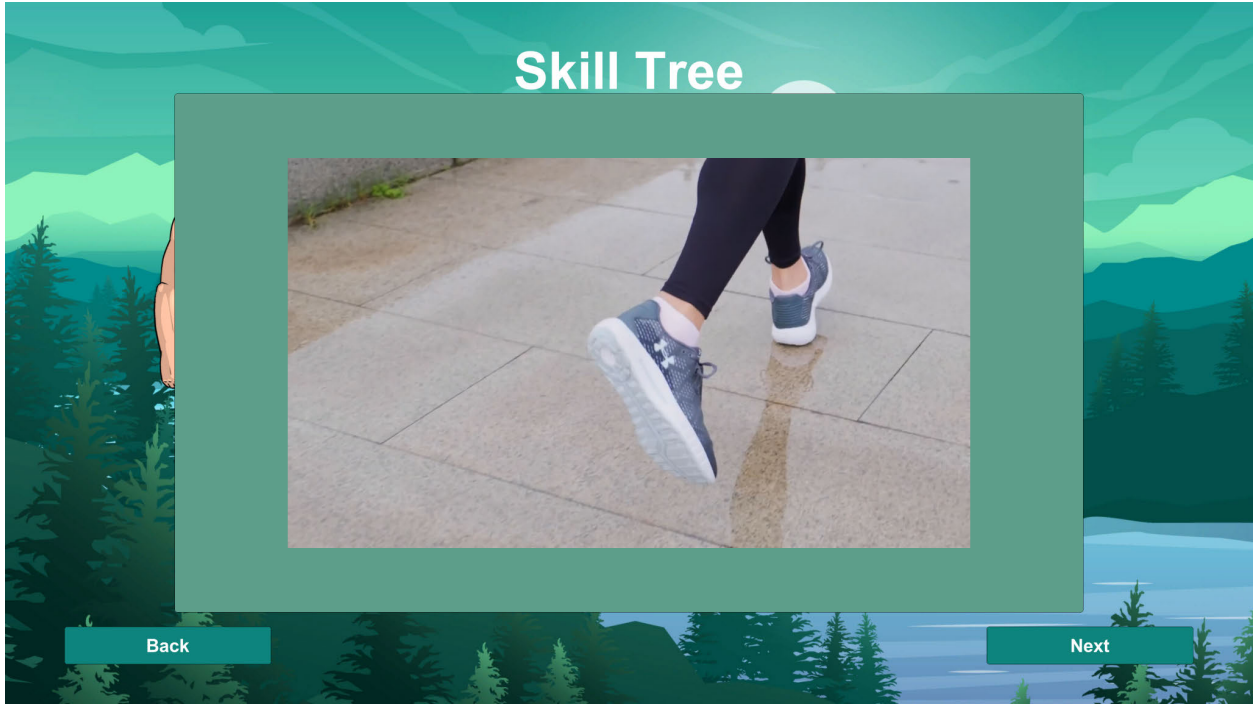


Figure D11. Screenshot of the running video from the skill tree pop-up screen.

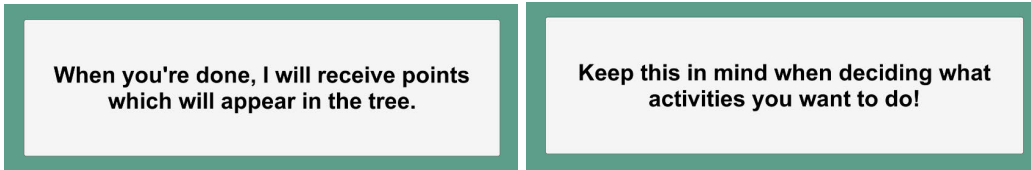


Figure D12. Screenshots of the speech-bubbles from the skill tree pop-up screen.

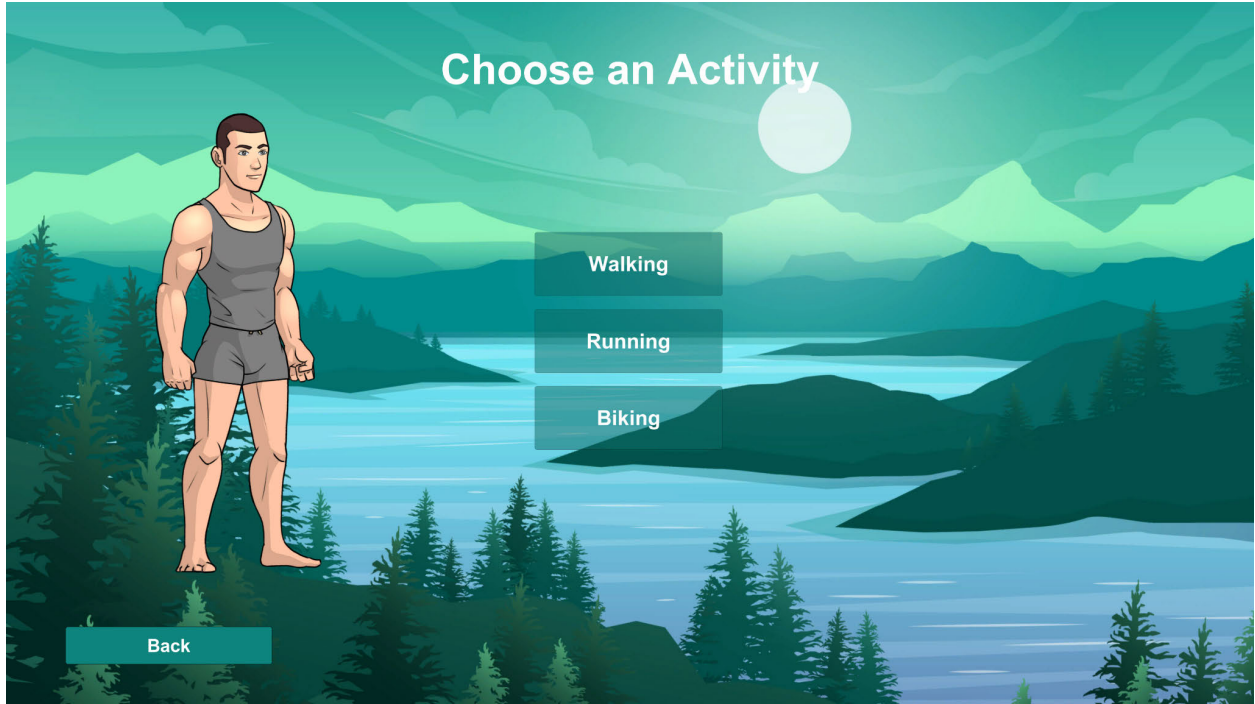


Figure D13. Screenshot of the high level activity selection screen.

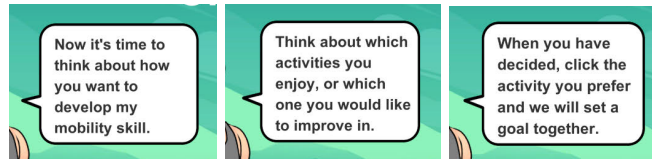


Figure D14. Screenshots of the speech-bubbles from the high level activity selection screen.

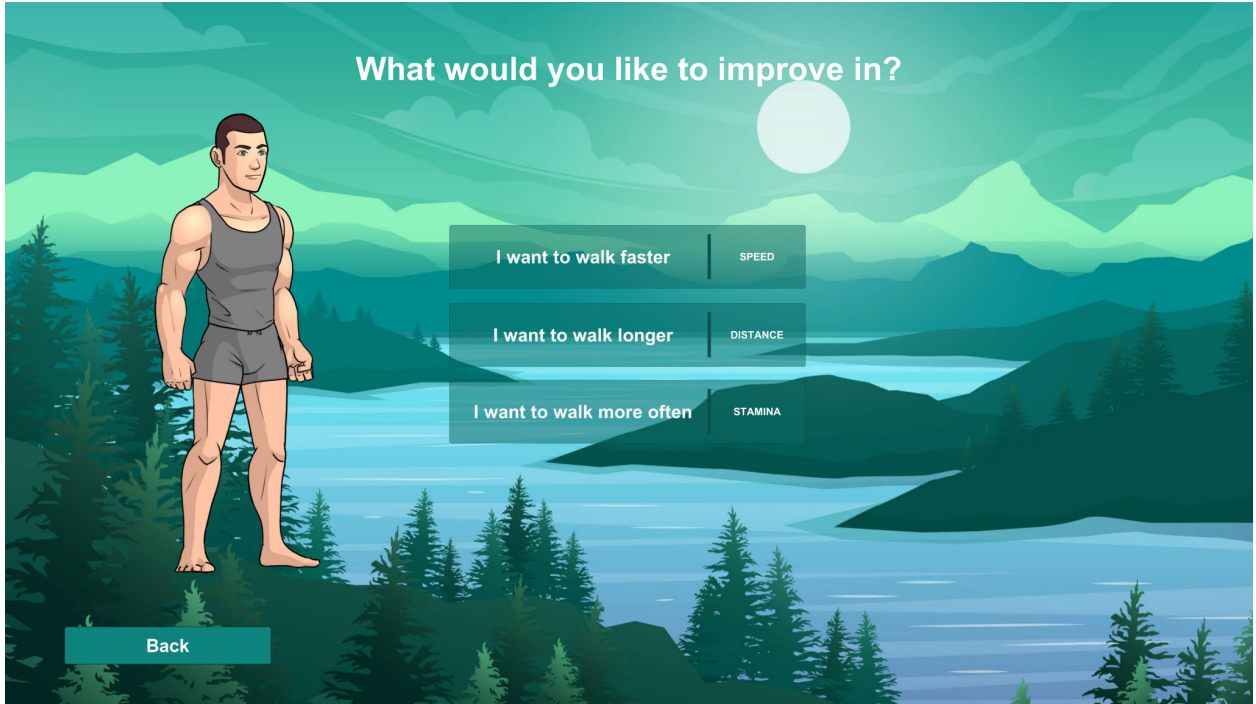


Figure D15. Screenshot of the branch selection screen.

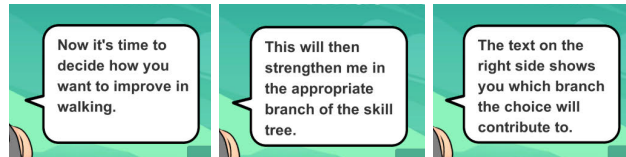


Figure D16. Screenshots of the speech-bubbles from the branch selection screen.

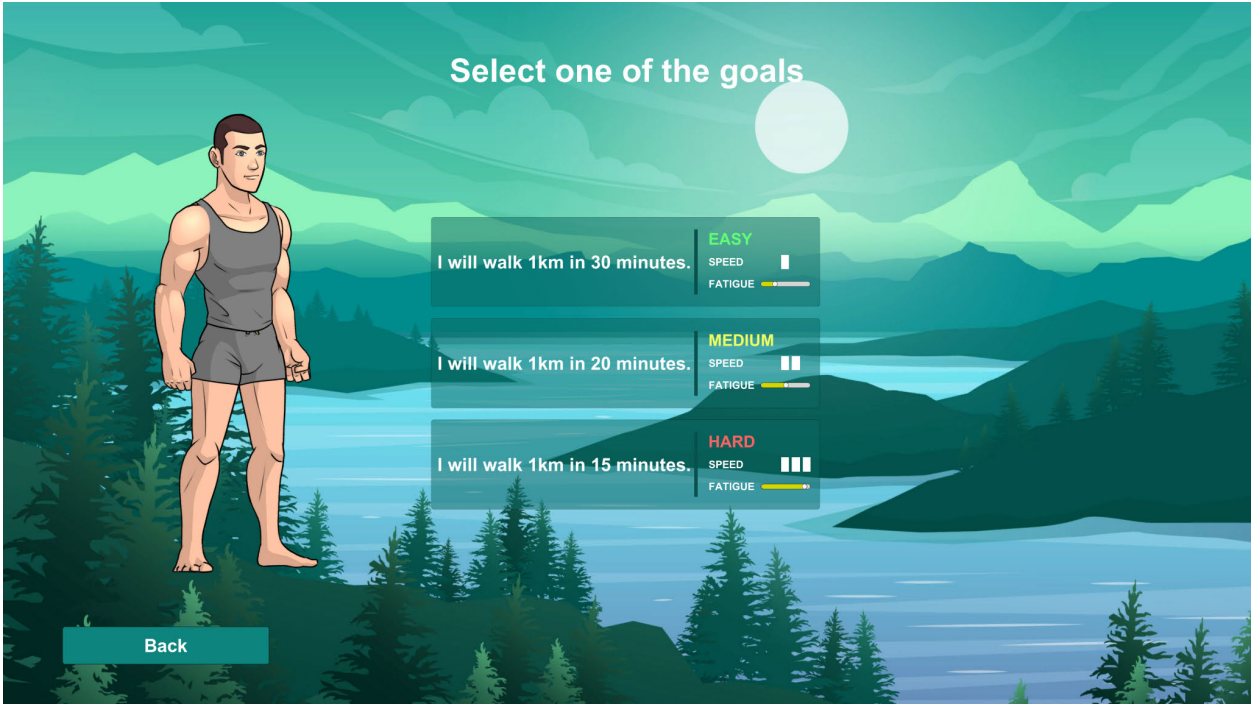


Figure D17. Screenshot of the difficulty selection screen for the speed ability.

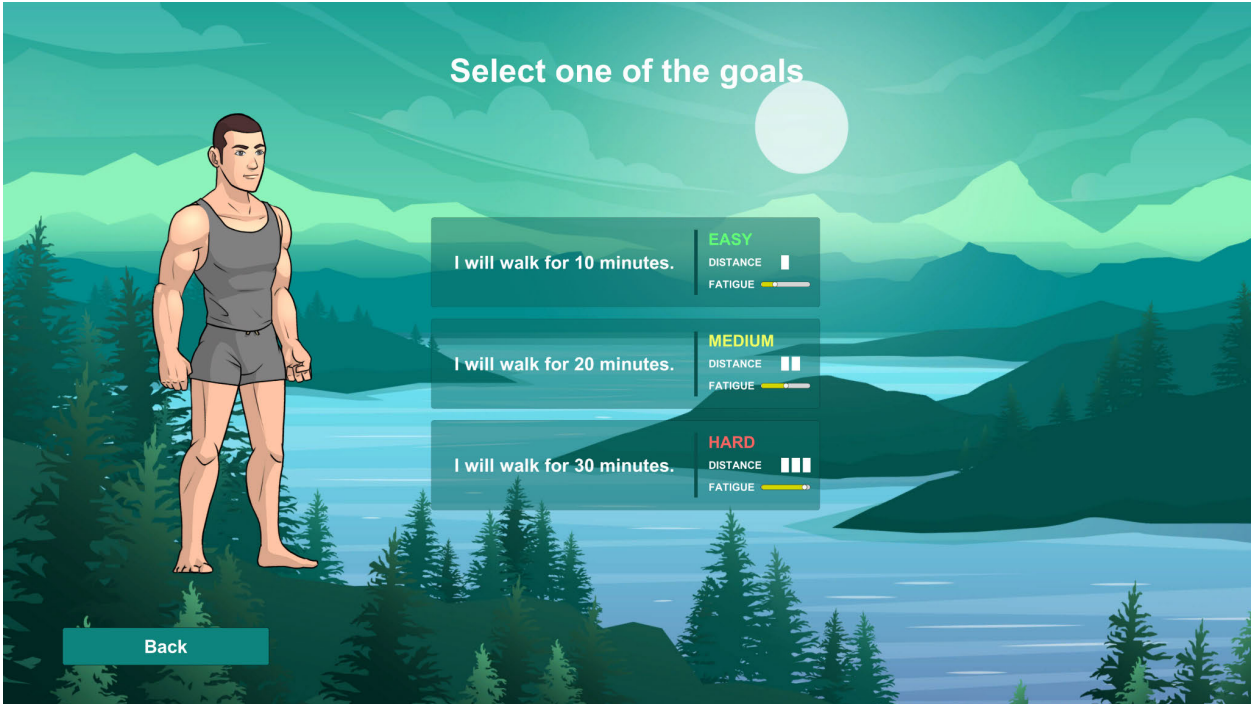


Figure D18. Screenshot of the difficulty selection screen for the distance ability.

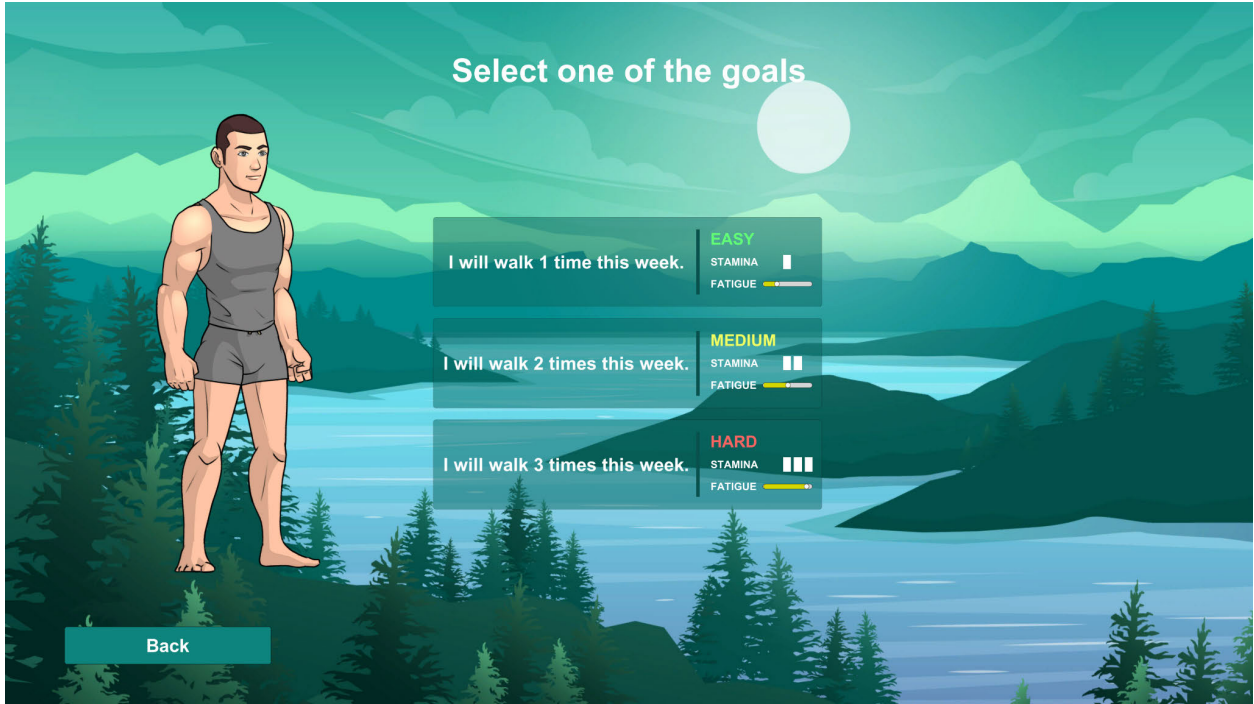


Figure D19. Screenshot of the difficulty selection screen for the stamina ability.

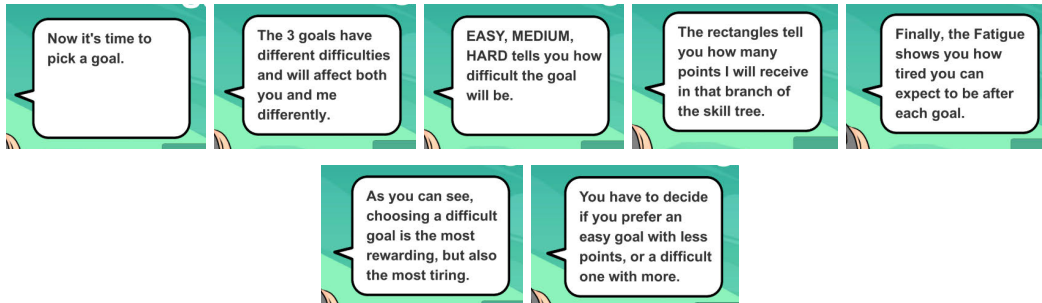


Figure D20. Screenshots of the speech bubbles from the difficulty selection screen.



Figure D21. Screenshot of the post-goal selection screen.

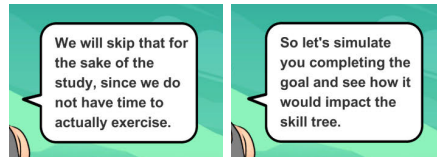


Figure D22. Screenshots of the speech-bubbles from the post-goal selection screen.



Figure D23. Screenshot of the goal completion simulation screen.

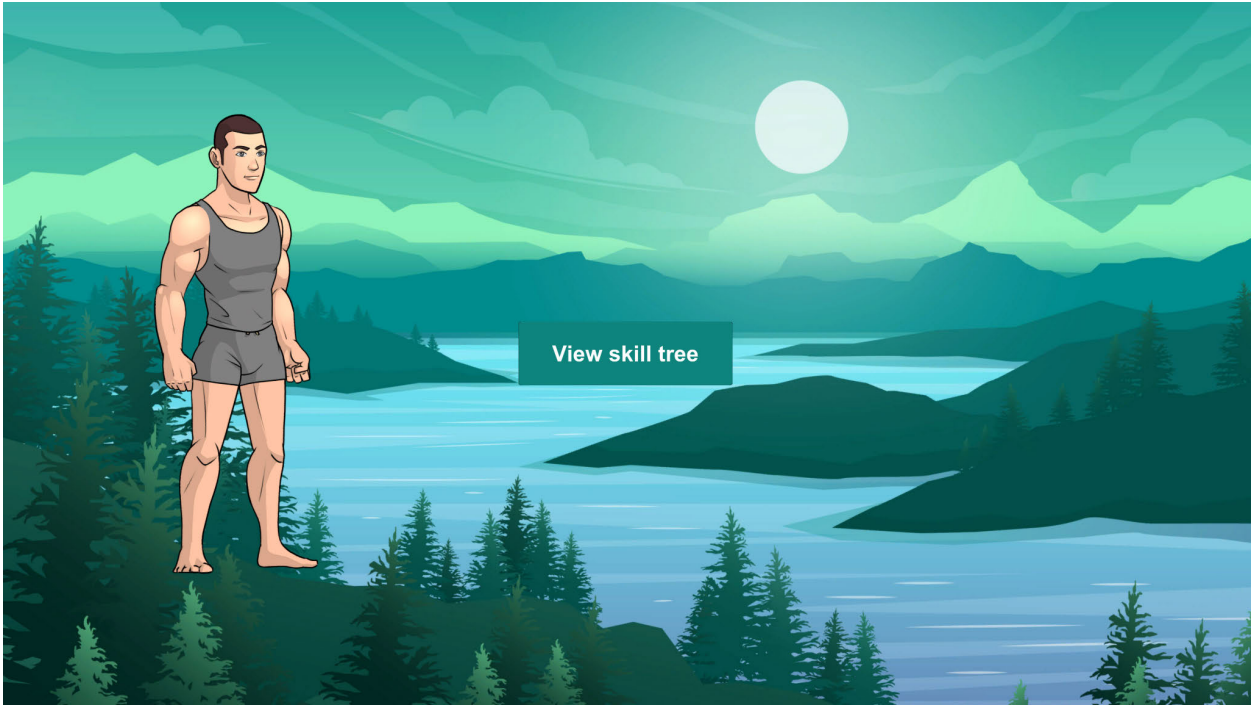


Figure D24. Screenshot of the view skill tree screen.

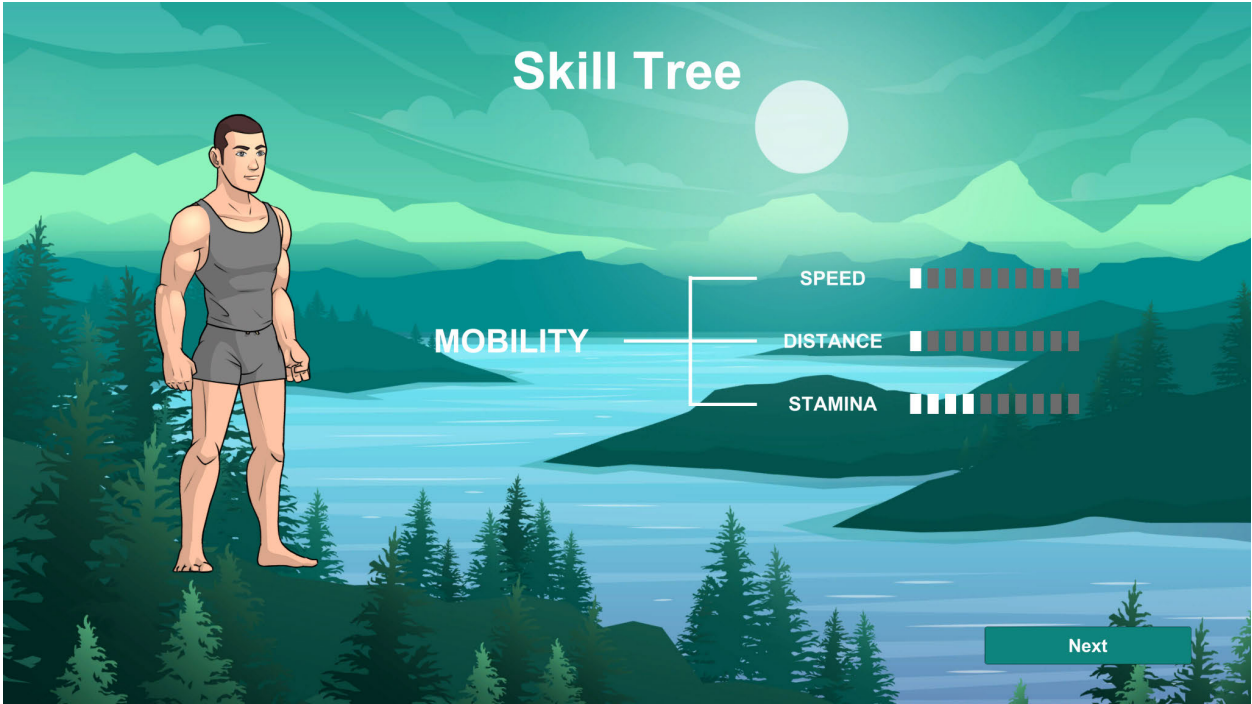


Figure D25. Screenshot of the updated skill tree screen.

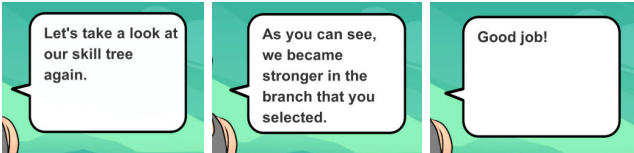


Figure D26. Screenshots of the speech-bubbles from the updated skill tree screen.



Figure D27. Screenshot from the interaction completed screen.

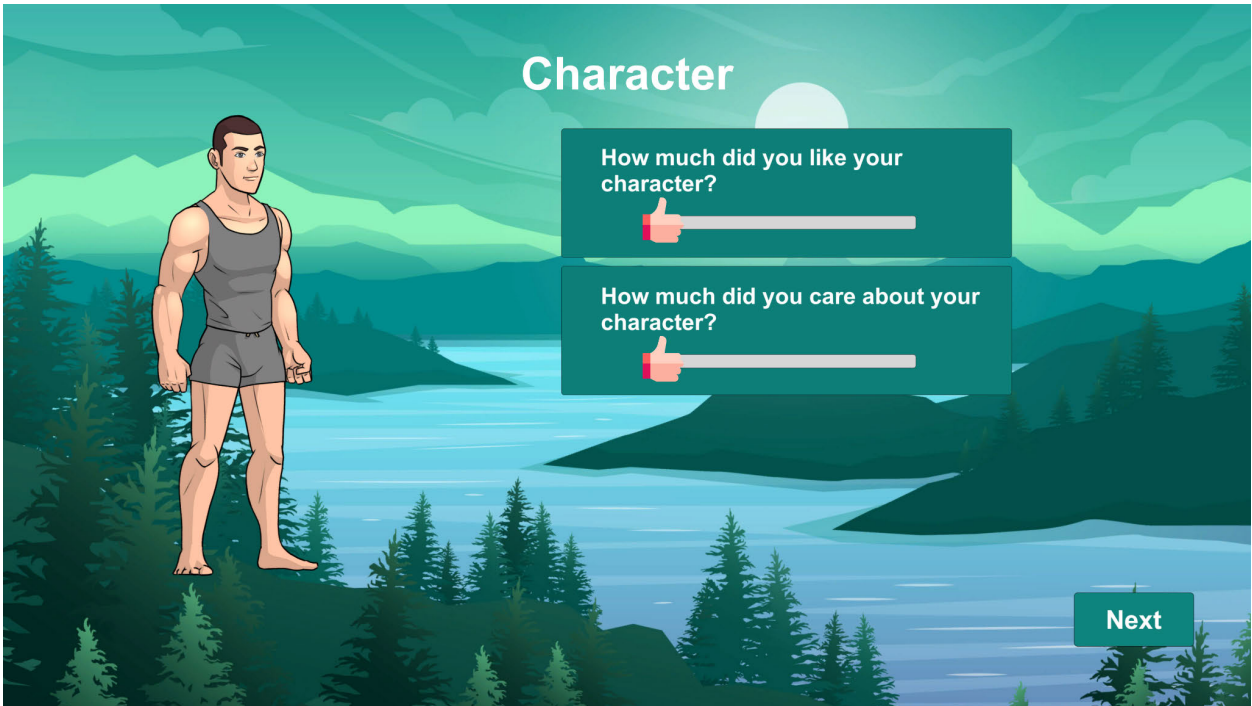


Figure D28. Screenshot of the character evaluation screen.

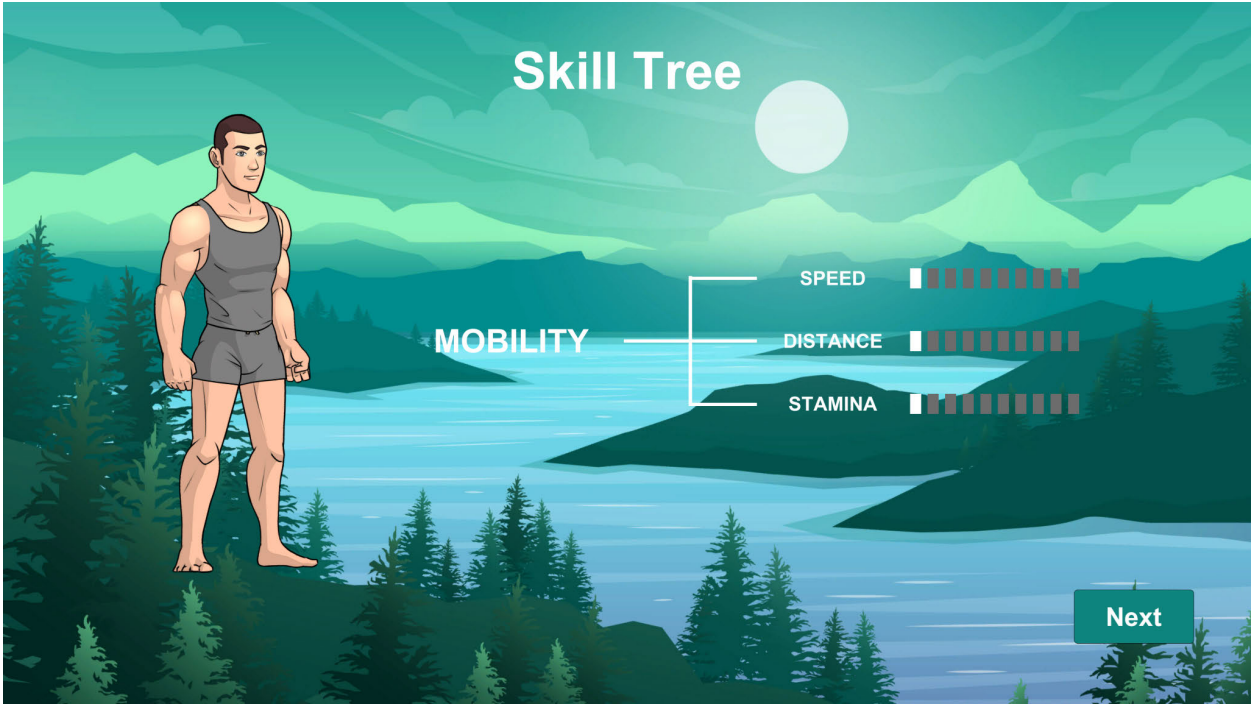


Figure D29. Screenshot of the skill tree evaluation screen.

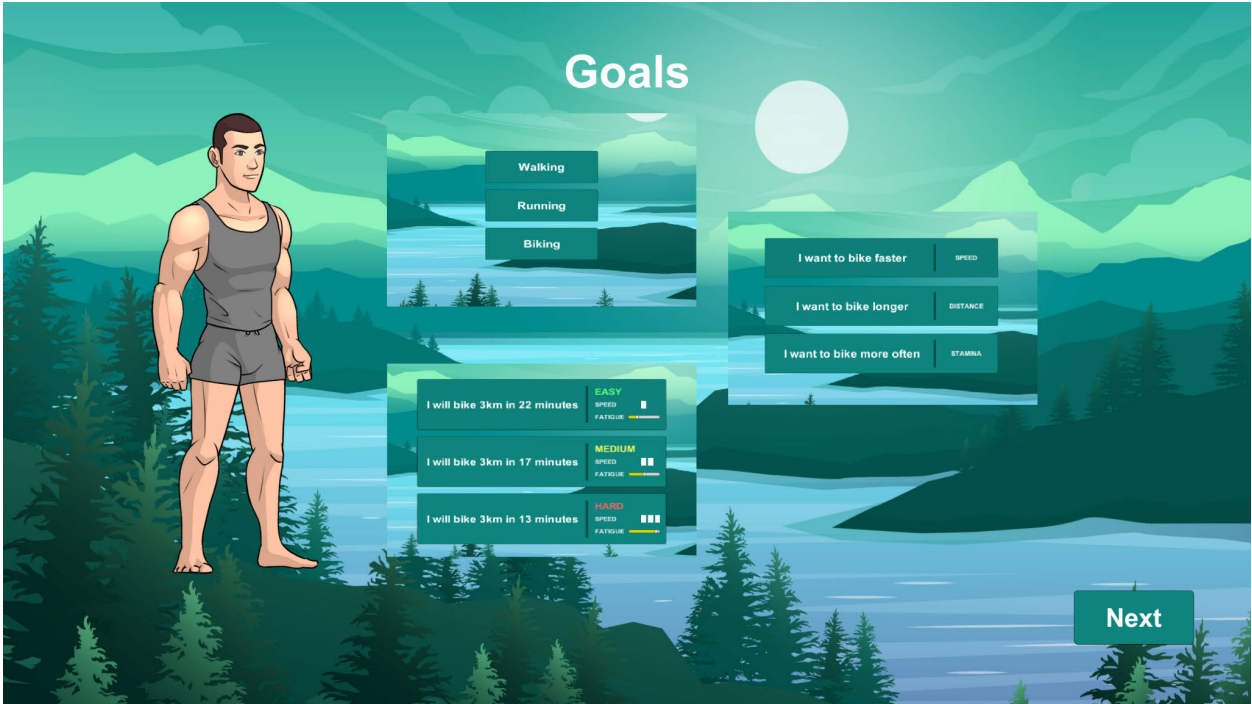


Figure D30. Screenshot of the first goal evaluation screen.

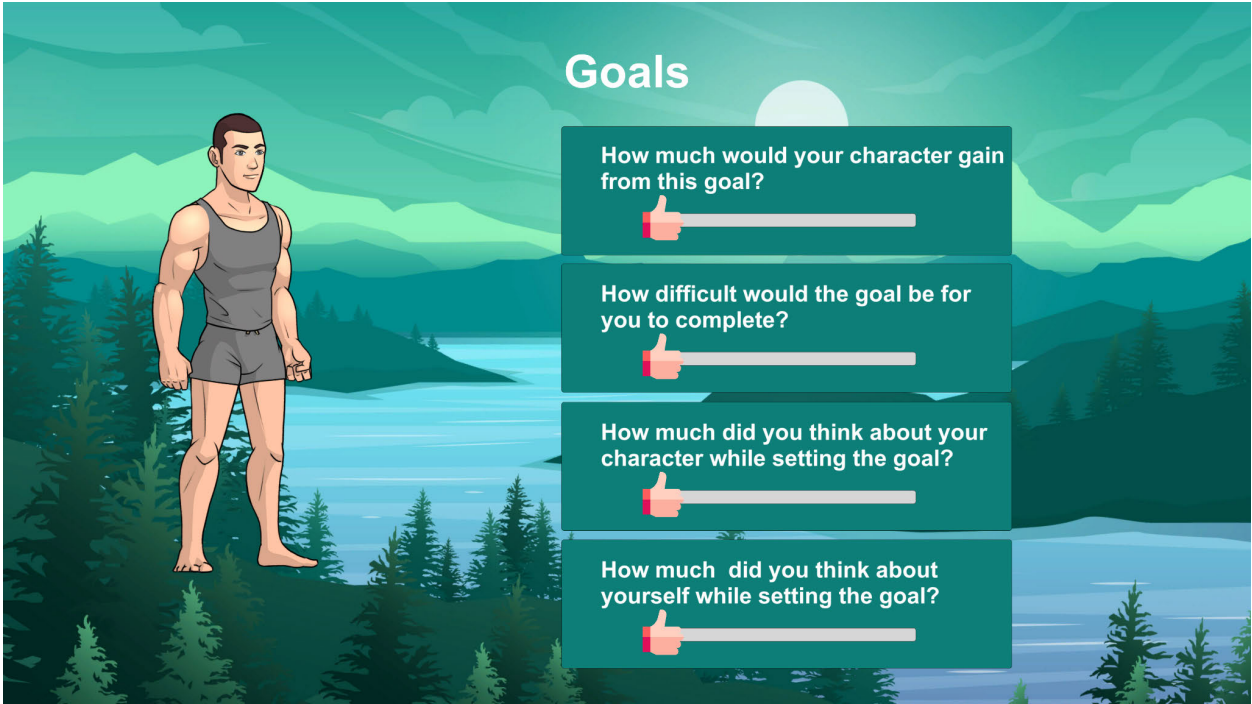


Figure D31. Screenshot of the second goal evaluation screen.

Appendix E. Protocol

This section presents the questions and flow which were used to guide the semi-structured interview process, done as a part of the user evaluation of the proposed design.

Introduction

- Introduce researcher
 - My name is Wojtek and I study at University of Twente
 - Today we're gonna be taking a look together at an app that I'm working on.
 - I'm talking to people who would end up using the app, and that's why you're here.
- I'm gonna start recording now
- Confirm willingness to participate.
- Introduce purpose of session
 - Here to try out and evaluate an early version of an activity app for children
 - The researcher will ask some questions, the user will try out the app, this will be followed by some more questions.
 - Don't be afraid to say what you think. Nothing you say can be wrong, this is all just feedback so that I can make improvements and make it better. You are the expert here because you would end up using the app.
- Explain think out loud protocol
 - During the interaction, as much as possible, try to say what you're thinking and doing out loud. It might feel strange, but knowing what you're thinking, can really help me.
- Introduce order
 - First I'm gonna ask you some questions about activity and goals and games that you might play.
 - Then you will try out the app that I am working on.
 - Then I will ask you some more questions to find out what works, and what we need to improve.

Interview Part 1

- What sports do you do?
 - NO → Any type of activity?
 - YES → Do you have any goals for that sport/activity?
 - Explain your goal.
 - How did you choose this goal?
 - Did someone help you set this goal?
- (Create a scenario in which a long term goal is set for that activity) How would you approach trying to accomplish this goal?

- Do you use any apps or play any games that make you move?

Introduction to Interaction

- Introduce the game
 - This app is called Active Quest
 - It's set in a medieval world and is all about creating a character, and then trying to make them stronger through being active yourself.
 - So when you are active, your character becomes stronger.
 - It also tries to help you set goals for yourself, so that you can be active with a purpose.
- Please share your screen
- Open the app
- From this point on, you can interact with the app. If you have any questions feel free to ask.
- Do you have any questions before we begin?

[Interaction with prototype]

- You will have 15 minutes to make your character. I'll let you know when the time is up.

Character Creation

- What did you like about creating the character?
- What did you not like about creating the character?
- Why did you make your character like this?

- [Tell them to press the title to open the hidden screen]
- Please use the screen to evaluate the character creation.
- Follow up on choices.

- [Please press the next button now]

Skill Tree

- In your opinion, what does the skill tree represent?
- How did you feel when the skill tree got filled?
- Did the skill tree affect your goal decisions?
- Would it affect them in the future if you kept using the app?
- Have you seen anything similar in a game before?

Goal Setting

- [show picture] Mobility choice → why did you pick walking/biking/running?
- [show picture] Type of activity → why did you pick speed/distance/stamina?
- [show picture] Goal difficulty → why did you choose easy/medium/hard?
- Do you like this approach of creating activity goals for yourself?
- How do you feel about being able to customize goals?
- [Tell them to press next and fill in sliders]
- Follow up on choices.
- Would you use this app again to set a goal?
- In what way did the character affect how you chose the goals?

General Questions

- If we go back to the (scenario) goal. How would you approach this goal now?

Prototype Usability

- Would you show this app to your friends?
- Do you think your friends at school would enjoy playing this game?
 - What would they think about it?
- Did anything confuse you while using the app?
- What was the most memorable part?
- Are there any features that are missing?
- How did you feel while using the app?

Debrief & Conclusion

- Progress is slower in real life as compared to the game
- All of the advice which was provided during the game should not be taken as legitimate advice
- If you have any questions let me know, or if you have any extra comments then tell me
- Thank you for participating

Appendix F. Affinity Diagram

This section depicts the affinity diagram which was generated as a result of the analysis process. The statements of the participants were divided into individual sticky-notes, and color coded based on participants. The participant numbers, and their corresponding colors were: P1 - orange, P2 - green, P3 - pink, P4 - yellow, and P5 - blue.

1 - Understanding Children's Goal Setting Practices

1-A: How do children currently approach goal setting?



1-B: Do children have experience with activity-oriented apps and games?

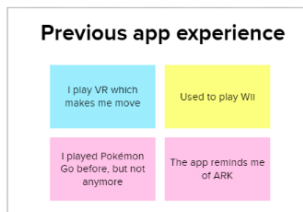
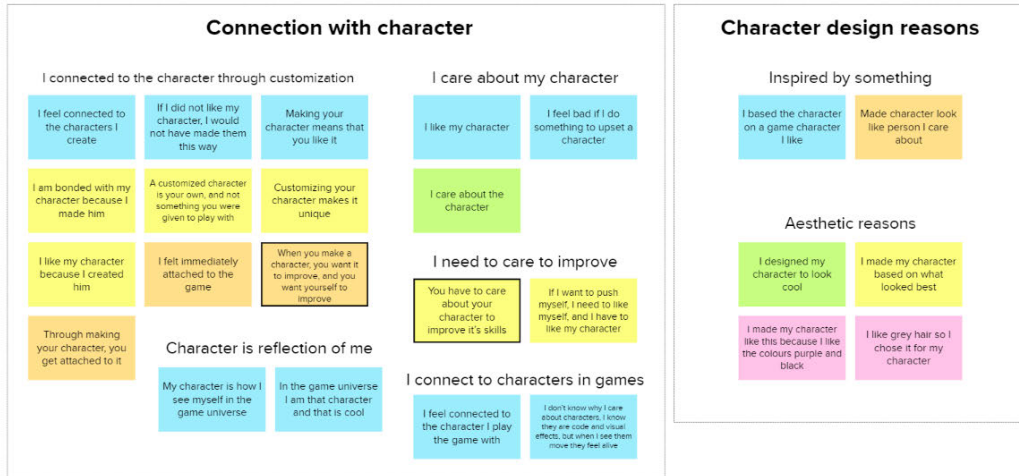


Figure F1. Diagram showing the findings for “Understanding Children’s Goal Setting Practices.”

2 - Characters & Character Customization

2-A: What is the influence of customization on connecting with a character?



2-B: How do children feel about the character customization feature?

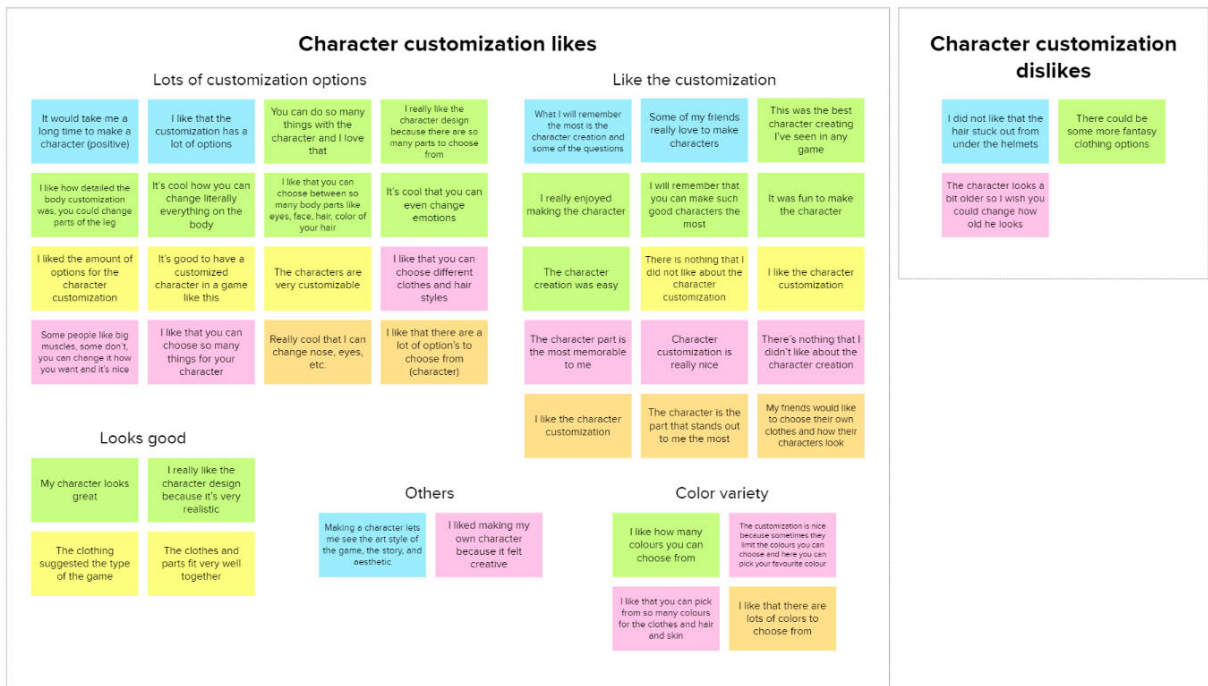


Figure F2. Diagram showing the findings for “Characters & Character Customization.”

3 - Skill Tree

3-A: How does the skill tree influence the goal setting process?



3-B: How do children interpret the skill tree element, with regards to goal setting?

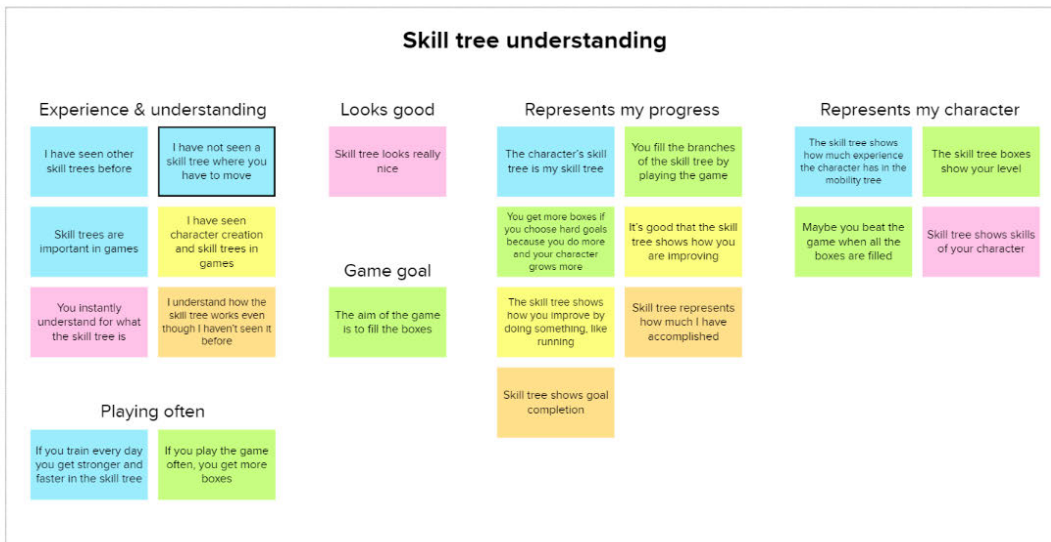


Figure F3. Diagram showing the findings for "Skill Tree."

4 - Goal Setting Process

4-A: What do children think about this approach towards goal setting?



4-B: What are the reasons behind the choices of the children during the goal setting process?

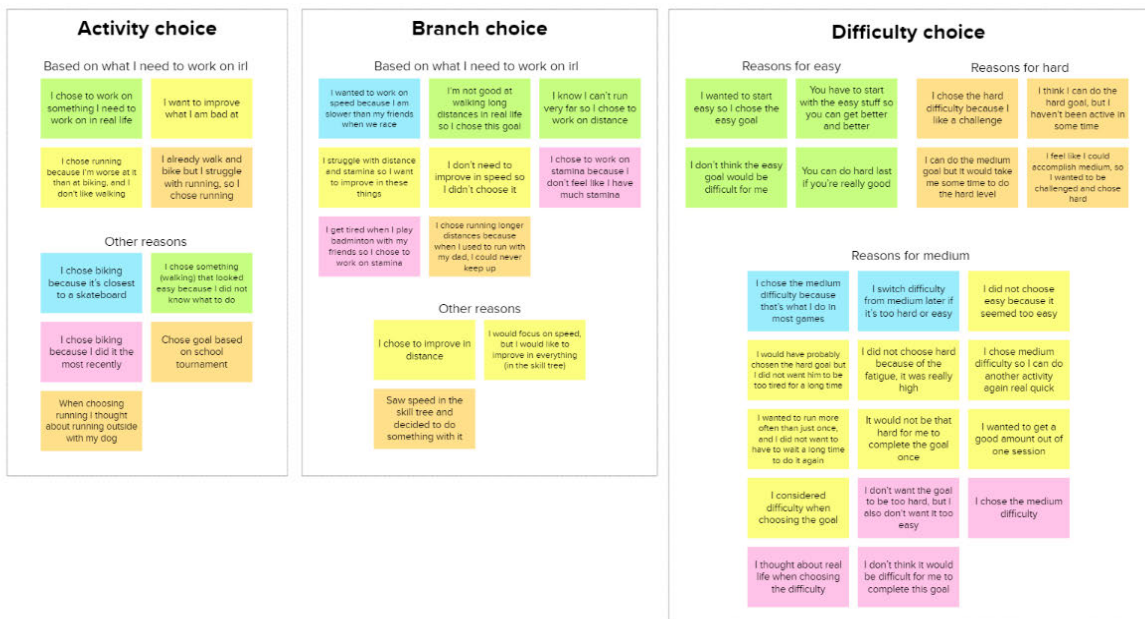
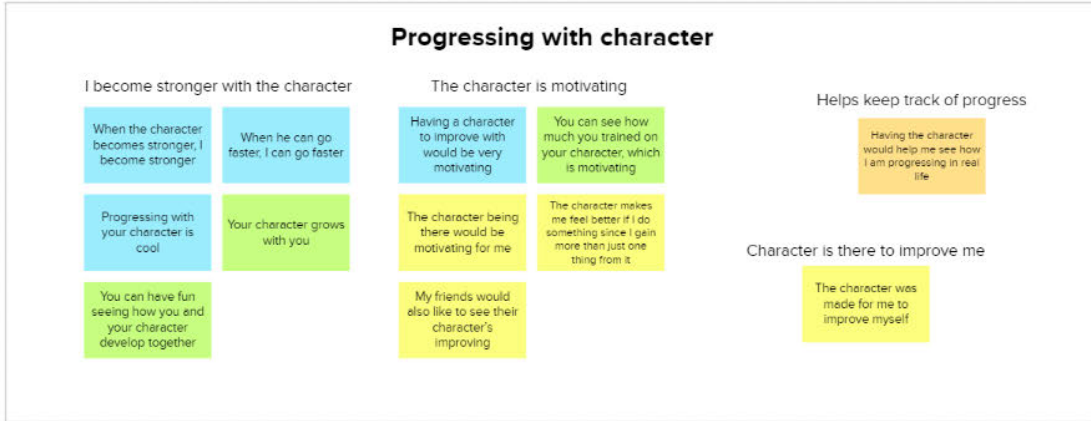


Figure F4. Diagram showing the findings for "Goal Setting Process."

5 - Link Between Character and Goals

5-A: How do children interpret their relationship with the character?



5-B: What is the influence of the character on the goal setting process?



Figure F5. Diagram showing the findings for “Link Between Character and Goals.”

6 - Prototype Evaluation & Usability

6-A: What did the children think of the prototype?



Figure F6. Diagram showing the findings for "Prototype Evaluation & Usability."